

## EJERCICIO 1

1. Una deuda se expresa en sentido negativo. Luego inicialmente el estado económico de Pedro es - 60 bs. Al recibir 320 bs. Aumenta su capital tantos bs. como ha recibido; entonces la operación queda expresada como se indica

- $-60+320=+260$  bs.  
2.  $1.170-1.515=-345$  sucres  
3.  $200+56-189=+\$67$   
4.  $-665-1.178+2.280=+437$  soles  
5.  $20-15+40-75=-\$30$   
6.  $-67+72-16+2=-\$9$   
7.  $200-78-81-93+41-59=-70$  colones  
8.  $-45-66-79+200-10=0$

## EJERCICIO 2

1.  $12-15=-3^\circ$   
2.  $-3+8-6=-1^\circ$   
3.  $15-(-3)=15+3=18^\circ$   
4.  $-(-8)+5=8+5=13^\circ$   
5.  $-4+7+2-11=-6^\circ$   
6.  $-8+4\cdot1=-8+4=-4^\circ \rightarrow 7$  am  
 $-8+4\cdot2=-8+8=0^\circ \rightarrow 8$  am  
 $-8+4\cdot5=-8+20=+12^\circ \rightarrow 11$  am  
7.  $-1-2\cdot2=-1-4=-5^\circ \rightarrow 10$  am  
 $-1-2\cdot3=-1-6=-7^\circ \rightarrow 11$  am  
 $-1-2\cdot3+3\cdot1=-1-6+3=-4^\circ \rightarrow 12$  am  
 $-1-2\cdot3+3\cdot3=-1-6+9=+2^\circ \rightarrow 2$  pm  
8.  $-56+7=-49^\circ$   
9.  $-71+5=-66^\circ$  long  
 $-15+(-5)=-20^\circ$  lat.  
10.  $18+3=+21^\circ$  long  
 $65-4=+61^\circ$  lat.  
11.  $-75+135=+60$  años

## EJERCICIO 3

1.  $+32m; -16m$   
2.  $+10m; -4m$   
3.  $50-85=-35m$   
4.  $-6\cdot11=-66m$   
5.  $-8\times6=-48m$   
 $9\times6=+54m$   
6.  $400\cdot2=+800m \rightarrow$  corredor  
 $-400\cdot3=-1.200m \rightarrow$  yo  
7. Los 40 pies de longitud del poste se reparten así: 15 pies que sobresalen - se asumen en sentido positivo - . 25 pies que se encuentran enterrados. - se asumen en sentido negativo - . Al introducir 3 pies más, se adicionan a los que están bajo el suelo y se deben descontar de los que están por encima. Aritméticamente significa:

- $40=15+25$   
 $-25-3=-28$  pies  
 $+15-3=+12$  pies  
8.  $55-52=+3m$   
9.  $-32+15=-17m$   
10.  $35-47=-12m$   
11.  $-39+56=+17m$   
12.  $90-58-36=-4m$   
13.  $72-30\cdot1=72-30=+42m$   
 $72-30\cdot2=72-60=+12m$   
 $72-30\cdot3=72-90=-18m$   
 $72-30\cdot4=72-120=-48m$   
14.  $-120-(-60)\cdot1=-120+60=-60$  Km  
 $-120-(-60)\cdot2=-120+120=0$   
 $-120-(-60)\cdot3=-120+180=+60$  Km  
 $-120-(-60)\cdot4=-120+240=+120$  Km

## EJERCICIO 7.

- $x+2x=3x$
- $8a+9a=17a$
- $11b+9b=20b$
- $-b-5b=-6b$
- $-8m-m=-9m$
- $-9m-7m=-16m$
- $4a^x+5a^x=9a^x$
- $6a^{x+1}+8a^{x+1}=14a^{x+1}$
- $-m^{x+1}-5m^{x+1}=-6m^{x+1}$
- $-3a^{x-2}-a^{x-2}=-4a^{x-2}$
- $\frac{1}{2}a+\frac{1}{2}a=\frac{1+1}{2}a=\frac{2}{2}a=a$
- $\frac{3}{5}ab+\frac{1}{10}ab=\frac{6ab+ab}{10}=\frac{7}{10}ab$
- $\frac{1}{3}xy+\frac{1}{6}xy=\frac{2+1}{6}xy=\frac{3}{6}xy=\frac{1}{2}xy$
- $-\frac{1}{5}xy-\frac{4}{5}xy=\frac{-1-4}{5}xy=-\frac{5}{5}xy=-xy$
- $-\frac{5}{6}a^2b-\frac{1}{8}a^2b=\frac{-20-3}{24}a^2b=-\frac{23}{24}a^2b$
- $-a-\frac{7}{8}a=\frac{-8-7}{8}a=-\frac{15}{8}a$
- $8a+9a+6a=23a$
- $15x+20x+x=36x$
- $-7m-8m-9m=-24m$
- $-a^2b-a^2b-3a^2b=-5a^2b$
- $a^x+3a^x+8a^x=12a^x$
- $-5a^{x+1}-3a^{x+1}-5a^{x+1}=-13a^{x+1}$
- $a+\frac{1}{2}a+\frac{2}{3}a=\frac{6+3+4}{6}a=\frac{13}{6}a$
- $-x-\frac{2}{3}x-\frac{1}{6}x=\frac{-6-4-1}{6}x=-\frac{11}{6}x$
- $\frac{1}{5}ax+\frac{3}{10}ax+ax=\frac{2+3+10}{10}ax=\frac{15}{10}ax=\frac{3}{2}ax$
- $-\frac{3}{4}a^2x-\frac{5}{6}a^2x-a^2x=\frac{-9-10-12}{12}a^2x=-\frac{31}{12}a^2x$

- $11a+8a+9a+11a=39a$
- $m^{x+1}+3m^{x+1}+4m^{x+1}+6m^{x+1}=14m^{x+1}$
- $-x^2y-8x^2y-9x^2y-20x^2y=-38x^2y$
- $-3a^m-5a^m-6a^m-9a^m=-23a^m$
- $\frac{1}{2}a+\frac{1}{4}a+\frac{1}{8}a+a=\frac{4+2+1+8}{8}a=\frac{15}{8}a$
- $\frac{2}{5}ax+\frac{1}{2}ax+\frac{1}{10}ax+\frac{1}{20}ax=\frac{8+10+2+1}{20}ax=\frac{21}{20}ax$
- $0,5m+0,6m+0,7m+0,8m=2,6m$
- $-\frac{1}{7}ab-\frac{1}{14}ab-\frac{1}{28}ab-ab$   
 $=\frac{-4-2-1-28}{28}ab=-\frac{35}{28}ab=-\frac{5}{4}ab$
- $-\frac{2}{3}x^3y-\frac{1}{6}x^3y-\frac{1}{9}x^3y-\frac{1}{12}x^3y$   
 $=\frac{-24-6-4-3}{36}x^3y=-\frac{37}{36}x^3y$
- $ab^2+ab^2+7ab^2+9ab^2+21ab^2=39ab^2$
- $-m-m-8m-7m-3m=-20m$
- $-x^{a+1}-8x^{a+1}-4x^{a+1}-5x^{a+1}-x^{a+1}=-19x^{a+1}$
- $\frac{1}{2}a+\frac{1}{3}a+\frac{1}{4}a+\frac{1}{5}a+\frac{1}{6}a$   
 $=\frac{30+20+15+12+10}{60}a=\frac{87}{60}a=\frac{29}{20}a$
- $-\frac{1}{3}ab-\frac{1}{6}ab-\frac{1}{2}ab-\frac{1}{12}ab-\frac{1}{9}ab$   
 $=\frac{-12-6-18-3-4}{36}ab=-\frac{43}{36}ab$

## EJERCICIO 8

- $8a-6a=2a$
- $6a-8a=-2a$
- $9ab-15ab=-6ab$
- $15ab-9ab=6ab$
- $2a-2a=0$
- $-7b+7b=0$
- $-14xy+32xy=18xy$

8.  $-25x^2y + 32x^2y = 7x^2y$
9.  $40x^3y - 51x^3y = -11x^3y$
10.  $-n^2n + 6m^2n = 5m^2n$
11.  $-15xy + 40xy = 25xy$
12.  $55a^3b^2 - 81a^3b^2 = -26a^3b^2$
13.  $-x^2y + x^2y = 0$
14.  $-9ab^2 + 9ab^2 = 0$
15.  $7x^2y - 7x^2y = 0$
16.  $-101mn + 118mn = 17mn$
17.  $502ab - 405ab = 97ab$
18.  $-1024x + 1018x = -6x$
19.  $-15ab + 15ab = 0$
20.  $\frac{1}{2}a - \frac{3}{4}a = \frac{2-3}{4}a = -\frac{1}{4}a$
21.  $\frac{3}{4}a - \frac{1}{2}a = \frac{3-2}{4}a = \frac{1}{4}a$
22.  $\frac{5}{6}a^2b - \frac{5}{12}a^2b = \frac{10-5}{12}a^2b = \frac{5}{12}a^2b$
23.  $-\frac{4}{7}x^2y + \frac{9}{14}x^2y = \frac{-8+9}{14}x^2y = \frac{1}{14}x^2y$
24.  $\frac{3}{8}am - \frac{5}{4}am = \frac{3-10}{8}am = -\frac{7}{8}am$
25.  $-am + \frac{3}{5}am = \frac{-5+3}{5}am = -\frac{2}{5}am$
26.  $\frac{5}{6}mn - \frac{7}{8}mn = \frac{20-21}{24}mn = -\frac{1}{24}mn$
27.  $-a^2b + \frac{3}{11}a^2b = \frac{-11+3}{11}a^2b = -\frac{8}{11}a^2b$
28.  $3,4a^4b^3 - 5,6a^4b^3 = -2,2a^4b^3$
29.  $-1,2yz + 3,4yz = 2,2yz$
30.  $4a^x - 2a^x = 2a^x$
31.  $-8a^{x+1} + 8a^{x+1} = 0$
32.  $25m^{a-1} - 32m^{a-1} = -7m^{a-1}$
33.  $-x^{a+1} + x^{a+1} = 0$
34.  $-\frac{1}{4}a^{m-2} + \frac{1}{2}a^{m-2} = \frac{-1+2}{4}a^{m-2} = \frac{1}{4}a^{m-2}$

$$35. \frac{5}{6}a^{m+1} - \frac{7}{12}a^{m+1} = \frac{10-7}{12}a^{m+1} = \frac{3}{12}a^{m+1} = \frac{1}{4}a^{m+1}$$

$$36. 4a^2 - \frac{1}{3}a^2 = \frac{12-1}{3}a^2 = \frac{11}{3}a^2$$

$$37. -5mn + \frac{3}{4}mn = \frac{-20+3}{4}mn = -\frac{17}{4}mn$$

$$38. 8a^{x+2}b^{x+3} - 25a^{x+2}b^{x+3} = -17a^{x+2}b^{x+3}$$

$$39. -\frac{7}{8}a^mb^n + a^mb^n = \frac{-7+8}{8}a^mb^n = \frac{1}{8}a^mb^n$$

$$40. 0,85mxy - 0,5mxy = 0,35mxy$$

## EJERCICIO 9

$$1. 9a - 3a + 5a = 11a$$

$$2. -8x + 9x - x = 0$$

$$3. 12mn - 23mn - 5mn = -16mn$$

$$4. -x + 19x - 18x = 0$$

$$5. 19m - 10m + 6m = 15m$$

$$6. -11ab - 15ab + 26ab = 0$$

$$7. -5a^x + 9a^x - 35a^x = -31a^x$$

$$8. -24a^{x+2} - 15a^{x+2} + 39a^{x+2} = 0$$

$$9. \frac{2}{3}y + \frac{1}{3}y - y = \frac{2+1-3}{3}y = \frac{0}{3}y = 0$$

$$10. -\frac{3}{5}m + \frac{1}{4}m - \frac{1}{2}m = \frac{-12+5-10}{20}m = -\frac{17}{20}m$$

$$11. \frac{3}{8}a^2b + \frac{1}{4}a^2b - a^2b = \frac{3+2-8}{8}a^2b = -\frac{3}{8}a^2b$$

$$12. -a + 8a + 9a - 15a = a$$

$$13. 7ab - 11ab + 20ab - 31ab = -15ab$$

$$14. 25x^2 - 50x^2 + 11x^2 + 14x^2 = 0$$

$$15. -xy - 8xy - 19xy + 40xy = 12xy$$

$$16. 7ab + 21ab - ab - 80ab = -53ab$$

$$17. -25xy^2 + 11xy^2 + 60xy^2 - 82xy^2 = -36xy^2$$

$$18. -72ax + 87ax - 101ax + 243ax = 157ax$$

$$19. -82bx - 71bx - 53bx + 206bx = 0$$

$$20. 105a^3 - 464a^3 + 58a^3 + 301a^3 = 0$$

$$21. \frac{1}{2}x - \frac{1}{3}x + \frac{1}{4}x - \frac{1}{5}x = \frac{30-20+15-12}{60}x = \frac{13}{60}x$$

$$22. \frac{1}{3}y - \frac{1}{3}y + \frac{1}{6}y - \frac{1}{12}y = \frac{4-4+2-1}{12}y = \frac{1}{12}y$$

$$23. \frac{3}{5}a^2b - \frac{1}{6}a^2b + \frac{1}{3}a^2b - a^2b = \frac{18-5+10-30}{30}a^2b = -\frac{7}{30}a^2b$$

$$24. -\frac{5}{6}ab^2 - \frac{1}{6}ab^2 + ab^2 - \frac{3}{8}ab^2 = \frac{-20-4+24-9}{24}ab^2 = -\frac{9}{24}ab^2 = -\frac{3}{8}ab^2$$

$$25. -a + 8a - 11a + 15a - 75a = -64a$$

$$26. -7c + 21c + 14c - 30c + 82c = 80c$$

$$27. -mn + 14mn - 31mn - mn + 20mn = mn$$

$$28. a^2y - 7a^2y - 93a^2y + 51a^2y + 48a^2y = 0$$

$$29. -a + a - a + a - 3a + 6a = 3a$$

$$30. \frac{1}{2}x + \frac{2}{3}x - \frac{7}{6}x + \frac{1}{2}x - x = \frac{3+4-7+3-6}{6}x = -\frac{3}{6}x = -\frac{1}{2}x$$

$$31. -2x + \frac{3}{4}x + \frac{1}{4}x + x - \frac{5}{6}x = \frac{-48+18+6+24-20}{24}x = -\frac{20}{24}x = -\frac{5}{6}x$$

$$32. 7a^x - 30a^x - 41a^x - 9a^x + 73a^x = 0$$

$$33. -a^{x+1} + 7a^{x+1} - 11a^{x+1} - 20a^{x+1} + 26a^{x+1} = a^{x+1}$$

$$34. a + 6a - 20a + 150a - 80a + 31a = 88a$$

$$35. -9b - 11b - 17b - 81b - b + 110b = -9b$$

$$36. -a^2b + 15a^2b + a^2b - 85a^2b - 131a^2b + 39a^2b = -162a^2b$$

$$37. 84m^2x - 50m^2x - 604m^2x - 715m^2x + 231m^2x + 165m^2x = -1340m^2x$$

$$38. \frac{5}{6}a^3b^2 + \frac{2}{3}a^3b^2 - \frac{1}{4}a^3b^2 - \frac{5}{8}a^3b^2 + 4a^3b^2 = \frac{20+16-6-15+96}{24}a^3b^2 = \frac{111}{24}a^3b^2 = \frac{37}{8}a^3b^2 = 4\frac{5}{8}a^3b^2$$

$$39. 40a - 81a + 130a + 41a - 83a - 91a + 16a = -28a$$

$$40. -21ab + 52ab - 60ab + 84ab - 31ab - ab - 23ab = 0$$

## EJERCICIO 10

$$1. 7a + 6a - 9b - 4b$$

$$7a + 6a = 13a \quad -9b - 4b = -13b = 13a - 13b$$

$$2. a + b - c - b - c + 2c - a$$

$$a - a = 0 \quad b - b = 0 \quad -c - c + 2c = 0 = 0$$

$$3. 5x - 11y - 9 + 20x - 1 - y$$

$$5x + 20x = 25x \quad -11y - y = -12y \quad -9 - 1 = -10 = 25x - 12y - 10$$

$$4. -6m + 8n + 5 - m - n - 6m - 11$$

$$-6m - m - 6m = -13m \quad 8n - n = 7n \quad 5 - 11 = -6 = -13m + 7n - 6$$

$$5. -a + b + 2b - 2c + 3a + 2c - 3b$$

$$-a + 3a = 2a \quad b + 2b - 3b = 0 \quad -2c + 2c = 0 = 2a$$

$$6. -81x + 19y - 30z + 6y + 80x + x - 25y$$

$$-81x + 80x + x = 0 \quad 19y + 6y - 25y = 0 \quad -30z = -30z$$

$$7. 15a^2 - 6ab - 8a^2 + 20 - 5ab - 31 + a^2 - ab$$

$$15a^2 - 8a^2 + a^2 = 8a^2 \\ -6ab - 5ab - ab = -12ab \quad 20 - 31 = -11 = 8a^2 - 12ab - 11$$

$$8. -3a + 4b - 6a + 81b - 114b + 31a - a - b$$

$$-3a - 6a + 31a - a = 21a \\ 4b + 81b - 114b - b = -30b = 21a - 30b$$

$$9. -71a^3b - 84a^4b^2 + 50a^3b + 84a^4b^2 - 45a^3b + 18a^3b$$

$$-71a^3b + 50a^3b - 45a^3b + 18a^3b = -48a^3b \\ -84a^4b^2 + 84a^4b^2 = 0 = -48a^3b$$

$$10. -a + b - c + 8 + 2a + 2b - 19 - 2c - 3a - 3 - 3b + 3c$$

$$-a + 2a - 3a = -2a \quad b + 2b - 3b = 0 \\ -c - 2c + 3c = 0 \quad 8 - 19 - 3 = -14 = -2a - 14$$

11.  $m^2 + 71mn - 14m^2 - 65mn + m^3 - m^2 - 115m^2 + 6m^3$   
 $m^3 + 6m^3 = 7m^3$        $m^2 - 14m^2 - m^2 - 115m^2 = -129m^2$        $71mn - 65mn = 6mn$   
 $= 7m^3 - 129m^2 + 6mn$
12.  $x^4y - x^3y^2 + x^2y - 8x^4y - x^2y - 10 + x^3y^2 - 7x^3y^2 - 9 + 21x^4y - y^3 + 50$   
 $x^4y - 8x^4y + 21x^4y = 14x^4y$        $-x^3y^2 + x^3y^2 - 7x^3y^2 = -7x^3y^2$   
 $x^2y - x^2y = 0$        $-y^3$        $-10 - 9 + 50 = 31$   
 $= 14x^4y - 7x^3y^2 - y^3 + 31$
13.  $5a^{x+1} - 3b^{x+2} - 8c^{x+3} - 5a^{x+1} - 50 + 4b^{x+2} - 65 - b^{x+2} + 90 + c^{x+3} + 7c^{x+3}$   
 $-8c^{x+3} + c^{x+3} + 7c^{x+3} = 0$        $-3b^{x+2} + 4b^{x+2} - b^{x+2} = 0$        $5a^{x+1} - 5a^{x+1} = 0$        $-50 - 65 + 90 = -25$   
 $= -25$
14.  $a^{m+2} - x^{m+3} - 5 + 8 - 3a^{m+2} + 5x^{m+3} - 6 + a^{m+2} - 5x^{m+3}$   
 $-x^{m+3} + 5x^{m+3} - 5x^{m+3} = -x^{m+3}$        $a^{m+2} - 3a^{m+2} + a^{m+2} = -a^{m+2}$        $-5 + 8 - 6 = -3$   
 $= -x^{m+3} - a^{m+2} - 3$
15.  $0,3a + 0,4b + 0,5c - 0,6a - 0,7b - 0,9c + 3a - 3b - 3c$   
 $0,3a - 0,6a + 3a = 2,7a$        $0,4b - 0,7b - 3b = -3,3b$        $0,5c - 0,9c - 3c = -3,4c$   
 $= 2,7a - 3,3b - 3,4c$
16.  $\frac{1}{2}a + \frac{1}{3}b + 2a - 3b - \frac{3}{4}a - \frac{1}{6}b + \frac{3}{4} - \frac{1}{2}$   
 $\frac{1}{2}a + 2a - \frac{3}{4}a = \frac{2+8-3}{4}a = \frac{7}{4}a$        $\frac{1}{3}b - 3b - \frac{1}{6}b = \frac{2-18-1}{6}b = -\frac{17}{6}b$        $\frac{3}{4} - \frac{1}{2} = \frac{3-2}{4} = \frac{1}{4}$   
 $= \frac{7}{4}a - \frac{17}{6}b + \frac{1}{4}$
17.  $\frac{3}{5}m^2 - 2mn + \frac{1}{10}m^2 - \frac{1}{3}mn + 2mn - 2m^2$   
 $\frac{3}{5}m^2 + \frac{1}{10}m^2 - 2m^2 = \frac{6+1-20}{10}m^2 = -\frac{13}{10}m^2$        $-2mn - \frac{1}{3}mn + 2mn = \frac{-6-1+6}{3}mn = -\frac{1}{3}mn$   
 $= -\frac{13}{10}m^2 - \frac{1}{3}mn$
18.  $-\frac{3}{4}a^2 + \frac{1}{2}ab - \frac{5}{6}b^2 + 2\frac{1}{3}a^2 - \frac{3}{4}ab + \frac{1}{6}b^2 - \frac{1}{3}b^2 - 2ab$   
 $-\frac{3}{4}a^2 + \frac{7}{3}a^2 = \frac{-9+28}{12}a^2 = \frac{19}{12}a^2$        $\frac{1}{2}ab - \frac{3}{4}ab - 2ab = \frac{2-3-8}{4}ab = -\frac{9}{4}ab$   
 $-\frac{5}{6}b^2 + \frac{1}{6}b^2 - \frac{1}{3}b^2 = \frac{-5+1-2}{6}b^2 = -\frac{6}{6}b^2 = -b^2$   
 $= \frac{19}{12}a^2 - \frac{9}{4}ab - b^2$

$$19. 0,4x^2y + 31 + \frac{3}{8}xy^2 - 0,6y^3 - \frac{2}{5}x^2y - 0,2xy^2 + \frac{1}{4}y^3 - 6$$

$$0,4x^2y - \frac{2}{5}x^2y = \frac{2-2}{5}x^2y = 0$$

$$-0,6y^3 + \frac{1}{4}y^3 = \frac{-2,4+1}{4}y^3 = -\frac{1,4}{4}y^3 = -0,35y^3$$

$$= 0,175xy^2 - 0,35y^3 + 25$$

$$\frac{3}{8}xy^2 - 0,2xy^2 = \frac{3-1,6}{8}xy^2 = \frac{1,4}{8}xy^2 = 0,175xy^2$$

$$31 - 6 = 25$$

$$20. \frac{3}{25}a^{m-1} - \frac{7}{50}b^{m-2} + \frac{3}{5}a^{m-1} - \frac{1}{25}b^{m-2} - 0,2a^{m-1} + \frac{1}{5}b^{m-2}$$

$$\frac{3}{25}a^{m-1} + \frac{3}{5}a^{m-1} - 0,2a^{m-1} = \frac{3+15-5}{25}a^{m-1} = \frac{13}{25}a^{m-1}$$

$$= \frac{13}{25}a^{m-1} + \frac{1}{50}b^{m-2}$$

$$-\frac{7}{50}b^{m-2} - \frac{1}{25}b^{m-2} + \frac{1}{5}b^{m-2} = \frac{-7-2+10}{50}b^{m-2} = \frac{1}{50}b^{m-2}$$

## EJERCICIO 11

Para resolver los problemas del 1 al 18 las literales toman los siguientes valores:

$$a = 1 \quad b = 2 \quad c = 3 \quad m = 1/2 \quad n = 1/3 \quad p = 1/4$$

$$1. 3ab = 3 \cdot 1 \cdot 2 = 6$$

$$2. 5a^2b^3c = 5 \cdot 1^2 \cdot 2^3 \cdot 3 = 5 \cdot 8 \cdot 3 = 120$$

$$3. b^2mn = 2^2 \cdot \frac{1}{2} \cdot \frac{1}{3} = \frac{4}{3} = \frac{2}{3}$$

$$4. 24m^2n^3p = 24 \left(\frac{1}{2}\right)^2 \left(\frac{1}{3}\right)^3 \cdot \frac{1}{4} = 6 \cdot \frac{1}{27} \cdot \frac{1}{4} = \frac{6}{108} = \frac{1}{18}$$

$$5. \frac{2}{3}a^4b^2m^3 = \frac{2}{3} \cdot 1^4 \cdot 2^2 \cdot \left(\frac{1}{2}\right)^3 = \frac{2}{3} \cdot 4 \cdot \frac{1}{8} = \frac{8}{24} = \frac{1}{3}$$

$$6. \frac{7}{12}c^3p^2m = \frac{7}{12} \cdot 3^3 \cdot \left(\frac{1}{4}\right)^2 \cdot \frac{1}{2} = \frac{189}{12} \cdot \frac{1}{16} \cdot \frac{1}{2} = \frac{189}{384} = \frac{63}{128}$$

$$7. m^bn^cp^a = \left(\frac{1}{2}\right)^2 \left(\frac{1}{3}\right)^3 \cdot \frac{1}{4} = \frac{1}{4} \cdot \frac{1}{27} \cdot \frac{1}{4} = \frac{1}{432}$$

$$8. \frac{5}{6}a^{b-1} \cdot m^{c-2} = \frac{5}{6} \cdot 1^{2-1} \cdot \left(\frac{1}{2}\right)^{3-2} = \frac{5}{6} \cdot \frac{1}{2} = \frac{5}{12}$$

$$9. \sqrt{2bc^2} = \sqrt{2 \cdot 2 \cdot 3^2} = \sqrt{4 \cdot 9} = \sqrt{36} = 6$$

$$10. 4m \cdot \sqrt[3]{12bc^2} = 4 \cdot \frac{1}{2} \cdot \sqrt[3]{12 \cdot 2 \cdot 3^2} = 2 \cdot \sqrt[3]{216} = 2 \cdot 6 = 12$$

$$11. mn \cdot \sqrt{8a^4b^3} = \frac{1}{2} \cdot \frac{1}{3} \cdot \sqrt{8 \cdot 1^4 \cdot 2^3} = \frac{1}{6} \cdot \sqrt{64} = \frac{8}{6} = \frac{4}{3}$$

$$12. \frac{4a}{3bc} = \frac{4 \cdot 1}{3 \cdot 2 \cdot 3} = \frac{4}{18} = \frac{2}{9}$$

$$13. \frac{5b^2m^2}{np} = \frac{5 \cdot 2^2 \cdot \left(\frac{1}{2}\right)^2}{\frac{1}{3} \cdot \frac{1}{4}} = \frac{20 \cdot \frac{1}{4}}{\frac{1}{12}} = \frac{5}{\frac{1}{12}} = 60$$

$$14. \frac{\frac{3}{4}b^3}{\frac{2}{3}c^2} = \frac{\frac{3}{4} \cdot 2^3}{\frac{2}{3} \cdot 3^2} = \frac{\frac{3 \cdot 8}{4}}{\frac{2 \cdot 9}{3}} = \frac{\frac{24}{4}}{\frac{18}{3}} = \frac{6}{6} = 1$$

$$15. \frac{2m}{\sqrt{n^2}} = \frac{2 \cdot \frac{1}{2}}{\sqrt{\left(\frac{1}{3}\right)^2}} = \frac{1}{\sqrt{\frac{1}{9}}} = \frac{1}{\frac{1}{3}} = 3$$

$$16. \frac{24mn}{2 \cdot \sqrt{n^2 p^2}} = \frac{24 \cdot \frac{1}{2} \cdot \frac{1}{3}}{2 \cdot \sqrt{\left(\frac{1}{3}\right)^2 \left(\frac{1}{4}\right)^2}} = \frac{\frac{24}{6}}{2 \cdot \sqrt{\frac{1}{9} \cdot \frac{1}{16}}} = \frac{4}{2 \cdot \sqrt{\frac{1}{144}}} = \frac{4}{2 \cdot \frac{1}{12}} = \frac{4}{\frac{1}{6}} = 24$$

$$17. \frac{3 \cdot \sqrt[3]{64b^3c^6}}{2m} = \frac{3 \cdot \sqrt[3]{64 \cdot 2^3 \cdot 3^6}}{2 \cdot \frac{1}{2}} = 3 \cdot \sqrt[3]{64 \cdot 8 \cdot 729} = 3 \cdot \sqrt[3]{373.248} = 3 \cdot 72 = 216$$

$$18. \frac{\frac{3}{5} \cdot \sqrt{ab^2}}{\frac{3}{2} \cdot \sqrt[3]{125bm}} = \frac{\frac{3}{5} \cdot \sqrt{1 \cdot \frac{1}{4} \cdot 2^2}}{\frac{3}{2} \cdot \sqrt[3]{125 \cdot 2 \cdot \frac{1}{2}}} = \frac{\frac{3}{5} \cdot \sqrt{\frac{4}{4}}}{\frac{3}{2} \cdot \sqrt[3]{\frac{250}{2}}} = \frac{\frac{3}{5} \cdot \sqrt{1}}{\frac{3}{2} \cdot \sqrt[3]{125}} = \frac{\frac{3}{5}}{\frac{3}{2} \cdot 5} = \frac{\frac{3}{5}}{\frac{15}{2}} = \frac{6}{75} = \frac{2}{25}$$

## EJERCICIO 12

Para resolver los problemas del 1 al 18 las literales toman los siguientes valores:

$$a = 3 \quad b = 4 \quad c = 1/3 \quad d = 1/2 \quad m = 6 \quad n = 1/4$$

$$1. a^2 - 2ab + b^2 = 3^2 - 2 \cdot 3 \cdot 4 + 4^2 = 9 - 24 + 16 = 1$$

$$2. c^2 + 2cd + d^2 = \left(\frac{1}{3}\right)^2 + 2 \cdot \frac{1}{3} \cdot \frac{1}{2} + \left(\frac{1}{2}\right)^2 = \frac{1}{9} + \frac{1}{3} + \frac{1}{4} = \frac{4+12+9}{36} = \frac{25}{36}$$

$$3. \frac{a}{c} + \frac{b}{d} = \frac{3}{\frac{1}{3}} + \frac{4}{\frac{1}{2}} = 9 + 8 = 17$$

$$4. \frac{c}{d} - \frac{m}{n} + 2 = \frac{\frac{1}{3}}{\frac{1}{2}} - \frac{6}{\frac{1}{4}} + 2 = \frac{2}{3} - 24 + 2 = \frac{2-72+6}{3} = -\frac{64}{3}$$

$$5. \frac{a^2}{3} - \frac{b^2}{2} + \frac{m^2}{6} = \frac{3^2}{3} - \frac{4^2}{2} + \frac{6^2}{6} = \frac{9}{3} - \frac{16}{2} + \frac{36}{6} = 3 - 8 + 6 = 1$$

$$6. \frac{3}{5}c - \frac{1}{2}b + 2d = \frac{3}{5} \cdot \frac{1}{3} - \frac{1}{2} \cdot 4 + 2 \cdot \frac{1}{2} = \frac{1}{5} - 2 + 1 = \frac{1-10+5}{5} = -\frac{4}{5}$$

$$7. \frac{ab}{n} + \frac{ac}{d} - \frac{bd}{m} = \frac{3 \cdot 4}{\frac{1}{4}} + \frac{3 \cdot \frac{1}{3}}{\frac{1}{2}} - \frac{4 \cdot \frac{1}{2}}{6} = \frac{12}{\frac{1}{4}} + \frac{1}{\frac{1}{2}} - \frac{2}{6} = 48 + 2 - \frac{1}{3} = \frac{144+6-1}{3} = \frac{149}{3} = 49\frac{2}{3}$$

$$8. \sqrt{b} + \sqrt{n} + \sqrt{6m} = \sqrt{4} + \sqrt{\frac{1}{4}} + \sqrt{6 \cdot 6} = 2 + \frac{1}{2} + 6 = \frac{4+1+12}{2} = \frac{17}{2} = 8\frac{1}{2}$$

$$9. c\sqrt{3a} - d\sqrt{16b^2} + n\sqrt{8d} = \frac{1}{3} \cdot \sqrt{3 \cdot 3} - \frac{1}{2} \cdot \sqrt{16 \cdot 4^2} + \frac{1}{4} \cdot \sqrt{8 \cdot \frac{1}{2}} = \frac{1}{3} \cdot 3 - \frac{1}{2} \cdot 16 + \frac{1}{4} \cdot 2 = 1 - 8 + \frac{1}{2} = \frac{2-16+1}{2} = -\frac{13}{2} = -6\frac{1}{2}$$

$$10. \frac{m^a}{d^b} = \frac{6^3}{\left(\frac{1}{2}\right)^4} = \frac{216}{\frac{1}{16}} = 216 \cdot 16 = 3.456$$

$$11. \frac{3}{4}c^2 + \frac{4n^2}{m} = \frac{3\left(\frac{1}{3}\right)^2}{4} + \frac{4\left(\frac{1}{4}\right)^2}{6} = \frac{1}{4} + \frac{1}{6} = \frac{1}{12} + \frac{1}{24} = \frac{2+1}{24} = \frac{3}{24} = \frac{1}{8}$$

$$12. \frac{4d^2}{2} + \frac{16n^2}{2} - 1 = 2 \cdot \left(\frac{1}{2}\right)^2 + 8 \cdot \left(\frac{1}{4}\right)^2 - 1 = \frac{2}{4} + \frac{8}{16} - 1 = \frac{1}{2} + \frac{1}{2} - 1 = 1 - 1 = 0$$

$$13. \frac{a+b}{c} - \frac{b+m}{d} = \frac{3+4}{3} - \frac{4+6}{2} = \frac{7}{3} - \frac{10}{2} = 21 - 20 = 1$$

$$14. \frac{b-a}{n} + \frac{m-b}{d} + 5a = \frac{4-3}{1} + \frac{6-4}{1} + 5 \cdot 3 = \frac{1}{4} + \frac{2}{1} + 15 = 4 + 4 + 15 = 23$$

$$15. \frac{12c-a}{2b} - \frac{16n-a}{m} + \frac{1}{d} = \frac{12 \cdot \frac{1}{3} - 3}{2 \cdot 4} - \frac{16 \cdot \frac{1}{4} - 3}{6} + \frac{1}{\frac{1}{2}} = \frac{4-3}{8} - \frac{4-3}{6} + 2 = \frac{1}{8} - \frac{1}{6} + 2 = \frac{3-4+48}{24} = \frac{47}{24} = 1\frac{23}{24}$$

$$16. \sqrt{4b} + \frac{\sqrt{3a}}{3} - \frac{\sqrt{6m}}{6} = \sqrt{4 \cdot 4} + \frac{\sqrt{3 \cdot 3}}{3} - \frac{\sqrt{6 \cdot 6}}{6} = \sqrt{16} + \frac{\sqrt{9}}{3} - \frac{\sqrt{36}}{6} = 4 + \frac{3}{3} - \frac{6}{6} = 4 + 1 - 1 = 4$$

$$17. \frac{\sqrt{b} + \sqrt{2d}}{2} - \frac{\sqrt{3c} + \sqrt{8d}}{4} = \frac{\sqrt{4} + \sqrt{2 \cdot \frac{1}{2}}}{2} - \frac{\sqrt{3 \cdot \frac{1}{3}} + \sqrt{8 \cdot \frac{1}{2}}}{4} = \frac{2+1}{2} - \frac{1+2}{4} = \frac{3}{2} - \frac{3}{4} = \frac{6-3}{4} = \frac{3}{4}$$

$$18. \frac{2 \cdot \sqrt{a^2 b^2}}{3} + \frac{3 \cdot \sqrt{2+d^2}}{4} - a \cdot \sqrt{n} = \frac{2 \cdot \sqrt{3^2 \cdot 4^2}}{3} + \frac{3 \cdot \sqrt{2 + \left(\frac{1}{2}\right)^2}}{4} - 3 \cdot \sqrt{\frac{1}{4}} = \frac{2 \cdot \sqrt{144}}{3} + \frac{3 \cdot \sqrt{\frac{9}{4}}}{4} - 3 \cdot \frac{1}{2}$$

$$= \frac{2 \cdot 12}{3} + \frac{3 \cdot \frac{3}{2}}{4} - \frac{3}{2} = \frac{24}{3} + \frac{9}{4} - \frac{3}{2} = 8 + \frac{9}{8} - \frac{3}{2} = \frac{64+9-12}{8} = \frac{61}{8} = 7\frac{5}{8}$$

### EJERCICIO 13

Para los problemas 1 al 24 las literales toman los siguientes valores:

$$a = 1 \quad b = 2 \quad c = 3 \quad d = 4 \quad m = 1/2 \quad n = 2/3 \quad p = 1/4 \quad x = 0$$

$$1. (a+b) \cdot c - d = (1+2) \cdot 3 - 4 = 3 \cdot 3 - 4 = 9 - 4 = 5$$

$$2. (a+b)(b-a) = (1+2)(2-1) = 3 \cdot 1 = 3$$

$$3. (b-m)(c-n) + 4a^2 = \left(2 - \frac{1}{2}\right) \left(3 - \frac{2}{3}\right) + 4 \cdot 1^2 = \left(\frac{4-1}{2}\right) \left(\frac{9-2}{3}\right) + 4 = \frac{3}{2} \cdot \frac{7}{3} + 4 = \frac{7}{2} + 4 = \frac{7+8}{2} = \frac{15}{2} = 7\frac{1}{2}$$

$$4. (2m+3n)(4p+b^2) = \left(2 \cdot \frac{1}{2} + 3 \cdot \frac{2}{3}\right) \left(4 \cdot \frac{1}{4} + 2^2\right) = (1+2)(1+4) = 3 \cdot 5 = 15$$

$$5. (4m+8p)(a^2+b^2)(6n-d) = \left(4 \cdot \frac{1}{2} + 8 \cdot \frac{1}{4}\right) (1^2+2^2) \left(6 \cdot \frac{2}{3} - 4\right) = (2+2) \cdot 3 \cdot 0 = 0$$



$$6. (c-b)(d-c)(b-a)(m-p) = (3-2)(4-3)(2-1)\left(\frac{1}{2}-\frac{1}{4}\right) = 1 \cdot 1 \cdot 1 \cdot \left(\frac{2-1}{4}\right) = \frac{1}{4}$$

$$7. b^2(c+d) - a^2(m+n) + 2x = 2^2(3+4) - 1^2\left(\frac{1}{2} + \frac{2}{3}\right) + 2 \cdot 0 = 4 \cdot 7 - \left(\frac{3+4}{6}\right) = 28 - \frac{7}{6} = \frac{168-7}{6} = \frac{161}{6} = 26\frac{5}{6}$$

$$8. 2mx + 6(b^2 + c^2) - 4d^2 = 2 \cdot \frac{1}{2} \cdot 0 + 6(2^2 + 3^2) - 4 \cdot 4^2 = 6(4+9) - 4 \cdot 16 = 6 \cdot 13 - 64 = 78 - 64 = 14$$

$$9. \left(\frac{8m}{9n} + \frac{16p}{b}\right)a = \left(\frac{8 \cdot \frac{1}{2}}{9 \cdot \frac{2}{3}} + \frac{16 \cdot \frac{1}{4}}{2}\right) \cdot 1 = \frac{4}{18} + \frac{4}{2} = \frac{4}{6} + 2 = \frac{2}{3} + 2 = \frac{2+6}{3} = \frac{8}{3} = 2\frac{2}{3}$$

$$10. x + m(a^b + d^c - c^a) = 0 + \frac{1}{2}(1^2 + 4^3 - 3^1) = \frac{1}{2}(1 + 64 - 3) = \frac{1}{2} \cdot 62 = 31$$

$$11. \frac{4(m+p)}{a} \div \frac{a^2+b^2}{c^2} = \frac{4\left(\frac{1}{2} + \frac{1}{4}\right)}{1} \div \frac{1^2+2^2}{3^2} = 4\left(\frac{2+1}{4}\right) \div \frac{1+4}{9} = 4 \cdot \frac{3}{4} \div \frac{5}{9} = \frac{3}{5} = \frac{27}{5} = 5\frac{2}{5}$$

$$12. (2m+3n+4p)(8p+6n-4m)(9n+20p) \\ = \left(2 \cdot \frac{1}{2} + 3 \cdot \frac{2}{3} + 4 \cdot \frac{1}{4}\right) \left(8 \cdot \frac{1}{4} + 6 \cdot \frac{2}{3} - 4 \cdot \frac{1}{2}\right) \left(9 \cdot \frac{2}{3} + 20 \cdot \frac{1}{4}\right) = (1+2+1)(2+4-2)(6+5) = 4 \cdot 4 \cdot 11 = 176$$

$$13. c^2(m+n) - d^2(m+p) + b^2(n+p) \\ = 3^2\left(\frac{1}{2} + \frac{2}{3}\right) - 4^2\left(\frac{1}{2} + \frac{1}{4}\right) + 2^2\left(\frac{2}{3} + \frac{1}{4}\right) = 9 \cdot \frac{7}{6} - 16 \cdot \frac{3}{4} + 4 \cdot \frac{11}{12} = \frac{21}{2} - 12 + \frac{44}{12} = \frac{126-144+44}{12} = \frac{26}{12} = 2\frac{2}{12} = 2\frac{1}{6}$$

$$14. \left(\frac{\sqrt{c^2+d^2}}{a} \div \frac{2}{\sqrt{d}}\right)m = \left(\frac{\sqrt{3^2+4^2}}{1} \div \frac{2}{\sqrt{4}}\right) \cdot \frac{1}{2} = \left(\frac{\sqrt{9+16}}{1} \div \frac{2}{2}\right) \cdot \frac{1}{2} = \left(\frac{\sqrt{25}}{1} \div \frac{2}{2}\right) \cdot \frac{1}{2} = 5 \cdot \frac{1}{2} = \frac{5}{2} = 2\frac{1}{2}$$

$$15. (4p+2b)(18n-24p) + 2(8m+2)(40p+a) \\ = \left(4 \cdot \frac{1}{4} + 2 \cdot 2\right) \left(18 \cdot \frac{2}{3} - 24 \cdot \frac{1}{4}\right) + 2\left(8 \cdot \frac{1}{2} + 2\right) \left(40 \cdot \frac{1}{4} + 1\right) = (1+4)(12-6) + 2(4+2)(11) = 5 \cdot 6 + 2 \cdot 66 = 30 + 132 = 162$$

$$16. \frac{a + \frac{d}{b}}{d-b} \cdot \frac{5 + \frac{2}{m^2}}{p^2} = \frac{1 + \frac{4}{2}}{4-2} \cdot \frac{5 + \left(\frac{1}{2}\right)^2}{\left(\frac{1}{4}\right)^2} = \frac{2+4}{2} \cdot \frac{5 + \frac{1}{4}}{\frac{1}{16}} = \frac{6}{2} \cdot \frac{5 + \frac{1}{4}}{\frac{1}{16}} = \frac{3}{2} \cdot \frac{5 + \frac{1}{4}}{\frac{1}{16}} = \frac{3}{2} \cdot \frac{13}{16} = \frac{3}{2} \cdot \frac{13}{16} = \frac{3}{2} \cdot 208 = \frac{624}{2} = 312$$

$$17. (a+b) \cdot \sqrt{c^2+8b} - m \cdot \sqrt{n^2} = (1+2) \cdot \sqrt{3^2+8 \cdot 2} - \frac{1}{2} \cdot \sqrt{\left(\frac{2}{3}\right)^2} = 3 \cdot \sqrt{25} - \frac{1}{2} \cdot \frac{2}{3} = 3 \cdot 5 - \frac{2}{6} = 15 - \frac{2}{6} = \frac{90-2}{6} = \frac{88}{6} = 14\frac{4}{6} = 14\frac{2}{3}$$

$$18. \left(\frac{\sqrt{a+c}}{2} + \frac{\sqrt{6n}}{b}\right) \div (c+d) \cdot \sqrt{p} = \left(\frac{\sqrt{1+3}}{2} + \frac{\sqrt{6 \cdot \frac{2}{3}}}{2}\right) \div (3+4) \cdot \sqrt{\frac{1}{4}} = \left(\frac{\sqrt{4}}{2} + \frac{\sqrt{4}}{2}\right) \div 7 \cdot \frac{1}{2} = \frac{2}{7} = \frac{4}{7}$$

$$19. 3(c-b) \cdot \sqrt{32m} - 2(d-a) \cdot \sqrt{16p} - \frac{2}{n}$$

$$= 3(3-2) \cdot \sqrt{32 \cdot \frac{1}{2}} - 2(4-1) \cdot \sqrt{16 \cdot \frac{1}{4}} - \frac{2}{\frac{2}{3}} = 3 \cdot \sqrt{16} - 6 \cdot \sqrt{4} - \frac{6}{\frac{2}{3}} = 3 \cdot 4 - 6 \cdot 2 - 3 = 12 - 12 - 3 = -3$$

$$20. \frac{\sqrt{6abc}}{2 \cdot \sqrt{8b}} + \frac{\sqrt{3mn}}{2(b-a)} - \frac{cdnp}{abc}$$

$$= \frac{\sqrt{6 \cdot 1 \cdot 2 \cdot 3}}{2 \cdot \sqrt{8 \cdot 2}} + \frac{\sqrt{3 \cdot \frac{1}{2} \cdot \frac{2}{3}}}{2(2-1)} - \frac{3 \cdot 4 \cdot \frac{2}{3} \cdot \frac{1}{4}}{1 \cdot 2 \cdot 3} = \frac{\sqrt{36}}{2 \cdot \sqrt{16}} + \frac{\sqrt{1}}{2} - \frac{2}{6} = \frac{6}{8} + \frac{1}{2} - \frac{1}{3} = \frac{18+12-8}{24} = \frac{22}{24} = \frac{11}{12}$$

$$21. \frac{a^2+b^2}{b^2-a^2} + 3(a+b)(2a+3b) = \frac{1^2+2^2}{2^2-1^2} + 3(1+2)(2 \cdot 1 + 3 \cdot 2) = \frac{5}{3} + 3 \cdot 3 \cdot 8 = \frac{5}{3} + 72 = \frac{5+216}{3} = \frac{221}{3} = 73\frac{2}{3}$$

$$22. b^2 + \left(\frac{1}{a} + \frac{1}{b}\right)\left(\frac{1}{b} + \frac{1}{c}\right) + \left(\frac{1}{n} + \frac{1}{m}\right)^2$$

$$= 2^2 + \left(\frac{1}{1} + \frac{1}{2}\right)\left(\frac{1}{2} + \frac{1}{3}\right) + \left(\frac{1}{\frac{2}{3}} + \frac{1}{\frac{1}{2}}\right)^2 = 4 + \left(\frac{3}{2} + \frac{5}{6}\right) + \left(\frac{3}{2} + 2\right)^2 = 4 + \frac{5}{4} + \left(\frac{7}{2}\right)^2 = \frac{21}{4} + \frac{49}{4} = \frac{70}{4} = \frac{35}{2} = 17\frac{1}{2}$$

$$(2m+3n)(4p+2c) - 4m^2n^2$$

$$23. = \left(2 \cdot \frac{1}{2} + 3 \cdot \frac{2}{3}\right)\left(4 \cdot \frac{1}{4} + 2 \cdot 3\right) - 4\left(\frac{1}{2}\right)^2 \left(\frac{2}{3}\right)^2 = (1+2)(1+6) - 4 \cdot \frac{1}{4} \cdot \frac{4}{9} = 3 \cdot 7 - \frac{4}{9} = 21 - \frac{4}{9} = \frac{189-4}{9} = \frac{185}{9} = 20\frac{5}{9}$$

$$24. \frac{b^2 - \frac{c}{3}}{2ab - m} - \frac{n}{b-m} = \frac{2^2 - \frac{3}{3}}{2 \cdot 1 \cdot 2 - \frac{1}{2}} - \frac{\frac{2}{3}}{2 - \frac{1}{2}} = \frac{3}{4 - \frac{1}{2}} - \frac{\frac{2}{3}}{\frac{3}{2}} = \frac{3}{\frac{7}{2}} - \frac{4}{9} = \frac{6}{7} - \frac{4}{9} = \frac{54-28}{63} = \frac{26}{63}$$

## EJERCICIO 14

1.  $a+b+m$

2.  $m^2 + b^3 + x^4$

3.  $a+1 ; a+2$

4.  $x-1 ; x-2$

5.  $y+2 ; y+4 ; y+6$

6.  $\$(a+x+m)$

7.  $m-n$

8.  $bs.(x-6)$

9.  $(x-m)Km$

10.  $\$(x+a-m)$

11.  $(m-a-b-c)Km$

12.  $\$(n-300)$

13.  $(365-x)$  días

14.  $\$8a ; \$15a ; \$ma$

15.  $2a+3b+\frac{c}{2}$

16.  $a \cdot b m^2$

17.  $23n m^2$

18.  $x^2 m^2$

19.  $\$(3a+6b) ; \$(ax+bm)$

20.  $(a+b)(x+y)$

21.  $\$(8x+48)$

22.  $bs.(a-8)(x+4)$

23.  $\frac{75}{x}$  sucres

24.  $\$\frac{a}{m}$

$$25. \frac{3.000}{n-1} \text{ colones}$$

$$26. \frac{x}{a-3} \text{ soles}$$

$$27. \frac{m}{14} m$$

$$28. \frac{x+1}{a} \text{ km/h}$$

$$29. \$ \frac{a+b}{m-2}$$

$$30. \left( x+2x+\frac{x}{2} \right) \text{ hab.}$$

$$31. \left[ 1.000 - \left( a + \frac{a}{3} + \frac{2a}{4} \right) \right] \text{ sucres}$$

## EJERCICIO 15

$$1. m, n \rightarrow m+n$$

$$2. m, -n \rightarrow m+(-n)=m-n$$

$$3. -3a, 4b \rightarrow -3a+4b$$

$$4. 5b, 6a \rightarrow -6a+5b$$

$$5. 7, -6 \rightarrow 7+(-6)=7-6=1$$

$$6. -6, 9 \rightarrow -6+9=3$$

$$7. -2x, 3y \rightarrow -2x+3y$$

$$8. 5mn, -m \rightarrow 5mn+(-m)=5mn-m$$

$$9. 5a, 7a \rightarrow 5a+7a=12a$$

$$10. -8x, -5x \rightarrow -8x+(-5x)=-8x-5x=-13x$$

$$11. -11m, 8m \rightarrow -11m+8m=-3m$$

$$12. 9ab, -15ab \rightarrow 9ab-15ab=-6ab$$

$$13. -xy, -9xy \rightarrow -9xy-xy=-10xy$$

$$14. mn, -11mn \rightarrow mn+(-11mn)=mn-11mn=-10mn$$

$$15. \frac{1}{2}a, -\frac{2}{3}b \rightarrow \frac{1}{2}a-\frac{2}{3}b$$

$$16. \frac{3}{5}b, \frac{3}{4}c \rightarrow \frac{3}{5}b+\frac{3}{4}c$$

$$17. \frac{1}{3}b, \frac{2}{3}b \rightarrow \frac{1}{3}b+\frac{2}{3}b=\frac{3}{3}b=b$$

$$18. -\frac{1}{2}xy, -\frac{1}{2}xy \rightarrow -\frac{1}{2}xy-\frac{1}{2}xy=-\frac{2}{2}xy=-xy$$

$$19. -\frac{3}{5}abc, -\frac{2}{5}abc$$

$$-\frac{3}{5}abc-\frac{2}{5}abc=-\frac{5}{5}abc=-abc$$

$$20. -4x^2y, \frac{3}{8}x^2y$$

$$-4x^2y+\frac{3}{8}x^2y=\frac{-32+3}{8}x^2y=-\frac{29}{8}x^2y$$

$$21. \frac{3}{8}mn, -\frac{3}{4}mn$$

$$\frac{3}{8}mn-\frac{3}{4}mn=\frac{3-6}{8}mn=-\frac{3}{8}mn$$

$$22. a, b, c \rightarrow a+b+c$$

$$23. a, -b, c \rightarrow a-b+c$$

$$24. a, -b, 2c \rightarrow a-b+2c$$

$$25. 3m, -2n, 4p \rightarrow 3m-2n+4p$$

$$26. a^2, -7ab, -5b^2 \rightarrow a^2-7ab-5b^2$$

$$27. x^2, -3xy, -4y^2 \rightarrow x^2-3xy-4y^2$$

$$28. x^3, -x^2y, 6 \rightarrow x^3-x^2y+6$$

$$29. 2a, -b, 3a \rightarrow 2a+3a-b=5a-b$$

$$30. -m, -8n, 4n \rightarrow -m-8n+4n=-m-4n$$

$$31. -7a, 8a, -b \rightarrow -7a+8a-b=a-b$$

$$32. \frac{1}{2}x, \frac{2}{3}y, -\frac{3}{4}x$$

$$\frac{1}{2}x-\frac{3}{4}x+\frac{2}{3}y=\frac{4-6}{8}x+\frac{2}{3}y=-\frac{1}{4}x+\frac{2}{3}y$$

$$33. -\frac{3}{5}m, -m, -\frac{2}{3}mn$$

$$-\frac{3}{5}m-m-\frac{2}{3}mn=\frac{-3-5}{5}m-\frac{2}{3}mn=-\frac{8}{5}m-\frac{2}{3}mn$$

$$34. -7a^2, 5ab, 3b^2, -a^2$$

$$-7a^2-a^2+5ab+3b^2=-8a^2+5ab+3b^2$$

35.  $-7mr^2 + 17mr^2 - 5m - 4m = 10mr^2 - 9m$
36.  $x^3 - 7x^3 - 8x^2y + 4x^2y + 5 = -6x^3 - 4x^2y + 5$
37.  $5x^2 - x^2 + 9xy - 6xy + 7y^2 = 4x^2 + 3xy + 7y^2$
38.  $-8a^2b - a^2b + 5ab^2 - 11ab^2 - 7b^3$   
 $= -9a^2b - 6ab^2 - 7b^3$
39.  $m^3 - 8m^2n + 7m^2n + 7mn^2 - n^3$   
 $= m^3 - n^2n + 7mn^2 - n^3$
40.  $\frac{1}{2}a - \frac{1}{4}a + \frac{2}{3}b + \frac{1}{5}b - 6$   
 $= \frac{2-1}{4}a + \frac{10+3}{15}b - 6 = \frac{1}{4}a + \frac{13}{15}b - 6$
41.  $a - a - 3b + 4b - 8c + 8c = b$
42.  $m^3 + 5m^3 - 5m^3 - 4m^2n - 4m^2n - 7mn^2$   
 $= m^3 - 8m^2n - 7mn^2$
43.  $9x - x - 11y - 6y + 4z - 6z = 8x - 17y - 2z$
44.  $6a^2 + 9a^2 - 5ab - 7b^2 - 8b^2 - 11$   
 $= 15a^2 - 5ab - 15b^2 - 11$
45.  $-x^2y^2 + x^2y^2 - 5xy^3 + 7xy^3 - 4y^4 - 8$   
 $= 2xy^3 - 4y^4 - 8$
46.  $3a - \frac{1}{2}a + \frac{1}{2}b - b - 4 + 6$   
 $= \frac{6-1}{2}a + \frac{1-2}{2}b + 2 = \frac{5}{2}a - \frac{1}{2}b + 2$
47.  $\frac{1}{2}x^2 + \frac{3}{4}x^2 + \frac{2}{3}xy - \frac{1}{3}xy + \frac{5}{6}y^2 - \frac{5}{6}y^2$   
 $= \frac{2+3}{4}x^2 + \frac{2-1}{3}xy = \frac{5}{4}x^2 + \frac{1}{3}xy$
48.  $5ax - 5ax - 6a^{x+1} + a^{x+1} + 5a^{x+1} + 8a^{x+2} = 8a^{x+2}$
49.  $\frac{3}{4}x^2 + x^2 - \frac{2}{3}xy - \frac{1}{3}xy + \frac{1}{3}y^2 + 5y^2$   
 $= \frac{3+4}{4}x^2 - \frac{2-1}{3}xy + \frac{1+15}{3}y^2 = \frac{7}{4}x^2 - xy + \frac{16}{3}y^2$
50.  $\frac{3}{4}a^2b - \frac{1}{4}a^2b + a^2b + \frac{1}{2}ab^2 + \frac{1}{2}ab^2 - \frac{5}{6}ab^2$   
 $= \frac{3-1+4}{4}a^2b + \frac{3+3-5}{6}ab^2 = \frac{3}{2}a^2b + \frac{1}{6}ab^2$

## EJERCICIO 16

1.  $\frac{3a+2b-c}{2a+3b+c}$   
 $\frac{5a+5b}{5a+5b}$
2.  $\frac{7a-4b+5c}{-7a+4b-6c}$   
 $-c$
3.  $\frac{m+n-p}{-m-n+p}$   
 $0$
4.  $\frac{9x-3y+5}{-x-y+4}$   
 $\frac{-5x+4y-9}{3x}$
5.  $\frac{a+b-c}{2a+2b-2c}$   
 $\frac{-3a-b+3c}{2b}$
6.  $\frac{p+q+r}{-2p-6q+3r}$   
 $\frac{p+5q-8r}{-4r}$
7.  $\frac{-7x-4y+6z}{10x-20y-8z}$   
 $\frac{-5x+24y+2z}{-2x}$
8.  $\frac{-2m+3n-6}{3m-8n+8}$   
 $\frac{-5m+n-10}{-4m-4n-8}$
9.  $\frac{-5a-2b-3c}{7a-3b+5c}$   
 $\frac{-8a+5b-3c}{-6a-c}$
10.  $\frac{ab+bc+cd}{-8ab-3bc-3cd}$   
 $\frac{5ab+2bc+2cd}{-2ab}$
11.  $\frac{ax-ay-az}{-5ax-7ay-6az}$   
 $\frac{4ax+9ay+8az}{ay+az}$
12.  $\frac{5x-7y+8}{-4x-y+6}$   
 $\frac{-3x+8y+9}{-2x+23}$
13.  $\frac{-am+6mn-4s}{-am-5mn+6s}$   
 $\frac{3am-5mn-2s}{am-4mn}$
14.  $\frac{2a+3b}{6b-4c}$   
 $\frac{-a+8c}{a+9b+4c}$
15.  $\frac{6m-3n}{-4n+5p}$   
 $\frac{-m-5p}{5m-7n}$
16.  $\frac{2a+3b}{+5c-4}$   
 $\frac{8a}{+7c-9}$   
 $\frac{10a+3b+12c-7}{+7c-9}$
17.  $\frac{2x-3y}{+5z+9}$   
 $\frac{6x}{3y-5}$   
 $\frac{8x}{+5z}$

$$\begin{array}{r}
 18. \quad 8a + 3b - c \\
 \quad 5a - b + c \\
 \quad -a - b - c \\
 \hline
 \quad 7a - b + 4c \\
 \hline
 19a \quad + 3c
 \end{array}$$

$$\begin{array}{r}
 19. \quad 7x + 2y \quad - 4 \\
 \quad + 9y - 6z + 5 \\
 \quad - y + 3z - 6 \\
 \hline
 \quad 8x - 3y \quad - 5 \\
 \hline
 15x + 7y - 3z - 10
 \end{array}$$

$$\begin{array}{r}
 20. \quad -m - n - p \\
 \quad m + 2n \quad - 5 \\
 \quad -6m \quad + 3p + 4 \\
 \hline
 \quad 5m + 2n \quad - 8 \\
 \hline
 -m + 3n + 2p - 9
 \end{array}$$

$$\begin{array}{r}
 21. \quad 5a^x - 3a^m - 7a^n \\
 \quad - 8a^x + 5a^m - 9a^n \\
 \hline
 \quad -11a^x + 5a^m + 16a^n \\
 \hline
 \quad -14a^x + 7a^m
 \end{array}$$

$$\begin{array}{r}
 22. \quad 6m^{a+1} - 7m^{a+2} - 5m^{a+3} \\
 \quad 4m^{a+1} - 7m^{a+2} - m^{a+3} \\
 \hline
 \quad -5m^{a+1} + 3m^{a+2} + 12m^{a+3} \\
 \hline
 \quad 5m^{a+1} - 11m^{a+2} + 6m^{a+3}
 \end{array}$$

$$\begin{array}{r}
 23. \quad 8x + y + z + u \\
 \quad -3x - 4y - 2z + 3u \\
 \hline
 \quad 4x + 5y + 3z - 4u \\
 \hline
 \quad -9x - y + z + 2u \\
 \hline
 \quad y + 3z + 2u
 \end{array}$$

$$\begin{array}{r}
 24. \quad a + b - c + d \\
 \quad a - b + c - d \\
 \hline
 \quad -2a + 3b - 2c + d \\
 \hline
 \quad -3a - 3b + 4c - d \\
 \hline
 \quad -3a \quad + 2c
 \end{array}$$

$$\begin{array}{r}
 25. \quad 5ab - 3bc + 4cd \\
 \quad + 2bc + 2cd - 3de \\
 \hline
 \quad -2ab + 4bc \quad + 3de \\
 \hline
 \quad -ab - 3bc - 6cd \\
 \hline
 \quad 2ab
 \end{array}$$

$$\begin{array}{r}
 26. \quad a - b \\
 \quad b - c \\
 \quad c + d \\
 \hline
 \quad a \quad - c \\
 \hline
 \quad c - d \\
 \hline
 \quad -a \quad + d \\
 \hline
 \quad a \quad - d \\
 \hline
 \quad 2a
 \end{array}$$

## EJERCICIO 17

$$\begin{array}{r}
 1. \quad x^2 + 4x \\
 \quad x^2 - 5x \\
 \hline
 2x^2 - x
 \end{array}$$

$$\begin{array}{r}
 2. \quad a^2 + ab \\
 \quad -2ab + b^2 \\
 \hline
 a^2 - ab + b^2
 \end{array}$$

$$\begin{array}{r}
 3. \quad x^3 \quad + 2x \\
 \quad -x^2 \quad + 4 \\
 \hline
 x^3 - x^2 + 2x + 4
 \end{array}$$

$$\begin{array}{r}
 4. \quad a^4 \quad - 3a^2 \\
 \quad + a^3 \quad + 4a \\
 \hline
 a^4 + a^3 - 3a^2 + 4a
 \end{array}$$

$$\begin{array}{r}
 5. \quad -x^2 + 3x \\
 \quad x^3 \quad + 6 \\
 \hline
 x^3 - x^2 + 3x + 6
 \end{array}$$

$$\begin{array}{r}
 6. \quad x^2 - 4x \\
 \quad - 7x + 6 \\
 \hline
 3x^2 \quad - 5 \\
 \hline
 4x^2 - 11x + 1
 \end{array}$$

$$\begin{array}{r}
 7. \quad m^2 + n^2 \\
 \quad + 4n^2 - 3mn \\
 \hline
 -5m^2 - 5n^2 \\
 \hline
 -4m^2 \quad - 3mn
 \end{array}$$

$$\begin{array}{r}
 8. \quad 3x + x^3 \\
 \quad - 4x^2 + 5 \\
 \hline
 \quad -x^3 + 4x^2 - 6 \\
 \hline
 3x \quad - 1
 \end{array}$$

$$\begin{array}{r}
 9. \quad x^2 - 3xy + y^2 \\
 \quad -x^2 + 3xy - 2y^2 \\
 \hline
 \quad x^2 + 3xy - y^2 \\
 \hline
 x^2 + 3xy - 2y^2
 \end{array}$$

$$\begin{array}{r}
 10. \quad a^2 - 3ab + b^2 \\
 \quad + a^2 - 5ab - b^2 \\
 \hline
 \quad -2a^2 + 8ab - b^2 \\
 \hline
 \quad - b^2
 \end{array}$$

$$\begin{array}{r}
 11. \quad -7x^2 + 5x - 6 \\
 \quad 4x^2 + 8x - 9 \\
 \hline
 \quad -x^2 - 7x + 14 \\
 \hline
 \quad -4x^2 + 6x - 1
 \end{array}$$

$$\begin{array}{r}
 12. \quad a^3 \quad - 4a + 5 \\
 \quad a^3 - 2a^2 \quad + 6 \\
 \quad + a^2 - 7a + 4 \\
 \hline
 2a^3 - a^2 - 11a + 15
 \end{array}$$

$$\begin{array}{r}
 13. \quad -x^2 + x - 6 \\
 \quad x^3 - 7x^2 \quad + 5 \\
 \hline
 \quad -x^3 + 8x - 5 \\
 \hline
 -8x^2 + 9x - 6
 \end{array}$$

$$\begin{array}{r}
 14. \quad a^3 \quad - b^3 \\
 \quad + 5a^2b - 4ab^2 \\
 \hline
 \quad a^3 \quad - 7ab^2 - b^3 \\
 \hline
 2a^3 + 5a^2b - 11ab^2 - 2b^3
 \end{array}$$

$$\begin{array}{r}
 15. \quad x^3 \quad + xy^2 + y^3 \\
 \quad x^3 - 5x^2y \quad - y^3 \\
 \hline
 2x^3 \quad - 4xy^2 - 5y^3 \\
 \hline
 4x^3 - 5x^2y - 3xy^2 - 5y^3
 \end{array}$$

$$\begin{array}{r}
 16. \quad -7m^2n \quad + 4n^3 \\
 \quad + m^3 \quad + 6mn^2 - n^3 \\
 \hline
 \quad -m^3 + 7m^2n \quad + 5n^3 \\
 \hline
 \quad + 6mn^2 + 8n^3
 \end{array}$$

$$\begin{array}{r}
 17. \quad x^4 \quad -x^2 + x \\
 \quad +x^3 - 4x^2 \quad + 5 \\
 \quad \quad + 7x^2 - 4x + 6 \\
 \hline
 x^4 + x^3 + 2x^2 - 3x + 11
 \end{array}$$

$$\begin{array}{r}
 18. \quad +a^6 \quad +a^4 \quad + 6 \\
 \quad +a^5 \quad -3a^3 \quad + 8 \\
 \quad \quad + a^3 - a^2 - 14 \\
 \hline
 +a^6 + a^5 + a^4 - 2a^3 - a^2
 \end{array}$$

$$\begin{array}{r}
 19. \quad x^5 \quad \quad \quad + x - 9 \\
 \quad + 3x^4 \quad - 7x^2 \quad + 6 \\
 \quad \quad - 3x^3 \quad - 4x + 5 \\
 \hline
 x^5 + 3x^4 - 3x^3 - 7x^2 - 3x + 2
 \end{array}$$

$$\begin{array}{r}
 20. \quad a^3 + a \\
 \quad + a^2 + 5 \\
 \quad + 4a + 7a^2 \\
 \quad \quad - 8a^2 - 6 \\
 \hline
 a^3 + 5a \quad - 1
 \end{array}$$

$$\begin{array}{r}
 21. \quad x^4 \quad - x^2 y^2 \\
 \quad - 5x^3 y \quad + 6xy^3 \\
 \quad \quad \quad - 4xy^3 + y^4 \\
 \quad \quad \quad - 4x^2 y^2 \quad - 6 \\
 \hline
 x^4 - 5x^3 y - 5x^2 y^2 + 2xy^3 + y^4 - 6
 \end{array}$$

$$\begin{array}{r}
 22. \quad + x^2 + xy \\
 \quad - x^2 + 4xy - 7y^2 \\
 \quad - x^2 + 6xy + 5y^2 \\
 \quad - 6x^2 - 4xy + y^2 \\
 \hline
 -7x^2 + 7xy - y^2
 \end{array}$$

$$\begin{array}{r}
 23. \quad a^3 - 8ax^2 + x^3 \\
 \quad - 6ax^2 - x^3 + 5a^2 x \\
 3a^3 \quad - x^3 - 5a^2 x \\
 \hline
 a^3 + 14ax^2 - x^3 \\
 \hline
 5a^3 \quad - 2x^3
 \end{array}$$

$$\begin{array}{r}
 24. \quad -8a^2 m + 6am^2 - m^3 \\
 \quad + a^3 \quad - 5am^2 + m^3 \\
 \quad - 4a^3 + 4a^2 m - 3am^2 \\
 \quad \quad + 7a^2 m - 4am^2 \quad - 6 \\
 \hline
 -3a^3 + 3a^2 m - 6am^2 \quad - 6
 \end{array}$$

$$\begin{array}{r}
 25. \quad x^5 \quad - x^3 y^2 \quad - xy^4 \\
 \quad + 2x^4 y \quad + 3x^2 y^3 \quad - y^5 \\
 \quad \quad + 3x^3 y^2 \quad - 4xy^4 - y^5 \\
 \hline
 x^5 \quad \quad \quad + 5xy^4 + 2y^5 \\
 \hline
 2x^5 + 2x^4 y + 2x^3 y^2 + 3x^2 y^3
 \end{array}$$

$$\begin{array}{r}
 26. \quad a^5 + a^6 + a^2 \\
 \quad \quad + a^4 + a^3 + 6 \\
 \quad \quad + 3a^2 \quad - 8 + 5a \\
 -a^5 \quad - 4a^2 \quad + 6 - 5a \\
 \hline
 + a^6 \quad + a^4 + a^3 + 4
 \end{array}$$

$$\begin{array}{r}
 27. \quad a^4 \quad \quad \quad - b^4 \\
 \quad - a^3 b + a^2 b^2 - ab^3 \\
 -3a^4 + 5a^3 b - 4a^2 b^2 \\
 \quad - 4a^3 b + 3a^2 b^2 \quad - 3b^4 \\
 \hline
 -2a^4 \quad \quad \quad - ab^3 - 4b^4
 \end{array}$$

$$\begin{array}{r}
 28. \quad m^3 - n^3 + 6m^2 n \\
 \quad + n^3 - 4m^2 n + 5mn^2 \\
 m^3 - n^3 \quad + 6mn^2 \\
 \hline
 -2m^3 + n^3 - 2m^2 n \\
 \hline
 11mn^2
 \end{array}$$

$$\begin{array}{r}
 29. \quad a^x \quad - 3a^{x-2} \\
 \quad + 5a^{x-1} \quad + 6a^{x-3} \\
 \quad \quad \quad + 7a^{x-3} + a^{x-4} \\
 \quad + a^{x-1} \quad - 13a^{x-3} \\
 \hline
 a^x + 6a^{x-1} - 3a^{x-2} \quad + a^{x-4}
 \end{array}$$

$$\begin{array}{r}
 30. \quad -a^x + a^{x+1} \quad \quad \quad + a^{x+2} \\
 \quad \quad \quad - 3a^{x+3} - a^{x-1} + a^{x-2} \\
 -a^x \quad + 4a^{x+3} \quad - 5a^{x+2} \\
 \quad \quad \quad + a^{x-1} - a^{x-2} + a^{x+2} \\
 \hline
 -2a^x + a^{x+1} + a^{x+3} \quad - 3a^{x+2} \\
 \Rightarrow a^{x+3} - 3a^{x+2} + a^{x+1} - 2a^x
 \end{array}$$

## EJERCICIO 18

$$1. \frac{1}{2}x^2 + \frac{1}{3}xy + \frac{1}{2}xy + \frac{1}{4}y^2$$

$$\frac{1}{2}x^2 + \frac{2+3}{6}xy + \frac{1}{4}y^2 = \frac{1}{2}x^2 + \frac{5}{6}xy + \frac{1}{4}y^2$$

$$2. a^2 + \frac{1}{2}ab - \frac{1}{4}ab + \frac{1}{2}b^2 - \frac{1}{4}ab - \frac{1}{5}b^2$$

$$a^2 + \frac{2-1-1}{4}ab + \frac{5-2}{10}b^2 = a^2 + \frac{3}{10}b^2$$

$$3. x^2 + \frac{2}{3}xy - \frac{1}{6}xy + y^2 - \frac{5}{6}xy + \frac{2}{3}y^2$$

$$x^2 + \frac{4-1-5}{6}xy + \frac{3+2}{3}y^2 = x^2 - \frac{2}{6}xy + \frac{5}{3}y^2 = x^2 - \frac{1}{3}xy + \frac{5}{3}y^2$$

$$4. \frac{3}{4}x^2 - \frac{1}{2}y^2 - \frac{2}{5}xy + \frac{1}{6}y^2 + \frac{1}{10}xy + \frac{1}{3}y^2$$

$$\frac{3}{4}x^2 + \frac{-4+1}{10}xy + \frac{-3+1+2}{6}y^2 = \frac{3}{4}x^2 - \frac{3}{10}xy$$

$$5. \frac{2}{3}a^2 + \frac{1}{5}ab - \frac{1}{2}b^2 + \frac{5}{6}a^2 - \frac{1}{10}ab + \frac{1}{6}b^2 - \frac{1}{12}a^2 + \frac{1}{20}ab - \frac{1}{3}b^2$$

$$\frac{8+10-1}{12}a^2 + \frac{4-2+1}{20}ab + \frac{-3+1-2}{6}b^2 = \frac{17}{12}a^2 + \frac{3}{20}ab - \frac{4}{6}b^2 = \frac{17}{12}a^2 + \frac{3}{20}ab - \frac{2}{3}b^2$$

$$6. \frac{5}{6}x^2 - \frac{2}{3}y^2 + \frac{3}{4}xy - \frac{1}{6}x^2 + \frac{1}{8}y^2 - \frac{1}{2}xy - \frac{1}{3}x^2 + \frac{1}{4}y^2 + \frac{5}{6}xy$$

$$\frac{5-1-2}{6}x^2 + \frac{-16+3+6}{24}y^2 + \frac{9-6+10}{12}xy = \frac{2}{6}x^2 - \frac{7}{24}y^2 + \frac{13}{12}xy \Rightarrow \frac{1}{3}x^2 + \frac{13}{12}xy - \frac{7}{24}y^2$$

$$7. a^3 - \frac{1}{2}ab^2 + b^3 - \frac{3}{8}ab^2 - 2b^3 + \frac{5}{6}a^2b + \frac{1}{4}a^3 - \frac{3}{5}b^3 - \frac{1}{2}a^2b$$

$$\frac{4+1}{4}a^3 + \frac{-4-3}{8}ab^2 + \frac{5-10-3}{5}b^3 + \frac{5-3}{6}a^2b = \frac{5}{4}a^3 - \frac{7}{8}ab^2 - \frac{8}{5}b^3 + \frac{2}{6}a^2b \Rightarrow \frac{5}{4}a^3 + \frac{1}{3}a^2b - \frac{7}{8}ab^2 - \frac{8}{5}b^3$$

$$8. x^4 - x^2 + 5 - 3 + \frac{2}{3}x^3 - \frac{3}{8}x - \frac{3}{5}x^4 + \frac{5}{6}x^3 - \frac{3}{4}x$$

$$\frac{5-3}{5}x^4 - x^2 + 2 + \frac{4+5}{6}x^3 + \frac{-3-6}{8}x = \frac{2}{5}x^4 - x^2 + 2 + \frac{9}{6}x^3 - \frac{9}{8}x = \frac{2}{5}x^4 + \frac{3}{2}x^3 - x^2 - \frac{9}{8}x + 2$$

$$9. \frac{2}{3}m^3 - \frac{1}{4}mn^2 + \frac{2}{5}n^3 + \frac{1}{8}mn^2 - \frac{3}{5}n^3 + \frac{1}{6}m^2n + m^3 - n^3 - \frac{1}{2}m^2n$$

$$\frac{2+3}{3}m^3 + \frac{-2+1}{8}mn^2 + \frac{2-3-5}{5}n^3 + \frac{1-3}{6}m^2n = \frac{5}{3}m^3 - \frac{1}{8}mn^2 - \frac{6}{5}n^3 - \frac{2}{6}m^2n \Rightarrow \frac{5}{3}m^3 - \frac{1}{3}m^2n - \frac{1}{8}mn^2 - \frac{6}{5}n^3$$

$$10. x^4 + 2x^2y^2 + \frac{2}{7}y^4 - \frac{5}{6}x^4 + \frac{3}{8}x^2y^2 - \frac{1}{14}y^4 - \frac{1}{6}xy^3 - \frac{1}{4}x^2y^2 + \frac{1}{7}y^4 - \frac{5}{6}x^3y$$

$$\frac{6-5}{6}x^4 + \frac{16+3-2}{8}x^2y^2 + \frac{4-1+2}{14}y^4 - \frac{1}{6}xy^3 - \frac{5}{6}x^3y = \frac{1}{6}x^4 + \frac{17}{8}x^2y^2 + \frac{5}{14}y^4 - \frac{1}{6}xy^3 - \frac{5}{6}x^3y \Rightarrow \frac{1}{6}x^4 - \frac{5}{6}x^3y + \frac{17}{8}x^2y^2 - \frac{1}{6}xy^3 + \frac{5}{14}y^4$$

$$\begin{aligned}
 11. \quad & x^5 - \frac{2}{3}x^3 + \frac{4}{5}x \\
 & -3x^5 - \frac{1}{10}x + \frac{3}{8}x^2 \\
 & + \frac{1}{6}x^3 - \frac{1}{4}x^2 - \frac{2}{3}x^4 \\
 & - \frac{1}{12}x^3 + \frac{3}{5}x - 4 \\
 \hline
 & -2x^5 + \frac{-8+2-1}{12}x^3 + \frac{8-1+6}{10}x + \frac{3-2}{8}x^2 - \frac{2}{3}x^4 - 4 \\
 & = -2x^5 - \frac{7}{12}x^3 + \frac{13}{10}x + \frac{1}{8}x^2 - \frac{2}{3}x^4 - 4 \\
 & \Rightarrow -2x^5 - \frac{2}{3}x^4 - \frac{7}{12}x^3 + \frac{1}{8}x^2 + \frac{13}{10}x - 4
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{2}{9}a^3 + \frac{5}{6}ax^2 - \frac{1}{3}x^3 \\
 & - \frac{3}{7}a^2x - \frac{7}{8}ax^2 - \frac{1}{9}x^3 \\
 & - \frac{2}{3}a^3 + \frac{1}{2}a^2x - \frac{1}{4}ax^2 \\
 \hline
 & \frac{2-6}{9}a^3 + \frac{-6+7}{14}a^2x + \frac{20-21-6}{24}ax^2 + \frac{-3-1}{9}x^3 \\
 & = -\frac{4}{9}a^3 + \frac{1}{14}a^2x - \frac{7}{24}ax^2 - \frac{4}{9}x^3
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & a^6 - a^4 + a^2 \\
 & + \frac{3}{5}a^5 - \frac{3}{8}a^3 - \frac{1}{2}a \\
 & - \frac{3}{7}a^4 - \frac{5}{8}a^2 + 6 \\
 & - \frac{3}{8}a - 6 \\
 \hline
 & a^6 + \frac{-7-3}{7}a^4 + \frac{8-5}{8}a^2 + \frac{3}{5}a^5 - \frac{3}{8}a^3 + \frac{-4-3}{8}a \\
 & = a^6 - \frac{10}{7}a^4 + \frac{3}{8}a^2 + \frac{3}{5}a^5 - \frac{3}{8}a^3 - \frac{7}{8}a \\
 & \Rightarrow a^6 + \frac{3}{5}a^5 - \frac{10}{7}a^4 - \frac{3}{8}a^3 + \frac{3}{8}a^2 - \frac{7}{8}a
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & x^5 - y^5 \\
 & + \frac{1}{10}x^3y^2 - \frac{3}{4}xy^4 - \frac{1}{6}y^5 \\
 & - \frac{2}{5}x^3y^2 - \frac{1}{9}y^5 + \frac{3}{5}x^4y - \frac{5}{6}x^2y^3 \\
 & - \frac{2}{5}x^3y^2 - \frac{1}{3}y^5 + 2x^4y \\
 \hline
 & x^5 + \frac{1-4}{10}x^3y^2 - \frac{3}{4}xy^4 + \frac{-18-3-2-6}{18}y^5 + \frac{3+10}{5}x^4y - \frac{5}{6}x^2y^3 \\
 & = x^5 - \frac{3}{10}x^3y^2 - \frac{3}{4}xy^4 - \frac{29}{18}y^5 + \frac{13}{5}x^4y - \frac{5}{6}x^2y^3 \\
 & \Rightarrow x^5 + \frac{13}{5}x^4y - \frac{3}{10}x^3y^2 - \frac{5}{6}x^2y^3 - \frac{3}{4}xy^4 - \frac{29}{18}y^5
 \end{aligned}$$

## EJERCICIO 19

Para los problemas 1 al 14 las literales toman los siguientes valores:

$$a = 2 \quad b = 3 \quad c = 10 \quad x = 5 \quad y = 4 \quad m = 2/3 \quad n = 1/5$$

$$\begin{aligned}
 1. \quad & 4x - 5y \\
 & -3x + 6y - 8 \\
 & -x + y \\
 \hline
 & 2y - 8 \\
 & \Rightarrow 2 \cdot 4 - 8 = 8 - 8 = 0
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & x^2 - 5x + 8 \\
 & -x^2 + 10x - 30 \\
 & -6x^2 + 5x - 50 \\
 \hline
 & -6x^2 + 10x - 72 \\
 & \Rightarrow -6 \cdot 5^2 + 10 \cdot 5 - 72 = -6 \cdot 25 + 50 - 72 \\
 & = -150 + 50 - 72 = -172
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & x^4 - y^4 \\
 & 2x^4 - 5x^2y^2 - 8 \\
 & -4x^4 + 7x^3y + 10xy^3 \\
 \hline
 & -x^4 - y^4 - 5x^2y^2 - 8 + 7x^3y + 10xy^3 \\
 & \Rightarrow -x^4 + 7x^3y - 5x^2y^2 + 10xy^3 - y^4 - 8 \\
 & = -5^4 + 7 \cdot 5^3 \cdot 4 - 5 \cdot 5^2 \cdot 4^2 + 10 \cdot 5 \cdot 4^3 - 4^4 - 8 \\
 & = -625 + 28 \cdot 125 - 5 \cdot 25 \cdot 16 + 50 \cdot 64 - 256 - 8 \\
 & = -625 + 3500 - 2000 + 3200 - 256 - 8 = 3811
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & 3m - 5n + 6 \\
 & -6m - 20n + 8 \\
 & 12m - 20n - 12 \\
 \hline
 & 9m - 45n + 2 \\
 & \Rightarrow 9 \cdot \frac{2}{3} - 45 \cdot \frac{1}{5} + 2 = \frac{18}{3} - \frac{45}{5} + 2 = 6 - 9 + 2 = -1
 \end{aligned}$$



5.  $nx + cn - ab$

$$8nx - 2cn - ab$$

$$\frac{nx \quad -ab - 5}{10nx - cn - 3ab - 5}$$

$$\Rightarrow 10 \cdot \frac{1}{5} \cdot 5 - 10 \cdot \frac{1}{5} - 3 \cdot 2 \cdot 3 - 5$$

$$= \frac{50}{5} - \frac{10}{5} - 6 \cdot 3 - 5$$

$$= 10 - 2 - 18 - 5 = -15$$

6.  $a^3 + b^3$

$$-3a^2b + 8ab^2 - b^3$$

$$-5a^3 \quad -6ab^2 \quad +8$$

$$\frac{+3a^2b \quad -2b^3}{-4a^3 \quad +2ab^2 - 2b^3 + 8}$$

$$\Rightarrow -4 \cdot 2^3 + 2 \cdot 2 \cdot 3^2 - 2 \cdot 3^3 + 8$$

$$= -4 \cdot 8 + 4 \cdot 9 - 2 \cdot 27 + 8$$

$$= -32 + 36 - 54 + 8 = -42$$

7.  $27m^3 + 125n^3$

$$-9m^2n + 25mn^2$$

$$-14mn^2 \quad -8$$

$$\frac{+10m^2n + 11mn^2}{27m^3 + m^2n + 22mn^2 + 125n^3 - 8}$$

$$\Rightarrow 27 \cdot \left(\frac{2}{3}\right)^3 + \left(\frac{2}{3}\right)^2 \cdot \frac{1}{5} + 22 \cdot \frac{2}{3} \cdot \left(\frac{1}{5}\right)^2 + 125 \cdot \left(\frac{1}{5}\right)^3 - 8$$

$$= 27 \cdot \frac{8}{27} + \frac{4}{9} \cdot \frac{1}{5} + \frac{44}{3} \cdot \frac{1}{25} + 125 \cdot \frac{1}{125} - 8$$

$$= 8 + \frac{4}{45} + \frac{44}{75} + 1 - 8 = \frac{4}{45} + \frac{44}{75} + 1$$

$$= \frac{20 + 132 + 225}{225} = \frac{377}{225} = 1 \frac{152}{225}$$

8.  $x^{a-1} + y^{b-2} + m^{x-4}$

$$2x^{a-1} - 2y^{b-2} - 2m^{x-4}$$

$$+ 3y^{b-2} - 2m^{x-4}$$

$$\frac{3x^{a-1} + 2y^{b-2} - 3m^{x-4}}{\Rightarrow 3 \cdot 5^{2-1} + 2 \cdot 4^{3-2} - 3 \left(\frac{2}{3}\right)^{5-4} = 15 + 8 - 2 = 21}$$

9.  $n^{b-1} - m^{x-3} + 8$

$$-5n^{b-1} - 3m^{x-3} + 10$$

$$\frac{4n^{b-1} + 5m^{x-3} - 18}{m^{x-3}}$$

$$\Rightarrow \left(\frac{2}{3}\right)^{5-3} = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

10.  $x^3y - xy^3 + 5$

$$5x^3y \quad -6 + x^4 - x^2y^2$$

$$-6xy^3 + 2 \quad + x^2y^2$$

$$\frac{+3xy^3 + 1 \quad -y^4}{6x^3y - 4xy^3 + 2 + x^4 - y^4}$$

$$\Rightarrow x^4 + 6x^3y - 4xy^3 - y^4 + 2$$

$$= 5^4 + 6 \cdot 5^3 \cdot 4 - 4 \cdot 5 \cdot 4^3 - 4^4 + 2$$

$$= 625 + 24 \cdot 125 - 20 \cdot 64 - 256 + 2$$

$$= 625 + 3.000 - 1.280 - 256 + 2 = 2.091$$

11.  $\frac{3}{4}a^2 + \frac{2}{3}b^2$

$$- \frac{1}{3}ab + \frac{1}{9}b^2$$

$$+ \frac{1}{6}ab - \frac{1}{3}b^2$$

$$\frac{\frac{3}{4}a^2 - \frac{-2+1}{6}ab + \frac{6+1-3}{9}b^2}{= \frac{3}{4}a^2 - \frac{1}{6}ab + \frac{4}{9}b^2}$$

$$\Rightarrow \frac{3}{4} \cdot 2^2 - \frac{1}{6} \cdot 2 \cdot 3 + \frac{4}{9} \cdot 3^2$$

$$= \frac{3}{4} \cdot 4 - \frac{1}{6} \cdot 6 + \frac{4}{9} \cdot 9 = 3 - 1 + 4 = 6$$

12.  $\frac{9}{17}m^2 + \frac{25}{34}n^2 - \frac{1}{4}$

$$\frac{7}{34}m^2 + \frac{5}{17}n^2 + \frac{1}{2} \quad -15mn$$

$$- \frac{7}{34}m^2 \quad - \frac{1}{4} \quad -30mn$$

$$+ 3$$

$$\frac{18+7-7}{34}m^2 + \frac{25+10}{34}n^2 + \frac{-1+2-1+12}{4} - 45mn$$

$$= \frac{18}{34}m^2 + \frac{35}{34}n^2 + \frac{12}{4} - 45mn$$

$$\Rightarrow \frac{9}{17}m^2 - 45mn + \frac{35}{34}n^2 + 3$$

$$= \frac{9}{17} \left(\frac{2}{3}\right)^2 - 45 \cdot \frac{2}{3} \cdot \frac{1}{5} + \frac{35}{34} \left(\frac{1}{5}\right)^2 + 3$$

$$= \frac{9}{17} \cdot \frac{4}{9} - \frac{90}{15} + \frac{35}{34} \cdot \frac{1}{25} + 3$$

$$= \frac{4}{17} - 6 + \frac{35}{850} + 3 = \frac{4}{17} + \frac{7}{170} - 3$$

$$= \frac{40+7-510}{170} = -\frac{463}{170} = -2 \frac{123}{170}$$

$$\begin{array}{r}
 13. \quad \frac{1}{2}b^2m \quad - \quad \frac{3}{5}cn \quad - \quad 2 \\
 \frac{3}{4}b^2m \quad - \quad \frac{1}{10}cn \quad + \quad 6 \\
 -\frac{1}{4}b^2m \quad + \quad \frac{1}{25}cn \quad + \quad 4 \\
 -\frac{1}{8}b^2m \quad + \quad 2cn \quad + \quad \frac{3}{5} \\
 \hline
 \frac{4+6-2-1}{8}b^2m + \frac{-30-5+2+100}{50}cn + \frac{-10+30+20+3}{5} \\
 \Rightarrow \frac{7}{8}b^2m + \frac{67}{50}cn + \frac{43}{5} = \frac{7}{8} \cdot 3^2 \cdot \frac{2}{3} + \frac{67}{50} \cdot 10 \cdot \frac{1}{5} + \frac{43}{5} \\
 = \frac{7 \cdot 9 \cdot 2}{24} + \frac{67}{50} + \frac{43}{5} = \frac{126}{24} + \frac{670}{250} + \frac{43}{5} = \frac{21}{4} + \frac{67}{25} + \frac{43}{5} \\
 = \frac{525+268+860}{100} = \frac{1.653}{100} = 16 \frac{53}{100}
 \end{array}$$

$$\begin{array}{r}
 14. \quad 0,2a^3 + 0,4ab^2 - 0,5a^2b \\
 \quad \quad + 0,6ab^2 - 0,3a^2b - 0,8b^3 \\
 -0,4a^3 \quad -0,8a^2b \quad + 6 \\
 0,2a^3 \quad + 1,5a^2b + 0,9b^3 \\
 \hline
 ab^2 - 0,1a^2b + 0,1b^3 + 6 \\
 \Rightarrow -0,1a^2b + ab^2 + 0,1b^3 + 6 \\
 = -0,1 \cdot 2^2 \cdot 3 + 2 \cdot 3^2 + 0,1 \cdot 3^3 + 6 \\
 = -0,3 \cdot 4 + 2 \cdot 9 + 0,1 \cdot 27 + 6 \\
 = -1,2 + 18 + 2,7 + 6 \\
 = 25,5
 \end{array}$$

## EJERCICIO 20

1.  $-8-5=-13$
2.  $-7-4=-11$
3.  $8-11=-3$
4.  $-8-(-11)=-8+11=3$
5.  $-1-(-9)=-1+9=8$
6.  $2a-3b=2a-3b$
7.  $3b-2=3b-2$
8.  $4x-6b=4x-6b$
9.  $-5a-6b=-5a-6b$
10.  $-8x-(-3)=-8x+3$
11.  $-9a^2-5b^2=-9a^2-5b^2$
12.  $-7xy-(-5yz)=-7xy+5yz$
13.  $3a-4a=-a$
14.  $11m^2-25m^2=-14m^2$
15.  $-6x^2y-(-x^2y)=-6x^2y+x^2y=-5x^2y$
16.  $11a^3m^2-(-7a^3m^2)=11a^3m^2+7a^3m^2=18a^3m^2$
17.  $-8ab^2-(-8ab^2)=-8ab^2+8ab^2=0$
18.  $31x^2y-(-46x^2y)=31x^2y+46x^2y=77x^2y$
19.  $-84a^2b-(-84a^2b)=-84a^2b+84a^2b=0$
20.  $3a^{x+1}-5b^{x+2}=3a^{x+1}-5b^{x+2}$
21.  $-8x^{a+2}-11=-8x^{a+2}-11$
22.  $6a^n-(-5a^n)=6a^n+5a^n=11a^n$
23.  $-45a^{x-1}-(-60a^{x-1})=-45a^{x-1}+60a^{x-1}=15a^{x-1}$
24.  $54b^{n-1}-(-86b^{n-1})=54b^{n-1}+86b^{n-1}=140b^{n-1}$
25.  $-35m^a-(-60m^a)=-35m^a+60m^a=25m^a$
26.  $5-\left(-\frac{1}{2}\right)=5+\frac{1}{2}=\frac{10+1}{2}=\frac{11}{2}=5\frac{1}{2}$
27.  $-\frac{2}{3}-\frac{3}{4}=\frac{-8-9}{12}=-\frac{17}{12}$
28.  $\frac{1}{3}x^2-\left(-\frac{2}{3}x^2\right)=\frac{1}{3}x^2+\frac{2}{3}x^2=\frac{3}{3}x^2=x^2$
29.  $\frac{4}{5}x^3y-\left(-\frac{5}{6}x^3y\right)=\frac{24+25}{30}x^3y=\frac{49}{30}x^3y$
30.  $-\frac{1}{8}ab^2-\left(-\frac{3}{4}ab^2\right)=\frac{-1+6}{8}ab^2=\frac{5}{8}ab^2$
31.  $-2-3=-5$
32.  $7-(-1)=7+1=8$
33.  $-8-(-5)=-8+5=-3$
34.  $5-(-4)=5+4=9$
35.  $-7-(-7)=-7+7=0$
36.  $2a-(-5)=2a+5$

$$37. -3x - b = -3x - b$$

$$38. -2n - 5m = -2n - 5m$$

$$39. 3b - (-6a) = 6a + 3b$$

$$40. 8b - (-5a^3) = 5a^3 + 8b$$

$$41. -7a - (-9) = -7a + 9$$

$$42. 25ab - (-25) = 25ab + 25$$

$$43. 3a - (-a) = 3a + a = 4a$$

$$44. -4b - (-3b) = -4b + 3b = -b$$

$$45. 54x^3 - (-11x^3) = 54x^3 + 11x^3 = 65x^3$$

$$46. 78a^2b - 14a^2b = 64a^2b$$

$$47. -54a^2y - (-43a^2y) = -54a^2y + 43a^2y = -11a^2y$$

$$48. -ab - 9ab = -10ab$$

$$49. -31x^2y - (-31x^2y) = -31x^2y + 31x^2y = 0$$

$$50. -3a^x - a^x = -4a^x$$

$$51. 311a^{x+1} - (-7a^{x+1}) = 311a^{x+1} + 7a^{x+1} = 318a^{x+1}$$

$$52. 105m^x - 9m^x = 96m^x$$

$$53. -31a^{x-1} - 18a^{x-1} = -49a^{x-1}$$

$$54. -236m^a - (-19m^a) = -236m^a + 19m^a = -217m^a$$

$$55. -85a^{x+2} - 54a^{x+2} = -139a^{x+2}$$

$$56. \frac{1}{4} - (-6a) = \frac{1}{4} + 6a$$

$$57. -\frac{2}{3} - (-5) = \frac{-2+15}{3} = \frac{13}{3}$$

$$58. -\frac{7}{10}m^3 - \frac{3}{8}m^3 = \frac{-56-30}{80}m^3 = -\frac{86}{80}m^3 = -\frac{43}{40}m^3$$

$$59. \frac{5}{6}a^2b^2 - \left(-\frac{11}{12}a^2b^2\right) = \frac{10+11}{12}a^2b^2 = \frac{21}{12}a^2b^2 = \frac{7}{4}a^2b^2$$

$$60. -\frac{1}{9}a^3b^2 - 45a^3b^2 = \frac{-1-405}{9}a^3b^2 = \frac{-406}{9}a^3b^2 = -45\frac{1}{9}a^3b^2$$

## EJERCICIO 21

$$1. \frac{a+b}{-a+b}$$

$$\frac{-a+b}{2b}$$

$$2. \frac{2x-3y}{x-2y}$$

$$\frac{3x-5y}{3x-5y}$$

$$3. \frac{8a+b}{3a}$$

$$\frac{-4}{11a+b-4}$$

$$4. \frac{x^2-3x}{5x-6}$$

$$\frac{x^2+2x-6}{x^2+2x-6}$$

$$5. \frac{a^3-a^2b}{-7a^2b-9ab^2}$$

$$\frac{a^3-8a^2b-9ab^2}{a^3-8a^2b-9ab^2}$$

$$6. \frac{x-y+z}{-x+y-z}$$

$$\frac{-x+y-z}{0}$$

$$7. \frac{x+y-z}{x+y-z}$$

$$\frac{2x+2y-2z}{2x+2y-2z}$$

$$8. \frac{x^2+y^2-3xy}{-3x^2+y^2+4xy}$$

$$\frac{-2x^2+2y^2+xy}{-2x^2+2y^2+xy} \Rightarrow -2x^2+xy+2y^2$$

$$9. \frac{x^3-x^2+6}{-5x^2-6+4x}$$

$$\frac{x^3-6x^2+4x}{x^3-6x^2+4x}$$

$$10. \frac{y^2+6y^3-8}{3y^2-2y^4-6y}$$

$$\frac{4y^2-2y^4+6y^3-6y-8}{4y^2-2y^4+6y^3-6y-8} \Rightarrow -2y^4+6y^3+4y^2-6y-8$$

$$11. \frac{a^3-6ab^2+9a}{+8a-15a^2b-5}$$

$$\frac{a^3-6ab^2+17a-15a^2b-5}{a^3-6ab^2+17a-15a^2b-5} \Rightarrow a^3-15a^2b-6ab^2+17a-5$$

$$12. \frac{x^4+9xy^3-11y^4}{-20y^4+8x^3y+6x^2y^2}$$

$$\frac{x^4+9xy^3-31y^4+8x^3y+6x^2y^2}{x^4+9xy^3-31y^4+8x^3y+6x^2y^2} \Rightarrow x^4+8x^3y+6x^2y^2+9xy^3-31y^4$$

$$13. \frac{a+b+c-d}{a+b-c+d}$$

$$\frac{2a+2b}{2a+2b}$$

$$14. \frac{ab+2ac-3cd-5de}{-8ab+4ac+5cd-5de}$$

$$\frac{-7ab+6ac+2cd-10de}{-7ab+6ac+2cd-10de}$$

$$15. \frac{x^3+6x^2-9x-19}{-6x^3+11x^2-21x+43}$$

$$\frac{-5x^3+17x^2-30x+24}{-5x^3+17x^2-30x+24}$$

$$16. \frac{y^5 - 9y^3 + 6y^2 - 31y^3 + 8y^2 + 11y^4 + 19y}{y^5 - 40y^3 + 14y^2 + 11y^4 + 19y - 31} \Rightarrow y^5 + 11y^4 - 40y^3 + 14y^2 + 19y - 31$$

$$17. \frac{5m^3 - 9n^3 + 6m^2n - 8mn^2 - 5m^3 + 21m^2n - 14mn^2 + 18}{-9n^3 + 27m^2n - 22mn^2 + 18} \Rightarrow 27m^2n - 22mn^2 - 9n^3 + 18$$

$$18. \frac{4x^3y - 19xy^3 + y^4 - 6x^2y^2}{25x^3y + 51xy^3 - 32x^2y^2 + x^4} \Rightarrow x^4 + 29x^3y - 38x^2y^2 + 32xy^3 + y^4$$

$$19. \frac{m^6 + m^4n^2 - 9m^2n^4 + 19 + 30m^2n^4 + 61 + 13m^3n^3 - 16mn^5}{m^6 + m^4n^2 + 21m^2n^4 + 80 + 13m^3n^3 - 16mn^5} \Rightarrow m^6 + m^4n^2 + 13m^3n^3 + 21m^2n^4 - 16mn^5 + 80$$

$$20. \frac{-a^5b + 6a^3b^3 - 18ab^5 + 42}{8a^6 + 11a^4b^2 + 11a^2b^4 - 9b^6} \Rightarrow 8a^6 - a^5b + 11a^4b^2 + 6a^3b^3 + 11a^2b^4 - 18ab^5 - 9b^6 + 42$$

$$21. \frac{1 - x^2 + x^4 - x^3 + 3x - 6x^5}{24 + 30x^2 - 8x^4 - 15x + x^6} \Rightarrow x^6 - 6x^5 - 7x^4 - x^3 + 29x^2 - 12x + 25$$

$$22. \frac{-6x^2y^3 + 8x^5 - 23x^4y + 80x^3y^2 - 18 + 51x^4y + 21x^3y^2 - 80 + y^5 - 9xy^4}{-6x^2y^3 + 8x^5 + 28x^4y + 101x^3y^2 - 98 + y^5 - 9xy^4} \Rightarrow 8x^5 + 28x^4y + 101x^3y^2 - 6x^2y^3 - 9xy^4 + y^5 - 98$$

$$23. \frac{m^6 - 8m^4n^2 + 21m^2n^4 - 6mn^5 + 8}{23m^5n - 14m^3n^3 + 24mn^5 - 8n^6 + 14} \Rightarrow m^6 + 23m^5n - 8m^4n^2 - 14m^3n^3 + 21m^2n^4 + 18mn^5 - 8n^6 + 22$$

$$24. \frac{x^7 - 8x + 16x^5 - 23x^2 - 15}{-51x + 18 + 8x^6 - 25x^4 + 30x^3} \Rightarrow x^7 + 8x^6 + 16x^5 - 25x^4 + 30x^3 - 23x^2 - 59x + 3$$

$$25. \frac{9a^6 - 15a^4b^2 + 31a^2b^4 - b^6 + 14}{+15a^4b^2 - 3b^6 - 25a^5b - 53a^3b^3 + 9ab^5} \Rightarrow 9a^6 - 25a^5b - 53a^3b^3 + 31a^2b^4 + 9ab^5 - 4b^6 + 14$$

$$26. \frac{a^x + a^{x+1} - a^{x+2}}{-5a^x + 6a^{x+1} + a^{x+2}} \Rightarrow -4a^x + 7a^{x+1}$$

27. 
$$\frac{m^a - m^{a-1} + 3m^{a-2}}{4m^a - 5m^{a-2} - 3m^{a+1} - 8m^{a-3}} = \frac{5m^a - m^{a-1} - 2m^{a-2} - 3m^{a+1} - 8m^{a-3}}{5m^a - m^{a-1} - 2m^{a-2} - 3m^{a+1} - 8m^{a-3}} \Rightarrow -3m^{a+1} + 5m^a - m^{a-1} - 2m^{a-2} - 8m^{a-3}$$
28. 
$$\frac{a^{m+4} - 7a^{m+2} - 8a^m + 6a^{m-1}}{14a^{m+2} + 8a^{m-1} + 5a^{m+3} + 11a^{m+1}} = \frac{a^{m+4} + 7a^{m+2} - 8a^m + 14a^{m-1} + 5a^{m+3} + 11a^{m+1}}{a^{m+4} + 7a^{m+2} - 8a^m + 14a^{m-1} + 5a^{m+3} + 11a^{m+1}} \Rightarrow a^{m+4} + 5a^{m+3} + 7a^{m+2} + 11a^{m+1} - 8a^m + 14a^{m-1}$$
29. 
$$\frac{x^{a+2} - 7x^a + 9x^{a-1} + 25x^{a-2}}{-19x^a - 45x^{a-1} + 11x^{a+1} - 60x^{a-3}} = \frac{x^{a+2} - 26x^a - 36x^{a-1} + 25x^{a-2} + 11x^{a+1} - 60x^{a-3}}{x^{a+2} - 26x^a - 36x^{a-1} + 25x^{a-2} + 11x^{a+1} - 60x^{a-3}} \Rightarrow x^{a+2} + 11x^{a+1} - 26x^a - 36x^{a-1} + 25x^{a-2} - 60x^{a-3}$$
30. 
$$\frac{m^{n+1} - 6m^{n-2} + 8m^{n-3} - 19m^{n-5}}{-5m^{n-2} - 6m^{n-3} - 9m^{n-5} - 8m^n - m^{n-4}} = \frac{m^{n+1} - 11m^{n-2} + 2m^{n-3} - 28m^{n-5} - 8m^n - m^{n-4}}{m^{n+1} - 11m^{n-2} + 2m^{n-3} - 28m^{n-5} - 8m^n - m^{n-4}} \Rightarrow m^{n+1} - 8m^n - 11m^{n-2} + 2m^{n-3} - m^{n-4} - 28m^{n-5}$$

## EJERCICIO 22

1. 
$$\frac{b-a}{2b-2a} \Rightarrow -2a+2b$$
2. 
$$\frac{2x+3y}{-x+y} = \frac{x+4y}{-2n+3m+4p} \Rightarrow 3m-2n+4p$$
3. 
$$\frac{-7a+5}{5a-b} = \frac{x-y+z}{2x+2y-5z}$$
4. 
$$\frac{-x^2+6}{-2x^2+6+5x} \Rightarrow -2x^2+5x+6$$
5. 
$$\frac{x^2y+5xy^2}{x^2y+6xy^2-x^3} \Rightarrow -x^3+x^2y+6xy^2$$
6. 
$$\frac{7a^2b+5ab^2}{-6a^2b+8a^3} \Rightarrow 8a^3+a^2b+5ab^2$$
7. 
$$\frac{-a+2b-3c}{-a+b-2c} = \frac{-2a+3b-5c}{-2a+3b-5c}$$
8. 
$$\frac{-3n+4m+5p}{+n-m-p} \Rightarrow 3m-2n+4p$$
9. 
$$\frac{x+3y-6z}{x-y+z} = \frac{2x+2y-5z}{2x+2y-5z}$$
10. 
$$\frac{-5b^2+8ab+a^2}{6b^2-ab-3a^2} = \frac{b^2+7ab-2a^2}{b^2+7ab-2a^2} \Rightarrow -2a^2+7ab+b^2$$
11. 
$$\frac{-5m^2-n^2+6mn}{-m^2+n^2+3mn} = \frac{-6m^2+9mn}{-6m^2+9mn}$$
12. 
$$\frac{-8x^2+5x-4}{+x-6+x^3} = \frac{-8x^2+6x-10+x^3}{-8x^2+6x-10+x^3} \Rightarrow x^3-8x^2+6x-10$$

$$13. \frac{14m^2 - 8n + 16}{-14m^2 - 9 - m^3} = \frac{-8n + 7 - m^3}{-m^3 - 8n + 7}$$

$$14. \frac{8ab + 5bc + 6cd}{-ab + bc - 6cd} = \frac{7ab + 6bc}{7ab + 6bc}$$

$$15. \frac{a^3 - 9a^2b - b^3}{-25a^2b + b^3 + 8ab^2} = \frac{a^3 - 34a^2b + 8ab^2}{+8ab^2}$$

$$16. \frac{6x^3 - 8x^2y - 6xy^2}{-xy^2 + 6y^3 - 4} = \frac{6x^3 - 8x^2y - 7xy^2 + 6y^3 - 4}{-4}$$

$$17. \frac{m^2 - 9n + 11c + 14}{-m^2 - 7n + 8c - d} = \frac{-16n + 19c + 14 - d}{19c - d - 16n + 14}$$

$$18. \frac{5a^4 + 9a^3b - 40ab^3 + 6b^4}{-7a^3b + 8a^2b^2 - 5ab^3 - b^4} = \frac{5a^4 + 2a^3b + 8a^2b^2 - 45ab^3 + 5b^4}{-45ab^3 + 5b^4}$$

$$19. \frac{x^5 - 8x^4 + 25x^2 + 15}{-6x^2 + 7 - 6x^3 + 9x} = \frac{x^5 - 8x^4 + 19x^2 + 22 - 6x^3 + 9x}{-6x^3 + 9x + 22}$$

$$20. \frac{-3xy^4 - 8x^3y^2 - 19y^5 + 18}{-6xy^4 - 25y^5 - x^5 + x^2y^3} = \frac{-9xy^4 - 8x^3y^2 - 44y^5 + 18 - x^5 + x^2y^3}{-x^5 - 8x^3y^2 + x^2y^3 - 9xy^4 - 44y^5 + 18}$$

$$21. \frac{x^3 - 6x^4 + 8x^2 - 9 + 15x}{-25x^3 + 18x^2 + 46 - 25x + 11x^5} = \frac{-24x^3 - 6x^4 + 26x^2 + 37 - 10x + 11x^5}{11x^5 - 6x^4 - 24x^3 + 26x^2 - 10x + 37}$$

$$22. \frac{a^5 - 26a^3b^2 + 8ab^4 - b^5 + 6}{-8a^4b - a^3b^2 + 15a^2b^3 + 45ab^4 + 8} = \frac{a^5 - 8a^4b - 27a^3b^2 + 15a^2b^3 + 53ab^4 - b^5 + 14}{14}$$

$$23. \frac{y^6 + y^3 + y^2 + 9}{-23y^3 + 5 - 8y^4 + 15y^5 + 8y} = \frac{y^6 - 22y^3 + y^2 + 14 - 8y^4 + 15y^5 + 8y}{y^6 + 15y^5 - 8y^4 - 22y^3 + y^2 + 8y + 14}$$

$$24. \frac{x^3 - x^6 + 3x^4 - 5x^2 - 9}{-36 - 7x^7 - 5x^5 + 23x^3 - 51x} = \frac{x^3 - x^6 + 3x^4 - 5x^2 - 45 - 7x^7 - 5x^5 + 23x^3 - 51x}{x^8 - 7x^7 - x^6 - 5x^5 + 3x^4 + 23x^3 - 5x^2 - 51x - 45}$$

$$25. \frac{x^7 - 3x^5y^2 + 35x^4y^3 - 8x^2y^5 + 60}{+60x^4y^3 + x^2y^5 - y^7 - 90x^3y^4 + 50xy^6} = \frac{x^7 - 3x^5y^2 + 95x^4y^3 - 7x^2y^5 + 60 - y^7 - 90x^3y^4 + 50xy^6}{x^7 - 3x^5y^2 + 95x^4y^3 - 90x^3y^4 - 7x^2y^5 + 50xy^6 - y^7 + 60}$$

$$26. \frac{a^{x+3} - 8a^{x+1} - 5}{+5a^{x+1} - a^{x+2} + 6a^x} = \frac{a^{x+3} - 3a^{x+1} - 5 - a^{x+2} + 6a^x}{a^{x+3} - a^{x+2} - 3a^{x+1} + 6a^x - 5}$$

$$27. \frac{-8a^n + 16a^{n-4} + 15a^{n-2} + a^{n-3}}{-7a^n - 5a^{n-2} - a^{n-3} - 8a^{n-1}} = \frac{-15a^n + 16a^{n-4} + 10a^{n-2} - 8a^{n-1}}{-15a^n - 8a^{n-1} + 10a^{n-2} + 16a^{n-4}}$$

$$28. \frac{15x^{a+3} + 5x^{a+2} - 6x^a + 41x^{a-1}}{+9x^{a+2} + 18x^{a-1} - 31x^{a+1} + x^{a+4}} = \frac{15x^{a+3} + 14x^{a+2} - 6x^a + 59x^{a-1} - 31x^{a+1} + x^{a+4}}{x^{a+4} + 15x^{a+3} + 14x^{a+2} - 31x^{a+1} - 6x^a + 59x^{a-1}}$$

$$29. \frac{9a^{m-1} - 21a^{m-2} + 26^{m-3} + 14a^{m-5}}{5a^{m-1} - 12a^{m-2} + a^m + 8a^{m-4}} = \frac{14a^{m-1} - 33a^{m-2} + 26^{m-3} + 14a^{m-5} + a^m + 8a^{m-4}}{a^m + 14a^{m-1} - 33a^{m-2} + 26^{m-3} + 8a^{m-4} + 14a^{m-5}}$$

$$30. \frac{-15m^{x+3} + 50m^{x+1} - 14m^x - 6m^{x-1} + 8m^{x-2}}{m^{x+4} + 23m^{x+2} + 6m^{x+1} + m^{x-1}} = \frac{m^{x+4} - 15m^{x+3} + 23m^{x+2} + 56m^{x+1} - 14m^x - 5m^{x-1} + 8m^{x-2}}{56m^{x+1} - 14m^x - 5m^{x-1} + 8m^{x-2}}$$

## EJERCICIO 23

$$1. \quad \begin{array}{r} 1 \\ -a+1 \\ \hline -a+2 \end{array}$$

$$2. \quad \begin{array}{r} 0 \\ -a+8 \\ \hline -a+8 \end{array}$$

$$3. \quad \begin{array}{r} -9 \\ -3a-a^2+5 \\ \hline -3a-a^2-4 \Rightarrow -a^2-3a-4 \end{array}$$

$$4. \quad \begin{array}{r} +16 \\ -5xy+x^2-16 \\ \hline -5xy+x^2 \Rightarrow x^2-5xy \end{array}$$

$$5. \quad \begin{array}{r} 1 \\ -a^3+a^2b-ab^2 \\ \hline 1-a^3+a^2b-ab^2 \Rightarrow -a^3+a^2b-ab^2+1 \end{array}$$

$$6. \quad \begin{array}{r} x^3 \\ x^3+8x^2y+6xy^2 \\ \hline 2x^3+8x^2y+6xy^2 \end{array}$$

$$7. \quad \begin{array}{r} a^3 \\ +8a^2b-6ab^2+b^3 \\ \hline a^3+8a^2b-6ab^2+b^3 \end{array}$$

$$8. \quad \begin{array}{r} +y^4 \\ 5x^3y-7x^2y^2+8xy^3 \\ \hline 5x^3y-7x^2y^2+8xy^3+y^4 \end{array}$$

$$9. \quad \begin{array}{r} m^4 \\ -5m^4+18am^3-7a^2m^2-a^3m+a^4 \\ \hline -4m^4+18am^3-7a^2m^2-a^3m+a^4 \end{array}$$

$$10. \quad \begin{array}{r} 16 \\ 14-b+a-c-d \\ \hline 30-b+a-c-d \Rightarrow a-b-c-d+30 \end{array}$$

$$11. \quad \begin{array}{r} x^2-1 \\ -xy-y^2 \\ \hline x^2-1-xy-y^2 \Rightarrow x^2-xy-y^2-1 \end{array}$$

$$12. \quad \begin{array}{r} a^3 \\ -5a^2b+8ab^2-b^3 \\ \hline a^3-5a^2b+8ab^2-b^3+6 \end{array}$$

$$13. \quad \begin{array}{r} x^3 \\ +y^3 \\ +5x^2y-17xy^2 \\ \hline x^3+5x^2y-17xy^2+y^3+5 \end{array}$$

$$14. \quad \begin{array}{r} x^4 \\ -9x^3y+8x^2y^2+15xy^3 \\ \hline x^4-9x^3y+8x^2y^2+15xy^3-1 \end{array}$$

$$15. \quad \begin{array}{r} a^5 \\ +11a^4b-2a^2b^3-8a^3b^2+4ab^4 \\ \hline a^5+11a^4b-2a^2b^3-8a^3b^2+4ab^4+b^5 \\ \Rightarrow a^5+11a^4b-8a^3b^2-2a^2b^3+4ab^4+b^5 \end{array}$$

$$16. \quad \begin{array}{r} x^4 \\ +x^2 \\ -5x^3 \\ +25x \\ \hline x^4-5x^3+x^2+25x+50 \end{array}$$

$$17. \quad \begin{array}{r} y^6+y-41 \\ -9y^5-17y^4+y^3-18y^2 \\ \hline y^6+y-41-9y^5-17y^4+y^3-18y^2 \\ \Rightarrow y^6-9y^5-17y^4+y^3-18y^2+y-41 \end{array}$$

$$18. \quad \begin{array}{r} a^6 \\ +9a^4b^2 \\ +a^2b^4 \\ +15a^5b \\ -17a^3b^3 \\ +14ab^5+b^6 \\ \hline a^6+15a^5b+9a^4b^2-17a^3b^3+a^2b^4+14ab^5+b^6 \end{array}$$

$$19. \quad \begin{array}{r} x^4+x^3-11x \\ -5x+x^2+34 \\ \hline x^4+x^3-16x+x^2+34 \Rightarrow x^4+x^3+x^2-16x+34 \end{array}$$

$$20. \quad \begin{array}{r} m^3 \\ -m^2n-7mn^2+3n^3 \\ \hline m^3-m^2n-7mn^2+3n^3-1 \end{array}$$

## EJERCICIO 24

1.  $\frac{1}{2}a^2$

$$\frac{\frac{1}{4}a^2 + \frac{1}{3}ab - \frac{2}{5}b^2}{\frac{2+1}{4}a^2 + \frac{1}{3}ab - \frac{2}{5}b^2} = \frac{\frac{1}{4}a^2 + \frac{1}{3}ab - \frac{2}{5}b^2}{\frac{3}{4}a^2 + \frac{1}{3}ab - \frac{2}{5}b^2}$$

2. 15

$$\begin{aligned} & -\frac{4}{5}xy - \frac{2}{3}yz + \frac{5}{9} \\ & \frac{-\frac{4}{5}xy - \frac{2}{3}yz + \frac{135+5}{9}}{-\frac{4}{5}xy - \frac{2}{3}yz + \frac{140}{9}} \\ & = -\frac{4}{5}xy - \frac{2}{3}yz + \frac{140}{9} \\ & = -\frac{4}{5}xy - \frac{2}{3}yz + 15\frac{5}{9} \end{aligned}$$

3.  $\frac{3}{5}bc$

$$\begin{aligned} & -\frac{1}{6}bc + \frac{3}{4}ab + \frac{2}{9}cd \\ & \frac{\frac{18-5}{30}bc + \frac{3}{4}ab + \frac{2}{9}cd}{\frac{18-5}{30}bc + \frac{3}{4}ab + \frac{2}{9}cd} \\ & \Rightarrow \frac{3}{4}ab + \frac{13}{30}bc + \frac{2}{9}cd \end{aligned}$$

4.  $\frac{1}{2}a - \frac{2}{3}b$

$$\begin{aligned} & -\frac{4}{5}a - \frac{2}{9}b + \frac{1}{2} \\ & \frac{\frac{5-8}{10}a - \frac{6+2}{9}b + \frac{1}{2}}{-\frac{3}{10}a - \frac{8}{9}b + \frac{1}{2}} \end{aligned}$$

5.  $\frac{5}{9}x^2 - \frac{3}{8}y^2$

$$\begin{aligned} & -\frac{1}{10}y^2 - \frac{5}{7}xy + \frac{3}{11} \\ & \frac{\frac{5}{9}x^2 - \frac{30+8}{80}y^2 - \frac{5}{7}xy + \frac{3}{11}}{\frac{5}{9}x^2 - \frac{38}{80}y^2 - \frac{5}{7}xy + \frac{3}{11}} \\ & = \frac{5}{9}x^2 - \frac{38}{80}y^2 - \frac{5}{7}xy + \frac{3}{11} \\ & \Rightarrow \frac{5}{9}x^2 - \frac{5}{7}xy - \frac{19}{40}y^2 + \frac{3}{11} \end{aligned}$$

6.  $\frac{5}{6}m^3 + \frac{2}{9}n^3$

$$\begin{aligned} & + \frac{1}{5}n^3 + \frac{1}{2}m^2n - \frac{3}{8}mn^2 \\ & \frac{\frac{5}{6}m^3 + \frac{10+9}{45}n^3 + \frac{1}{2}m^2n - \frac{3}{8}mn^2}{\frac{5}{6}m^3 + \frac{1}{2}m^2n - \frac{3}{8}mn^2 + \frac{19}{45}n^3} \end{aligned}$$

7.  $\frac{3}{7}a^2 + \frac{1}{3}ab - \frac{3}{5}b^2$

$$\begin{aligned} & -\frac{5}{14}a^2 - \frac{1}{2}ab + \frac{1}{8} \\ & \frac{\frac{6-5}{14}a^2 + \frac{2-3}{6}ab}{\frac{1}{14}a^2 - \frac{1}{6}ab - \frac{3}{5}b^2 + \frac{1}{8}} \end{aligned}$$

8.  $\frac{3}{8}x^2 + \frac{5}{6}xy - \frac{1}{10}y^2$

$$\begin{aligned} & \frac{\frac{3}{5}x^2 + \frac{3}{10}xy - 2y^2}{\frac{15+24}{40}x^2 + \frac{50+18}{60}xy - \frac{1+20}{10}y^2} \\ & = \frac{39}{40}x^2 + \frac{68}{60}xy - \frac{21}{10}y^2 = \frac{39}{40}x^2 + \frac{17}{15}xy - \frac{21}{10}y^2 \end{aligned}$$

9.  $a^3 + a^2 - a + \frac{5}{6}$

$$\begin{aligned} & + \frac{7}{8}a^2 - \frac{9}{10}a - \frac{7}{8} \\ & \frac{a^3 + \frac{8+7}{8}a^2 - \frac{10+9}{10}a + \frac{20-21}{24}}{= a^3 + \frac{15}{8}a^2 - \frac{19}{10}a - \frac{1}{24}} \end{aligned}$$

10.  $m^3 + \frac{7}{12}mn^2 - \frac{4}{7}n^3$

$$\begin{aligned} & -\frac{5}{9}mn^2 - n^3 + \frac{5}{21}m^2n + \frac{1}{8} \\ & \frac{m^3 + \frac{21-20}{36}mn^2 - \frac{4+7}{7}n^3 + \frac{5}{21}m^2n + \frac{1}{8}}{\Rightarrow m^3 + \frac{5}{21}m^2n + \frac{1}{36}mn^2 - \frac{11}{7}n^3 + \frac{1}{8}} \end{aligned}$$



$$\begin{aligned}
 11. \quad & \frac{3}{5}x^4 + \frac{3}{4}x^3y - \frac{5}{7}xy^3 + \frac{2}{3}y^4 \\
 & -x^4 - \frac{5}{8}x^2y^2 + \frac{1}{3}xy^3 - \frac{5}{6}y^4 \\
 \hline
 & \frac{3-5}{5}x^4 + \frac{3}{4}x^3y - \frac{5}{8}x^2y^2 - \frac{15-7}{21}xy^3 + \frac{4-5}{6}y^4 \\
 & = -\frac{2}{5}x^4 + \frac{3}{4}x^3y - \frac{5}{8}x^2y^2 - \frac{8}{21}xy^3 - \frac{1}{6}y^4
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{1}{2}a + \frac{3}{5}b - \frac{7}{8}c + \frac{8}{9}d \\
 & + \frac{7}{20}b - \frac{1}{8}c + \frac{1}{9}d - \frac{7}{8} \\
 \hline
 & \frac{1}{2}a + \frac{12+7}{20}b - \frac{7+1}{8}c + \frac{8+1}{9}d - \frac{7}{8} \\
 & = \frac{1}{2}a + \frac{19}{20}b - \frac{8}{8}c + \frac{9}{9}d - \frac{7}{8} \\
 & = \frac{1}{2}a + \frac{19}{20}b - c + d - \frac{7}{8}
 \end{aligned}$$

## EJERCICIO 25

$$\begin{aligned}
 1. \quad & \frac{3}{8}a^2 - \frac{5}{6}a \\
 & - \frac{5}{6}a^2 \\
 \hline
 & \frac{9-20}{24}a^2 - \frac{5}{6}a = -\frac{11}{24}a^2 - \frac{5}{6}a
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 8a + 6b - 5 \\
 & - \frac{1}{2}a + \frac{3}{5}b \\
 \hline
 & \frac{16-1}{2}a + \frac{30+3}{5}b - 5 = \frac{15}{2}a + \frac{33}{5}b - 5
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & x^3 + \frac{2}{3}x^2y - 6 \\
 & - \frac{7}{9}x^2y \\
 \hline
 & x^3 + \frac{6-7}{9}x^2y - 6 = x^3 - \frac{1}{9}x^2y - 6
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & a + b - c \\
 & - \frac{1}{2}a + \frac{3}{4}b - \frac{2}{3}c \\
 \hline
 & \frac{2-1}{2}a + \frac{4+3}{4}b - \frac{3+2}{3}c = \frac{1}{2}a + \frac{7}{4}b - \frac{5}{3}c
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{2}{3}m + \frac{5}{6}n + \frac{1}{2}p \\
 & - m - n + p \\
 \hline
 & \frac{2-3}{3}m + \frac{5-6}{6}n + \frac{1+2}{2}p = -\frac{1}{3}m - \frac{1}{6}n + \frac{3}{2}p
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{5}{8}a^2b + \frac{1}{4}ab^2 - \frac{1}{3} \\
 & + \frac{7}{8}ab^2 - 6 - \frac{5}{6}a^3 \\
 \hline
 & \frac{5}{8}a^2b + \frac{2+7}{8}ab^2 - \frac{1+18}{3} - \frac{5}{6}a^3 \\
 & = \frac{5}{8}a^2b + \frac{9}{8}ab^2 - \frac{19}{3} - \frac{5}{6}a^3 \\
 & \Rightarrow -\frac{5}{6}a^3 + \frac{5}{8}a^2b + \frac{9}{8}ab^2 - \frac{19}{3}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{2}{11}m^3n + \frac{5}{14}m^2n^2 + \frac{1}{3}mn^3 - 6 \\
 & m^4 - \frac{7}{8}m^2n^2 + \frac{2}{9}mn^3 \\
 \hline
 & m^4 + \frac{2}{11}m^3n + \frac{20-49}{56}m^2n^2 + \frac{3+2}{9}mn^3 - 6 \\
 & = m^4 + \frac{2}{11}m^3n - \frac{29}{56}m^2n^2 + \frac{5}{9}mn^3 - 6
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & -\frac{7}{8}x^4y + \frac{1}{14}x^3y^2 + \frac{2}{3}x^2y^3 + \frac{1}{3}xy^4 - 7 \\
 & \frac{1}{2}x^5 - \frac{3}{7}x^3y^2 + \frac{1}{8}xy^4 - \frac{2}{9} \\
 \hline
 & \frac{1}{2}x^5 - \frac{7}{8}x^4y + \frac{1-6}{14}x^3y^2 + \frac{2}{3}x^2y^3 + \frac{8+3}{24}xy^4 - \frac{63+2}{9} \\
 & = \frac{1}{2}x^5 - \frac{7}{8}x^4y - \frac{5}{14}x^3y^2 + \frac{2}{3}x^2y^3 + \frac{11}{24}xy^4 - \frac{65}{9} \\
 & = \frac{1}{2}x^5 - \frac{7}{8}x^4y - \frac{5}{14}x^3y^2 + \frac{2}{3}x^2y^3 + \frac{11}{24}xy^4 - 7\frac{2}{9}
 \end{aligned}$$

$$9. \quad \frac{\frac{7}{9}x^5y + \frac{2}{3}x^4y^2 - \frac{1}{8}x^3y^3 - x^2y^4 + xy^5 + \frac{2}{13}y^6}{-x^6 + \frac{7}{9}x^5y + \frac{6+7}{9}x^4y^2 - \frac{1}{8}x^3y^3 - \frac{11+1}{11}x^2y^4 + \frac{2+13}{13}y^6} = -x^6 + \frac{7}{9}x^5y + \frac{13}{9}x^4y^2 - \frac{1}{8}x^3y^3 - \frac{12}{11}x^2y^4 + \frac{15}{13}y^6$$

$$10. \quad \frac{\frac{1}{3}x^3 - \frac{7}{9}x^2y + \frac{5}{8}xy^2 - \frac{7}{11}y^3 - \frac{2}{5}}{\frac{2}{3}x^3 + \frac{1}{6}x^2y - \frac{3}{4}xy^2 - 6} = \frac{\frac{1+2}{3}x^3 - \frac{14-3}{18}x^2y + \frac{5-6}{8}xy^2 - \frac{7}{11}y^3 - \frac{2+30}{5}}{x^3 - \frac{11}{18}x^2y - \frac{1}{8}xy^2 - \frac{7}{11}y^3 - \frac{32}{5}}$$

$$11. \quad \frac{\frac{3}{10}m^4n^2 - \frac{3}{7}m^2n^4 + \frac{5}{9}n^6}{\frac{2}{13}m^6 + \frac{7}{20}m^4n^2 - \frac{5}{14}m^2n^4 - \frac{1}{3}n^6 + \frac{3}{5}} = \frac{\frac{2}{13}m^6 + \frac{6+7}{20}m^4n^2 - \frac{6+5}{14}m^2n^4 + \frac{5-3}{9}n^6 + \frac{3}{5}}{\frac{2}{13}m^6 + \frac{13}{20}m^4n^2 - \frac{11}{14}m^2n^4 + \frac{2}{9}n^6 + \frac{3}{5}}$$

$$12. \quad \frac{\frac{3}{8}c^5 + \frac{7}{22}c^4d + \frac{7}{12}c^3d^2 + \frac{1}{2}c^2d^3 - \frac{1}{3}d^5 - 35}{+\frac{5}{11}c^4d + \frac{5}{6}c^3d^2 - \frac{3}{4}cd^4 - \frac{3}{13}d^5} = \frac{\frac{3}{8}c^5 + \frac{7+10}{22}c^4d + \frac{7+10}{12}c^3d^2 + \frac{1}{2}c^2d^3 - \frac{3}{4}cd^4 - \frac{13+9}{39}d^5 - 35}{= \frac{3}{8}c^5 + \frac{17}{22}c^4d + \frac{17}{12}c^3d^2 + \frac{1}{2}c^2d^3 - \frac{3}{4}cd^4 - \frac{22}{39}d^5 - 35}$$

## EJERCICIO 26

Para los problemas 1 al 14 las literales toman los siguientes valores:

$$a = 1 \quad b = 2 \quad c = 3 \quad x = 4 \quad y = 5 \quad m = 3/2 \quad n = 2/5$$

$$1. \quad \frac{a^2 - ab}{-3ab - b^2} = \frac{a^2 - 4ab - b^2}{-12 - 4 - 4} = \frac{1^2 - 4 \cdot 1 \cdot 2 - 2^2}{-1 - 8 - 4} = -11$$

$$2. \quad \frac{a^3 + b^3}{+2b^3 + 5a^2b - 6ab^2} = \frac{a^3 + 3b^3 + 5a^2b - 6ab^2}{a^3 + 3b^3 + 5a^2b - 6ab^2} \Rightarrow a^3 + 5a^2b - 6ab^2 + 3b^3$$

$$= 1^3 + 5 \cdot 1^2 \cdot 2 - 6 \cdot 1 \cdot 2^2 + 3 \cdot 2^3 = 1 + 5 \cdot 2 - 6 \cdot 4 + 3 \cdot 8$$

$$= 1 + 10 - 24 + 24 = 11$$

$$3. \frac{1}{2}a$$

$$-a - \frac{1}{2}b + \frac{5}{3}c$$

$$\frac{1-2}{2}a - \frac{1}{2}b + \frac{5}{3}c = -\frac{1}{2}a - \frac{1}{2}b + \frac{5}{3}c$$

$$\Rightarrow -\frac{1}{2} \cdot 1 - \frac{1}{2} \cdot 2 + \frac{5}{3} \cdot 3 = -\frac{1}{2} - 1 + 5$$

$$= \frac{-1-2+10}{2} = \frac{7}{2} = 3\frac{1}{2}$$

$$4. 3m^2 - 5n^2$$

$$-m^2 - 10n^2 - 8mn$$

$$2m^2 - 15n^2 - 8mn \Rightarrow 2m^2 - 8mn - 15n^2$$

$$= 2\left(\frac{3}{2}\right)^2 - 8 \cdot \frac{3}{2} \cdot \frac{2}{5} - 15\left(\frac{2}{5}\right)^2 = 2 \cdot \frac{9}{4} - \frac{48}{10} - 3 \cdot \frac{4}{5}$$

$$= \frac{9}{2} - \frac{24}{5} - \frac{12}{5} = \frac{45-48-24}{10} = -\frac{27}{10}$$

$$5. x^4 - 18x^2y^2 + 15y^4$$

$$16x^3y + 6xy^3 - 9y^4$$

$$x^4 + 16x^3y - 18x^2y^2 + 6xy^3 + 6y^4$$

$$= 4^4 + 16 \cdot 4^3 \cdot 5 - 18 \cdot 4^2 \cdot 5^2 + 6 \cdot 4 \cdot 5^3 + 6 \cdot 5^4$$

$$= 256 + 80 \cdot 64 - 18 \cdot 16 \cdot 25 + 24 \cdot 125 + 6 \cdot 625$$

$$= 256 + 5120 - 7200 + 3000 + 3750 = 4.926$$

$$6. a^3 - 7am^2 + m^3$$

$$+ 5am^2 + 5m^3 - 8a^2m$$

$$a^3 - 2am^2 + 6m^3 - 8a^2m \Rightarrow a^3 - 8a^2m - 2am^2 + 6m^3$$

$$= 1^3 - 8 \cdot 1^2 \cdot \frac{3}{2} - 2 \cdot 1 \cdot \left(\frac{3}{2}\right)^2 + 6\left(\frac{3}{2}\right)^3 = 1 - \frac{24}{2} - 2 \cdot \frac{9}{4} + 6 \cdot \frac{27}{8}$$

$$= 1 - 12 - \frac{9}{2} + \frac{81}{4} = \frac{4-48-18+81}{4} = \frac{19}{4}$$

$$7. \frac{2}{3}a^2 + \frac{7}{8}ab - \frac{1}{5}b^2$$

$$-\frac{1}{6}a^2 - ab + \frac{1}{10}b^2$$

$$\frac{4-1}{6}a^2 + \frac{7-8}{8}ab - \frac{2-1}{10}b^2 = \frac{1}{2}a^2 - \frac{1}{8}ab - \frac{1}{10}b^2$$

$$\Rightarrow \frac{1}{2} \cdot 1^2 - \frac{1}{8} \cdot 1 \cdot 2 - \frac{1}{10} \cdot 2^2 = \frac{1}{2} - \frac{2}{8} - \frac{4}{10}$$

$$= \frac{1}{2} - \frac{1}{4} - \frac{2}{5} = \frac{10-5-8}{20} = -\frac{3}{20}$$

$$8. \frac{2}{3}m^2n + \frac{3}{4}mn^2 - \frac{1}{2}n^3$$

$$\frac{1}{6}m^2n + \frac{1}{4}mn^2 + \frac{1}{2}n^3 + m^3$$

$$\frac{4+1}{6}m^2n + \frac{3+1}{4}mn^2 + m^3 = m^3 + \frac{5}{6}m^2n + mn^2$$

$$= \left(\frac{3}{2}\right)^3 + \frac{5}{6}\left(\frac{3}{2}\right)^2 \cdot \frac{2}{5} + \frac{3}{2}\left(\frac{2}{5}\right)^2 = \frac{27}{8} + \frac{5}{6} \cdot \frac{18}{20} + \frac{3}{2} \cdot \frac{4}{25}$$

$$= \frac{27}{8} + \frac{3}{4} + \frac{12}{50} = \frac{675+150+48}{200} = \frac{873}{200}$$

$$9. a^5 - 3a^2b^4 + b^5$$

$$-a^4b^2 + 5a^3b^3$$

$$a^5 - a^4b^2 + 5a^3b^3 - 3a^2b^4 + b^5$$

$$= 1^5 - 1^4 \cdot 2^2 + 5 \cdot 1^3 \cdot 2^3 - 3 \cdot 1^2 \cdot 2^4 + 2^5$$

$$= 1 - 4 + 5 \cdot 8 - 3 \cdot 16 + 32 = 1 - 4 + 40 - 48 + 32 = 21$$

$$10. -ab + 10mn - 8mx$$

$$-15ab$$

$$-16ab + 10mn - 8mx$$

$$= -16 \cdot 1 \cdot 2 + 10 \cdot \frac{3}{2} \cdot \frac{2}{5} - 8 \cdot \frac{3}{2} \cdot 4$$

$$= -32 + 6 - 48 = -74$$

$$11. a^3$$

$$-11a^2b + 9ab^2 - b^3$$

$$a^3 - 11a^2b + 9ab^2 - b^3$$

$$= 1^3 - 11 \cdot 1^2 \cdot 2 + 9 \cdot 1 \cdot 2^2 - 2^3$$

$$= 1 - 22 + 36 - 8 = 7$$

$$12. \frac{1}{64}x^4$$

$$-\frac{2}{3}x^2 - \frac{5}{6}x + \frac{3}{8}$$

$$\frac{1}{64}x^4 - \frac{2}{3}x^2 - \frac{5}{6}x + \frac{3}{8}$$

$$= \frac{1}{64} \cdot 4^4 - \frac{2}{3} \cdot 4^2 - \frac{5}{6} \cdot 4 + \frac{3}{8}$$

$$= 4 - \frac{32}{3} - \frac{20}{6} + \frac{3}{8} = \frac{96-256-80+9}{24}$$

$$= -\frac{231}{24} = -\frac{77}{8} = -9\frac{5}{8}$$

$$\begin{aligned}
 13. \quad & x^3 + \frac{3}{16}x^2y - \frac{2}{5}xy^2 \\
 & - \frac{3}{4}x^3 + \frac{3}{5}xy^2 + \frac{1}{25}y^3 \\
 & \hline
 & \frac{4-3}{4}x^3 + \frac{3}{16}x^2y - \frac{2-3}{5}xy^2 + \frac{1}{25}y^3 \\
 & \Rightarrow \frac{1}{4}x^3 + \frac{3}{16}x^2y + \frac{1}{5}xy^2 + \frac{1}{25}y^3 \\
 & = \frac{1}{4} \cdot 4^3 + \frac{3}{16} \cdot 4^2 \cdot 5 + \frac{1}{5} \cdot 4 \cdot 5^2 + \frac{1}{25} \cdot 5^3 \\
 & = \frac{1}{4} \cdot 64 + \frac{15}{16} \cdot 16 + \frac{4}{5} \cdot 25 + \frac{125}{25} \\
 & = 16 + 15 + 20 + 5 = 56
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{2}{5}a^{x-1} + a^x - \frac{5}{6}a^{x-3} + a^{x-2} \\
 & - a^{x-1} + 9a^{x-3} - a^{x-2} \\
 & \hline
 & \frac{2-5}{5}a^{x-1} + a^x - \frac{5-54}{6}a^{x-3} \\
 & \Rightarrow a^x - \frac{3}{5}a^{x-1} + \frac{49}{6}a^{x-3} \\
 & = 1^4 - \frac{3}{5} \cdot 1^{4-1} + \frac{49}{6} \cdot 1^{4-3} \\
 & = 1 - \frac{3}{5} + \frac{49}{6} = \frac{+30-18+245}{30} = \frac{257}{30} = 8\frac{17}{30}
 \end{aligned}$$

## EJERCICIO 27

$$\begin{array}{r}
 1. \quad +ab + b^2 \quad a^2 \\
 \frac{a^2 \quad -5b^2}{a^2 + ab - 4b^2} \quad \frac{-a^2 - ab + 4b^2}{-ab + 4b^2}
 \end{array}$$

$$\begin{array}{r}
 2. \quad a+8 \quad 1 \\
 \frac{-a+6}{14} \quad \frac{-14}{-13}
 \end{array}$$

$$\begin{array}{r}
 3. \quad -x^3 \quad +4xy^2 \\
 \frac{\quad +5x^2y \quad +y^3}{-x^3 + 5x^2y + 4xy^2 + y^3}
 \end{array}$$

$$\begin{array}{r}
 -7x^2y \\
 \frac{x^3 - 5x^2y - 4xy^2 - y^3}{x^3 - 12x^2y - 4xy^2 - y^3}
 \end{array}$$

$$\begin{array}{r}
 4. \quad -3m^3n + 4mn^2 - n^3 \quad 5m^4 \\
 \frac{3m^3n - 4mn^2 + 5n^3}{+4n^3} \quad \frac{-4n^3}{5m^4 - 4n^3}
 \end{array}$$

$$\begin{array}{r}
 5. \quad 8a+9b-3c \quad 6a \\
 \frac{-7a-9b+3c}{a} \quad \frac{-a}{5a}
 \end{array}$$

$$\begin{array}{r}
 6. \quad a-b+c \quad a+b-c \\
 \frac{-2a+b-c}{-a} \quad \frac{a}{2a+b-c}
 \end{array}$$

$$\begin{array}{r}
 7. \quad -m+n-p \quad m-n+p \\
 \frac{2m-2n+2p}{m-n+p} \quad \frac{-m+n-p}{0}
 \end{array}$$

$$\begin{array}{r}
 8. \quad 9ax - a^2 \quad x^2 - 5ax + 3a^2 \\
 \frac{-9ax + 7a^2 + 25x^2}{6a^2 + 25x^2} \quad \frac{-25x^2 - 6a^2}{-24x^2 - 5ax - 3a^2}
 \end{array}$$

$$\begin{array}{r}
 9. \quad 5a^2 + 6a - 4 \quad a^3 \quad -1 \\
 \frac{2a^3 - 8a + 6}{2a^3 + 5a^2 - 2a + 2} \quad \frac{-2a^3 - 5a^2 + 2a - 2}{-a^3 - 5a^2 + 2a - 3}
 \end{array}$$

$$\begin{array}{r}
 \quad \quad \quad 5x^3 - 9x^2 \quad +4 \quad x^4 \quad -1 \\
 10. \quad \frac{-11x^4 - 7x^3 - 6x}{-11x^4 - 2x^3 - 9x^2 - 6x + 4} \quad \frac{11x^4 + 2x^3 + 9x^2 + 6x - 4}{12x^4 + 2x^3 + 9x^2 + 6x - 5}
 \end{array}$$

$$\begin{array}{r}
 11. \quad \frac{35a^2b - 7ab^2 - 11}{-7a^3 - 35a^2b + 8ab^2 + 6} \quad \frac{a^3 \quad +b^3}{7a^3 - ab^2 \quad +5} \\
 \frac{-7a^3 \quad + ab^2 - 5}{8a^3 - ab^2 + b^3 + 5}
 \end{array}$$

$$\begin{array}{r}
 12. \quad -11n^4 \quad +14n^2 - 25n + 8 \\
 \frac{19n^3 - 6n^2 + 9n - 4}{-11n^4 + 19n^3 + 8n^2 - 16n + 4}
 \end{array}$$

$$\begin{array}{r}
 n^5 \quad -7n^3 \quad + 4n \\
 \frac{11n^4 - 19n^3 - 8n^2 + 16n - 4}{n^5 + 11n^4 - 26n^3 - 8n^2 + 20n - 4}
 \end{array}$$

$$13. \quad \begin{array}{r} -6a^3m \quad +5am^3 \quad -6 \\ 7a^4 - 5a^3m - 11a^2m^2 \quad -6m^4 \\ \hline 7a^4 - 11a^3m - 11a^2m^2 + 5am^3 - 6m^4 - 6 \end{array}$$

$$\begin{array}{r} a^4 \quad -8a^2m^2 \quad +m^4 \\ -7a^4 + 11a^3m + 11a^2m^2 - 5am^3 + 6m^4 + 6 \\ \hline -6a^4 + 11a^3m + 3a^2m^2 - 5am^3 + 7m^4 + 6 \end{array}$$

$$14. \quad \begin{array}{r} -4x^4y \quad +13x^2y^3 - 9xy^4 \\ -6x^5 \quad +8x^3y^2 \quad +xy^4 - 2y^5 \\ \hline -6x^5 - 4x^4y + 8x^3y^2 + 13x^2y^3 - 8xy^4 - 2y^5 \end{array}$$

$$\begin{array}{r} x^5 \quad -30x^3y^2 \quad +40xy^4 + y^5 \\ 6x^5 + 4x^4y - 8x^3y^2 - 13x^2y^3 + 8xy^4 + 2y^5 \\ \hline 7x^5 + 4x^4y - 38x^3y^2 - 13x^2y^3 + 48xy^4 + 3y^5 \end{array}$$

$$15. \quad \begin{array}{r} a+b \quad 2a \\ a-b \quad -2a+b \\ \hline 2a \quad b \end{array}$$

$$16. \quad \begin{array}{r} 8x \quad +9 \quad 8x+6y+4 \\ 6y-5 \quad 2 \\ \hline 8x+6y+4 \quad 8x+6y+6 \end{array}$$

$$17. \quad \begin{array}{r} x^2 \quad -6y^2 \quad x^2 - 7xy + 34y^2 \\ -7xy + 40y^2 \quad 9y^2 - 16 \\ \hline x^2 - 7xy + 34y^2 \quad x^2 - 7xy + 43y^2 - 16 \end{array}$$

$$18. \quad \begin{array}{r} 4a^2 + 8ab - 5b^2 \quad 5a^2 + ab + b^2 \\ a^2 - 7ab + 6b^2 \quad -4a^2 - ab + b^2 \\ \hline 5a^2 + ab + b^2 \quad a^2 + 2b^2 \end{array}$$

$$19. \quad \begin{array}{r} x^3 \quad -y^3 \\ -14x^2y + 5xy^2 \\ \hline x^3 - 14x^2y + 5xy^2 - y^3 \end{array}$$

$$\begin{array}{r} x^3 - 14x^2y + 5xy^2 - y^3 \\ 3x^3 \quad -19y^3 \\ \hline 4x^3 - 14x^2y + 5xy^2 - 20y^3 \end{array}$$

$$20. \quad \begin{array}{r} x^4 - 6x^2y^2 + y^4 \quad x^4 - 2x^2y^2 + 32y^4 \\ + 8x^2y^2 + 31y^4 \quad -x^4 - 2x^2y^2 - 32y^4 \\ \hline x^4 + 2x^2y^2 + 32y^4 \quad 0 \end{array}$$

$$21. \quad \begin{array}{r} -6n^5 + n^4 \quad +n^2 \\ +7n^3 - n^2 - 8n - 6 \\ \hline -6n^5 + n^4 + 7n^3 \quad -8n - 6 \end{array}$$

$$\begin{array}{r} -6n^5 + n^4 + 7n^3 - 8n - 6 \\ n^6 \quad +3n^4 + 8n^3 \quad -19 \\ \hline n^6 - 6n^5 + 4n^4 + 15n^3 - 8n - 25 \end{array}$$

$$22. \quad \begin{array}{r} a^5 \quad -3a^3b^2 + 6ab^4 \\ +22a^4b + 10a^3b^2 - 11ab^4 - b^5 \\ \hline a^5 + 22a^4b + 7a^3b^2 - 5ab^4 - b^5 \end{array}$$

$$\begin{array}{r} a^5 + 22a^4b + 7a^3b^2 \quad -5ab^4 - b^5 \\ -5a^4b \quad +7a^2b^3 \quad -b^5 \\ \hline a^5 + 17a^4b + 7a^3b^2 + 7a^2b^3 - 5ab^4 - 2b^5 \end{array}$$

$$23. \quad \begin{array}{r} 4m^3 - 5m^2 - 2m \quad -3m^3 - 5m^2 + 6m + 4 \\ -7m^3 \quad +8m + 4 \quad m^4 \quad -5 \\ \hline -3m^3 - 5m^2 + 6m + 4 \quad m^4 - 3m^3 - 5m^2 + 6m - 1 \end{array}$$

$$24. \quad \begin{array}{r} 7a^2 - 11ab + b^2 \quad 2b^2 - 8 \\ -7a^2 + 11ab + b^2 - 8 \quad +4 \\ \hline 2b^2 - 8 \quad 2b^2 - 4 \end{array}$$

$$25. \quad \begin{array}{r} 3a - 4b + 5c \\ -7a + 8b \quad -11 \quad -5a + 6b - 2c - 11 \\ -a + 2b - 7c \quad -a + b + 2c \\ \hline -5a + 6b - 2c - 11 \quad -6a + 7b \quad -11 \end{array}$$

$$26. \quad \begin{array}{r} 5a^3 + 14a^2 - 19a + 8 \\ a^5 \quad +9a - 1 \\ -a^4 \quad +3a^2 \quad -1 \\ \hline a^5 - a^4 + 5a^3 + 17a^2 - 10a + 6 \\ -a^4 + 3a^3 \quad -5 \\ \hline a^5 - 2a^4 + 8a^3 + 17a^2 - 10a + 1 \end{array}$$

$$27. \frac{m^4 + 10m^2n^2 + 15n^4 - 11m^3n - 14m^2n^2 - 3mn^3 + n^4}{m^4 - 11m^3n - 4m^2n^2 - 3mn^3 + 16n^4}$$

$$\frac{6m^4 + 7m^2n^2 + 8mn^3 - n^4 - m^4 + 11m^3n + 4m^2n^2 + 3mn^3 - 16n^4}{5m^4 + 11m^3n + 11m^2n^2 + 11mn^3 - 17n^4}$$

$$28. \frac{a^5 + 4a^3b^2 + 8ab^4 - b^5 - 7a^4b + 15a^2b^3 - 25ab^4 + 3b^5 - a^3b^2 + 3a^2b^3 - 5ab^4}{a^5 - 7a^4b + 3a^3b^2 + 18a^2b^3 - 22ab^4 + 2b^5}$$

$$\frac{3a^5 - 6a^2b^3 - 21ab^4 - 6 - a^5 + 7a^4b - 3a^3b^2 - 18a^2b^3 + 22ab^4 - 2b^5}{2a^5 + 7a^4b - 3a^3b^2 - 24a^2b^3 + ab^4 - 2b^5 - 6}$$

$$29. \frac{x^5 + y^5 + 3x^4y + 21x^3y^2 + 18x^2y^3 - y^5}{x^5 + 3x^4y + 21x^3y^2 + 18x^2y^3}$$

$$\frac{x^5 + 32x^4y - 26x^3y^2 + 18x^2y^3 - 2xy^4 + y^5 - x^5 - 3x^4y - 21x^3y^2 - 18x^2y^3}{29x^4y - 47x^3y^2 - 2xy^4 + y^5}$$

$$30. \frac{3a^x + 6a^{x-1} + a^x - 7a^{x-1} + a^{x-2}}{4a^x - a^{x-1} + a^{x-2}}$$

$$\frac{8a^{x+2} - 7a^{x+1} - a^x + 12a^{x-1} - 4a^x + a^{x-1} - a^{x-2}}{8a^{x+2} - 7a^{x+1} - 5a^x + 13a^{x-1} - a^{x-2}}$$

## EJERCICIO 28

$$1. \frac{x^2 + 5}{2x - 6} - \frac{x - 4}{-x + 6} + \frac{x^2 + 2x - 1}{-2} - \frac{x^2 + 2x - 3}{x^2 + 2x - 3}$$

$$2. \frac{3a - 5b + c}{a - b - 3c} - \frac{7a + b}{-8b - 3c} + \frac{4a - 6b - 2c}{-7a + 7b + 3c} - \frac{4a - 6b - 2c}{-3a + b + c}$$

$$3. \frac{x^3 + 1}{5x^3 - x^2 + 7} - \frac{9x + 4}{-3x^2 - x + 1} + \frac{6x^3 - x^2 + 8}{3x^2 - 8x - 5} - \frac{6x^3 + 2x^2 - 8x + 3}{6x^3 - x^2 + 8}$$

$$4. \frac{a^2 + 1}{a^3 - 1} - \frac{a^4 + 2}{a - 2} + \frac{a^3 + a^2}{-a^4} - \frac{a}{-a^4 + a^3 + a^2 - a}$$

$$5. \frac{ab + bc + ac}{ab - 6bc + 9ac - 9} - \frac{5ab - 3bc + 4ac}{-ab + 3bc + 5ac} + \frac{ab - 6bc + 9ac - 9}{-4ab - 9ac} - \frac{ab - 6bc + 9ac - 9}{-4ab - 9ac}$$

$$6. \frac{a^2x - 3x^3}{a^3 + 3ax^2} - \frac{-5a^2x + 11ax^2 - 11x^3}{a^3 - 4a^2x + 6ax^2 + 8x^3} - \frac{-5a^2x + 11ax^2 - 11x^3}{a^3 - 9a^2x + 17ax^2 - 3x^3}$$

$$\frac{a^3 + a^2x + 3ax^2 - 3x^3 - a^3 + 9a^2x - 17ax^2 + 3x^3}{10a^2x - 14ax^2}$$

$$7. \frac{x^4 + x^2 - 3}{-x^3 - 3x + 5} - \frac{-7x^3 + 8x^2 - 3x + 4}{x^4 - 5x^2 + 4x} + \frac{x^4}{2x^4 - x^3 - 4x^2 + x + 2} - \frac{-3}{x^4 - 7x^3 + 8x^2 - 3x + 1}$$

$$\frac{2x^4 - x^3 - 4x^2 + x + 2 - x^4 + 7x^3 - 8x^2 + 3x - 1}{x^4 + 6x^3 - 12x^2 + 4x + 1}$$

$$8. \begin{array}{r} m^4 \qquad \qquad \qquad - n^4 \\ 17m^3n - 4m^2n^2 - 7mn^3 \qquad \qquad -m^4 \qquad \qquad + 6 \qquad \qquad 17m^3n + 2m^2n^2 - 7mn^3 - 81n^4 \\ -m^4 \qquad + 6m^2n^2 \qquad - 80n^4 \qquad \qquad -m^2n^2 + mn^3 - 4 \qquad \qquad m^4 \qquad + m^2n^2 \qquad - mn^3 \qquad - 2 \\ \hline 17m^3n + 2m^2n^2 - 7mn^3 - 81n^4 \qquad \qquad -m^4 - m^2n^2 + mn^3 + 2 \qquad \qquad m^4 + 17m^3n + 3m^2n^2 - 8mn^3 - 81n^4 - 2 \end{array}$$

$$9. \begin{array}{r} + a^3 \qquad + a \qquad - 7 \\ a^5 - a^4 \qquad - 6a^2 \qquad + 8 \qquad - a^4 - 4a^3 + a^2 \qquad \qquad a^5 - a^4 + a^3 - 11a^2 - 10a + 27 \\ \qquad \qquad - 5a^2 - 11a + 26 \qquad \qquad 16a^3 - 8a^2 - 7a - 15 \qquad \qquad + a^4 - 12a^3 + 7a^2 + 7a + 15 \\ \hline a^5 - a^4 + a^3 - 11a^2 - 10a + 27 \qquad - a^4 + 12a^3 - 7a^2 - 7a - 15 \qquad a^5 \qquad - 11a^3 - 4a^2 - 3a + 42 \end{array}$$

$$10. \begin{array}{r} 3x^2 \qquad - y^2 \qquad \qquad x^2 - 3xy - y^2 \qquad \qquad 20x^2 - 11xy + 8y^2 \\ - 11xy + 9y^2 - 14 \qquad \qquad 19x^2 - 8xy + 9y^2 \qquad \qquad - 3x^2 + 11xy - 8y^2 + 14 \\ \hline 3x^2 - 11xy + 8y^2 - 14 \qquad \qquad 20x^2 - 11xy + 8y^2 \qquad \qquad 17x^2 \qquad \qquad + 14 \end{array}$$

$$11. \begin{array}{r} a-1 \qquad a^2 \qquad - 3 \\ -a+1 \qquad \qquad a - 4 \\ \hline 0 \qquad - 3a + 8 \\ \hline a^2 - 2a + 1 \end{array} \qquad 12. \begin{array}{r} a^2 - ab + b^2 \\ 3a^2 - 8ab + 7b^2 \qquad - a^2 + 9ab + 3b^2 \qquad - a^2 + ab - 4b^2 \\ - 5a^2 + 11ab - 17b^2 \qquad - 8ab - 7b^2 \qquad a^2 - 2ab + 9b^2 \\ \hline - a^2 + 2ab - 9b^2 \qquad - a^2 + ab - 4b^2 \qquad - ab + 5b^2 \end{array}$$

$$13. \begin{array}{r} m^4 \qquad \qquad \qquad - 1 \\ -m^3 + 8m^2 - 6m + 5 \qquad m^5 \qquad \qquad - 16 \qquad \qquad m^5 - 16m^4 \qquad + 7m^2 \qquad - 19 \\ \qquad \qquad - m^2 - 7m + 1 \qquad \qquad - 16m^4 + 7m^2 - 3 \qquad \qquad - m^4 + m^3 - 7m^2 + 13m - 5 \\ \hline m^4 - m^3 + 7m^2 - 13m + 5 \qquad m^5 - 16m^4 + 7m^2 - 19 \qquad m^5 - 17m^4 + m^3 \qquad + 13m - 24 \end{array}$$

$$14. \begin{array}{r} x^5 \qquad \qquad \qquad - y^5 \\ - 2x^4y + 5x^3y^2 - 7x^2y^3 \qquad - 3y^5 \qquad 7x^4y - x^3y^2 + 11xy^4 \qquad - x^5 + 2x^4y + 2x^3y^2 + 7x^2y^3 - 6xy^4 + 4y^5 + 8 \\ \qquad \qquad - 7x^3y^2 \qquad + 6xy^4 \qquad - 8 \qquad \qquad - xy^4 - 1 \qquad 7x^4y - x^3y^2 \qquad + 10xy^4 \qquad - 1 \\ \hline x^5 - 2x^4y - 2x^3y^2 - 7x^2y^3 + 6xy^4 - 4y^5 - 8 \qquad 7x^4y - x^3y^2 + 10xy^4 - 1 \qquad - x^5 + 9x^4y + x^3y^2 + 7x^2y^3 + 4xy^4 + 4y^5 + 7 \end{array}$$

$$15. \begin{array}{r} - a^6 \qquad + 7a^4 \qquad \qquad - 8a \\ - 3a^5 \qquad + 11a^3 - a^2 \qquad + 4 \\ \qquad \qquad - 6a^4 - 11a^3 \qquad - 2a + 8 \qquad - 3a^4 \qquad + 7a^2 - 8a + 5 \qquad 5a^5 - 3a^4 - 7a^3 + 48a^2 - 58a + 13 \\ \qquad \qquad - 5a^3 + 5a^2 - 4a + 1 \qquad 5a^5 \qquad - 7a^3 + 41a^2 - 50a + 8 \qquad a^6 + 3a^5 - a^4 + 5a^3 - 4a^2 + 14a - 13 \\ \hline - a^6 - 3a^5 + a^4 - 5a^3 + 4a^2 - 14a + 13 \qquad 5a^5 - 3a^4 - 7a^3 + 48a^2 - 58a + 13 \qquad a^6 + 8a^5 - 4a^4 - 2a^3 + 44a^2 - 44a \end{array}$$

$$16. \begin{array}{r} a^5 \qquad \qquad - 7a^3x^2 \qquad \qquad + 9 \qquad \qquad + 18a^3x^2 \qquad - 4x^5 - 8 \\ - 20a^4x \qquad + 21a^2x^3 - 19ax^4 \qquad \qquad - 9a^4x - 17a^3x^2 + 11a^2x^3 \\ \qquad \qquad + 9a^3x^2 \qquad - 7ax^4 + x^5 - 80 \qquad \qquad a^5 \qquad \qquad \qquad + 36 \\ \hline a^5 - 20a^4x + 2a^3x^2 + 21a^2x^3 - 26ax^4 + x^5 - 71 \qquad a^5 - 9a^4x + a^3x^2 + 11a^2x^3 - 4x^5 + 28 \end{array}$$

$$\begin{array}{r} a^5 - 9a^4x + a^3x^2 + 11a^2x^3 \qquad - 4x^5 + 28 \\ - a^5 + 20a^4x - 2a^3x^2 - 21a^2x^3 + 26ax^4 - x^5 + 71 \\ \hline 11a^4x - a^3x^2 - 10a^2x^3 + 26ax^4 - 5x^5 + 99 \end{array}$$

## EJERCICIO 29

$$\begin{array}{r}
 1. \quad a + \frac{1}{2}b \qquad \frac{3}{4}a \\
 -\frac{2}{3}a + \frac{3}{4}b \qquad -\frac{1}{3}a - \frac{5}{4}b \\
 \hline
 \frac{3-2}{3}a + \frac{2+3}{4}b \qquad \frac{9-4}{12}a - \frac{5}{4}b \\
 = \frac{1}{3}a + \frac{5}{4}b \qquad = \frac{5}{12}a - \frac{5}{4}b
 \end{array}$$

$$\begin{array}{r}
 2. \qquad \frac{3}{8}a-6 \qquad \frac{1}{2}a^3 + \frac{3}{5}a^2 \\
 -\frac{5}{6}a^3 + \frac{3}{5}a^2 \qquad \frac{5}{6}a^3 - \frac{3}{5}a^2 - \frac{3}{8}a+6 \\
 \hline
 -\frac{5}{6}a^3 + \frac{3}{5}a^2 + \frac{3}{8}a-6 \qquad \frac{3+5}{6}a^3 - \frac{3}{8}a+6 \\
 = \frac{4}{3}a^3 - \frac{3}{8}a+6
 \end{array}$$

$$\begin{array}{r}
 3. \quad a + 3b \qquad \frac{3}{5}a + \frac{7}{3}b + 6 \\
 -\frac{2}{5}a - \frac{2}{3}b + 6 \qquad -\frac{1}{5}a + \frac{1}{6}b \\
 \hline
 \frac{5-2}{5}a + \frac{9-2}{3}b+6 \qquad \frac{3-1}{5}a + \frac{14+1}{6}b+6 \\
 = \frac{3}{5}a + \frac{7}{3}b+6 \qquad = \frac{2}{5}a + \frac{5}{2}b+6
 \end{array}$$

$$\begin{array}{r}
 4. \quad \frac{1}{3}x^3 - \frac{3}{7}x^2 + \frac{1}{5} \\
 \qquad \frac{1}{14}x^2 - \frac{2}{9}x+6 \\
 \hline
 \frac{1}{3}x^3 - \frac{6-1}{14}x^2 - \frac{2}{9}x + \frac{1+30}{5} \\
 = \frac{1}{3}x^3 - \frac{5}{14}x^2 - \frac{2}{9}x + \frac{31}{5} \\
 - \frac{5}{6}x^3 \\
 - \frac{1}{3}x^3 + \frac{5}{14}x^2 + \frac{2}{9}x - \frac{31}{5} \\
 \hline
 -\frac{5+2}{6}x^3 + \frac{5}{14}x^2 + \frac{2}{9}x - \frac{31}{5} \\
 = -\frac{7}{6}x^3 + \frac{5}{14}x^2 + \frac{2}{9}x - 6\frac{1}{5}
 \end{array}$$

$$\begin{array}{r}
 5. \quad \frac{7}{12}a^4 \qquad \frac{7}{12}a^4 - \frac{3}{7}a^3 + \frac{2}{5}a^2 - 6 \\
 -\frac{3}{7}a^3 + \frac{2}{5}a^2 - 6 \qquad \frac{3}{4}a^4 - \frac{1}{5}a + \frac{1}{3} \\
 \hline
 \frac{7}{12}a^4 - \frac{3}{7}a^3 + \frac{2}{5}a^2 - 6 \qquad \frac{7+9}{12}a^4 - \frac{3}{7}a^3 + \frac{2}{5}a^2 - \frac{1}{5}a - \frac{18-1}{3} \\
 = \frac{4}{3}a^4 - \frac{3}{7}a^3 + \frac{2}{5}a^2 - \frac{1}{5}a - \frac{17}{3}
 \end{array}$$

$$\begin{array}{r}
 6. \quad -\frac{1}{2}x + \frac{2}{3}y - \frac{1}{4}z \qquad \frac{5}{9}y - \frac{2}{5} \\
 -\frac{1}{9}y - \frac{2}{5}z + 3 \qquad \frac{1}{2}x - \frac{5}{9}y + \frac{13}{20}z - 3 \\
 \hline
 -\frac{1}{2}x + \frac{6-1}{9}y - \frac{5+8}{20}z + 3 \qquad \frac{1}{2}x - \frac{5}{9}y + \frac{13}{20}z - \frac{2+15}{5} \\
 = -\frac{1}{2}x + \frac{5}{9}y - \frac{13}{20}z + 3 \qquad = \frac{1}{2}x + \frac{13}{20}z - \frac{17}{5}
 \end{array}$$

$$\begin{array}{r}
 7. \quad -\frac{3}{2}a^2b + \frac{3}{4}ab^2 - b^3 \\
 \frac{1}{8}a^2b - \frac{5}{8}ab^2 + \frac{2}{3}b^3 \\
 \hline
 -\frac{12-1}{8}a^2b + \frac{9-10}{12}ab^2 - \frac{3-2}{3}b^3 \\
 = -\frac{11}{8}a^2b - \frac{1}{12}ab^2 - \frac{1}{3}b^3
 \end{array}$$

$$\begin{array}{r}
 \frac{1}{2}a^3 \qquad -\frac{1}{3}b^3 \\
 \frac{11}{8}a^2b + \frac{1}{12}ab^2 + \frac{1}{3}b^3 \\
 \hline
 \frac{1}{2}a^3 + \frac{11}{8}a^2b + \frac{1}{12}ab^2
 \end{array}$$

$$\begin{array}{r}
 8. \quad \frac{1}{2}a - \frac{2}{9}b \qquad \frac{2}{3}b + \frac{1}{5}c \qquad \frac{1}{2}a + \frac{1}{9}b - \frac{3}{5}c \\
 \frac{1}{3}b - \frac{3}{5}c - \frac{5}{9}b - \frac{1}{10}c \qquad -\frac{1}{9}b - \frac{1}{10}c \\
 \hline
 \frac{1}{2}a - \frac{2-3}{9}b - \frac{3}{5}c \qquad \frac{6-5}{9}b + \frac{2-1}{10}c \qquad \frac{1}{2}a - \frac{6+1}{10}c \\
 = \frac{1}{2}a + \frac{1}{9}b - \frac{3}{5}c \qquad = \frac{1}{9}b + \frac{1}{10}c \qquad = \frac{1}{2}a - \frac{7}{10}c
 \end{array}$$



$$\begin{array}{l}
 \text{9. } \frac{1}{3}a^3 + \frac{1}{8}a^2 + \frac{1}{5} \\
 \quad - \frac{3}{5}a^2 - \frac{3}{4}a - \frac{1}{10} \\
 \hline
 \frac{1}{3}a^3 + \frac{5-24}{40}a^2 - \frac{3}{4}a + \frac{2-1}{10} \\
 = \frac{1}{3}a^3 - \frac{19}{40}a^2 - \frac{3}{4}a + \frac{1}{10}
 \end{array}
 \qquad
 \begin{array}{l}
 \frac{1}{4}a^2 - \frac{2}{3}a + \frac{1}{4} \\
 \frac{1}{3}a^3 - \frac{29}{40}a^2 - \frac{1}{8} \\
 \hline
 \frac{1}{3}a^3 + \frac{10-29}{40}a^2 - \frac{2}{3}a + \frac{2-1}{8} \\
 = \frac{1}{3}a^3 - \frac{19}{40}a^2 - \frac{2}{3}a + \frac{1}{8}
 \end{array}
 \qquad
 \begin{array}{l}
 \frac{1}{3}a^3 - \frac{19}{40}a^2 - \frac{2}{3}a + \frac{1}{8} \\
 - \frac{1}{3}a^3 + \frac{19}{40}a^2 + \frac{3}{4}a - \frac{1}{10} \\
 \hline
 -\frac{8-9}{12}a + \frac{10-8}{80} \\
 = \frac{1}{12}a + \frac{2}{80} = \frac{1}{12}a + \frac{1}{40}
 \end{array}$$

$$\begin{array}{l}
 \text{10. } \frac{3}{5}x^2 - \frac{5}{6}xy + \frac{2}{9}y^2 \\
 \quad - \frac{3}{2}xy - \frac{1}{3}y^2 + \frac{1}{4} \\
 \hline
 \frac{3}{5}x^2 - \frac{10+18}{12}xy + \frac{2-3}{9}y^2 + \frac{1}{4} \\
 = \frac{3}{5}x^2 - \frac{28}{12}xy - \frac{1}{9}y^2 + \frac{1}{4} \\
 = \frac{3}{5}x^2 - \frac{7}{3}xy - \frac{1}{9}y^2 + \frac{1}{4}
 \end{array}
 \qquad
 \begin{array}{l}
 \frac{2}{9}x^2 + \frac{1}{9}xy - \frac{2}{3}y^2 \\
 \frac{17}{45}x^2 - \frac{22}{9}xy - \frac{3}{2}y^2 - \frac{1}{2} \\
 \hline
 \frac{10+17}{45}x^2 + \frac{1-22}{9}xy - \frac{4+9}{6}y^2 - \frac{1}{2} \\
 = \frac{27}{45}x^2 - \frac{21}{9}xy - \frac{13}{6}y^2 - \frac{1}{2} \\
 = \frac{3}{5}x^2 - \frac{7}{3}xy - \frac{13}{6}y^2 - \frac{1}{2}
 \end{array}
 \qquad
 \begin{array}{l}
 -\frac{3}{5}x^2 + \frac{7}{3}xy + \frac{13}{6}y^2 + \frac{1}{2} \\
 \frac{3}{5}x^2 - \frac{7}{3}xy - \frac{1}{9}y^2 + \frac{1}{4} \\
 \hline
 \frac{39-2}{18}y^2 + \frac{2+1}{4} \\
 = \frac{37}{18}y^2 + \frac{3}{4}
 \end{array}$$

$$\begin{array}{l}
 \text{11. } \frac{2}{7}a^3 - \frac{1}{5}b^3 \\
 \quad - \frac{3}{4}a^2b + \frac{3}{8}ab^2 + \frac{1}{10}b^3 \\
 \hline
 \frac{2}{7}a^3 - \frac{3}{4}a^2b + \frac{3}{8}ab^2 - \frac{2-1}{10}b^3 \\
 = \frac{2}{7}a^3 - \frac{3}{4}a^2b + \frac{3}{8}ab^2 - \frac{1}{10}b^3
 \end{array}
 \qquad
 \begin{array}{l}
 \frac{1}{2}a^2b + \frac{1}{4}ab^2 - \frac{1}{5} \\
 - \frac{5}{4}a^2b + \frac{1}{8}ab^2 - \frac{3}{2}b^3 - \frac{1}{2} \\
 \hline
 \frac{2-5}{4}a^2b + \frac{2+1}{8}ab^2 - \frac{3}{2}b^3 - \frac{2+5}{10} \\
 = -\frac{3}{4}a^2b + \frac{3}{8}ab^2 - \frac{3}{2}b^3 - \frac{7}{10}
 \end{array}
 \qquad
 \begin{array}{l}
 -\frac{3}{4}a^2b + \frac{3}{8}ab^2 - \frac{3}{2}b^3 - \frac{7}{10} \\
 -\frac{2}{7}a^3 + \frac{3}{4}a^2b - \frac{3}{8}ab^2 + \frac{1}{10}b^3 \\
 \hline
 -\frac{2}{7}a^3 - \frac{15-1}{10}b^3 - \frac{7}{10} \\
 = -\frac{2}{7}a^3 - \frac{14}{10}b^3 - \frac{7}{10} = -\frac{2}{7}a^3 - \frac{7}{5}b^3 - \frac{7}{10}
 \end{array}$$

$$\begin{array}{l}
 \text{12. } \frac{1}{3}m^2n^2 - \frac{1}{4}mn^3 - n^4 \\
 \frac{2}{7}m^4 + \frac{3}{5}m^3n - \frac{2}{5}m^2n^2 + \frac{5}{3}n^4 \\
 \frac{1}{14}m^4 - \frac{7}{20}m^3n + \frac{1}{4}m^2n^2 - \frac{2}{3}n^4 \\
 \hline
 \frac{4+1}{14}m^4 + \frac{12-7}{20}m^3n + \frac{20-24+15}{60}m^2n^2 - \frac{1}{4}mn^3 - \frac{3-5+2}{3}n^4 \\
 = \frac{5}{14}m^4 + \frac{5}{20}m^3n + \frac{11}{60}m^2n^2 - \frac{1}{4}mn^3 - \frac{0}{3}n^4 \\
 = \frac{5}{14}m^4 + \frac{1}{4}m^3n + \frac{11}{60}m^2n^2 - \frac{1}{4}mn^3
 \end{array}
 \qquad
 \begin{array}{l}
 \frac{5}{14}m^4 - \frac{2}{5}n^4 \\
 -\frac{5}{14}m^4 - \frac{1}{4}m^3n - \frac{11}{60}m^2n^2 + \frac{1}{4}mn^3 \\
 \hline
 -\frac{1}{4}m^3n - \frac{11}{60}m^2n^2 + \frac{1}{4}mn^3 - \frac{2}{5}n^4
 \end{array}$$

$$\begin{array}{r}
 13. \quad \frac{1}{2}x + \frac{1}{3}y \\
 \quad \quad \frac{3}{4}y - \frac{1}{6}z \\
 \quad \quad \quad \frac{2}{5}z + \frac{1}{4}m \\
 \quad \quad \quad \quad -\frac{1}{2}m + \frac{1}{3}n + \frac{3}{8} \\
 \hline
 \frac{1}{2}x + \frac{4+9}{12}y - \frac{5-12}{30}z + \frac{1-2}{4}m + \frac{1}{3}n + \frac{3}{8} \\
 = \frac{1}{2}x + \frac{13}{12}y + \frac{7}{30}z - \frac{1}{4}m + \frac{1}{3}n + \frac{3}{8}
 \end{array}
 \qquad
 \begin{array}{r}
 5 \\
 -\frac{1}{2}x - \frac{13}{12}y - \frac{7}{30}z + \frac{1}{4}m - \frac{1}{3}n - \frac{3}{8} \\
 \hline
 -\frac{1}{2}x - \frac{13}{12}y - \frac{7}{30}z + \frac{1}{4}m - \frac{1}{3}n + \frac{40-3}{8} \\
 = -\frac{1}{2}x - \frac{13}{12}y - \frac{7}{30}z + \frac{1}{4}m - \frac{1}{3}n + \frac{37}{8}
 \end{array}$$

$$\begin{array}{r}
 14. \quad \frac{5}{6}a^4 + \frac{1}{2}a^3 \qquad - \frac{3}{5}a \\
 \quad \quad \quad - \frac{2}{3}a^2 - \frac{3}{8}a \qquad + 5 \\
 \hline
 -\frac{3}{8}a^4 - \frac{3}{4}a^3 + \frac{1}{6}a^2 \qquad - \frac{2}{3} \\
 \quad \quad + \frac{1}{6}a^3 \qquad + \frac{39}{40}a \qquad + \frac{3}{11} \\
 \hline
 \frac{20-9}{24}a^4 + \frac{6-9+2}{12}a^3 - \frac{4-1}{6}a^2 - \frac{24+15-39}{40}a + \frac{165-22+9}{33} \\
 = \frac{11}{24}a^4 - \frac{1}{12}a^3 - \frac{3}{6}a^2 - \frac{0}{40}a + \frac{152}{33} = \frac{11}{24}a^4 - \frac{1}{12}a^3 - \frac{1}{2}a^2 + \frac{152}{33}
 \end{array}
 \qquad
 \begin{array}{r}
 \frac{11}{24}a^4 - \frac{1}{12}a^3 - \frac{1}{2}a^2 + \frac{152}{33} \\
 -a^4 + \frac{1}{12}a^3 - \frac{3}{8} \\
 \hline
 \frac{11-24}{24}a^4 - \frac{1}{2}a^2 + \frac{1216-99}{264} \\
 = -\frac{13}{24}a^4 - \frac{1}{2}a^2 + \frac{1117}{264}
 \end{array}$$

### EJERCICIO 30

$$\begin{array}{r}
 1. \quad x^3 - x^2 + 5 \\
 \quad -x^3 + x^2 + 3x - 5 - 6 \\
 \hline
 \quad \quad \quad 3x - 6 \\
 \text{Rta. } -x^3 + x^2 + 3x - 11
 \end{array}$$

$$\begin{array}{r}
 4. \quad x^3 - 4x^2 + 8 \\
 \quad -x^3 + 4x^2 + x - 13 \\
 \hline
 \quad \quad \quad x - 5 \\
 \text{Rta. } x^3 - 4x^2 - x + 13
 \end{array}$$

$$\begin{array}{r}
 7. \quad 5a^3 + 8ab^2 - b^3 - 11 \\
 \quad -a^3 + b^3 \\
 \hline
 \quad \quad \quad 4a^3 + 8ab^2 - 11 \\
 \text{Rta. } 5a^3 + 8ab^2 - b^3 - 11
 \end{array}$$

$$\begin{array}{r}
 2. \quad -5a + 9b - 6c \\
 \quad 5a - 9b + 6c + 8x + 9 \\
 \hline
 \quad \quad \quad 8x + 9 \\
 \text{Rta. } 5a - 9b + 6c + 8x + 9
 \end{array}$$

$$\begin{array}{r}
 5. \quad m^4 - 3mn^3 + 6n^4 \\
 \quad -m^4 + 4m^2n^2 + 3mn^3 - 6n^4 - 8 \\
 \hline
 \quad \quad \quad 4m^2n^2 - 8 \\
 \text{Rta. } m^4 - 4m^2n^2 - 3mn^3 + 6n^4 + 8
 \end{array}$$

$$\begin{array}{r}
 8. \quad \frac{1}{2}x - \frac{1}{3}y - 4 \\
 \quad -\frac{1}{2}x + \frac{1}{3}y \\
 \hline
 \quad \quad \quad -4 \\
 \text{Rta. } \frac{1}{2}x - \frac{1}{3}y - 4
 \end{array}$$

$$\begin{array}{r}
 3. \quad a^3 - b^3 \\
 \quad -a^3 - 8a^2b + 5ab^2 - 3b^3 \\
 \hline
 \quad \quad \quad -8a^2b + 5ab^2 - 4b^3 \\
 \text{Rta. } -a^3 - 8a^2b + 5ab^2 - 3b^3
 \end{array}$$

$$\begin{array}{r}
 6. \quad 4x^3 + 5x^2 - 5x - 2 \\
 \quad -5x^2 - 4x + 8 \\
 \hline
 \quad \quad \quad 4x^3 - 9x + 6 \\
 \text{Rta. } 4x^3 + 5x^2 - 5x - 2
 \end{array}$$

$$9. \frac{5x^2 - 7xy - 8y^2}{-5x^2 + 7xy + 8y^2 + 1} \cdot 1$$

Rta.  $-5x^2 + 7xy + 8y^2 + 1$

$$10. \frac{n^3}{-9m^3 + 8m^2n - 5mn^2 + n^3} \cdot \frac{-9m^3 + 8m^2n - 5mn^2 + 2n^3}{-9m^3 + 8m^2n - 5mn^2 + 2n^3}$$

$$\frac{10m^3 - 8m^2n + 5mn^2 - 2n^3}{m^3}$$

Rta.  $10m^3 - 8m^2n + 5mn^2 - 2n^3$

$$11. \frac{0}{-a^3 + 5a - 8} \cdot \frac{-a^3 + 5a - 8}{-a^3 + 5a - 8}$$

Rta. 0

## EJERCICIO 31

$$1. x - (x - y)$$

$$= x - x + y$$

$$= y$$

$$6. a + (a - b) + (-a + b)$$

$$= a + a - b - a + b$$

$$= 2a - a = a$$

$$11. x + y + (x - y + z) - (x + y - z)$$

$$= x + y + x - y + z - x - y + z$$

$$= x - y + 2z$$

$$2. x^2 + (-3x - x^2 + 5)$$

$$= x^2 - 3x - x^2 + 5$$

$$= -3x + 5$$

$$7. a^2 + [-b^2 + 2a^2] - [a^2 - b^2]$$

$$= a^2 - b^2 + 2a^2 - a^2 + b^2$$

$$= 3a^2 - a^2 = 2a^2$$

$$12. a - (b + a) + (-a + b) - (-a + 2b)$$

$$= a - b - a - a + b + a - 2b$$

$$= -2b$$

$$3. a + b - (-2a + 3)$$

$$= a + b + 2a - 3$$

$$= 3a + b - 3$$

$$8. 2a - \{-x + a - 1\} - \{a + x - 3\}$$

$$= 2a + x - a + 1 - a - x + 3$$

$$= 1 + 3 = 4$$

$$13. -(x^2 - y^2) + xy + (-2x^2 + 3xy) - [-y^2 + xy]$$

$$= -x^2 + y^2 + xy - 2x^2 + 3xy + y^2 - xy$$

$$= -3x^2 + 3xy + 2y^2$$

$$4. 4m - (-2m - n)$$

$$= 4m + 2m + n$$

$$= 6m + n$$

$$9. x^2 + y^2 - (x^2 + 2xy + y^2) + [-x^2 + y^2]$$

$$= x^2 + y^2 - x^2 - 2xy - y^2 - x^2 + y^2$$

$$= -x^2 - 2xy + y^2$$

$$14. 8x^2 + [-2xy + y^2] - \{-x^2 + xy - 3y^2\} - (x^2 - 3xy)$$

$$= 8x^2 - 2xy + y^2 + x^2 - xy + 3y^2 - x^2 + 3xy$$

$$= 8x^2 + 4y^2$$

$$5. 2x + 3y - (4x + 3y)$$

$$= 2x + 3y - 4x - 3y$$

$$= -2x$$

$$10. (-5m + 6) + (-m + 5) - 6$$

$$= -5m + 6 - m + 5 - 6$$

$$= -6m + 5$$

$$15. -(a + b) + (-a - b) - (-b + a) + (3a + b)$$

$$= -a - b - a - b + b - a + 3a + b$$

$$= 0$$

## EJERCICIO 32

$$1. 2a + [a - (a + b)]$$

$$= 2a + [a - a - b]$$

$$= 2a + a - a - b$$

$$= 2a - b$$

$$2. 3x - [x + y - (2x + y)]$$

$$= 3x - [x + y - 2x - y]$$

$$= 3x - x - y + 2x + y$$

$$= 4x$$

$$3. 2m - [(m - n) - (m + n)]$$

$$= 2m - [m - n - m - n]$$

$$= 2m - m + n + m + n$$

$$= 2m + 2n$$

$$\begin{aligned}
4. & 4x^2 + [-(x^2 - xy) + (-3y^2 + 2xy) - (-3x^2 + y^2)] \\
& = 4x^2 + [-x^2 + xy - 3y^2 + 2xy + 3x^2 - y^2] \\
& = 4x^2 - x^2 + xy - 3y^2 + 2xy + 3x^2 - y^2 \\
& = 6x^2 + 3xy - 4y^2
\end{aligned}$$

$$\begin{aligned}
5. & a + \{(-2a + b) - (-a + b - c) + a\} \\
& = a + \{-2a + b + a - b + c + a\} \\
& = a - 2a + b + a - b + c + a \\
& = a + c
\end{aligned}$$

$$\begin{aligned}
6. & 4m - [2m + (n - 3)] + [-4n - (2m + 1)] \\
& = 4m - [2m + n - 3] + [-4n - 2m - 1] \\
& = 4m - 2m - n + 3 - 4n - 2m - 1 \\
& = -5n + 2
\end{aligned}$$

$$\begin{aligned}
7. & 2x + [-5x - (-2y + \{-x + y\})] \\
& = 2x + [-5x - (-2y - x + y)] \\
& = 2x + [-5x + 2y + x - y] \\
& = 2x - 5x + 2y + x - y \\
& = -2x + y
\end{aligned}$$

$$\begin{aligned}
8. & x^2 - \{-7xy + [-y^2 + (-x^2 + 3xy - 2y^2)]\} \\
& = x^2 - \{-7xy + [-y^2 - x^2 + 3xy - 2y^2]\} \\
& = x^2 - \{-7xy - y^2 - x^2 + 3xy - 2y^2\} \\
& = x^2 + 7xy + y^2 + x^2 - 3xy + 2y^2 \\
& = 2x^2 + 4xy + 3y^2
\end{aligned}$$

$$\begin{aligned}
9. & -(a + b) + [-3a + b - \{-2a + b - (a - b)\} + 2a] \\
& = -a - b + [-a + b - \{-2a + b - a + b\}] \\
& = -a - b + [-a + b + 2a - b + a - b] \\
& = -a - b - a + b + 2a - b + a - b \\
& = a - 2b
\end{aligned}$$

$$\begin{aligned}
10. & (-x + y) - \{4x + 2y + [-x - y - (x + y)]\} \\
& = -x + y - \{4x + 2y + [-x - y - x - y]\} \\
& = -x + y - \{4x + 2y - x - y - x - y\} \\
& = -x + y - 4x - 2y + x + y + x + y \\
& = -3x + y
\end{aligned}$$

$$\begin{aligned}
11. & -(-a + b) + [-(a + b) - (-2a + 3b) + (-b + a - b)] \\
& = a - b + [-a - b + 2a - 3b - b + a - b] \\
& = a - b - a - b + 2a - 3b - b + a - b \\
& = 3a - 7b
\end{aligned}$$

$$\begin{aligned}
12. & 7m^2 - \{-[m^2 + 3n - (5 - n) - (-3 + m^2)]\} - (2n + 3) \\
& = 7m^2 - \{-[m^2 + 3n - 5 + n + 3 - m^2]\} - 2n - 3 \\
& = 7m^2 - \{-m^2 - 3n + 5 - n + 3 + m^2\} - 2n - 3 \\
& = 7m^2 + m^2 + 3n - 5 + n + 3 - m^2 - 2n - 3 \\
& = 7m^2 + 2n - 5
\end{aligned}$$

$$\begin{aligned}
13. & 2a - (-4a + b) - \{-[-4a + (b - a) - (-b + a)]\} \\
& = 2a + 4a - b - \{-[-4a + b - a + b - a]\} \\
& = 6a - b - \{4a - b + a - b + a\} \\
& = 6a - b - 4a + b - a + b - a \\
& = b
\end{aligned}$$

$$\begin{aligned}
14. & 3x - (5y + [-2x + \{y - (6 + x)\} - (-x + y)]) \\
& = 3x - (5y + [-2x + \{y - 6 - x\} + x - y]) \\
& = 3x - (5y + [-2x + y - 6 - x + x - y]) \\
& = 3x - (5y - 2x + y - 6 - x + x - y) \\
& = 3x - 5y + 2x - y + 6 + x - x + y \\
& = 5x - 5y + 6
\end{aligned}$$

$$\begin{aligned}
15. & 6c - [-(2a + c) + \{-(a + c) - 2a - (a + c)\} + 2c] \\
& = 6c - [-2a - c + \{-a - c - 2a - a - c\} + 2c] \\
& = 6c - [-2a - c - a - c - 2a - a - c + 2c] \\
& = 6c + 2a + c + a + c + 2a + a + c - 2c \\
& = 6a + 7c
\end{aligned}$$

$$\begin{aligned}
16. & -(3m + n) - [2m + \{-m + (2m - (2n - 5))\}] - (n + 6) \\
& = -3m - n - [2m + \{-m + (2m - 2n + 5)\} - n - 6] \\
& = -3m - n - [2m + \{-m + 2m - 2n + 5\} - n - 6] \\
& = -3m - n - [2m - m + 2m - 2n + 5 - n - 6] \\
& = -3m - n - 2m + m - 2m + 2n - 5 + n + 6 \\
& = -6m + 2n + 1
\end{aligned}$$

$$\begin{aligned}
17. & 2a + \left\{ - \left[ 5b + (3a - c) + 2 - (-a + b - (c + 4)) \right] - (-a + b) \right\} \\
& = 2a + \left\{ - \left[ 5b + 3a - c + 2 - (-a + b - c - 4) \right] + a - b \right\} \\
& = 2a + \left\{ - \left[ 5b + 3a - c + 2 + a - b + c + 4 \right] + a - b \right\} \\
& = 2a + \left\{ - 5b - 3a + c - 2 - a + b - c - 4 + a - b \right\} \\
& = 2a - 5b - 3a + c - 2 - a + b - c - 4 + a - b \\
& = -a - 5b - 6
\end{aligned}$$

$$\begin{aligned}
18. & - \left[ -3x + (-x - (2y - 3)) \right] + \left\{ - (2x + y) + (-x - 3) + 2 - (x + y) \right\} \\
& = - \left[ -3x + (-x - 2y + 3) \right] + \left\{ -2x - y - x - 3 + 2 - x - y \right\} \\
& = - \left[ -3x - x - 2y + 3 \right] - 2x - y - x - 3 + 2 - x - y \\
& = 3x + x + 2y - 3 - 4x - 2y - 1 \\
& = -4
\end{aligned}$$

$$\begin{aligned}
19. & - \left[ -(-a) \right] - \left[ +(-a) \right] + \left\{ -[-b + c] - \left[ +(-c) \right] \right\} \\
& = -[a] - [-a] + \{ b - c - [-c] \} \\
& = -a + a + \{ b - c + c \} \\
& = b - c + c \\
& = b
\end{aligned}$$

$$\begin{aligned}
20. & - \left\{ - \left[ -(a + b) \right] \right\} - \left\{ + \left[ -(-b - a) \right] \right\} - (a + b) \\
& = - \left\{ -[-a - b] \right\} - \left\{ +[b + a] \right\} - a - b \\
& = - \{ a + b \} - \{ b + a \} - a - b \\
& = -a - b - b - a - a - b \\
& = -3a - 3b
\end{aligned}$$

$$\begin{aligned}
21. & - \left\{ - \left[ -(a + b - c) \right] \right\} - \left\{ + \left[ -(c - a + b) \right] \right\} + \left\{ - \left[ -a + (-b) \right] \right\} \\
& = - \left\{ -[-a - b + c] \right\} - \left\{ +[-c + a - b] \right\} + \left\{ -[-a - b] \right\} \\
& = - \{ a + b - c \} - \{ -c + a - b \} + \{ a + b \} \\
& = -a - b + c + c - a + b + a + b \\
& = -a + b + 2c
\end{aligned}$$

$$\begin{aligned}
22. & - \left[ 3m + \left\{ -m - (n - (m + 4)) \right\} \right] + \left\{ -(m + n) + (-2n + 3) \right\} \\
& = - \left[ 3m + \left\{ -m - (n - m - 4) \right\} \right] + \left\{ -m - n - 2n + 3 \right\} \\
& = - \left[ 3m + \left\{ -m - n + m + 4 \right\} - m - n - 2n + 3 \right] \\
& = - \left[ 3m - m - n + m + 4 - m - n - 2n + 3 \right] \\
& = -3m + m + n - m - 4 + m + n + 2n - 3 \\
& = -2m + 4n - 7
\end{aligned}$$

$$\begin{aligned}
23. & - \left[ x + \left\{ -(x + y) - \left[ -x + (y - z) - (-x + y) \right] - y \right\} \right] \\
& = - \left[ x + \left\{ -x - y - \left[ -x + y - z + x - y \right] - y \right\} \right] \\
& = - \left[ x + \left\{ -x - y + x - y + z - x + y - y \right\} \right] \\
& = - \left[ x - x - 2y + z \right] \\
& = -x + x + 2y - z = 2y - z
\end{aligned}$$

$$\begin{aligned}
24. & - \left[ -a + \left\{ -a + (a - b) - (a - b + c) - \left[ -(-a) + b \right] \right\} \right] \\
& = - \left[ -a + \left\{ -a + a - b - a + b - c - [a + b] \right\} \right] \\
& = - \left[ -a + \left\{ -a - c - a - b \right\} \right] \\
& = - \left[ -a - a - c - a - b \right] = 3a + b + c
\end{aligned}$$

## EJERCICIO 33

$$\begin{aligned}
1. & a - b + c - d \\
& = a + (-b + c - d)
\end{aligned}$$

$$\begin{aligned}
2. & x^2 - 3xy - y^2 + 6 \\
& = x^2 + (-3xy - y^2 + 6)
\end{aligned}$$

$$\begin{aligned}
3. & x^3 + 4x^2 - 3x + 1 \\
& = x^3 + (4x^2 - 3x + 1)
\end{aligned}$$

$$\begin{aligned}
4. & a^3 - 5a^2b + 3ab^2 - b^3 \\
& = a^3 + (-5a^2b + 3ab^2 - b^3)
\end{aligned}$$

$$\begin{aligned}
5. & x^4 - x^3 + 2x^2 - 2x + 1 \\
& = x^4 - x^3 + (2x^2 - 2x + 1)
\end{aligned}$$

$$\begin{aligned}
6. & 2a + b - c + d \\
& = 2a - (-b + c - d)
\end{aligned}$$

$$\begin{aligned}
7. & x^3 + x^2 + 3x - 4 \\
& = x^3 - (-x^2 - 3x + 4)
\end{aligned}$$

$$\begin{aligned}
8. & x^3 - 5x^2y + 3xy^2 - y^3 \\
& = x^3 - (5x^2y - 3xy^2 + y^3)
\end{aligned}$$

$$\begin{aligned}
9. & a^2 - x^2 - 2xy - y^2 \\
& = a^2 - (x^2 + 2xy + y^2)
\end{aligned}$$

$$\begin{aligned}
10. & a^2 + b^2 - 2bc - c^2 \\
& = a^2 - (-b^2 + 2bc + c^2)
\end{aligned}$$

## EJERCICIO 34

$$1. x + 2y + (x - y) \\ = x - [-2y - (x - y)]$$

$$2. 4m - 2n + 3 - (-m + n) + (2m - n) \\ = 4m - [2n - 3 + (-m + n) - (2m - n)]$$

$$3. x^2 - 3xy + [(x^2 - xy) + y^2] \\ = x^2 - \{3xy - [(x^2 - xy) + y^2]\}$$

$$4. x^3 - 3x^2 + [-4x + 2] - 3x - (2x + 3) \\ = x^3 - [3x^2 - [-4x + 2] + 3x + (2x + 3)]$$

$$5. 2a + 3b - \{-2a + [a + (b - a)]\} \\ = 2a - [-3b + \{-2a + [a + (b - a)]\}]$$

$$6. -2a + (-3a + b) \\ = -[2a - (-3a + b)]$$

$$7. 2x^2 + 3xy - (y^2 + xy) + (-x^2 + y^2) \\ = -[-2x^2 - 3xy + (y^2 + xy) - (-x^2 + y^2)]$$

$$8. x^3 - [-3x^2 + 4x - 2] \\ = -\{x^3 + [-3x^2 + 4x - 2]\}$$

$$9. [m^4 - (3m^2 + 2m + 3)] + (-2m + 3) \\ = -\{-[m^4 - (3m^2 + 2m + 3)] - (-2m + 3)\}$$

## EJERCICIO 35

$$1. 2 \cdot -3 = -6$$

$$2. -4 \cdot -8 = 32$$

$$3. -15 \cdot 16 = -240$$

$$4. ab \cdot -ab = -a^{1+1}b^{1+1} = -a^2b^2$$

$$5. 2x^2 \cdot -3x = -6x^{2+1} = -6x^3$$

$$6. -4a^2b \cdot -ab^2 = 4a^{2+1}b^{1+2} = 4a^3b^3$$

$$7. -5x^3y \cdot xy^2 = -5x^{3+1}y^{1+2} = -5x^4y^3$$

$$8. a^2b^3 \cdot 3a^2x = 3a^{2+2}b^3x = 3a^4b^3x$$

$$9. -4m^2 \cdot -5mn^2p = 20m^{2+1}n^2p = 20m^3n^2p$$

$$10. 5a^2y \cdot -6x^2 = -30a^2x^2y$$

$$11. -x^2y^3 \cdot -4y^3z^4 = 4x^2y^{3+3}z^4 = 4x^2y^6z^4$$

$$12. abc \cdot cd = abc^{1+1}d = abc^2d$$

$$13. -15x^4y^3 \cdot -16a^2x^3 = 240a^2x^{4+3}y^3 = 240a^2x^7y^3$$

$$14. 3a^2b^3 \cdot -4x^2y = -12a^2b^3x^2y$$

$$15. 3a^2bx \cdot 7b^3x^5 = 21a^2b^{1+3}x^{1+5} = 21a^2b^4x^6$$

$$16. -8n^2n^3 \cdot -9a^2mx^4 = 72a^2m^{2+1}n^3x^4 = 72a^2m^3n^3x^4$$

$$17. a^m b^n \cdot -ab = -a^{m+1}b^{n+1}$$

$$18. -5a^m b^n \cdot -6a^2 b^3 x = 30a^{m+2}b^{n+3}x$$

$$19. x^m y^n c \cdot -x^m y^n c^x = -x^{m+m}y^{n+n}c^{1+x} = -x^{2m}y^{2n}c^{1+x}$$

$$20. -m^x n^a \cdot -6m^2 n = 6m^{x+2}n^{a+1}$$

## EJERCICIO 36

$$1. a^m \cdot a^{m+1} = a^{m+m+1} = a^{2m+1}$$

$$2. -x^a \cdot -x^{a+2} = x^{a+a+2} = x^{2a+2}$$

$$3. 4a^n b^x \cdot -ab^{x+1} = -4a^{n+1}b^{x+x+1} = -4a^{n+1}b^{2x+1}$$

$$4. -a^{n+1}b^{n+2} \cdot a^{n+2}b^n = -a^{n+1+n+2}b^{n+2+n} = -a^{2n+3}b^{2n+2}$$

$$5. -3a^{n+4}b^{n+1} \cdot -4a^{n+2}b^{n+3} = 12a^{2n+6}b^{2n+4}$$

$$6. 3x^2y^3 \cdot 4x^{m+1}y^{m+2} = 12x^{2+m+1}y^{3+m+2} = 12x^{m+3}y^{m+5}$$

$$7. 4x^{a+2}b^{a+4} \cdot -5x^{a+5}b^{a+1} = -20x^{2a+7}b^{2a+5}$$

$$8. a^m b^n c \cdot -a^m b^{2n} = -a^{m+m}b^{n+2n}c = -a^{2m}b^{3n}c$$

$$9. -x^{m+1}y^{a+2} \cdot -4x^{m-3}y^{a-5}c^2 = 4x^{2m-2}y^{2a-3}c^2$$

$$10. -5m^a n^{b-1}c \cdot -7m^{2a-3}n^{b-4} = 35m^{3a-3}n^{2b-5}c$$

## EJERCICIO 37

$$1. \frac{1}{2}a^2 \cdot \frac{4}{5}a^3b = \frac{1}{2} \cdot \frac{4}{5}a^5b = \frac{4}{10}a^5b = \frac{2}{5}a^5b$$

$$2. -\frac{3}{7}m^2n \cdot -\frac{7}{14}a^2m^3 \\ = -\frac{3}{7} \cdot -\frac{7}{14}a^2m^5n = \frac{21}{98}a^2m^5n = \frac{3}{14}a^2m^5n$$

$$3. \frac{2}{3}x^2y^3 \cdot -\frac{3}{5}a^2x^4y = -\frac{6}{15}a^2x^6y^4 = -\frac{2}{5}a^2x^6y^4$$

$$4. -\frac{1}{8}m^3n^4 \cdot -\frac{4}{5}a^3m^2n = \frac{4}{40}a^3m^5n^5 = \frac{1}{10}a^3m^5n^5$$

$$5. -\frac{7}{8}abc \cdot \frac{2}{7}a^3 = -\frac{14}{56}a^4bc = -\frac{1}{4}a^4bc$$

$$6. -\frac{3}{5}x^3y^4 \cdot -\frac{5}{6}a^2by^5 = \frac{3}{6}a^2bx^3y^9 = \frac{1}{2}a^2bx^3y^9$$

$$7. \frac{1}{3}a \cdot \frac{3}{5}a^m = \frac{3}{15}a^{m+1} = \frac{1}{5}a^{m+1}$$

$$8. -\frac{3}{4}a^m \cdot -\frac{2}{5}ab^3 = \frac{3}{2} \cdot \frac{1}{5}a^{m+1}b^3 = \frac{3}{10}a^{m+1}b^3$$

$$9. \frac{5}{6}a^mb^n \cdot -\frac{3}{10}ab^2c \\ = -\frac{1}{2} \cdot \frac{1}{2}a^{m+1}b^{n+2}c = -\frac{1}{4}a^{m+1}b^{n+2}c$$

$$10. -\frac{2}{9}a^xb^{m+1} \cdot -\frac{3}{5}a^{x-1}b^m \\ = \frac{2}{3} \cdot \frac{1}{5}a^{2x-1}b^{2m+1} = \frac{2}{15}a^{2x-1}b^{2m+1}$$

$$11. \frac{3}{8}a^mb^n \cdot -\frac{4}{5}a^2mb^n = -\frac{12}{40}a^3mb^{2n} = -\frac{3}{10}a^3mb^{2n}$$

$$12. -\frac{2}{11}a^{x+1}b^{x-3}c^2 \cdot -\frac{44}{7}a^{x-3}b^2 \\ = 2 \cdot \frac{4}{7}a^{2x-2}b^{x-1}c^2 = \frac{8}{7}a^{2x-2}b^{x-1}c^2$$

## EJERCICIO 38

$$1. a \cdot -3a \cdot a^2 = -3a^{1+1+2} = -3a^4$$

$$2. 3x^2 \cdot -x^3y \cdot -a^2x = 3a^2x^{2+3+1}y = 3a^2x^6y$$

$$3. -m^2n \cdot -3m^2 \cdot -5mn^3 = -15m^{2+2+1}n^{1+3} = -15m^5n^4$$

$$4. 4a^2 \cdot -5a^3x^2 \cdot -ay^2 = 20a^{2+3+1}x^2y^2 = 20a^6x^2y^2$$

$$5. -a^m \cdot -2ab \cdot -3a^2b^x = -6a^{m+1+2}b^{1+x} = -6a^{m+3}b^{x+1}$$

$$6. \frac{1}{2}x^3 \cdot -\frac{2}{3}a^2x \cdot -\frac{3}{5}a^4m = \frac{6}{30}a^{2+4}x^{3+1}m = \frac{1}{5}a^6x^4m$$

$$7. \frac{2}{3}a^m \cdot \frac{3}{4}a^2b^4 \cdot -3a^4b^{x+1} \\ = -\frac{18}{12}a^{m+2+4}b^{4+x+1} = -\frac{3}{2}a^{m+6}b^{x+5}$$

$$8. -\frac{3}{5}m^3 \cdot -5a^2m \cdot -\frac{1}{10}a^xm^a \\ = -\frac{15}{50}a^{2+x}m^{3+1+a} = -\frac{3}{10}a^{x+2}m^{a+4}$$

$$9. 2a \cdot -a^2 \cdot -3a^3 \cdot 4a = 24a^{1+2+3+1} = 24a^7$$

$$10. -3b^2 \cdot -4a^3b \cdot ab \cdot -5a^2x \\ = -60a^{3+1+2}b^{2+1+1}x = -60a^6b^4x$$

$$11. a^mb^x \cdot -a^2 \cdot -2ab \cdot -3a^2x \\ = -6a^{m+2+1+2}b^{x+1}x = -6a^{m+5}b^{x+1}x$$

$$12. -\frac{1}{2}x^2y \cdot -\frac{3}{5}xy^2 \cdot -\frac{10}{3}x^3 \cdot -\frac{3}{4}x^2y \\ = \frac{6}{8}x^{2+1+3+2}y^{1+2+1} = \frac{3}{4}x^8y^4$$

## EJERCICIO 39

$$1. \frac{3x^3 - x^2}{-2x} \\ = \frac{-6x^4 + 2x^3}{-2x}$$

$$2. \frac{8x^2y - 3y^2}{2ax^3} \\ = \frac{16ax^5y - 6ax^3y^2}{16ax^5y - 6ax^3y^2}$$

$$3. \frac{x^2 - 4x + 3}{-2x} \\ = \frac{-2x^3 + 8x^2 - 6x}{-2x^3 + 8x^2 - 6x}$$

$$4. \frac{a^3 - 4a^2 + 6a}{3ab} \\ = \frac{3a^4b - 12a^3b + 18a^2b}{3a^4b - 12a^3b + 18a^2b}$$

$$5. \frac{a^2 - 2ab + b^2}{-ab} \\ \frac{-a^3b + 2a^2b^2 - ab^3}{-a^3b + 2a^2b^2 - ab^3}$$

$$6. \frac{x^5 - 6x^3 - 8x}{3a^2x^2} \\ \frac{3a^2x^7 - 18a^2x^5 - 24a^2x^3}{3a^2x^7 - 18a^2x^5 - 24a^2x^3}$$

$$7. \frac{m^4 - 3m^2n^2 + 7n^4}{-4m^3x} \\ \frac{-4m^7x + 12m^5n^2x - 28m^3n^4x}{-4m^7x + 12m^5n^2x - 28m^3n^4x}$$

$$8. \frac{x^3 - 4x^2y + 6xy^2}{ax^3y} \\ \frac{ax^6y - 4ax^5y^2 + 6ax^4y^3}{ax^6y - 4ax^5y^2 + 6ax^4y^3}$$

$$9. \frac{a^3 - 5a^2b - 8ab^2}{-4a^4m^2} \\ \frac{-4a^7m^2 + 20a^6bm^2 + 32a^5b^2m^2}{-4a^7m^2 + 20a^6bm^2 + 32a^5b^2m^2}$$

$$10. \frac{a^m - a^{m-1} + a^{m-2}}{-2a} \\ \frac{-2a^{m+1} + 2a^{m-1+1} - 2a^{m-2+1}}{-2a^{m+1} + 2a^m - 2a^{m-1}}$$

$$11. \frac{x^{m+1} + 3x^m - x^{m-1}}{3x^{2m}} \\ \frac{3x^{3m+1} + 9x^{3m} - 3x^{3m-1}}{3x^{3m+1} + 9x^{3m} - 3x^{3m-1}}$$

$$12. \frac{a^m b^n + a^{m-1} b^{n+1} - a^{m-2} b^{n+2}}{3a^2 b} \\ \frac{3a^{m+2} b^{n+1} + 3a^{m+1} b^{n+2} - 3a^m b^{n+3}}{3a^{m+2} b^{n+1} + 3a^{m+1} b^{n+2} - 3a^m b^{n+3}}$$

$$13. \frac{x^3 - 3x^2 + 5x - 6}{-4x^2} \\ \frac{-4x^5 + 12x^4 - 20x^3 + 24x^2}{-4x^5 + 12x^4 - 20x^3 + 24x^2}$$

$$14. \frac{a^4 - 6a^3x + 9a^2x^2 - 8}{3bx^3} \\ \frac{3a^4bx^3 - 18a^3bx^4 + 27a^2bx^5 - 24bx^8}{3a^4bx^3 - 18a^3bx^4 + 27a^2bx^5 - 24bx^8}$$

$$15. \frac{a^{n+3} - 3a^{n+2} - 4a^{n+1} - a^n}{-a^n x^2} \\ \frac{-a^{2n+3}x^2 + 3a^{2n+2}x^2 + 4a^{2n+1}x^2 + a^{2n}x^2}{-a^{2n+3}x^2 + 3a^{2n+2}x^2 + 4a^{2n+1}x^2 + a^{2n}x^2}$$

$$16. \frac{x^4 - 6x^3 + 8x^2 - 7x + 5}{-3a^2x^3} \\ \frac{-3a^2x^7 + 18a^2x^6 - 24a^2x^5 + 21a^2x^4 - 15a^2x^3}{-3a^2x^7 + 18a^2x^6 - 24a^2x^5 + 21a^2x^4 - 15a^2x^3}$$

$$17. \frac{-3x^3 + 5x^2y - 7xy^2 - 4y^3}{5a^2xy^2} \\ \frac{-15a^2x^4y^2 + 25a^2x^3y^3 - 35a^2x^2y^4 - 20a^2xy^5}{-15a^2x^4y^2 + 25a^2x^3y^3 - 35a^2x^2y^4 - 20a^2xy^5}$$

$$18. \frac{x^{a+5} - 3x^{a+4} + x^{a+3} - 5x^{a+1}}{-2x^2} \\ \frac{-2x^{a+7} + 6x^{a+6} - 2x^{a+5} + 10x^{a+3}}{-2x^{a+7} + 6x^{a+6} - 2x^{a+5} + 10x^{a+3}}$$

$$19. \frac{a^8 - 3a^6b^2 + a^4b^4 - 3a^2b^6 + b^8}{-5a^3y^2} \\ \frac{-5a^{11}y^2 + 15a^9b^2y^2 - 5a^7b^4y^2 + 15a^5b^6y^2 - 5a^3b^8y^2}{-5a^{11}y^2 + 15a^9b^2y^2 - 5a^7b^4y^2 + 15a^5b^6y^2 - 5a^3b^8y^2}$$

$$20. \frac{a^m b^n + 3a^{m-1} b^{n+2} - a^{m-2} b^{n+4} + a^{m-3} b^{n+6}}{4a^m b^3} \\ \frac{4a^{2m} b^{n+3} + 12a^{2m-1} b^{n+5} - 4a^{2m-2} b^{n+7} + 4a^{2m-3} b^{n+9}}{4a^{2m} b^{n+3} + 12a^{2m-1} b^{n+5} - 4a^{2m-2} b^{n+7} + 4a^{2m-3} b^{n+9}}$$

## EJERCICIO 40

$$1. \frac{\frac{1}{2}a - \frac{2}{3}b}{\frac{2}{5}a^2} \\ \frac{\frac{2}{10}a^{1+2} - \frac{4}{15}a^2b}{\frac{2}{10}a^{1+2} - \frac{4}{15}a^2b} \\ = \frac{1}{5}a^3 - \frac{4}{15}a^2b$$

$$2. \frac{\frac{2}{3}a - \frac{3}{4}b}{-\frac{2}{3}a^3b} \\ \frac{-\frac{4}{9}a^{3+1}b + \frac{6}{12}a^3b^{1+1}}{-\frac{4}{9}a^4b + \frac{1}{2}a^3b^2} \\ = -\frac{4}{9}a^4b + \frac{1}{2}a^3b^2$$

$$3. \frac{\frac{3}{5}a - \frac{1}{6}b + \frac{2}{5}c}{-\frac{5}{3}ac^2} \\ \frac{-\frac{15}{15}a^{1+1}c^2 + \frac{5}{18}abc^2 - \frac{10}{15}ac^{2+1}}{-\frac{15}{15}a^{1+1}c^2 + \frac{5}{18}abc^2 - \frac{10}{15}ac^{2+1}} \\ = -a^2c^2 + \frac{5}{18}abc^2 - \frac{2}{3}ac^3$$

$$4. \frac{\frac{2}{5}a^2 + \frac{1}{3}ab - \frac{2}{9}b^2}{3a^2x} \\ \frac{\frac{6}{5}a^{2+2}x + \frac{3}{3}a^{2+1}bx - \frac{6}{9}a^2b^2x}{\frac{6}{5}a^{2+2}x + \frac{3}{3}a^{2+1}bx - \frac{6}{9}a^2b^2x} \\ = \frac{6}{5}a^4x + a^3bx - \frac{2}{3}a^2b^2x$$



$$5. \frac{1}{3}x^2 - \frac{2}{5}xy - \frac{1}{4}y^2$$

$$\frac{3}{2}y^3$$

$$\frac{3}{6}x^2y^3 - \frac{6}{10}xy^{3+1} - \frac{3}{8}y^{2+3}$$

$$= \frac{1}{2}x^2y^3 - \frac{3}{5}xy^4 - \frac{3}{8}y^5$$

$$6. 3a - 5b + 6c$$

$$-\frac{3}{10}a^2x^3$$

$$-\frac{9}{10}a^{2+1}x^3 + \frac{15}{10}a^2bx^3 - \frac{18}{10}a^2cx^3$$

$$= -\frac{9}{10}a^3x^3 + \frac{3}{2}a^2bx^3 - \frac{9}{5}a^2cx^3$$

$$7. \frac{2}{9}x^4 - x^2y^2 + \frac{1}{3}y^4$$

$$\frac{3}{7}x^3y^4$$

$$\frac{6}{63}x^{4+3}y^4 - \frac{3}{7}x^{2+3}y^{2+4} + \frac{3}{21}x^3y^{4+4}$$

$$= \frac{2}{21}x^7y^4 - \frac{3}{7}x^5y^6 + \frac{1}{7}x^3y^8$$

$$\frac{1}{2}a^2 - \frac{1}{3}b^2 + \frac{1}{4}x^2 - \frac{1}{5}y^2$$

$$-\frac{5}{8}a^2m$$

$$8. -\frac{5}{16}a^{2+2}m + \frac{5}{24}a^2b^2m - \frac{5}{32}a^2mx^2 + \frac{5}{40}a^2my^2$$

$$= -\frac{5}{16}a^4m + \frac{5}{24}a^2b^2m - \frac{5}{32}a^2mx^2 + \frac{1}{8}a^2my^2$$

$$9. \frac{2}{3}m^3 + \frac{1}{2}m^2n - \frac{5}{6}mn^2 - \frac{1}{9}n^3$$

$$\frac{3}{4}m^2n^3$$

$$\frac{6}{12}m^{3+2}n^3 + \frac{3}{8}m^{2+2}n^{1+3} - \frac{15}{24}m^{1+2}n^{2+3} - \frac{3}{36}m^2n^{3+3}$$

$$= \frac{1}{2}m^5n^3 + \frac{3}{8}m^4n^4 - \frac{5}{8}m^3n^5 - \frac{1}{12}m^2n^6$$

$$\frac{2}{5}x^6 - \frac{1}{3}x^4y^2 + \frac{3}{5}x^2y^4 - \frac{1}{10}y^6$$

$$-\frac{5}{7}a^3x^4y^3$$

$$10. -\frac{10}{35}a^3x^{6+4}y^3 + \frac{5}{21}a^3x^{4+4}y^{2+3} - \frac{15}{35}a^3x^{2+4}y^{4+3} + \frac{5}{70}a^3x^4y^{6+3}$$

$$= -\frac{2}{7}a^3x^{10}y^3 + \frac{5}{21}a^3x^8y^5 - \frac{3}{7}a^3x^6y^7 + \frac{1}{14}a^3x^4y^9$$

## EJERCICIO 41

$$1. a+3$$

$$a-1$$

$$\frac{a^2+3a}{-a-3}$$

$$\frac{a^2+2a-3}{a^2+2a-3}$$

$$3. x+5$$

$$x-4$$

$$\frac{x^2+5x}{-4x-20}$$

$$\frac{x^2+x-20}{x^2+x-20}$$

$$5. -x+3$$

$$-x+5$$

$$\frac{x^2-3x}{-5x+15}$$

$$\frac{x^2-8x+15}{x^2-8x+15}$$

$$7. 3x-2y$$

$$2x+y$$

$$\frac{6x^2-4xy}{+3xy-2y^2}$$

$$\frac{6x^2-xy-2y^2}{6x^2-xy-2y^2}$$

$$2. a-3$$

$$a+1$$

$$\frac{a^2-3a}{a-3}$$

$$\frac{a^2-2a-3}{a^2-2a-3}$$

$$4. m-6$$

$$m-5$$

$$\frac{m^2-6m}{-5m+30}$$

$$\frac{m^2-11m+30}{m^2-11m+30}$$

$$6. -a-2$$

$$-a-3$$

$$\frac{a^2+2a}{+3a+6}$$

$$\frac{a^2+5a+6}{a^2+5a+6}$$

$$8. 5x-4y$$

$$-3x+2y$$

$$\frac{-15x^2+12xy}{+10xy-8y^2}$$

$$\frac{-15x^2+22xy-8y^2}{-15x^2+22xy-8y^2}$$

$$\begin{array}{r}
 9. \quad 5a-7b \\
 \quad a+3b \\
 \hline
 5a^2-7ab \\
 \quad +15ab-21b^2 \\
 \hline
 5a^2+8ab-21b^2
 \end{array}$$

$$\begin{array}{r}
 10. \quad 7x-3 \\
 \quad 2x+4 \\
 \hline
 14x^2-6x \\
 \quad +28x-12 \\
 \hline
 14x^2+22x-12
 \end{array}$$

$$\begin{array}{r}
 11. \quad -a+b \\
 \quad 8a-4b \\
 \hline
 -8a^2+8ab \\
 \quad +4ab-4b^2 \\
 \hline
 -8a^2+12ab-4b^2
 \end{array}$$

$$\begin{array}{r}
 12. \quad 6m-5n \\
 \quad m-n \\
 \hline
 6m^2-5mn \\
 \quad -6mn+5n^2 \\
 \hline
 6m^2-11mn+5n^2
 \end{array}$$

$$\begin{array}{r}
 13. \quad -9m+8n \\
 \quad 6m+4n \\
 \hline
 -54m^2+48mn \\
 \quad -36mn+32n^2 \\
 \hline
 -54m^2+12mn+32n^2
 \end{array}$$

$$\begin{array}{r}
 14. \quad -7y-3 \\
 \quad 2y-11 \\
 \hline
 -14y^2-6y \\
 \quad +77y+33 \\
 \hline
 -14y^2+71y+33
 \end{array}$$

## EJERCICIO 42

$$\begin{array}{r}
 1. \quad x^2+xy+y^2 \\
 \quad x-y \\
 \hline
 x^3+x^2y+xy^2 \\
 \quad -x^2y-xy^2-y^3 \\
 \hline
 x^3 \qquad \qquad -y^3
 \end{array}$$

$$\begin{array}{r}
 2. \quad a^2-2ab+b^2 \\
 \quad a-b \\
 \hline
 a^3-2a^2b+ab^2 \\
 \quad -a^2b+2ab^2-b^3 \\
 \hline
 a^3-3a^2b+3ab^2-b^3
 \end{array}$$

$$\begin{array}{r}
 3. \quad a^2+2ab+b^2 \\
 \quad a+b \\
 \hline
 a^3+2a^2b+ab^2 \\
 \quad +a^2b+2ab^2+b^3 \\
 \hline
 a^3+3a^2b+3ab^2+b^3
 \end{array}$$

$$\begin{array}{r}
 4. \quad x^3-3x^2+1 \\
 \quad x+3 \\
 \hline
 x^4-3x^3 \quad +x \\
 \quad +3x^3-9x^2 \quad +3 \\
 \hline
 x^4 \quad -9x^2+x+3
 \end{array}$$

$$\begin{array}{r}
 5. \quad a^3+a^2-a \\
 \quad a-1 \\
 \hline
 a^4+a^3-a^2 \\
 \quad -a^3-a^2+a \\
 \hline
 a^4 \quad -2a^2+a
 \end{array}$$

$$\begin{array}{r}
 6. \quad m^4+m^2n^2+n^4 \\
 \quad m^2-n^2 \\
 \hline
 m^6+m^4n^2+n^2n^4 \\
 \quad -m^4n^2-n^2n^4-n^6 \\
 \hline
 m^6 \qquad \qquad -n^6
 \end{array}$$

$$\begin{array}{r}
 7. \quad x^3-2x^2+3x-1 \\
 \quad 2x+3 \\
 \hline
 2x^4-4x^3+6x^2-2x \\
 \quad +3x^3-6x^2+9x-3 \\
 \hline
 2x^4-x^3 \quad +7x-3
 \end{array}$$

$$\begin{array}{r}
 9. \quad 3y^3-6y+5 \\
 \quad y^2+2 \\
 \hline
 3y^5-6y^3+5y^2 \\
 \quad +6y^3 \quad -12y+10 \\
 \hline
 3y^5 \quad +5y^2-12y+10
 \end{array}$$

$$\begin{array}{r}
 9. \quad m^3-m^2+m-2 \\
 \quad am+a \\
 \hline
 am^4-am^3+am^2-2am \\
 \quad +am^3-am^2+am-2a \\
 \hline
 am^4 \qquad \qquad -am-2a
 \end{array}$$

$$\begin{array}{r}
 10. \quad 3a^2-5ab+2b^2 \\
 \quad 4a-5b \\
 \hline
 12a^3-20a^2b+8ab^2 \\
 \quad -15a^2b+25ab^2-10b^3 \\
 \hline
 12a^3-35a^2b+33ab^2-10b^3
 \end{array}$$

$$\begin{array}{r}
 11. \quad 5m^4-3m^2n^2+n^4 \\
 \quad 3m-n \\
 \hline
 15m^5 \quad -9m^3n^2 \quad +3mn^4 \\
 \quad -5m^4n \quad +3m^2n^3 \quad -n^5 \\
 \hline
 15m^5-5m^4n-9m^3n^2+3m^2n^3+3mn^4-n^5
 \end{array}$$

$$\begin{array}{r}
 12. \quad a^2+a+1 \\
 \quad a^2-a-1 \\
 \hline
 a^4+a^3+a^2 \\
 \quad -a^3-a^2-a \\
 \hline
 \quad -a^2-a-1 \\
 \hline
 a^4 \quad -a^2-2a-1
 \end{array}$$

$$\begin{array}{r}
 13. \quad x^3 + 2x^2 - x \\
 \quad x^2 - 2x + 5 \\
 \hline
 x^5 + 2x^4 - x^3 \\
 \quad - 2x^4 - 4x^3 + 2x^2 \\
 \quad \quad + 5x^3 + 10x^2 - 5x \\
 \hline
 x^5 \quad \quad + 12x^2 - 5x
 \end{array}$$

$$\begin{array}{r}
 14. \quad m^3 - 3m^2n + 2mn^2 \\
 \quad m^2 - 2mn - 8n^2 \\
 \hline
 m^5 - 3m^4n + 2m^3n^2 \\
 \quad - 2m^4n + 6m^3n^2 - 4m^2n^3 \\
 \quad \quad - 8m^3n^2 + 24m^2n^3 - 16mn^4 \\
 \hline
 m^5 - 5m^4n \quad \quad + 20m^2n^3 - 16mn^4
 \end{array}$$

$$\begin{array}{r}
 15. \quad x^2 + x + 1 \\
 \quad x^2 - x - 1 \\
 \hline
 x^4 + x^3 + x^2 \\
 \quad - x^3 - x^2 - x \\
 \quad \quad - x^2 - x - 1 \\
 \hline
 x^4 \quad - x^2 - 2x - 1
 \end{array}$$

$$\begin{array}{r}
 16. \quad x^4 - 3x^2 + 2 \\
 \quad x^2 - 2x + 3 \\
 \hline
 x^6 \quad - 3x^4 \quad + 2x^2 \\
 \quad - 2x^5 \quad + 6x^3 \quad - 4x \\
 \quad \quad + 3x^4 \quad - 9x^2 \quad + 6 \\
 \hline
 x^6 - 2x^5 \quad + 6x^3 - 7x^2 - 4x + 6
 \end{array}$$

$$\begin{array}{r}
 17. \quad m^3 + m^2 - 4m - 1 \\
 \quad m^3 + 1 \\
 \hline
 m^6 + m^5 - 4m^4 - m^3 \\
 \quad \quad + m^3 + m^2 - 4m - 1 \\
 \hline
 m^6 + m^5 - 4m^4 \quad + m^2 - 4m - 1
 \end{array}$$

$$\begin{array}{r}
 18. \quad a^3 - 5a + 2 \\
 \quad a^2 - a + 5 \\
 \hline
 a^5 \quad - 5a^3 + 2a^2 \\
 \quad - a^4 \quad + 5a^2 - 2a \\
 \quad \quad + 5a^3 \quad - 25a + 10 \\
 \hline
 a^5 - a^4 \quad + 7a^2 - 27a + 10
 \end{array}$$

$$\begin{array}{r}
 19. \quad x^2 - 2xy + y^2 \\
 \quad - x^2 + xy + 3y^2 \\
 \hline
 -x^4 + 2x^3y - x^2y^2 \\
 \quad + x^3y - 2x^2y^2 + xy^3 \\
 \quad \quad + 3x^2y^2 - 6xy^3 + 3y^4 \\
 \hline
 -x^4 + 3x^3y \quad - 5xy^3 + 3y^4
 \end{array}$$

$$\begin{array}{r}
 20. \quad n^2 - 2n + 1 \\
 \quad n^2 - 1 \\
 \hline
 n^4 - 2n^3 + n^2 \\
 \quad \quad - n^2 + 2n - 1 \\
 \hline
 n^4 - 2n^3 \quad + 2n - 1
 \end{array}$$

$$\begin{array}{r}
 21. \quad a^3 - 3a^2b + 4ab^2 \\
 \quad a^2b - 2ab^2 - 10b^3 \\
 \hline
 a^5b - 3a^4b^2 + 4a^3b^3 \\
 \quad - 2a^4b^2 + 6a^3b^3 - 8a^2b^4 \\
 \quad \quad - 10a^3b^3 + 30a^2b^4 - 40ab^5 \\
 \hline
 a^5b - 5a^4b^2 \quad + 22a^2b^4 - 40ab^5
 \end{array}$$

$$\begin{array}{r}
 22. \quad 8x^3 - 12x^2y + 6xy^2 - 9y^3 \\
 \quad 2x + 3y \\
 \hline
 16x^4 - 24x^3y + 12x^2y^2 - 18xy^3 \\
 \quad + 24x^3y - 36x^2y^2 + 18xy^3 - 27y^4 \\
 \hline
 16x^4 \quad - 24x^2y^2 \quad - 27y^4
 \end{array}$$

$$\begin{array}{r}
 23. \quad 2y^3 - 3y^2 + y - 4 \\
 \quad 2y + 5 \\
 \hline
 4y^4 - 6y^3 + 2y^2 - 8y \\
 \quad + 10y^3 - 15y^2 + 5y - 20 \\
 \hline
 4y^4 + 4y^3 - 13y^2 - 3y - 20
 \end{array}$$

$$\begin{array}{r}
 24. \quad -a^3 + 2ax^2 + 3x^3 \\
 \quad 2a^2 - 3ax - x^2 \\
 \hline
 -2a^5 \quad + 4a^3x^2 + 6a^2x^3 \\
 \quad + 3a^4x \quad - 6a^2x^3 - 9ax^4 \\
 \quad \quad + a^3x^2 \quad - 2ax^4 - 3x^5 \\
 \hline
 -2a^5 + 3a^4x + 5a^3x^2 \quad - 11ax^4 - 3x^5
 \end{array}$$

$$\begin{array}{r}
 25. \quad x^4 - 3x^3y + 2x^2y^2 + xy^3 \\
 \quad -x^2 - xy - y^2 \\
 \hline
 -x^6 + 3x^5y - 2x^4y^2 - x^2y^3 \\
 \quad -x^5y + 3x^4y^2 - 2x^3y^3 - x^2y^4 \\
 \quad \quad -x^4y^2 + 3x^3y^3 - 2x^2y^4 - xy^5 \\
 \hline
 -x^6 + 2x^5y \qquad \qquad -3x^2y^4 - xy^5
 \end{array}$$

$$\begin{array}{r}
 30. \quad y^2 - 2y + 1 \\
 \quad y^4 - 2y^2 + 2 \\
 \hline
 y^6 - 2y^5 + y^4 \\
 \quad -2y^4 + 4y^3 - 2y^2 \\
 \quad \quad + 2y^2 - 4y + 2 \\
 \hline
 y^6 - 2y^5 - y^4 + 4y^3 \qquad -4y + 2
 \end{array}$$

$$\begin{array}{r}
 26. \quad a^3 - 5a^2 + 2a - 3 \\
 \quad a^3 - 2a - 7 \\
 \hline
 a^6 - 5a^5 + 2a^4 - 3a^3 \\
 \quad -2a^4 + 10a^3 - 4a^2 + 6a \\
 \quad \quad -7a^3 + 35a^2 - 14a + 21 \\
 \hline
 a^6 - 5a^5 \qquad \quad + 31a^2 - 8a + 21
 \end{array}$$

$$\begin{array}{r}
 31. \quad m^4 - 3m^2 + 4 \\
 \quad 3m^3 - 2m + 1 \\
 \hline
 3m^7 - 9m^5 \qquad \quad + 12m^3 \\
 \quad -2m^5 \qquad \quad + 6m^3 \qquad \quad - 8m \\
 \quad \quad + m^4 \qquad \quad - 3m^2 \qquad \quad + 4 \\
 \hline
 3m^7 - 11m^5 + m^4 + 18m^3 - 3m^2 - 8m + 4
 \end{array}$$

$$\begin{array}{r}
 27. \quad m^4 + m^3 - m^2 + 3 \\
 \quad m^2 - 2m + 3 \\
 \hline
 m^6 + m^5 - m^4 \qquad \quad + 3m^2 \\
 \quad -2m^5 - 2m^4 + 2m^3 \qquad \quad - 6m \\
 \quad \quad + 3m^4 + 3m^3 - 3m^2 \qquad \quad + 9 \\
 \hline
 m^6 - m^5 \qquad \quad + 5m^3 \qquad \quad - 6m + 9
 \end{array}$$

$$\begin{array}{r}
 32. \quad a^3 + a^2 - a + 1 \\
 \quad a^3 + a^2 - 2a - 1 \\
 \hline
 a^6 + a^5 - a^4 \qquad \quad + a^3 \\
 \quad + a^5 + a^4 - a^3 + a^2 \\
 \quad \quad - 2a^4 - 2a^3 + 2a^2 - 2a \\
 \quad \quad \quad - a^3 - a^2 + a - 1 \\
 \hline
 a^6 + 2a^5 - 2a^4 - 3a^3 + 2a^2 - a - 1
 \end{array}$$

$$\begin{array}{r}
 28. \quad a^4 + a^3b - 3a^2b^2 - ab^3 + b^4 \\
 \quad a^2 - 2ab + b^2 \\
 \hline
 a^6 + a^5b - 3a^4b^2 - a^3b^3 + a^2b^4 \\
 \quad -2a^5b - 2a^4b^2 + 6a^3b^3 + 2a^2b^4 - 2ab^5 \\
 \quad \quad + a^4b^2 + a^3b^3 - 3a^2b^4 - ab^5 + b^6 \\
 \hline
 a^6 - a^5b - 4a^4b^2 + 6a^3b^3 \qquad -3ab^5 + b^6
 \end{array}$$

$$\begin{array}{r}
 33. \quad 8x^3 - 12x^2y - 6xy^2 + y^3 \\
 \quad 3x^2 - 2xy + 4y^2 \\
 \hline
 24x^5 - 36x^4y - 18x^3y^2 + 3x^2y^3 \\
 \quad -16x^4y + 24x^3y^2 + 12x^2y^3 - 2xy^4 \\
 \quad \quad + 32x^3y^2 - 48x^2y^3 - 24xy^4 + 4y^5 \\
 \hline
 24x^5 - 52x^4y + 38x^3y^2 - 33x^2y^3 - 26xy^4 + 4y^5
 \end{array}$$

$$\begin{array}{r}
 29. \quad x^4 - x^3y + x^2y^2 - xy^3 + y^4 \\
 \quad x^2 + xy - 2y^2 \\
 \hline
 x^6 - x^5y + x^4y^2 - x^3y^3 + x^2y^4 \\
 \quad + x^5y - x^4y^2 + x^3y^3 - x^2y^4 + xy^5 \\
 \quad \quad - 2x^4y^2 + 2x^3y^3 - 2x^2y^4 + 2xy^5 - 2y^6 \\
 \hline
 x^6 \qquad - 2x^4y^2 + 2x^3y^3 - 2x^2y^4 + 3xy^5 - 2y^6
 \end{array}$$

$$\begin{array}{r}
 34. \quad 5a^4 - 4a^3 + 2a^2 - 3a - 1 \\
 \quad a^4 - 2a^2 + 2 \\
 \hline
 5a^8 - 4a^7 + 2a^6 - 3a^5 - a^4 \\
 \quad -10a^6 + 8a^5 - 4a^4 + 6a^3 + 2a^2 \\
 \quad \quad + 10a^4 - 8a^3 + 4a^2 - 6a - 2 \\
 \hline
 5a^8 - 4a^7 - 8a^6 + 5a^5 + 5a^4 - 2a^3 + 6a^2 - 6a - 2
 \end{array}$$

$$\begin{array}{r}
 35. \quad x^4 - x^3 + x^2 - x + 1 \\
 \quad x^3 - 2x^2 + 3x + 6 \\
 \hline
 x^7 - x^6 + x^5 - x^4 + x^3 \\
 \quad - 2x^6 + 2x^5 - 2x^4 + 2x^3 - 2x^2 \\
 \quad \quad + 3x^5 - 3x^4 + 3x^3 - 3x^2 + 3x \\
 \quad \quad \quad + 6x^4 - 6x^3 + 6x^2 - 6x + 6 \\
 \hline
 x^7 - 3x^6 + 6x^5 \quad \quad + x^2 - 3x + 6
 \end{array}$$

$$\begin{array}{r}
 36. \quad 3a^3 + 2a^2 - 5a - 4 \\
 \quad a^3 + a^2 - 2a + 1 \\
 \hline
 3a^6 + 2a^5 - 5a^4 - 4a^3 \\
 \quad + 3a^5 + 2a^4 - 5a^3 - 4a^2 \\
 \quad \quad - 6a^4 - 4a^3 + 10a^2 + 8a \\
 \quad \quad \quad + 3a^3 + 2a^2 - 5a - 4 \\
 \hline
 3a^6 + 5a^5 - 9a^4 - 10a^3 + 8a^2 + 3a - 4
 \end{array}$$

$$\begin{array}{r}
 37. \quad 5y^4 - 3y^3 + 4y^2 + 2y \\
 \quad y^4 - 3y^2 - 1 \\
 \hline
 5y^8 - 3y^7 + 4y^6 + 2y^5 \\
 \quad - 15y^6 + 9y^5 - 12y^4 - 6y^3 \\
 \quad \quad - 5y^4 + 3y^3 - 4y^2 - 2y \\
 \hline
 5y^8 - 3y^7 - 11y^6 + 11y^5 - 17y^4 - 3y^3 - 4y^2 - 2y
 \end{array}$$

$$\begin{array}{r}
 38. \quad m^4 - 2m^3n + 3m^2n^2 - 4n^4 \\
 \quad - m^3 + 3m^2n - 5mn^2 + n^3 \\
 \hline
 -m^7 + 2m^6n - 3m^5n^2 + 4m^3n^4 \\
 \quad + 3m^6n - 6m^5n^2 + 9m^4n^3 - 12m^2n^5 \\
 \quad \quad - 5m^5n^2 + 10m^4n^3 - 15m^3n^4 + 20mn^6 \\
 \quad \quad \quad + m^4n^3 - 2m^3n^4 + 3m^2n^5 - 4n^7 \\
 \hline
 -m^7 + 5m^6n - 14m^5n^2 + 20m^4n^3 - 13m^3n^4 - 9m^2n^5 + 20mn^6 - 4n^7
 \end{array}$$

$$\begin{array}{r}
 39. \quad x^6 - 3x^4y^2 - x^2y^4 + y^6 \\
 \quad x^5 - 2x^3y^2 + 3xy^4 \\
 \hline
 x^{11} - 3x^9y^2 - x^7y^4 + x^5y^6 \\
 \quad - 2x^9y^2 + 6x^7y^4 + 2x^5y^6 - 2x^3y^8 \\
 \quad \quad + 3x^7y^4 - 9x^5y^6 - 3x^3y^8 + 3xy^{10} \\
 \hline
 x^{11} - 5x^9y^2 + 8x^7y^4 - 6x^5y^6 - 5x^3y^8 + 3xy^{10}
 \end{array}$$

$$\begin{array}{r}
 40. \quad 3a^5 - 6a^3 + 2a^2 - 3a + 2 \\
 \quad a^4 - 3a^2 + 4a - 5 \\
 \hline
 3a^9 - 6a^7 + 2a^6 - 3a^5 + 2a^4 \\
 \quad - 9a^7 + 18a^5 - 6a^4 + 9a^3 - 6a^2 \\
 \quad \quad + 12a^6 - 24a^4 + 8a^3 - 12a^2 + 8a \\
 \quad \quad \quad - 15a^5 + 30a^3 - 10a^2 + 15a - 10 \\
 \hline
 3a^9 - 15a^7 + 14a^6 - 28a^4 + 47a^3 - 28a^2 + 23a - 10
 \end{array}$$

$$\begin{array}{r}
 41. \quad a + b - c \\
 \quad a - b + c \\
 \hline
 a^2 + ab - ac \\
 \quad - ab \quad - b^2 + bc \\
 \quad \quad + ac \quad + bc - c^2 \\
 \hline
 a^2 \quad \quad - b^2 + 2bc - c^2
 \end{array}$$

$$\begin{array}{r}
 42. \quad x + 2y - z \\
 \quad x - y + z \\
 \hline
 x^2 + 2xy - xz \\
 \quad - xy \quad - 2y^2 + yz \\
 \quad \quad + xz \quad + 2yz - z^2 \\
 \hline
 x^2 + xy \quad - 2y^2 + 3yz - z^2
 \end{array}$$

$$\begin{array}{r}
 43. \quad 2x - 3y + 5z \\
 \quad - x + y + 2z \\
 \hline
 -2x^2 + 3xy - 5xz \\
 \quad + 2xy \quad - 3y^2 + 5yz \\
 \quad \quad + 4xz \quad - 6yz + 10z^2 \\
 \hline
 -2x^2 + 5xy - xz - 3y^2 - yz + 10z^2
 \end{array}$$

$$\begin{array}{r}
 44. \quad x^2 - xy - xz + y^2 - yz + z^2 \\
 \quad x + y + z \\
 \hline
 x^3 - x^2y - x^2z + xy^2 - xyz + xz^2 \\
 \quad + x^2y \quad - xy^2 - xyz \quad + y^3 - y^2z + yz^2 \\
 \quad \quad + x^2z \quad - xyz - xz^2 \quad + y^2z - yz^2 + z^3 \\
 \hline
 x^3 \quad \quad - 3xyz \quad + y^3 \quad \quad + z^3
 \end{array}$$

## EJERCICIO 43

1.  $a^{x+2} - a^{x+1} + a^x$

$$\frac{a+1}{a^{x+3} - a^{x+2} + a^{x+1}} + \frac{a^{x+2} - a^{x+1} + a^x}{a^{x+3} + a^x}$$

2.  $-x^{\eta+3} + 2x^{\eta+2} + x^{\eta+1}$

$$\frac{x^2 + x}{-x^{\eta+5} + 2x^{\eta+4} + x^{\eta+3}} - \frac{x^{\eta+4} + 2x^{\eta+3} + x^{\eta+2}}{-x^{\eta+5} + x^{\eta+4} + 3x^{\eta+3} + x^{\eta+2}}$$

3.  $m^{a+2} + m^{a+1} - m^a + m^{a-1}$

$$\frac{m^2 - 2m + 3}{m^{a+4} + m^{a+3} - m^{a+2} + m^{a+1}} - \frac{-2m^{a+3} - 2m^{a+2} + 2m^{a+1} - 2m^a + 3m^{a+2} + 3m^{a+1} - 3m^a + 3m^{a-1}}{m^{a+4} - m^{a+3} + 6m^{a+1} - 5m^a + 3m^{a-1}}$$

4.  $a^{n+2} + 3a^{n+1} - 2a^n$

$$\frac{a^{n+1} + a^n}{a^{2n+3} + 3a^{2n+2} - 2a^{2n+1}} + \frac{a^{2n+2} + 3a^{2n+1} - 2a^{2n}}{a^{2n+3} + 4a^{2n+2} + a^{2n+1} - 2a^{2n}}$$

5.  $x^{a+2} + 2x^{a+1} - x^a$

$$\frac{x^{a+3} - 2x^{a+1}}{x^{2a+5} + 2x^{2a+4} - x^{2a+3}} - \frac{-2x^{2a+3} - 4x^{2a+2} + 2x^{2a+1}}{x^{2a+5} + 2x^{2a+4} - 3x^{2a+3} - 4x^{2a+2} + 2x^{2a+1}}$$

6.  $a^x - 2a^{x-1} + 3a^{x-2}$

$$\frac{a^2 + 2a - 1}{a^{x+2} - 2a^{x+1} + 3a^x} + \frac{2a^{x+1} - 4a^x + 6a^{x-1} - a^x + 2a^{x-1} - 3a^{x-2}}{a^{x+2} - 2a^x + 8a^{x-1} - 3a^{x-2}}$$

7.  $a^x + 3a^{x-1} - 2a^{x-2}$

$$\frac{a^x - a^{x-1} + a^{x-2}}{a^{2x} + 3a^{2x-1} - 2a^{2x-2}} - \frac{-a^{2x-1} - 3a^{2x-2} + 2a^{2x-3} + a^{2x-2} + 3a^{2x-3} - 2a^{2x-4}}{a^{2x} + 2a^{2x-1} - 4a^{2x-2} + 5a^{2x-3} - 2a^{2x-4}}$$

8.  $m^{a+4} - m^{a+3} - 2m^{a+2} + m^{a+1}$

$$\frac{-m^{a+1} + m^{a+2} + m^{a+3}}{-m^{2a+3} + m^{2a+2} + 2m^{2a+1} - m^{2a}} + \frac{m^{2a+2} - m^{2a+1} - 2m^{2a} + m^{2a-1} + m^{2a+1} - m^{2a} - 2m^{2a-1} + m^{2a-2}}{-m^{2a+3} + 2m^{2a+2} + 2m^{2a+1} - 4m^{2a} - m^{2a-1} + m^{2a-2}}$$

9.  $x^{a-1} + 2x^{a-2} - x^{a-3} + x^{a-4}$

$$\frac{x^{a-1} - x^{a-2} - x^{a-3}}{x^{2a-2} + 2x^{2a-3} - x^{2a-4} + x^{2a-5}} - \frac{-x^{2a-3} - 2x^{2a-4} + x^{2a-5} - x^{2a-6} - x^{2a-4} - 2x^{2a-5} + x^{2a-6} - x^{2a-7}}{x^{2a-2} + x^{2a-3} - 4x^{2a-4} - x^{2a-7}}$$

10.  $a^n b - a^{n-1} b^2 + 2a^{n-2} b^3 - a^{n-3} b^4$

$$\frac{a^n b^2 - a^{n-2} b^4}{a^{2n} b^3 - a^{2n-1} b^4 + 2a^{2n-2} b^5 - a^{2n-3} b^6} - \frac{-a^{2n-2} b^5 + a^{2n-3} b^6 - 2a^{2n-4} b^7 + a^{2n-5} b^8}{a^{2n} b^3 - a^{2n-1} b^4 + a^{2n-2} b^5 - 2a^{2n-4} b^7 + a^{2n-5} b^8}$$

11.  $a^x + b^x$

$$\frac{a^m + b^m}{a^{m+x} + a^m b^x} + \frac{a^x b^m + b^{m+x}}{a^{m+x} + a^m b^x + a^x b^m + b^{m+x}}$$

12.  $a^{x-1} - b^{\eta-1}$

$$\frac{a-b}{a^x - ab^{\eta-1}} - \frac{-a^{x-1} b + b^{\eta}}{a^x - ab^{\eta-1} - a^{x-1} b + b^{\eta}}$$

$$\begin{array}{r}
 13. \quad -5a^{2m+2} + a^{2m+1} + 3a^{2m} \\
 6a^{3m-1} - 8a^{3m-2} + a^{3m-3} \\
 \hline
 -30a^{5m+1} + 6a^{5m} + 18a^{5m-1} \\
 +40a^{5m} - 8a^{5m-1} - 24a^{5m-2} \\
 - 5a^{5m-1} + a^{5m-2} + 3a^{5m-3} \\
 \hline
 -30a^{5m+1} + 46a^{5m} + 5a^{5m-1} - 23a^{5m-2} + 3a^{5m-3}
 \end{array}$$

$$\begin{array}{r}
 14. \quad x^{a+2}y^{x-1} - 4x^{a+1}y^x + 3x^ay^{x+1} \\
 -2x^{2a-1}y^{x-2} - 4x^{2a-2}y^{x-1} - 10x^{2a-3}y^x \\
 \hline
 -2x^{3a+1}y^{2x-3} + 8x^{3a}y^{2x-2} - 6x^{3a-1}y^{2x-1} \\
 -4x^{3a}y^{2x-2} + 16x^{3a-1}y^{2x-1} - 12x^{3a-2}y^{2x} \\
 -10x^{3a-1}y^{2x-1} + 40x^{3a-2}y^{2x} - 30x^{3a-3}y^{2x+1} \\
 \hline
 -2x^{3a+1}y^{2x-3} + 4x^{3a}y^{2x-2} + 28x^{3a-2}y^{2x} - 30x^{3a-3}y^{2x+1}
 \end{array}$$

## EJERCICIO 44

$$\begin{array}{r}
 1. \quad \frac{1}{2}a - \frac{1}{3}b \\
 \frac{1}{3}a + \frac{1}{2}b \\
 \hline
 \frac{1}{6}a^2 - \frac{1}{9}ab \\
 + \frac{1}{4}ab - \frac{1}{6}b^2 \\
 \hline
 \frac{1}{6}a^2 - \frac{4-9}{36}ab - \frac{1}{6}b^2 \\
 = \frac{1}{6}a^2 + \frac{5}{36}ab - \frac{1}{6}b^2
 \end{array}$$

$$\begin{array}{r}
 2. \quad x - \frac{2}{5}y \\
 \frac{1}{3}x + \frac{5}{6}y \\
 \hline
 \frac{1}{3}x^2 - \frac{2}{15}xy \\
 + \frac{5}{6}xy - \frac{10}{30}y^2 \\
 \hline
 \frac{1}{3}x^2 - \frac{4-25}{30}xy - \frac{10}{30}y^2 \\
 = \frac{1}{3}x^2 + \frac{21}{30}xy - \frac{1}{3}y^2 \\
 = \frac{1}{3}x^2 + \frac{7}{10}xy - \frac{1}{3}y^2
 \end{array}$$

$$\begin{array}{r}
 3. \quad \frac{1}{2}x^2 - \frac{1}{3}xy + \frac{1}{4}y^2 \\
 \frac{2}{3}x - \frac{3}{2}y \\
 \hline
 \frac{2}{6}x^3 - \frac{2}{9}x^2y + \frac{2}{12}xy^2 \\
 - \frac{3}{4}x^2y + \frac{3}{6}xy^2 - \frac{3}{8}y^3 \\
 \hline
 \frac{2}{6}x^3 - \frac{8+27}{36}x^2y + \frac{2+6}{12}xy^2 - \frac{3}{8}y^3 \\
 = \frac{1}{3}x^3 - \frac{35}{36}x^2y + \frac{8}{12}xy^2 - \frac{3}{8}y^3 \\
 = \frac{1}{3}x^3 - \frac{35}{36}x^2y + \frac{2}{3}xy^2 - \frac{3}{8}y^3
 \end{array}$$

$$\begin{array}{r}
 4. \quad \frac{1}{4}a^2 - ab + \frac{2}{3}b^2 \\
 \frac{1}{4}a - \frac{3}{2}b \\
 \hline
 \frac{1}{16}a^3 - \frac{1}{4}a^2b + \frac{2}{12}ab^2 \\
 - \frac{3}{8}a^2b + \frac{3}{2}ab^2 - \frac{6}{6}b^3 \\
 \hline
 \frac{1}{16}a^3 - \frac{2+3}{8}a^2b + \frac{2+18}{12}ab^2 - b^3 \\
 = \frac{1}{16}a^3 - \frac{5}{8}a^2b + \frac{20}{12}ab^2 - b^3 \\
 = \frac{1}{16}a^3 - \frac{5}{8}a^2b + \frac{5}{3}ab^2 - b^3
 \end{array}$$

$$5. \frac{2}{5}m^2 + \frac{1}{3}mn - \frac{1}{2}n^2$$

$$\frac{3}{2}m^2 - mn + 2n^2$$

$$\frac{6}{10}m^4 + \frac{3}{6}m^3n - \frac{3}{4}m^2n^2$$

$$-\frac{2}{5}m^3n - \frac{1}{3}m^2n^2 + \frac{1}{2}mn^3 + \frac{2}{3}mn^3 - \frac{2}{2}n^4 + \frac{4}{5}m^2n^2$$

$$\frac{6}{10}m^4 + \frac{15-12}{30}m^3n - \frac{45+20-48}{60}m^2n^2 + \frac{3+4}{6}mn^3 - \frac{2}{2}n^4$$

$$= \frac{6}{10}m^4 + \frac{3}{30}m^3n - \frac{17}{60}m^2n^2 + \frac{7}{6}mn^3 - n^4$$

$$= \frac{3}{5}m^4 + \frac{1}{10}m^3n - \frac{17}{60}m^2n^2 + \frac{7}{6}mn^3 - n^4$$

$$6. \frac{3}{8}x^2 + \frac{1}{4}x - \frac{2}{5}$$

$$2x^3 - \frac{1}{3}x + 2$$

$$\frac{6}{8}x^5 + \frac{2}{4}x^4 - \frac{4}{5}x^3$$

$$-\frac{3}{24}x^3 - \frac{1}{12}x^2 + \frac{2}{15}x + \frac{6}{8}x^2 + \frac{2}{4}x - \frac{4}{5}$$

$$\frac{6}{8}x^5 + \frac{2}{4}x^4 - \frac{96+15}{120}x^3 - \frac{2-18}{24}x^2 + \frac{8+30}{60}x - \frac{4}{5}$$

$$= \frac{3}{4}x^5 + \frac{1}{2}x^4 - \frac{111}{120}x^3 + \frac{16}{24}x^2 + \frac{38}{60}x - \frac{4}{5}$$

$$= \frac{3}{4}x^5 + \frac{1}{2}x^4 - \frac{37}{40}x^3 + \frac{2}{3}x^2 + \frac{19}{30}x - \frac{4}{5}$$

$$7. -\frac{1}{2}x^2 + \frac{1}{3}ax + \frac{3}{2}a^2$$

$$\frac{3}{2}x^2 - ax + \frac{2}{3}a^2$$

$$-\frac{3}{4}x^4 + \frac{3}{6}ax^3 + \frac{9}{4}a^2x^2$$

$$+\frac{1}{2}ax^3 - \frac{1}{3}a^2x^2 - \frac{3}{2}a^3x - \frac{2}{6}a^2x^2 + \frac{2}{9}a^3x + \frac{6}{6}a^4$$

$$-\frac{3}{4}x^4 + \frac{3+3}{6}ax^3 + \frac{27-4-4}{12}a^2x^2 - \frac{27-4}{18}a^3x + \frac{6}{6}a^4$$

$$= -\frac{3}{4}x^4 + \frac{6}{6}ax^3 + \frac{19}{12}a^2x^2 - \frac{23}{18}a^3x + \frac{6}{6}a^4$$

$$= -\frac{3}{4}x^4 + ax^3 + \frac{19}{12}a^2x^2 - \frac{23}{18}a^3x + a^4$$

$$8. \frac{2}{7}x^3 - \frac{1}{5}x^2y + \frac{1}{2}xy^2$$

$$\frac{1}{4}x^2 - \frac{2}{3}xy + \frac{5}{6}y^2$$

$$\frac{2}{28}x^5 - \frac{1}{20}x^4y + \frac{1}{8}x^3y^2$$

$$-\frac{4}{21}x^4y + \frac{2}{15}x^3y^2 - \frac{2}{6}x^2y^3 + \frac{10}{42}x^3y^2 - \frac{5}{30}x^2y^3 + \frac{5}{12}xy^4$$

$$\frac{2}{28}x^5 - \frac{21+80}{420}x^4y + \frac{105+112+200}{840}x^3y^2 - \frac{10+5}{30}x^2y^3 + \frac{5}{12}xy^4$$

$$= \frac{2}{28}x^5 - \frac{101}{420}x^4y + \frac{417}{840}x^3y^2 - \frac{15}{30}x^2y^3 + \frac{5}{12}xy^4$$

$$= \frac{1}{14}x^5 - \frac{101}{420}x^4y + \frac{139}{280}x^3y^2 - \frac{1}{2}x^2y^3 + \frac{5}{12}xy^4$$

$$9. \frac{1}{4}x^3 + \frac{1}{3}x^2 - \frac{1}{4}x + \frac{1}{2}$$

$$\frac{3}{2}x^2 + \frac{1}{10}x - \frac{1}{5}$$

$$\frac{3}{8}x^5 + \frac{3}{6}x^4 - \frac{3}{8}x^3 + \frac{3}{4}x^2$$

$$+\frac{1}{40}x^4 + \frac{1}{30}x^3 - \frac{1}{40}x^2 + \frac{1}{20}x$$

$$-\frac{1}{20}x^3 - \frac{1}{15}x^2 + \frac{1}{20}x - \frac{1}{10}$$

$$\frac{3}{8}x^5 + \frac{60+3}{120}x^4 - \frac{45-4+6}{120}x^3 + \frac{90-3-8}{120}x^2 + \frac{1+1}{20}x - \frac{1}{10}$$

$$= \frac{3}{8}x^5 + \frac{63}{120}x^4 - \frac{47}{120}x^3 + \frac{79}{120}x^2 + \frac{2}{20}x - \frac{1}{10} = \frac{3}{8}x^5 + \frac{21}{40}x^4 - \frac{47}{120}x^3 + \frac{79}{120}x^2 + \frac{1}{10}x - \frac{1}{10}$$



$$\begin{array}{r}
 10. \quad \frac{3}{4}m^3 - \frac{1}{2}m^2n + \frac{2}{5}mn^2 - \frac{1}{4}n^3 \\
 \frac{2}{3}m^2 - \frac{2}{3}mn + \frac{5}{2}n^2 \\
 \hline
 \frac{6}{12}m^5 - \frac{2}{6}m^4n + \frac{4}{15}m^3n^2 \quad - \quad \frac{2}{12}m^2n^3 \\
 \quad - \frac{6}{12}m^4n + \frac{2}{6}m^3n^2 \quad - \quad \frac{4}{15}m^2n^3 \quad + \quad \frac{2}{12}mn^4 \\
 \quad \quad + \quad \frac{15}{8}m^3n^2 \quad - \quad \frac{5}{4}m^2n^3 \quad + \quad \frac{10}{10}mn^4 \quad - \quad \frac{5}{8}n^5 \\
 \hline
 \frac{6}{12}m^5 - \frac{4+6}{12}m^4n + \frac{32+40+225}{120}m^3n^2 - \frac{10+16+75}{60}m^2n^3 + \frac{20+120}{120}mn^4 - \frac{5}{8}n^5 \\
 = \frac{1}{2}m^5 - \frac{10}{12}m^4n + \frac{297}{120}m^3n^2 - \frac{101}{60}m^2n^3 + \frac{140}{120}mn^4 - \frac{5}{8}n^5 = \frac{1}{2}m^5 - \frac{5}{6}m^4n + \frac{99}{40}m^3n^2 - \frac{101}{60}m^2n^3 + \frac{7}{6}mn^4 - \frac{5}{8}n^5
 \end{array}$$

### EJERCICIO 45

1.  $x^3 - x^2 + x$  por  $x^2 - 1$

$$\begin{array}{r}
 1-1+1 \\
 1+0-1 \\
 \hline
 1-1+1 \\
 \quad -1+1-1 \\
 \hline
 1-1+0+1-1 \\
 =x^5 - x^4 + x^2 - x
 \end{array}$$

2.  $x^4 + 3x^3 - 5x^2 + 8$  por  $x^3 - 2x^2 - 7$

$$\begin{array}{r}
 1+3-5+0+8 \\
 1-2+0-7 \\
 \hline
 1+3-5+0+8 \\
 \quad -2-6+10+0-16 \\
 \quad \quad -7-21+35+0-56 \\
 \hline
 1+1-11+3-13+19+0-56 \\
 =x^7 + x^6 - 11x^5 + 3x^4 - 13x^3 + 19x^2 - 56
 \end{array}$$

3.  $a^4 + 3a^3b - 2a^2b^2 + 5ab^3 - b^4$  por  $a^2 - 2ab + b^2$

$$\begin{array}{r}
 1+3-2+5-1 \\
 1-2+1 \\
 \hline
 1+3-2+5-1 \\
 \quad -2-6+4-10+2 \\
 \quad \quad +1+3-2+5-1 \\
 \hline
 1+1-7+12-13+7-1 \\
 =a^6 + a^5b - 7a^4b^2 + 12a^3b^3 - 13a^2b^4 + 7ab^5 - b^6
 \end{array}$$

4.  $m^3 - 5m^2n + 6mn^2 + n^3$  por  $m^3 - 4mn^2 - n^3$

$$\begin{array}{r}
 1-5+6+1 \\
 1+0-4-1 \\
 \hline
 1-5+6+1 \\
 \quad -4+20-24-4 \\
 \quad \quad -1+5-6-1 \\
 \hline
 1-5+2+20-19-10-1 \\
 =m^6 - 5m^5n + 2m^4n^2 + 20m^3n^3 - 19m^2n^4 - 10mn^5 - n^6
 \end{array}$$

5.  $x^4 - 8x^2 + 3$  por  $x^4 + 6x^2 - 5$

$$\begin{array}{r}
 1+0-8+0+3 \\
 1+0+6+0-5 \\
 \hline
 1+0-8+0+3 \\
 \quad +6+0-48+0+18 \\
 \quad \quad -5+0+40+0-15 \\
 \hline
 1+0-2+0-50+0+58+0-15 \\
 =x^8 - 2x^6 - 50x^4 + 58x^2 - 15
 \end{array}$$

6.  $a^6 - 3a^4 - 6a^2 + 10$  por  $a^8 - 4a^6 + 3a^4 - 2a^2$

$$\begin{array}{r}
 1+0-3+0-6+0+10 \\
 1+0-4+0+3+0-2 \\
 \hline
 1+0-3+0-6+0+10 \\
 \quad -4+0+12+0+24+0-40 \\
 \quad \quad +3+0-9+0-18+0+30 \\
 \quad \quad \quad -2+0+6+0+12+0-20 \\
 \hline
 1+0-7+0+9+0+23+0-52+0+42+0-20 \\
 =a^{14} - 7a^{12} + 9a^{10} + 23a^8 - 52a^6 + 42a^4 - 20a^2
 \end{array}$$

7.  $x^9 - 4x^6 + 3x^3 - 2$  por  $3x^6 - 8x^3 + 10$

$$1+0+0-4+0+0+3+0+0-2$$

$$3+0+0-8+0+0+10$$

$$\hline 3+0+0-12+0+0+9+0+0-6$$

$$-8+0+0+32+0+0-24+0+0+16$$

$$+10+0+0-40+0+0+30+0+0-20$$

$$\hline 3+0+0-20+0+0+51+0+0-70+0+0+46+0+0-20$$

$$=3x^{15} - 20x^{12} + 51x^9 - 70x^6 + 46x^3 - 20$$

9.  $x^5 - 3x^4y - 6x^3y^2 - 4x^2y^3 - y^5$  por  $2x^2 + 4y^2$

$$1-3-6-4+0-1$$

$$2+0+4$$

$$\hline 2-6-12-8+0-2$$

$$+4-12-24-16+0-4$$

$$\hline 2-6-8-20-24-18+0-4$$

$$=2x^7 - 6x^6y - 8x^5y^2 - 20x^4y^3 - 24x^3y^4 - 18x^2y^5 - 4y^7$$

11.  $n^6 - 3n^4 + 5n^3 - 8n + 4$  por  $n^4 - 3n^2 + 4$

$$1+0-3+5+0-8+4$$

$$1+0-3+0+4$$

$$\hline 1+0-3+5+0-8+4$$

$$-3+0+9-15+0+24-12$$

$$+4+0-12+20+0-32+16$$

$$\hline 1+0-6+5+13-23-8+44-12-32+16$$

$$=n^{10} - 6n^8 + 5n^7 + 13n^6 - 23n^5 - 8n^4 + 44n^3 - 12n^2 - 32n + 16$$

13.  $x^{10} - 5x^6y^4 + 3x^2y^8 - 6y^{10}$  por  $x^6 - 4x^4y^2 - 5x^2y^4 + y^6$

$$1+0+0+0-5+0+0+0+3+0-6$$

$$1+0-4+0-5+0+1$$

$$\hline 1+0+0+0-5+0+0+0+3+0-6$$

$$-4+0+0+0+20+0+0+0-12+0+24$$

$$-5+0+0+0+25+0+0+0-15+0+30$$

$$+1+0+0+0-5+0+0+0+3+0-6$$

$$\hline 1+0-4+0-10+0+21+0+28+0-23+0+9+0+33+0-6$$

$$x^{16} - 4x^{14}y^2 - 10x^{12}y^4 + 21x^{10}y^6 + 28x^8y^8 - 23x^6y^{10} + 9x^4y^{12} + 33x^2y^{14} - 6y^{16}$$

14.  $a^m - 3a^{m-1} + 5a^{m-3}$  por  $a^2 - 5$

$$1-3+0+5$$

$$1+0-5$$

$$\hline 1-3+0+5$$

$$-5+15+0-25$$

$$\hline 1-3-5+20+0-25$$

$$=a^{m+2} - 3a^{m+1} - 5a^m + 20a^{m-1} - 25a^{m-3}$$

8.  $m^{12} - 7m^8 + 9m^4 - 15$  por  $m^{16} - 5m^{12} + 9m^8 - 4m^4 + 3$

$$1-7+9-15$$

$$1-5+9-4+3$$

$$\hline 1-7+9-15$$

$$-5+35-45+75$$

$$+9-63+81-135$$

$$-4-28-36+60$$

$$+3-21+27-45$$

$$\hline 1-12+53-127+187-192+87-45$$

$$=m^{28} - 12m^{24} + 53m^{20} - 127m^{16} + 187m^{12} - 192m^8 + 87m^4 - 45$$

10.  $6a^5 - 4a^2 + 6a - 2$  por  $a^4 - 2a^2 + a - 7$

$$6+0+0-4+6-2$$

$$1+0-2+1-7$$

$$\hline 6+0+0-4+6-2$$

$$-12+0+0+8-12+4$$

$$+6+0+0-4+6-2$$

$$-42+0+0+28-42+14$$

$$\hline 6+0-12+2-36+6-16+38-44+14$$

$$=6a^9 - 12a^7 + 2a^6 - 36a^5 + 6a^4 - 16a^3 + 38a^2 - 44a + 14$$

12.  $3x^4 - 4x^3y - y^4$  por  $x^3 - 5xy^2 + 3y^3$

$$3-4+0+0-1$$

$$1+0-5+3$$

$$\hline 3-4+0+0-1$$

$$-15+20+0+0+5$$

$$+9-12+0+0-3$$

$$\hline 3-4-15+29-13+0+5-3$$

$$=3x^7 - 4x^6y - 15x^5y^2 + 29x^4y^3 - 13x^3y^4 + 5xy^6 - 3y^7$$

15.  $a^{x+2} - 5a^{x+1} - 7a^{x-1}$  por  $7a^{x+3} + 6a^{x+1} + a^x$

$$1-5+0-7$$

$$7+0+6+1$$

$$\hline 7-35+0-49$$

$$+6-30+0-42$$

$$+1-5+0-7$$

$$\hline 7-35+6-78-5-42-7$$

$$=7a^{2x+5} - 35a^{2x+4} + 6a^{2x+3}$$

$$-78a^{2x+2} - 5a^{2x+1} - 42a^{2x} - 7a^{2x-1}$$

$$\begin{array}{r}
 16. \ x^{a+2} - 5x^a - 6x^{a-2} \text{ por } 6x^{a+1} - 4x^a + 2x^{a-1} + x^{a-2} \\
 1+0-5+0-6 \\
 6-4+2+1 \\
 \hline
 6+0-30+0-36 \\
 -4+0+20+0+24 \\
 +2+0-10+0-12 \\
 +1+0-5+0-6 \\
 \hline
 6-4-28+21-46+19-12-6 \\
 = 6x^{2a+3} - 4x^{2a+2} - 28x^{2a+1} + 21x^{2a} \\
 - 46x^{2a-1} + 19x^{2a-2} - 12x^{2a-3} - 6x^{2a-4}
 \end{array}$$

$$\begin{array}{r}
 17. \ a^{2x+2} - 3a^{2x+1} - a^{2x} - 5a^{2x-1} \text{ por } 6a^{3x+1} - 5a^{3x} + 3a^{3x-1} \\
 1-3-1-5 \\
 6-5+3 \\
 \hline
 6-18-6-30 \\
 -5+15+5+25 \\
 +3-9-3-15 \\
 \hline
 6-23+12-34+22-15 \\
 = 6a^{5x+3} - 23a^{5x+2} + 12a^{5x+1} - 34a^{5x} + 22a^{5x-1} - 15a^{5x-2}
 \end{array}$$

## EJERCICIO 46

- $$\begin{array}{r}
 4(a+5)(a-3) \\
 4a+20 \\
 a-3 \\
 \hline
 4a^2+20a \\
 -12a-60 \\
 \hline
 4a^2+8a-60
 \end{array}$$
- $$\begin{array}{r}
 3a^2(x+1)(x-1) \\
 3a^2x+3a^2 \\
 x-1 \\
 \hline
 3a^2x^2+3a^2x \\
 -3a^2x-3a^2 \\
 \hline
 3a^2x^2-3a^2
 \end{array}$$
- $$\begin{array}{r}
 2(a-3)(a-1)(a+4) \\
 2a-6 \\
 a-1 \\
 \hline
 2a^2-6a \\
 -2a+6 \\
 \hline
 2a^2-8a+6 \\
 a+4 \\
 \hline
 2a^3-8a^2+6a \\
 +8a^2-32a+24 \\
 \hline
 2a^3-26a+24
 \end{array}$$
- $$\begin{array}{r}
 (x^2+1)(x^2-1)(x^2+1) \\
 x^2+1 \\
 x^2+1 \\
 \hline
 x^4+x^2 \\
 +x^2+1 \\
 \hline
 x^4+2x^2+1 \\
 x^2-1 \\
 \hline
 x^6+2x^4+x^2 \\
 -x^4-2x^2-1 \\
 \hline
 x^6+x^4-x^2-1
 \end{array}$$
- $$\begin{array}{r}
 m(m-4)(m-6)(3m+2) \\
 m^2-4m \\
 m-6 \\
 \hline
 m^3-4m^2 \\
 -6m^2+24m \\
 \hline
 m^3-10m^2+24m \\
 3m+2 \\
 \hline
 3m^4-30m^3+72m^2 \\
 +2m^3-20m^2+48m \\
 \hline
 3m^4-28m^3+52m^2+48m
 \end{array}$$
- $$\begin{array}{r}
 (a-b)(a^2-2ab+b^2)(a+b) \\
 a^2-2ab+b^2 \\
 a+b \\
 \hline
 a^3-2a^2b+ab^2 \\
 +a^2b-2ab^2+b^3 \\
 \hline
 a^3-a^2b-ab^2+b^3 \\
 a-b \\
 \hline
 a^4-a^3b-a^2b^2+ab^3 \\
 -a^3b+a^2b^2+ab^3-b^4 \\
 \hline
 a^4-2a^3b+2ab^3-b^4
 \end{array}$$
- $$\begin{array}{r}
 3x(x^2-2x+1)(x-1)(x+1) \\
 3x^3-6x^2+3x \\
 x-1 \\
 \hline
 3x^4-6x^3+3x^2 \\
 -3x^3+6x^2-3x \\
 \hline
 3x^4-9x^3+9x^2-3x \\
 x+1 \\
 \hline
 3x^5-9x^4+9x^3-3x^2 \\
 +3x^4-9x^3+9x^2-3x \\
 \hline
 3x^5-6x^4+6x^2-3x
 \end{array}$$

$$8. (x^2 - x + 1)(x^2 + x - 1)(x - 2)$$

$$\begin{array}{r} x^2 - x + 1 \\ x^2 + x - 1 \\ \hline x^4 - x^3 + x^2 \\ + x^3 - x^2 + x \\ - x^2 + x - 1 \\ \hline x^4 - x^2 + 2x - 1 \\ x - 2 \\ \hline x^5 - x^3 + 2x^2 - x \\ - 2x^4 + 2x^2 - 4x + 2 \\ \hline x^5 - 2x^4 - x^3 + 4x^2 - 5x + 2 \end{array}$$

$$9. (a^m - 3)(a^{m-1} + 2)(a^{m-1} - 1)$$

$$\begin{array}{r} a^m - 3 \\ a^{m-1} + 2 \\ \hline a^{2m-1} - 3a^{m-1} \\ 2a^m - 6 \\ \hline 2a^m + a^{2m-1} - 3a^{m-1} - 6 \\ a^{m-1} - 1 \\ \hline 2a^{2m-1} + a^{3m-2} - 3a^{2m-2} - 6a^{m-1} \\ - a^{2m-1} + 3a^{m-1} - 2a^m + 6 \\ \hline a^{2m-1} + a^{3m-2} - 3a^{2m-2} - 3a^{m-1} - 2a^m + 6 \\ \Rightarrow a^{3m-2} + a^{2m-1} - 3a^{2m-2} - 2a^m - 3a^{m-1} + 6 \end{array}$$

$$10. a(a-1)(a-2)(a-3)$$

$$\begin{array}{r} a^2 - a \\ a - 2 \\ \hline a^3 - a^2 \\ - 2a^2 + 2a \\ \hline a^3 - 3a^2 + 2a \\ a - 3 \\ \hline a^4 - 3a^3 + 2a^2 \\ - 3a^3 + 9a^2 - 6a \\ \hline a^4 - 6a^3 + 11a^2 - 6a \end{array}$$

$$11. (x-3)(x+4)(x-5)(x+1)$$

$$\begin{array}{r} x-3 \quad x-5 \\ x+4 \quad x+1 \\ \hline x^2-3x \quad x^2-5x \\ + 4x-12 \quad + x-5 \\ \hline x^2+x-12 \quad x^2-4x-5 \\ x^2-4x-5 \\ \hline x^4+x^3-12x^2 \\ - 4x^3-4x^2+48x \\ - 5x^2-5x+60 \\ \hline x^4-3x^3-21x^2+43x+60 \end{array}$$

$$12. (x^2-3)(x^2+2x+1)(x-1)(x^2+3)$$

$$\begin{array}{r} x^2+2x+1 \quad x^2-3 \\ x^2+3 \quad x-1 \\ \hline x^4+2x^3+x^2 \quad x^3-3x \\ + 3x^2+6x+3 \quad -x^2+3 \\ \hline x^4+2x^3+4x^2+6x+3 \quad x^3-x^2-3x+3 \\ x^3-x^2-3x+3 \\ \hline x^7+2x^6+4x^5+6x^4+3x^3 \\ - x^6-2x^5-4x^4-6x^3-3x^2 \\ - 3x^5-6x^4-12x^3-18x^2-9x \\ + 3x^4+6x^3+12x^2+18x+9 \\ \hline x^7+x^6-x^5-x^4-9x^3-9x^2+9x+9 \end{array}$$

$$13. 9a^2(3a-2)(2a+1)(a-1)(2a-1)$$

$$\begin{array}{r} 27a^3-18a^2 \quad 2a-1 \\ 2a+1 \quad a-1 \\ \hline 54a^4-36a^3 \quad 2a^2-a \\ + 27a^3-18a^2 \quad -2a+1 \\ \hline 54a^4-9a^3-18a^2 \quad 2a^2-3a+1 \\ 2a^2-3a+1 \\ \hline 108a^6-18a^5-36a^4 \\ - 162a^5+27a^4+54a^3 \\ + 54a^4-9a^3-18a^2 \\ \hline 108a^6-180a^5+45a^4-45a^3-18a^2 \end{array}$$

$$14. a^x(a^{x+1}+b^{x+2})(a^{x+1}-b^{x+2})b^x$$

$$\begin{array}{r} a^{2x+1}+a^x b^{x+2} \\ a^{x+1}b^x-b^{2x+2} \\ \hline a^{3x+2}b^x+a^{2x+1}b^{2x+2} \\ - a^{2x+1}b^{2x+2}-a^x b^{3x+4} \\ \hline a^{3x+2}b^x \quad - a^x b^{3x+4} \end{array}$$

## EJERCICIO 47

$$\begin{aligned} 1. & 4(x+3)+5(x+2) \\ & = 4x+12+5x+10 \\ & = 9x+22 \end{aligned}$$

$$\begin{aligned} 2. & 6(x^2+4)-3(x^2+1)+5(x^2+2) \\ & = 6x^2+24-3x^2-3+5x^2+10 \\ & = 8x^2+31 \end{aligned}$$

$$\begin{aligned} 3. & a(a-x)+3a(x+2a)-a(x-3a) \\ & = a^2-ax+3ax+6a^2-ax+3a^2 \\ & = 10a^2+ax \end{aligned}$$

$$\begin{aligned} 4. & x^2(y^2+1)+y^2(x^2+1)-3x^2y^2 \\ & = x^2y^2+x^2+x^2y^2+y^2-3x^2y^2 \\ & = -x^2y^2+x^2+y^2 \end{aligned}$$

$$\begin{aligned} 5. & 4m^3-5mn^2+3m^2(m^2+n^2)-3m(m^2-n^2) \\ & = 4m^3-5mn^2+3m^4+3m^2n^2-3m^3+3mn^2 \\ & = 3m^4+m^3+3m^2n^2-2mn^2 \end{aligned}$$

$$\begin{aligned} 6. & y^2+x^2y^3-y^3(x^2+1)+y^2(x^2+1)-y^2(x^2-1) \\ & = y^2+x^2y^3-x^2y^3-y^3+x^2y^2+y^2-x^2y^2+y^2 \\ & = -y^3+3y^2 \end{aligned}$$

$$\begin{aligned} 7. & 5(x+2)-(x+1)(x+4)-6x \\ & = 5x+10-(x^2+4x+x+4)-6x \\ & = -x+10-x^2-4x-x-4 \\ & = -x^2-6x+6 \end{aligned}$$

$$\begin{aligned} 8. & (a+5)(a-5)-3(a+2)(a-2)+5(a+4) \\ & = a^2-5a+5a-25-3(a^2-2a+2a-4)+5a+20 \\ & = a^2+5a-5-3(a^2-4) \\ & = a^2+5a-5-3a^2+12 \\ & = -2a^2+5a+7 \end{aligned}$$

$$\begin{aligned} 9. & (a+b)(4a-3b)-(5a-2b)(3a+b)-(a+b)(3a-6b) \\ & = 4a^2+ab-3b^2-(15a^2-ab-2b^2)-(3a^2-3ab-6b^2) \\ & = 4a^2+ab-3b^2-15a^2+ab+2b^2-3a^2+3ab+6b^2 \\ & = -14a^2+5ab+5b^2 \end{aligned}$$

$$\begin{aligned} 10. & (a+c)^2-(a-c)^2 \\ & = (a+c)(a+c)-(a-c)(a-c) \\ & = a^2+ac+ac+c^2-(a^2-ac-ac+c^2) \\ & = a^2+2ac+c^2-a^2+ac+ac-c^2 \\ & = 4ac \end{aligned}$$

$$\begin{aligned} 11. & 3(x+y)^2-4(x-y)^2+3x^2-3y^2 \\ & = 3(x+y)(x+y)-4(x-y)(x-y)+3x^2-3y^2 \\ & = 3(x^2+xy+xy+y^2)-4(x^2-xy-xy+y^2)+3x^2-3y^2 \\ & = 3(x^2+2xy+y^2)-4(x^2-2xy+y^2)+3x^2-3y^2 \\ & = 3x^2+6xy+3y^2-4x^2+8xy-4y^2+3x^2-3y^2 \\ & = 2x^2+14xy-4y^2 \end{aligned}$$

$$\begin{aligned} 12. & (m+n)^2-(2m+n)^2+(m-4n)^2 \\ & = (m+n)(m+n)-(2m+n)(2m+n)+(m-4n)(m-4n) \\ & = m^2+2mn+n^2-(4m^2+4mn+n^2)+m^2-8mn+16n^2 \\ & = 2m^2-6mn+17n^2-4m^2-4mn-n^2 \\ & = -2m^2-10mn+16n^2 \end{aligned}$$

$$\begin{aligned} 13. & x(a+x)+3x(a+1)-(x+1)(a+2x)-(a-x)^2 \\ & = ax+x^2+3ax+3x-(ax+2x^2+a+2x)-(a-x)(a-x) \\ & = 4ax+x^2+3x-ax-2x^2-a-2x-(a^2-ax-ax+x^2) \\ & = 3ax-x^2+x-a-a^2+ax+ax-x^2 \\ & = -2x^2+x+5ax-a-a^2 \end{aligned}$$

$$\begin{aligned} 14. & (a+b-c)^2+(a-b+c)^2-(a+b+c)^2 \\ & \begin{array}{r} a+b-c \\ a+b-c \\ \hline a^2+ab-ab-ac \\ +ab \\ -ac \end{array} \quad \begin{array}{r} a-b+c \\ a-b+c \\ \hline a^2-ab+ab+ac \\ +b^2-bc \\ -bc+c^2 \end{array} \quad \begin{array}{r} a+b+c \\ a+b+c \\ \hline a^2-ab+ac \\ -ab \\ +ac \\ +b^2-bc \\ -bc+c^2 \end{array} \\ & \hline a^2+2ab-2ac+b^2-2bc+c^2 \quad a^2-2ab+2ac+b^2-2bc+c^2 \end{aligned}$$

$$\begin{aligned} & \begin{array}{r} a+b+c \\ a+b+c \\ \hline a^2+ab+ac \\ +ab \\ +ac \end{array} \quad \begin{array}{r} +b^2+bc \\ +bc+c^2 \end{array} \\ & \hline a^2+2ab+2ac+b^2+2bc+c^2 \\ & \begin{array}{r} a^2+2ab-2ac+b^2-2bc+c^2 \\ a^2-2ab+2ac+b^2-2bc+c^2 \\ -a^2-2ab-2ac-b^2-2bc-c^2 \\ \hline a^2-2ab-2ac+b^2-6bc+c^2 \\ \Rightarrow a^2+b^2+c^2-2ab-2ac-6bc \end{array} \end{aligned}$$

$$15. \begin{array}{r} (x^2+x-3)^2 - (x^2-2+x)^2 + (x^2-x-3)^2 \\ \hline x^2+x-3 \qquad x^2+x-2 \\ \hline x^2+x-3 \qquad x^2+x-2 \\ \hline x^4+x^3-3x^2 \qquad x^4+x^3-2x^2 \\ +x^3+x^2-3x \qquad +x^3+x^2-2x \\ \hline -3x^2-3x+9 \qquad -2x^2-2x+4 \\ \hline x^4+2x^3-5x^2-6x+9 \qquad x^4+2x^3-3x^2-4x+4 \end{array}$$

$$\begin{array}{r} x^2-x-3 \\ \hline x^2-x-3 \\ \hline x^4-x^3-3x^2 \qquad x^4+2x^3-5x^2-6x+9 \\ -x^3+x^2+3x \qquad -x^4-2x^3+3x^2+4x-4 \\ \hline -3x^2+3x+9 \qquad x^4-2x^3-5x^2+6x+9 \\ \hline x^4-2x^3-5x^2+6x+9 \qquad x^4-2x^3-7x^2+4x+14 \end{array}$$

$$17. \begin{aligned} & [x+(2x-3)][3x-(x+1)]+4x-x^2 \\ &= [x+2x-3][3x-x-1]+4x-x^2 \\ &= [3x-3][2x-1]+4x-x^2 \\ &= 6x^2-3x-6x+3+4x-x^2 \\ &= 5x^2-5x+3 \end{aligned}$$

$$19. \begin{aligned} & [(m+n)(m-n)-(m+n)(m+n)][2(m+n)-3(m-n)] \\ &= [m^2-n^2-(m^2+2mn+n^2)][2m+2n-3m+3n] \\ &= [m^2-n^2-m^2-2mn-n^2][-m+5n] \\ &= [-2mn-2n^2][-m+5n] \\ &= 2m^2n-10mn^2+2mn^2-10n^3 \\ &= 2m^2n-8mn^2-10n^3 \end{aligned}$$

## EJERCICIO 48

$$1. \begin{aligned} & x - [3a + 2(-x + 1)] \\ &= x - [3a - 2x + 2] \\ &= x - 3a + 2x - 2 \\ &= 3x - 3a - 2 \end{aligned}$$

$$2. \begin{aligned} & -(a+b) - 3[2a+b(-a+2)] \\ &= -a-b-3[2a-ab+2b] \\ &= -a-b-6a+3ab-6b \\ &= -7a-7b+3ab \Rightarrow -7a+3ab-7b \end{aligned}$$

$$16. \begin{array}{r} (x+y+z)^2 - (x+y)(x-y) + 3(x^2+xy+y^2) \\ \hline x+y+z \qquad x+y \\ \hline x+y+z \qquad x-y \\ \hline x^2+xy+xz \qquad x^2+xy \\ +xy \qquad +y^2+yz \qquad -xy-y^2 \\ \hline +xz \qquad +yz \qquad +z^2 \qquad x^2-y^2 \\ \hline x^2+2xy+2xz+y^2+2yz+z^2 \end{array}$$

$$\begin{aligned} & x^2+2xy+2xz+y^2+2yz+z^2 \\ & -x^2 \qquad +y^2 \\ & 3x^2+3xy \qquad +3y^2 \\ \hline & 3x^2+5xy+2xz+5y^2+2yz+z^2 \\ & \Rightarrow 3x^2+5y^2+z^2+5xy+2xz+2yz \end{aligned}$$

$$18. \begin{aligned} & [3(x+2)-4(x+1)][3(x+4)-2(x+2)] \\ &= [3x+6-4x-4][3x+12-2x-4] \\ &= [-x+2][x+8] \\ &= -x^2-8x+2x+16 \\ &= -x^2-6x+16 \end{aligned}$$

$$20. \begin{aligned} & [(x+y)^2-3(x-y)^2][(x+y)(x-y)+x(y-x)] \\ &= [x^2+2xy+y^2-3(x^2-2xy+y^2)][x^2-y^2+xy-x^2] \\ &= [x^2+2xy+y^2-3x^2+6xy-3y^2][xy-y^2] \\ &= [-2x^2+8xy-2y^2][xy-y^2] \\ &= -2x^3y+2x^2y^2+8x^2y^2-8xy^3-2xy^3+2y^4 \\ &= -2x^3y+10x^2y^2-10xy^3+2y^4 \end{aligned}$$

$$3. \begin{aligned} & -[3x-2y+(x-2y)-2(x+y)-3(2x+1)] \\ &= -[3x-2y+x-2y-2x-2y-6x-3] \\ &= -[-4x-6y-3] \\ &= 4x+6y+3 \end{aligned}$$

$$4. \begin{aligned} & 4x^2 - \left\{ -3x+5 - [-x+x(2-x)] \right\} \\ &= 4x^2 - \left\{ -3x+5 - [-x+2x-x^2] \right\} \\ &= 4x^2 - \left\{ -3x+5+x-2x+x^2 \right\} \\ &= 4x^2 - \left\{ -4x+5+x^2 \right\} \\ &= 4x^2+4x-5-x^2 \\ &= 3x^2+4x-5 \end{aligned}$$

$$\begin{aligned}
5. & 2a - \left\{ -3x + 2 \left[ -a + 3x - 2(-a + b - (2+a)) \right] \right\} \\
& = 2a - \left\{ -3x + 2 \left[ -a + 3x - 2(-a + b - 2 - a) \right] \right\} \\
& = 2a - \left\{ -3x + 2 \left[ -a + 3x + 2a - 2b + 4 + 2a \right] \right\} \\
& = 2a - \left\{ -3x + 2 \left[ 3a + 3x - 2b + 4 \right] \right\} \\
& = 2a - \left\{ -3x + 6a + 6x - 4b + 8 \right\} \\
& = 2a + 3x - 6a - 6x + 4b - 8 \\
& = -4a - 3x + 4b - 8 \Rightarrow -4a + 4b - 3x - 8
\end{aligned}$$

$$\begin{aligned}
6. & a - (x + y) - 3(x - y) + 2 \left[ -(x - 2y) - 2(-x - y) \right] \\
& = a - x - y - 3x + 3y + 2 \left[ -x + 2y + 2x + 2y \right] \\
& = a - 4x + 2y + 2 \left[ x + 4y \right] \\
& = a - 4x + 2y + 2x + 8y \\
& = a - 2x + 10y
\end{aligned}$$

$$\begin{aligned}
7. & m - (m + n) - 3 \left\{ -2m + \left[ -2m + n + 2(-1 + n) - (m + n - 1) \right] \right\} \\
& = m - m - n - 3 \left\{ -2m + \left[ -2m + n - 2 + 2n - m - n + 1 \right] \right\} \\
& = -n - 3 \left\{ -2m + \left[ -3m + 2n - 1 \right] \right\} \\
& = -n - 3 \left\{ -2m - 3m + 2n - 1 \right\} \\
& = -n - 3 \left\{ -5m + 2n - 1 \right\} \\
& = -n + 15m - 6n + 3 \\
& = -7n + 15m + 3 \Rightarrow 15m - 7n + 3
\end{aligned}$$

$$\begin{aligned}
8. & -2(a - b) - 3(a + 2b) - 4 \left\{ a - 2b + 2 \left[ -a + b - 1 + 2(a - b) \right] \right\} \\
& = -2a + 2b - 3a - 6b - 4 \left\{ a - 2b + 2 \left[ -a + b - 1 + 2a - 2b \right] \right\} \\
& = -5a - 4b - 4 \left\{ a - 2b + 2 \left[ a - b - 1 \right] \right\} \\
& = -5a - 4b - 4 \left\{ a - 2b + 2a - 2b - 2 \right\} \\
& = -5a - 4b - 4 \left\{ 3a - 4b - 2 \right\} \\
& = -5a - 4b - 12a + 16b + 8 \\
& = -17a + 12b + 8
\end{aligned}$$

$$\begin{aligned}
9. & -5(x + y) - \left[ 2x - y + 2 \left\{ -x + y - 3 - (x - y - 1) \right\} \right] + 2x \\
& = -5x - 5y - \left[ 2x - y + 2 \left\{ -x + y - 3 - x + y + 1 \right\} \right] + 2x \\
& = -3x - 5y - \left[ 2x - y + 2 \left\{ -2x + 2y - 2 \right\} \right] \\
& = -3x - 5y - \left[ 2x - y - 4x + 4y - 4 \right] \\
& = -3x - 5y - \left[ -2x + 3y - 4 \right] \\
& = -3x - 5y + 2x - 3y + 4 \\
& = -x - 8y + 4
\end{aligned}$$

$$\begin{aligned}
10. & m - 3(m + n) + \left[ - \left\{ -(-2m + n - 2 - 3 \left[ m - n + 1 \right]) + m \right\} \right] \\
& = m - 3m - 3n + \left[ - \left\{ -(-2m + n - 2 - 3m + 3n - 3) + m \right\} \right] \\
& = -2m - 3n + \left[ - \left\{ -(-5m + 4n - 5) + m \right\} \right] \\
& = -2m - 3n + \left[ - \left\{ 5m - 4n + 5 + m \right\} \right] \\
& = -2m - 3n + \left[ - \left\{ 6m - 4n + 5 \right\} \right] \\
& = -2m - 3n + \left[ -6m + 4n - 5 \right] \\
& = -2m - 3n - 6m + 4n - 5 \\
& = -8m + n - 5
\end{aligned}$$

$$\begin{aligned}
11. & -3(x - 2y) + 2 \left\{ -4 \left[ -2x - 3(x + y) \right] \right\} - \left\{ - \left[ -(x + y) \right] \right\} \\
& = -3x + 6y + 2 \left\{ -4 \left[ -2x - 3x - 3y \right] \right\} - \left\{ - \left[ -x - y \right] \right\} \\
& = -3x + 6y + 2 \left\{ -4 \left[ -5x - 3y \right] \right\} - \left\{ x + y \right\} \\
& = -3x + 6y + 2 \left\{ 20x + 12y \right\} - x - y \\
& = -4x + 5y + 40x + 24y \\
& = 36x + 29y
\end{aligned}$$

$$\begin{aligned}
12. & 5 \left\{ -(a + b) - 3 \left[ -2a + 3b - (a + b) + (-a - b) + 2(-a + b) \right] - a \right\} \\
& = 5 \left\{ -a - b - 3 \left[ -2a + 3b - a - b - a - b - 2a + 2b \right] - a \right\} \\
& = 5 \left\{ -a - b - 3 \left[ -6a + 3b \right] - a \right\} \\
& = 5 \left\{ -2a - b + 18a - 9b \right\} \\
& = 5 \left\{ 16a - 10b \right\} \\
& = 80a - 50b
\end{aligned}$$

$$\begin{aligned}
13. & -3 \left\{ - \left[ +(-a + b) \right] \right\} - 4 \left\{ - \left[ -(-a - b) \right] \right\} \\
& = -3 \left\{ - \left[ -a + b \right] \right\} - 4 \left\{ - \left[ a + b \right] \right\} \\
& = -3 \left\{ a - b \right\} - 4 \left\{ -a - b \right\} \\
& = -3a + 3b + 4a + 4b \\
& = a + 7b
\end{aligned}$$

$$\begin{aligned}
14. & - \left\{ a + b - 2(a - b) + 3 \left\{ - \left[ 2a + b - 3(a + b - 1) \right] \right\} - 3 \left[ -a + 2(-1 + a) \right] \right\} \\
& = - \left\{ a + b - 2a + 2b + 3 \left\{ - \left[ 2a + b - 3a - 3b + 3 \right] \right\} - 3 \left[ -a - 2 + 2a \right] \right\} \\
& = - \left\{ -a + 3b + 3 \left\{ a + 2b - 3 \right\} - 3a + 6 \right\} \\
& = - \left\{ -4a + 3b + 6 + 3a + 6b - 9 \right\} \\
& = - \left\{ -a + 9b - 3 \right\} \\
& = a - 9b + 3
\end{aligned}$$

## EJERCICIO 49

- $-24 \div 8 = -3$
- $-63 \div -7 = 9$
- $-5a^2 \div -a = 5a^{2-1} = 5a$
- $14a^3b^4 \div -2ab^2 = -7a^{3-1}b^{4-2} = -7a^2b^2$
- $-a^3b^4c \div a^3b^4 = -a^{3-3}b^{4-4}c = -c$
- $-a^2b \div -ab = a^{2-1}b^{1-1} = a$
- $54x^2y^2z^3 \div -6xy^2z^3 = -9x^{2-1}y^{2-2}z^{3-3} = -9x$
- $-5m^2n \div m^2n = -5m^{2-2}n^{1-1} = -5$
- $-8a^2x^3 \div -8a^2x^3 = a^{2-2}x^{3-3} = 1$
- $-xy^2 \div 2y = -\frac{xy^{2-1}}{2} = -\frac{xy}{2}$
- $5x^4y^5 \div -6x^4y = -\frac{5}{6}x^{4-4}y^{5-1} = -\frac{5}{6}y^4$
- $-a^8b^9c^4 \div 8c^4 = -\frac{1}{8}a^8b^9c^{4-4} = -\frac{1}{8}a^8b^9$
- $16m^6n^4 \div -5n^3 = -\frac{16}{5}m^6n^{4-3} = -\frac{16}{5}m^6n$
- $-108a^7b^6c^8 \div -20b^6c^8 = \frac{108}{20}a^7b^{6-6}c^{8-8} = \frac{27}{5}a^7$
- $-2m^2n^6 \div -3mn^6 = \frac{2}{3}m^{2-1}n^{6-6} = \frac{2}{3}m$
- $a^x \div a^2 = a^{x-2}$
- $-3a^xb^m \div ab^2 = -3a^{x-1}b^{m-2}$
- $5a^mb^nc \div -6a^3b^4c = -\frac{5}{6}a^{m-3}b^{n-4}c^{1-1} = -\frac{5}{6}a^{m-3}b^{n-4}$
- $a^xb^m \div -4a^mb^n = -\frac{1}{4}a^{x-m}b^{m-n}$
- $-3m^an^x \div -5m^xn^2 = \frac{3}{5}m^{a-x}n^{x-2} = \frac{3}{5}m^{a-x}n^{x-2}$

## EJERCICIO 50

- $a^{m+3} \div a^{m+2} = a^{m+3-m-2} = a$
- $-3a^{m-2} \div -5a^{m-5} = \frac{3}{5}a^{m-2-m+5} = \frac{3}{5}a^3$
- $-4a^{x-2}b^n \div -5a^3b^2 = \frac{4}{5}a^{x-2-3}b^{n-2} = \frac{4}{5}a^{x-5}b^{n-2}$
- $5a^{2m-1}b^{x-3} \div -6a^{2m-2}b^{x-4} = -\frac{5}{6}a^{2m-1-2m+2}b^{x-3-x+4} = -\frac{5}{6}ab$
- $a^{m+n}b^{x+a} \div a^mb^a = a^{m+n-m}b^{x+a-a} = a^n b^x$
- $2x^{a+4} \div -x^{a+2} = -2x^{a+4-a-2} = -2x^2$
- $x^{2n+3} \div -4x^{n+4} = -\frac{1}{4}x^{2n+3-n-4} = -\frac{1}{4}x^{n-1}$
- $-7x^{m+3}y^{m-1} \div -8x^4y^2 = \frac{7}{8}x^{m+3-4}y^{m-1-2} = \frac{7}{8}x^{m-1}y^{m-3}$
- $-4x^{n-1}y^{n+1} \div 5x^{n-1}y^{n+1} = -\frac{4}{5}x^{n-1-n+1}y^{n+1-n-1} = -\frac{4}{5}$
- $-5ab^2c^3 \div 6a^mb^nc^x = -\frac{5}{6}a^{1-m}b^{2-n}c^{3-x}$

## EJERCICIO 51

- $\frac{1}{2}x^2 \div \frac{2}{3} = \frac{1}{2}x^2 \cdot \frac{3}{2} = \frac{3}{4}x^2$
- $-\frac{3}{5}a^3b \div -\frac{4}{5}a^2b = \frac{3}{4}a^{3-2}b^{1-1} = \frac{3}{4}a$
- $\frac{2}{3}xy^5z^3 \div -\frac{1}{6}z^3 = -\frac{2}{1}xy^5z^{3-3} = -2xy^5$
- $\frac{7}{8}a^mb^n \div -\frac{3}{4}ab^2 = -\frac{7}{24}a^{m-1}b^{n-2} = -\frac{7}{24}a^{m-1}b^{n-2}$
- $-\frac{2}{9}x^4y^5 \div -2 = \frac{2}{9}x^4y^5 = \frac{2}{18}x^4y^5 = \frac{1}{9}x^4y^5$
- $3m^4n^5p^6 \div -\frac{1}{3}m^4np^5 = -\frac{3}{1}m^{4-4}n^{5-1}p^{6-5} = -9n^4p$
- $-\frac{7}{8}a^2b^5c^6 \div -\frac{5}{2}ab^5c^6 = \frac{7}{8}a^{2-1}b^{5-5}c^{6-6} = \frac{7}{8}a = \frac{7}{20}a$
- $\frac{2}{3}a^xb^m \div -\frac{3}{5}ab^2 = -\frac{2}{3}a^{x-1}b^{m-2} = -\frac{10}{9}a^{x-1}b^{m-2}$



$$9. -\frac{3}{8}c^3d^5 + \frac{3}{4}d^x = -\frac{8}{3}c^3d^{5-x} = -\frac{12}{24}c^3d^{5-x} = -\frac{1}{2}c^3d^{5-x}$$

$$10. \frac{3}{4}a^m b^n + \frac{3}{2}b^3 = -\frac{4}{3}a^m b^{n-3} = -\frac{6}{12}a^m b^{n-3} = -\frac{1}{2}a^m b^{n-3}$$

$$11. -2a^{x+4}b^{m-3} + \frac{1}{2}a^4b^3 = \frac{2}{1}a^{x+4-4}b^{m-3-3} = 4a^x b^{m-6}$$

$$12. -\frac{1}{15}a^{x-3}b^{m+5}c^2 + \frac{3}{5}a^{x-4}b^{m-1} = -\frac{1}{15}a^{x-3-x+4}b^{m+5-m+1}c^2 = -\frac{5}{45}ab^6c^2 = -\frac{1}{9}ab^6c^2$$

## EJERCICIO 52

$$1. a^2 - ab \div a = \frac{a^2 - ab}{a} = \frac{a^2}{a} - \frac{ab}{a} = a - b$$

$$2. \frac{3x^2y^3 - 5a^2x^4 + -3x^2}{-3x^2} = \frac{3x^2y^3 - 5a^2x^4}{-3x^2} = \frac{3x^2y^3}{-3x^2} - \frac{5a^2x^4}{-3x^2} = -y^3 + \frac{5}{3}a^2x^2$$

$$3. \frac{3a^3 - 5ab^2 - 6a^2b^3}{-2a} = \frac{3a^3}{-2a} - \frac{5ab^2}{-2a} - \frac{6a^2b^3}{-2a} = -\frac{3}{2}a^2 + \frac{5}{2}b^2 + 3ab^3$$

$$4. \frac{x^3 - 4x^2 + x}{x} = \frac{x^3}{x} - \frac{4x^2}{x} + \frac{x}{x} = x^2 - 4x + 1$$

$$5. \frac{4x^8 - 10x^6 - 5x^4}{2x^3} = \frac{4x^8}{2x^3} - \frac{10x^6}{2x^3} - \frac{5x^4}{2x^3} = 2x^5 - 5x^3 - \frac{5}{2}x$$

$$6. \frac{6m^3 - 8m^2n + 20mn^2}{-2m} = \frac{6m^3}{-2m} - \frac{8m^2n}{-2m} + \frac{20mn^2}{-2m} = -3m^2 + 4mn - 10n^2$$

$$7. \frac{6a^8b^8 - 3a^6b^6 - a^2b^3}{3a^2b^3} = \frac{6a^8b^8}{3a^2b^3} - \frac{3a^6b^6}{3a^2b^3} - \frac{a^2b^3}{3a^2b^3} = 2a^6b^5 - a^4b^3 - \frac{1}{3}$$

$$8. \frac{x^4 - 5x^3 - 10x^2 + 15x}{-5x} = \frac{x^4}{-5x} - \frac{5x^3}{-5x} - \frac{10x^2}{-5x} + \frac{15x}{-5x} = -\frac{1}{5}x^3 + x^2 + 2x - 3$$

$$9. \frac{8m^9n^2 - 10m^7n^4 - 20m^5n^6 + 12m^3n^8}{2m^2} = \frac{8m^9n^2}{2m^2} - \frac{10m^7n^4}{2m^2} - \frac{20m^5n^6}{2m^2} + \frac{12m^3n^8}{2m^2} = 4m^7n^2 - 5m^5n^4 - 10m^3n^6 + 6mn^8$$

$$10. \frac{a^x + a^{m-1}}{a^2} = \frac{a^x}{a^2} + \frac{a^{m-1}}{a^2} = a^{x-2} + a^{m-3}$$

$$11. \frac{2a^m - 3a^{m+2} + 6a^{m+4}}{-3a^3} = \frac{2a^m}{-3a^3} - \frac{3a^{m+2}}{-3a^3} + \frac{6a^{m+4}}{-3a^3} = -\frac{2}{3}a^{m-3} + a^{m-1} - 2a^{m+1}$$

$$12. \frac{a^m b^n + a^{m-1} b^{n+2} - a^{m-2} b^{n+4}}{a^2 b^3} = \frac{a^m b^n}{a^2 b^3} + \frac{a^{m-1} b^{n+2}}{a^2 b^3} - \frac{a^{m-2} b^{n+4}}{a^2 b^3} = a^{m-2} b^{n-3} + a^{m-3} b^{n-1} - a^{m-4} b^{n+1}$$

$$13. \frac{x^{m+2} - 5x^m + 6x^{m+1} - x^{m-1}}{x^{m-2}} = \frac{x^{m+2}}{x^{m-2}} - \frac{5x^m}{x^{m-2}} + \frac{6x^{m+1}}{x^{m-2}} - \frac{x^{m-1}}{x^{m-2}} = x^4 - 5x^2 + 6x^3 - x \Rightarrow x^4 + 6x^3 - 5x^2 - x$$

$$14. \frac{4a^{x+4}b^{m-1} - 6a^{x+3}b^{m-2} + 8a^{x+2}b^{m-3}}{-2a^{x+2}b^{m-4}} = \frac{4a^{x+4}b^{m-1}}{-2a^{x+2}b^{m-4}} - \frac{6a^{x+3}b^{m-2}}{-2a^{x+2}b^{m-4}} + \frac{8a^{x+2}b^{m-3}}{-2a^{x+2}b^{m-4}} = -2a^2b^3 + 3ab^2 - 4b$$

## EJERCICIO 53

$$1. \frac{1}{2}x^2 - \frac{2}{3}x = \frac{3}{4}x - \frac{6}{6} = \frac{3}{4}x - 1$$

$$2. \frac{1}{3}a^3 - \frac{3}{5}a^2 + \frac{1}{4}a = -\frac{3}{5}a^2 - \frac{3}{5}a^2 - \frac{3}{5}a^2 = -\frac{5}{9}a^3 + \frac{15}{15}a^2 - \frac{5}{12}a = -\frac{5}{9}a^3 + a^2 - \frac{5}{12}a$$

$$3. \frac{\frac{1}{4}m^4 - \frac{2}{3}m^3n + \frac{3}{8}m^2n^2}{\frac{1}{4}m^2 - \frac{1}{4}m^2 + \frac{1}{4}m^2} = \frac{4}{4}m^2 - \frac{8}{3}mn + \frac{12}{8}n^2 = m^2 - \frac{8}{3}mn + \frac{3}{2}n^2$$

$$4. \frac{\frac{2}{3}x^4y^3 - \frac{1}{5}x^3y^4 + \frac{1}{4}x^2y^5}{-\frac{1}{5}xy^3 - \frac{1}{5}xy^3 - \frac{1}{5}xy^3} - \frac{xy^6}{-\frac{1}{5}xy^3} = -\frac{10}{3}x^3 + \frac{5}{5}x^2y - \frac{5}{4}xy^2 + 5y^3 = -\frac{10}{3}x^3 + x^2y - \frac{5}{4}xy^2 + 5y^3$$

$$5. \frac{\frac{2}{5}a^5}{5a} - \frac{\frac{1}{3}a^3b^3}{5a} - \frac{ab^5}{5a} = \frac{2}{25}a^4 - \frac{1}{15}a^2b^3 - \frac{1}{5}b^5$$

$$6. \frac{\frac{1}{3}a^m}{\frac{1}{2}a} + \frac{\frac{1}{4}a^{m-1}}{\frac{1}{2}a} = \frac{2}{3}a^{m-1} + \frac{2}{4}a^{m-2} = \frac{2}{3}a^{m-1} + \frac{1}{2}a^{m-2}$$

$$7. \frac{\frac{2}{3}a^{x+1}}{\frac{1}{6}a^{x-2}} - \frac{\frac{1}{4}a^{x-1}}{\frac{1}{6}a^{x-2}} - \frac{\frac{2}{5}a^x}{\frac{1}{6}a^{x-2}} = \frac{12}{3}a^3 - \frac{6}{4}a - \frac{12}{5}a^2 \Rightarrow 4a^3 - \frac{12}{5}a^2 - \frac{3}{2}a$$

$$8. \frac{-\frac{3}{4}a^{n-1}x^{m+2}}{-\frac{2}{5}a^3x^2} + \frac{\frac{1}{8}a^n x^{m+1}}{-\frac{2}{5}a^3x^2} - \frac{\frac{2}{3}a^{n+1}x^m}{-\frac{2}{5}a^3x^2} = \frac{15}{8}a^{n-4}x^m - \frac{5}{16}a^{n-3}x^{m-1} + \frac{10}{6}a^{n-2}x^{m-2} = \frac{15}{8}a^{n-4}x^m - \frac{5}{16}a^{n-3}x^{m-1} + \frac{5}{3}a^{n-2}x^{m-2}$$

## EJERCICIO 54

$$1. \frac{a^2+2a-3}{-a^2-3a} \left| \frac{a+3}{a-1} \right.$$

$$\frac{-a-3}{+a+3}$$

$$6. \frac{a^2+5a+6}{-a^2-2a} \left| \frac{a+2}{a+3} \right.$$

$$\frac{3a+6}{-3a-6}$$

$$11. \frac{-8a^2+12ab-4b^2}{+8a^2-8ab} \left| \frac{-a+b}{8a-4b} \right.$$

$$\frac{4ab-4b^2}{-4ab+4b^2}$$

$$2. \frac{a^2-2a-3}{-a^2-a} \left| \frac{a+1}{a-3} \right.$$

$$\frac{-3a-3}{+3a+3}$$

$$7. \frac{6x^2-xy-2y^2}{-6x^2-3xy} \left| \frac{2x+y}{3x-2y} \right.$$

$$\frac{-4xy-2y^2}{+4xy+2y^2}$$

$$12. \frac{6m^2-11mn+5n^2}{-6m^2+6mn} \left| \frac{m-n}{6m-5n} \right.$$

$$\frac{-5mn+5n^2}{+5mn-5n^2}$$

$$3. \frac{x^2+x-20}{-x^2-5x} \left| \frac{x+5}{x-4} \right.$$

$$\frac{-4x-20}{+4x+20}$$

$$8. \frac{-15x^2+22xy-8y^2}{+15x^2-10xy} \left| \frac{-3x+2y}{5x-4y} \right.$$

$$\frac{12xy-8y^2}{-12xy+8y^2}$$

$$13. \frac{-54m^2+12mn+32n^2}{+54m^2-48mn} \left| \frac{-9m+8n}{6m+4n} \right.$$

$$\frac{-36mn+32n^2}{+36mn-32n^2}$$

$$4. \frac{m^2-11m+30}{-m^2+6m} \left| \frac{m-6}{m-5} \right.$$

$$\frac{-5m+30}{+5m-30}$$

$$9. \frac{5a^2+8ab-21b^2}{-5a^2-15ab} \left| \frac{a+3b}{5a-7b} \right.$$

$$\frac{-7ab-21b^2}{+7ab+21b^2}$$

$$14. \frac{-14y^2+71y+33}{+14y^2+6y} \left| \frac{-7y-3}{2y-11} \right.$$

$$\frac{+77y+33}{-77y-33}$$

$$5. \frac{x^2-8x+15}{-x^2+3x} \left| \frac{-x+3}{-x+5} \right.$$

$$\frac{-5x+15}{+5x-15}$$

$$10. \frac{14x^2+22x-12}{-14x^2+6x} \left| \frac{7x-3}{2x+4} \right.$$

$$\frac{28x-12}{-28x+12}$$

$$\begin{array}{r}
 15. \quad x^3 \quad -y^3 \quad \left| \begin{array}{l} x-y \\ x^2+xy+y^2 \end{array} \right. \\
 \hline
 -x^3+x^2y \\
 \hline
 x^2y \\
 -x^2y+xy^2 \\
 \hline
 xy^2-y^3 \\
 -xy^2+y^3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 21. \quad 3y^5 \quad -12y+5y^2+10 \quad \left| \begin{array}{l} y^2+2 \\ y^3-6y+5 \end{array} \right. \\
 \hline
 -3y^5-6y^3 \\
 \hline
 -6y^3-12y \\
 +6y^3+12y \\
 \hline
 5y^2+10 \\
 -5y^2-10 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 16. \quad a^3-3a^2b+3ab^2-b^3 \quad \left| \begin{array}{l} a-b \\ a^2-2ab+b^2 \end{array} \right. \\
 \hline
 -a^3+a^2b \\
 \hline
 -2a^2b+3ab^2 \\
 +2a^2b-2ab^2 \\
 \hline
 ab^2-b^3 \\
 -ab^2+b^3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 22. \quad am^4 \quad -am-2a \quad \left| \begin{array}{l} am+a \\ m^3-m^2+m-2 \end{array} \right. \\
 \hline
 -am^4-am^3 \\
 \hline
 -am^3 \\
 +am^3+am^2 \\
 \hline
 am^2-am \\
 -am^2-am \\
 \hline
 -2am-2a \\
 +2am+2a \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 17. \quad x^4 \quad -9x^2+x+3 \quad \left| \begin{array}{l} x+3 \\ x^3-3x^2+1 \end{array} \right. \\
 \hline
 -x^4-3x^3 \\
 \hline
 -3x^3-9x^2 \\
 +3x^3+9x^2 \\
 \hline
 x+3 \\
 -x-3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 23. \quad 12a^3-35a^2b+33ab^2-10b^3 \quad \left| \begin{array}{l} 4a-5b \\ 3a^2-5ab+2b^2 \end{array} \right. \\
 \hline
 -12a^3+15a^2b \\
 \hline
 -20a^2b+33ab^2 \\
 +20a^2b-25ab^2 \\
 \hline
 8ab^2-10b^3 \\
 -8ab^2+10b^3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 18. \quad a^4 \quad +a \quad \left| \begin{array}{l} a+1 \\ a^3-a^2+a \end{array} \right. \\
 \hline
 -a^4-a^3 \\
 \hline
 -a^3 \\
 +a^3+a^2 \\
 \hline
 a^2+a \\
 -a^2-a \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 24. \quad 15m^5-5m^4n-9m^3n^2+3m^2n^3+3mn^4-n^5 \quad \left| \begin{array}{l} 3m-n \\ 5m^4-3m^2n^2+n^4 \end{array} \right. \\
 \hline
 -15m^5+5m^4n \\
 \hline
 -9m^3n^2+3m^2n^3 \\
 +9m^3n^2-3m^2n^3 \\
 \hline
 3mn^4-n^5 \\
 -3mn^4+n^5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 19. \quad m^6 \quad -n^6 \quad \left| \begin{array}{l} m^2-n^2 \\ m^4+m^2n^2+n^4 \end{array} \right. \\
 \hline
 -m^6+m^4n^2 \\
 \hline
 m^4n^2 \\
 -m^4n^2+m^2n^4 \\
 \hline
 m^2n^4-n^6 \\
 -m^2n^4+n^6 \\
 \hline
 \end{array}$$

### EJERCICIO 55

$$\begin{array}{r}
 20. \quad 2x^4-x^3 \quad +7x-3 \quad \left| \begin{array}{l} 2x+3 \\ x^3-2x^2+3x-1 \end{array} \right. \\
 \hline
 -2x^4-3x^3 \\
 \hline
 -4x^3 \\
 +4x^3+6x^2 \\
 \hline
 6x^2+7x \\
 -6x^2-9x \\
 \hline
 -2x-3 \\
 2x+3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 1. \quad a^4 \quad -a^2-2a-1 \quad \left| \begin{array}{l} a^2+a+1 \\ a^2-a-1 \end{array} \right. \\
 \hline
 -a^4-a^3-a^2 \\
 \hline
 -a^3-2a^2-2a \\
 +a^3+a^2+a \\
 \hline
 -a^2-a-1 \\
 +a^2+a+1 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 2. \quad x^5 + 12x^2 - 5x \quad \left| \begin{array}{l} x^2 - 2x + 5 \\ x^3 + 2x^2 - x \end{array} \right. \\
 \underline{-x^5 + 2x^4 - 5x^3} \\
 2x^4 - 5x^3 + 12x^2 \\
 \underline{-2x^4 + 4x^3 - 10x^2} \\
 -x^3 + 2x^2 - 5x \\
 \underline{+x^3 - 2x^2 + 5x} \\
 0
 \end{array}$$

$$\begin{array}{r}
 8. \quad -x^4 + 3x^3y - 5xy^3 + 3y^4 \quad \left| \begin{array}{l} x^2 - 2xy + y^2 \\ -x^2 + xy + 3y^2 \end{array} \right. \\
 \underline{+x^4 - 2x^3y + x^2y^2} \\
 x^3y + x^2y^2 - 5xy^3 \\
 \underline{-x^3y + 2x^2y^2 - xy^3} \\
 3x^2y^2 - 6xy^3 + 3y^4 \\
 \underline{-3x^2y^2 + 6xy^3 - 3y^4} \\
 0
 \end{array}$$

$$\begin{array}{r}
 3. \quad m^5 - 5m^4n + 20m^2n^3 - 16mn^4 \quad \left| \begin{array}{l} m^2 - 2mn - 8n^2 \\ m^3 - 3m^2n + 2mn^2 \end{array} \right. \\
 \underline{-m^5 + 2m^4n + 8m^3n^2} \\
 -3m^4n + 8m^3n^2 + 20m^2n^3 \\
 \underline{+3m^4n - 6m^3n^2 - 24m^2n^3} \\
 2m^3n^2 - 4m^2n^3 - 16mn^4 \\
 \underline{-2m^3n^2 + 4m^2n^3 + 16mn^4} \\
 0
 \end{array}$$

$$\begin{array}{r}
 9. \quad n^4 - 2n^3 + 2n - 1 \quad \left| \begin{array}{l} n^2 - 2n + 1 \\ n^2 - 1 \end{array} \right. \\
 \underline{-n^4 + 2n^3 - n^2} \\
 -n^2 + 2n - 1 \\
 \underline{+n^2 - 2n + 1} \\
 0
 \end{array}$$

$$\begin{array}{r}
 4. \quad x^4 - x^2 - 2x - 1 \quad \left| \begin{array}{l} x^2 - x - 1 \\ x^2 + x + 1 \end{array} \right. \\
 \underline{-x^4 + x^3 + x^2} \\
 +x^3 - 2x \\
 \underline{-x^3 + x^2 + x} \\
 x^2 - x - 1 \\
 \underline{-x^2 + x + 1} \\
 0
 \end{array}$$

$$\begin{array}{r}
 10. \quad a^5b - 5a^4b^2 + 22a^2b^4 - 40ab^5 \quad \left| \begin{array}{l} a^2b - 2ab^2 - 10b^3 \\ a^3 - 3a^2b + 4ab^2 \end{array} \right. \\
 \underline{-a^5b + 2a^4b^2 + 10a^3b^3} \\
 -3a^4b^2 + 10a^3b^3 + 22a^2b^4 \\
 \underline{+3a^4b^2 - 6a^3b^3 - 30a^2b^4} \\
 4a^3b^3 - 8a^2b^4 - 40ab^5 \\
 \underline{-4a^3b^3 + 8a^2b^4 + 40ab^5} \\
 0
 \end{array}$$

$$\begin{array}{r}
 5. \quad x^6 - 2x^5 + 6x^3 - 7x^2 - 4x + 6 \quad \left| \begin{array}{l} x^4 - 3x^2 + 2 \\ x^2 - 2x + 3 \end{array} \right. \\
 \underline{-x^6 + 2x^5} \\
 3x^4 - 7x^2 - 4x + 6 \\
 \underline{+2x^5 - 6x^3 + 4x} \\
 3x^4 - 9x^2 + 6 \\
 \underline{-3x^4 + 9x^2 - 6} \\
 0
 \end{array}$$

$$\begin{array}{r}
 11. \quad 16x^4 - 24x^2y^2 - 27y^4 \quad \left| \begin{array}{l} 8x^3 - 12x^2y + 6xy^2 - 9y^3 \\ 2x + 3y \end{array} \right. \\
 \underline{-16x^4 + 24x^3y - 12x^2y^2 + 18xy^3} \\
 24x^3y - 36x^2y^2 + 18xy^3 - 27y^4 \\
 \underline{-24x^3y + 36x^2y^2 - 18xy^3 + 27y^4} \\
 0
 \end{array}$$

$$\begin{array}{r}
 6. \quad m^6 + m^5 - 4m^4 + m^2 - 4m - 1 \quad \left| \begin{array}{l} m^3 + m^2 - 4m - 1 \\ m^3 + 1 \end{array} \right. \\
 \underline{-m^6 - m^5 + 4m^4 + m^3} \\
 m^3 + m^2 - 4m - 1 \\
 \underline{-m^3 - m^2 + 4m + 1} \\
 0
 \end{array}$$

$$\begin{array}{r}
 12. \quad 4y^4 + 4y^3 - 13y^2 - 3y - 20 \quad \left| \begin{array}{l} 2y + 5 \\ 2y^3 - 3y^2 + y - 4 \end{array} \right. \\
 \underline{-4y^4 - 10y^3} \\
 -6y^3 - 13y^2 \\
 \underline{+6y^3 + 15y^2} \\
 -2y^2 - 5y - 20 \\
 \underline{-2y^2 - 5y - 20} \\
 -8y - 20 \\
 \underline{8y + 20} \\
 0
 \end{array}$$

$$\begin{array}{r}
 7. \quad a^5 - a^4 + 7a^2 - 27a + 10 \quad \left| \begin{array}{l} a^2 - a + 5 \\ a^3 - 5a + 2 \end{array} \right. \\
 \underline{-a^5 + a^4 - 5a^3} \\
 -5a^3 + 7a^2 - 27a \\
 \underline{+5a^3 - 5a^2 + 25a} \\
 2a^2 - 2a + 10 \\
 \underline{-2a^2 + 2a - 10} \\
 0
 \end{array}$$

$$\begin{array}{r}
 13. \quad -2a^5 - 3a^4x + 5a^3x^2 - 11ax^4 - 3x^5 \quad \left| \begin{array}{l} -a^3 + 2ax^2 + 3x^3 \\ 2a^2 - 3ax - x^2 \end{array} \right. \\
 \underline{+2a^5 - 4a^3x^2 - 6a^2x^3} \\
 3a^4x + a^3x^2 - 6a^2x^3 - 11ax^4 \\
 \underline{-3a^4x + 6a^2x^3 + 9ax^4} \\
 a^3x^2 - 2ax^4 - 3x^5 \\
 \underline{-a^3x^2 + 2ax^4 + 3x^5} \\
 0
 \end{array}$$

$$14. \begin{array}{r} -x^6 + 2x^5y \\ + x^6 - 3x^5y + 2x^4y^2 + x^3y^3 \end{array} \quad \begin{array}{r} -3x^2y^4 - xy^5 \\ -x^2 - xy - y^2 \end{array} \quad \left| \begin{array}{r} x^4 - 3x^3y + 2x^2y^2 + xy^3 \\ -x^2 - xy - y^2 \end{array} \right.$$

$$\begin{array}{r} -x^5y + 2x^4y^2 + x^3y^3 - 3x^2y^4 \\ + x^5y - 3x^4y^2 + 2x^3y^3 + x^2y^4 \\ -x^4y^2 + 3x^3y^3 - 2x^2y^4 - xy^5 \\ + x^4y^2 - 3x^3y^3 + 2x^2y^4 + xy^5 \end{array}$$

$$19. \begin{array}{r} y^6 - 2y^5 - y^4 + 4y^3 \\ -y^6 + 2y^4 - 2y^2 \end{array} \quad \begin{array}{r} -4y + 2 \\ y^2 - 2y + 1 \end{array} \quad \left| \begin{array}{r} y^4 - 2y^2 + 2 \\ -2y^5 + y^4 + 4y^3 - 2y^2 - 4y \\ + 2y^5 - 4y^3 + 4y \end{array} \right.$$

$$\begin{array}{r} -2y^5 + y^4 + 4y^3 - 2y^2 - 4y \\ + 2y^5 - 4y^3 + 4y \end{array}$$

$$15. \begin{array}{r} a^6 - 5a^5 \\ -a^6 + 2a^4 + 7a^3 \end{array} \quad \begin{array}{r} + 31a^2 - 8a + 21 \\ + 2a^4 + 7a^3 \end{array} \quad \left| \begin{array}{r} a^3 - 2a - 7 \\ a^3 - 5a^2 + 2a - 3 \end{array} \right.$$

$$\begin{array}{r} -5a^5 + 2a^4 + 7a^3 + 31a^2 \\ + 5a^5 - 10a^3 - 35a^2 \\ 2a^4 - 3a^3 - 4a^2 - 8a \\ -2a^4 + 4a^2 + 14a \\ -3a^3 + 6a + 21 \\ + 3a^3 - 6a - 21 \end{array}$$

$$20. \begin{array}{r} 3m^7 - 11m^5 + m^4 + 18m^3 - 3m^2 - 8m + 4 \\ -3m^7 + 9m^5 - 12m^3 \end{array} \quad \left| \begin{array}{r} m^4 - 3m^2 + 4 \\ 3m^3 - 2m + 1 \end{array} \right.$$

$$\begin{array}{r} -2m^5 + m^4 + 6m^3 - 8m \\ + 2m^5 - 6m^3 + 8m \\ m^4 - 3m^2 + 4 \\ -m^4 + 3m^2 - 4 \end{array}$$

$$16. \begin{array}{r} m^6 - m^5 + 5m^3 \\ -m^6 - m^5 + m^4 \end{array} \quad \begin{array}{r} -6m + 9 \\ -3m^2 \end{array} \quad \left| \begin{array}{r} m^4 + m^3 - m^2 + 3 \\ m^2 - 2m + 3 \end{array} \right.$$

$$\begin{array}{r} -2m^5 + m^4 + 5m^3 - 3m^2 - 6m \\ + 2m^5 + 2m^4 - 2m^3 + 6m \\ 3m^4 + 3m^3 - 3m^2 + 9 \\ -3m^4 - 3m^3 + 3m^2 - 9 \end{array}$$

$$21. \begin{array}{r} a^6 + 2a^5 - 2a^4 - 3a^3 + 2a^2 - a - 1 \\ -a^6 - a^5 + a^4 - a^3 \end{array} \quad \left| \begin{array}{r} a^3 + a^2 - a + 1 \\ a^3 + a^2 - 2a - 1 \end{array} \right.$$

$$\begin{array}{r} a^5 - a^4 - 4a^3 + 2a^2 \\ -a^5 - a^4 + a^3 - a^2 \\ -2a^4 - 3a^3 + a^2 - a \\ + 2a^4 + 2a^3 - 2a^2 + 2a - 1 \end{array}$$

$$17. \begin{array}{r} a^6 - a^5b - 4a^4b^2 + 6a^3b^3 \\ -a^6 + 2a^5b - a^4b^2 \end{array} \quad \begin{array}{r} -3ab^5 + b^6 \\ a^4 + a^3b - 3a^2b^2 - ab^3 + b^4 \end{array} \quad \left| \begin{array}{r} a^2 - 2ab + b^2 \\ a^4 + a^3b - 3a^2b^2 - ab^3 + b^4 \end{array} \right.$$

$$\begin{array}{r} a^5b - 5a^4b^2 + 6a^3b^3 \\ -a^5b + 2a^4b^2 - a^3b^3 \\ -3a^4b^2 + 5a^3b^3 \\ + 3a^4b^2 - 6a^3b^3 + 3a^2b^4 \\ -a^3b^3 + 3a^2b^4 - 3ab^5 \\ + a^3b^3 - 2a^2b^4 + ab^5 \\ a^2b^4 - 2ab^5 + b^6 \\ -a^2b^4 + 2ab^5 - b^6 \end{array}$$

$$22. \begin{array}{r} 24x^5 - 52x^4y + 38x^3y^2 - 33x^2y^3 - 26xy^4 + 4y^5 \\ -24x^5 + 36x^4y + 18x^3y^2 - 3x^2y^3 \end{array} \quad \left| \begin{array}{r} 8x^3 - 12x^2y - 6xy^2 + y^3 \\ 3x^2 - 2xy + 4y^2 \end{array} \right.$$

$$\begin{array}{r} -16x^4y + 56x^3y^2 - 36x^2y^3 - 26xy^4 \\ + 16x^4y - 24x^3y^2 - 12x^2y^3 + 2xy^4 \\ 32x^3y^2 - 48x^2y^3 - 24xy^4 + 4y^5 \\ -32x^3y^2 - 48x^2y^3 + 24xy^4 - 4y^5 \end{array}$$

$$18. \begin{array}{r} x^6 - 2x^4y^2 + 2x^3y^3 - 2x^2y^4 + 3xy^5 - 2y^6 \\ -x^6 - x^5y + 2x^4y^2 \end{array} \quad \left| \begin{array}{r} x^2 + xy - 2y^2 \\ x^4 - x^3y + x^2y^2 - xy^3 + y^4 \end{array} \right.$$

$$\begin{array}{r} -x^5y + 2x^3y^3 \\ x^3y + x^4y^2 - 2x^3y^3 \\ + x^4y^2 - 2x^2y^4 \\ -x^4y^2 - x^3y^3 + 2x^2y^4 \\ -x^3y^3 + 3xy^5 \\ + x^3y^3 + x^2y^4 - 2xy^5 \\ x^2y^4 + xy^5 - 2y^6 \\ -x^2y^4 - xy^5 + 2y^6 \end{array}$$

$$23. \begin{array}{r} 5a^8 - 4a^7 - 8a^6 + 5a^5 + 6a^4 - 2a^3 + 4a^2 - 6a \\ -5a^8 + 10a^6 - 10a^4 \end{array} \quad \left| \begin{array}{r} a^4 - 2a^2 + 2 \\ 5a^4 - 4a^3 + 2a^2 - 3a \end{array} \right.$$

$$\begin{array}{r} -4a^7 + 2a^6 + 5a^5 - 4a^4 - 2a^3 \\ + 4a^7 - 8a^5 + 8a^3 \\ + 2a^5 - 3a^5 - 4a^4 + 6a^3 + 4a^2 \\ -2a^5 + 4a^4 - 4a^2 \\ -3a^5 + 6a^3 - 6a \\ 3a^5 - 6a^3 + 6a \end{array}$$

$$24. \frac{x^7 - 3x^6 + 6x^5}{-x^7 + 2x^6 - 3x^5 - 6x^4} + \frac{x^2 - 3x + 6}{x^4 - x^3 + x^2 - x + 1}$$

$$-x^6 + 3x^5 - 6x^4$$

$$+x^6 - 2x^5 + 3x^4 + 6x^3$$

$$x^5 - 3x^4 + 6x^3 + x^2$$

$$-x^5 + 2x^4 - 3x^3 - 6x^2 - 3x$$

$$-x^4 + 3x^3 - 5x^2 - 3x$$

$$+x^4 - 2x^3 + 3x^2 + 6x + 6$$

$$x^3 - 2x^2 + 3x + 6$$

$$-x^3 + 2x^2 - 3x - 6$$

$$29. \frac{3a^9 - 15a^7 + 14a^6}{-3a^9 + 6a^7 - 2a^6 + 3a^5 - 2a^4} - \frac{28a^4 + 47a^3 - 28a^2 + 23a - 10}{a^4 - 3a^2 + 4a - 5} \Big| \frac{3a^5 - 6a^3 + 2a^2 - 3a + 2}{a^4 - 3a^2 + 4a - 5}$$

$$-9a^7 + 12a^6 + 3a^5 - 30a^4 + 47a^3 - 28a^2$$

$$+9a^7 - 18a^5 + 6a^4 - 9a^3 + 6a^2$$

$$+12a^6 - 15a^5 - 24a^4 + 38a^3 - 22a^2 + 23a$$

$$-12a^6 + 24a^4 - 8a^3 + 12a^2 - 8a$$

$$-15a^5 + 30a^3 - 10a^2 + 15a - 10$$

$$+15a^5 - 30a^3 + 10a^2 - 15a + 10$$

$$25. \frac{3a^6 + 5a^5 - 9a^4 - 10a^3 + 8a^2 + 3a - 4}{-3a^6 - 2a^5 + 5a^4 + 4a^3} \Big| \frac{3a^3 + 2a^2 - 5a - 4}{a^3 + a^2 - 2a + 1}$$

$$+3a^5 - 4a^4 - 6a^3 + 8a^2$$

$$-3a^5 - 2a^4 + 5a^3 + 4a^2$$

$$-6a^4 - a^3 + 12a^2 + 3a$$

$$+6a^4 + 4a^3 - 10a^2 - 8a$$

$$3a^3 + 2a^2 - 5a - 4$$

$$-3a^3 - 2a^2 + 5a + 4$$

$$30. \frac{a^2 - b^2 + 2bc - c^2}{-a^2 - ab + ac} \Big| \frac{a+b-c}{a-b+c}$$

$$-ab - b^2 + ac + 2bc$$

$$+ab + b^2 - bc$$

$$ac + bc - c^2$$

$$-ac - bc + c^2$$

$$26. \frac{5y^8 - 3y^7 - 11y^6 + 11y^5 - 17y^4 - 3y^3 - 4y^2 - 2y}{-5y^8 + 3y^7 - 4y^6 - 2y^5} \Big| \frac{5y^4 - 3y^3 + 4y^2 + 2y}{y^4 - 3y^2 - 1}$$

$$-15y^6 + 9y^5 - 17y^4 - 3y^3$$

$$+15y^6 - 9y^5 + 12y^4 + 6y^3$$

$$-5y^4 + 3y^3 - 4y^2 - 2y$$

$$+5y^4 - 3y^3 + 4y^2 + 2y$$

$$31. \frac{-2x^2 + 5xy - xz - 3y^2 - yz + 10z^2}{+2x^2 - 3xy + 5xz} \Big| \frac{2x - 3y + 5z}{-x + y + 2z}$$

$$2xy + 4xz - 3y^2 - yz$$

$$-2xy + 3y^2 - 5yz$$

$$4xz - 6yz + 10z^2$$

$$-4xz + 6yz - 10z^2$$

$$27. \frac{-m^7 + 5m^6n - 14m^5n^2 + 20m^4n^3 - 13m^3n^4 - 9m^2n^5 + 20mn^6 - 4n^7}{+m^7 - 3m^6n + 5m^5n^2 - m^4n^3} \Big| \frac{-m^3 + 3m^2n - 5mn^2 + n^3}{m^4 - 2m^3n + 3m^2n^2 - 4n^4}$$

$$2m^6n - 9m^5n^2 + 19m^4n^3 - 13m^3n^4$$

$$-2m^6n + 6m^5n^2 - 10m^4n^3 + 2m^3n^4$$

$$-3m^5n^2 + 9m^4n^3 - 11m^3n^4 - 9m^2n^5$$

$$+3m^5n^2 - 9m^4n^3 + 15m^3n^4 - 3m^2n^5$$

$$4m^3n^4 - 12m^2n^5 + 20mn^6 - 4n^7$$

$$-4m^3n^4 + 12m^2n^5 - 20mn^6 + 4n^7$$

$$28. \frac{x^{11} - 5x^9y^2 + 8x^7y^4 - 6x^5y^6 - 5x^3y^8 + 3xy^{10}}{-x^{11} + 2x^9y^2 - 3x^7y^4} \Big| \frac{x^5 - 2x^3y^2 + 3xy^4}{x^6 - 3x^4y^2 - x^2y^4 + y^6}$$

$$-3x^9y^2 + 5x^7y^4 - 6x^5y^6$$

$$+3x^9y^2 - 6x^7y^4 + 9x^5y^6$$

$$-x^7y^4 + 3x^5y^6 - 5x^3y^8$$

$$+x^7y^4 - 2x^5y^6 + 3x^3y^8$$

$$+x^5y^6 - 2x^3y^8 + 3xy^{10}$$

$$-x^5y^6 + 2x^3y^8 - 3xy^{10}$$

$$32. \frac{x^3 + y^3 - 3xyz + z^3}{-x^3 + x^2y + x^2z - xy^2 + xyz - xz^2} \Big| \frac{x^2 - xy - xz + y^2 - yz + z^2}{x + y + z}$$

$$x^2y + x^2z + y^3 - xy^2 - 2xyz + z^3 - xz^2$$

$$-x^2y - y^3 + xy^2 + xyz + y^2z - yz^2$$

$$x^2z - xyz + z^3 - xz^2 + y^2z - yz^2$$

$$-x^2z + xyz - z^3 + xz^2 - y^2z + yz^2$$

$$\begin{array}{r}
 33. \quad a^5 \qquad \qquad \qquad + b^5 \mid a+b \\
 \hline
 -a^5 - a^4b \\
 \hline
 -a^4b \\
 + a^4b + a^3b^2 \\
 \hline
 a^3b^2 \\
 -a^3b^2 - a^2b^3 \\
 \hline
 -a^2b^3 \\
 + a^2b^3 + ab^4 \\
 \hline
 ab^4 + b^5 \\
 -ab^4 - b^5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 37. \quad x^{15} \qquad \qquad \qquad + y^{15} \mid x^3 + y^3 \\
 \hline
 -x^{15} - x^{12}y^3 \\
 \hline
 -x^{12}y^3 \\
 x^{12}y^3 + x^9y^6 \\
 \hline
 x^9y^6 \\
 -x^9y^6 - x^6y^9 \\
 \hline
 -x^6y^9 \\
 x^6y^9 + x^3y^{12} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34. \quad 21x^5 \qquad \qquad \qquad -21y^5 \mid 3x-3y \\
 \hline
 -21x^5 + 21x^4y \\
 \hline
 21x^4y \\
 -21x^4y + 21x^3y^2 \\
 \hline
 21x^3y^2 \\
 -21x^3y^2 + 21x^2y^3 \\
 \hline
 21x^2y^3 \\
 -21x^2y^3 + 21xy^4 \\
 \hline
 21xy^4 - 21y^5 \\
 -21xy^4 + 21y^5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 38. \quad x^3 + 3x^2y + 3xy^2 + y^3 - 1 \\
 \hline
 -x^3 - 2x^2y - xy^2 \\
 \hline
 x^2y + 2xy^2 + y^3 - 1 - x^2 - xy - x \\
 -x^2y - 2xy^2 - y^3 \qquad \qquad -xy \qquad \qquad -y^2 - y \\
 \hline
 -1 - x^2 - 2xy - x - y^2 - y \\
 +1 + x^2 + 2xy + x + y^2 + y \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 35. \quad 16x^8 \qquad \qquad \qquad -16y^8 \mid 2x^2 + 2y^2 \\
 \hline
 -16x^8 - 16x^6y^2 \\
 \hline
 -16x^6y^2 \\
 +16x^6y^2 + 16x^4y^4 \\
 \hline
 16x^4y^4 \\
 -16x^4y^4 - 16x^2y^6 \\
 \hline
 -16x^2y^6 - 16y^8 \\
 +16x^2y^6 + 16y^8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 39. \quad x^5 \qquad \qquad \qquad + y^5 \mid x^4 - x^3y + x^2y^2 - xy^3 + y^4 \\
 \hline
 -x^5 + x^4y - x^3y^2 + x^2y^3 - xy^4 \\
 \hline
 x^4y - x^3y^2 + x^2y^3 - xy^4 + y^5 \\
 -x^4y + x^3y^2 - x^2y^3 + xy^4 - y^5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 36. \quad x^{10} \qquad \qquad \qquad -y^{10} \mid x^2 - y^2 \\
 \hline
 -x^{10} + x^8y^2 \\
 \hline
 x^8y^2 \\
 -x^8y^2 + x^6y^4 \\
 \hline
 x^6y^4 \\
 -x^6y^4 + x^4y^6 \\
 \hline
 x^4y^6 \\
 -x^4y^6 + x^2y^8 \\
 \hline
 x^2y^8 - y^{10} \\
 -x^2y^8 + y^{10} \\
 \hline
 \end{array}$$

### EJERCICIO 56

$$\begin{array}{r}
 1. \quad a^{x+3} \qquad \qquad \qquad + a^x \mid a+1 \\
 \hline
 -a^{x+3} - a^{x+2} \\
 \hline
 -a^{x+2} \\
 +a^{x+2} + a^{x+1} \\
 \hline
 a^{x+1} + a^x \\
 -a^{x+1} - a^x \\
 \hline
 \end{array}$$

$$\begin{array}{l}
 2. \quad \frac{-x^{n+5} + x^{n+4} + 3x^{n+3} + x^{n+2}}{+x^{n+5} + x^{n+4}} \left| \frac{x^2 + x}{-x^{n+3} + 2x^{n+2} + x^{n+1}} \right. \\
 \quad \frac{+2x^{n+4} + 3x^{n+3}}{-2x^{n+4} - 2x^{n+3}} \\
 \quad \quad \frac{x^{n+3} + x^{n+2}}{-x^{n+3} - x^{n+2}}
 \end{array}$$

$$\begin{array}{l}
 8. \quad \frac{-m^{2a+3} + 2m^{2a+2} + 2m^{2a+1} - 4m^{2a} - m^{2a-1} + m^{2a-2}}{+m^{2a+3} - m^{2a+2} - m^{2a+1}} \left| \frac{-m^{a-1} + m^{a-2} + m^{a-3}}{m^{a+4} - m^{a+3} - 2m^{a+2} + m^{a+1}} \right. \\
 \quad \frac{+m^{2a+2} + m^{2a+1} - 4m^{2a}}{-m^{2a+2} + m^{2a+1} + m^{2a}} \\
 \quad \quad \frac{2m^{2a+1} - 3m^{2a} - m^{2a-1}}{-2m^{2a+1} + 2m^{2a} + 2m^{2a-1}}
 \end{array}$$

$$\begin{array}{l}
 3. \quad \frac{m^{a+4} - m^{a+3} + 6m^{a+1} - 5m^a + 3m^{a-1}}{-m^{a+4} + 2m^{a+3} - 3m^{a+2}} \left| \frac{m^2 - 2m + 3}{m^{a+2} + m^{a+1} - m^a + m^{a-1}} \right. \\
 \quad \frac{m^{a+3} - 3m^{a+2} + 6m^{a+1}}{-m^{a+3} + 2m^{a+2} - 3m^{a+1}} \\
 \quad \quad \frac{-m^{a+2} + 3m^{a+1} - 5m^a}{+m^{a+2} - 2m^{a+1} + 3m^a} \\
 \quad \quad \quad \frac{m^{a+1} - 2m^a + 3m^{a-1}}{-m^{a+1} + 2m^a - 3m^{a-1}}
 \end{array}$$

$$\begin{array}{l}
 9. \quad \frac{x^{2a-2} + x^{2a-3} - 4x^{2a-4}}{-x^{2a-2} + x^{2a-3} + x^{2a-4}} \left| \frac{-x^{2a-7}}{x^{a-1} - x^{a-2} - x^{a-3}} \right. \\
 \quad \frac{+2x^{2a-3} - 3x^{2a-4}}{-2x^{2a-3} + 2x^{2a-4} + 2x^{2a-5}} \\
 \quad \quad \frac{-x^{2a-4} + 2x^{2a-5}}{+x^{2a-4} - x^{2a-5} - x^{2a-6}} \\
 \quad \quad \quad \frac{+x^{2a-5} - x^{2a-6} - x^{2a-7}}{-x^{2a-5} + x^{2a-6} + x^{2a-7}}
 \end{array}$$

$$\begin{array}{l}
 4. \quad \frac{a^{2n+3} + 4a^{2n+2} + a^{2n+1} - 2a^{2n}}{-a^{2n+3} - a^{2n+2}} \left| \frac{a^{n+1} + a^n}{a^{n+2} + 3a^{n+1} - 2a^n} \right. \\
 \quad \frac{3a^{2n+2} + a^{2n+1}}{-3a^{2n+2} - 3a^{2n+1}} \\
 \quad \quad \frac{-2a^{2n+1} - 2a^{2n}}{2a^{2n+1} + 2a^{2n}}
 \end{array}$$

$$\begin{array}{l}
 10. \quad \frac{a^{2n}b^3 - a^{2n-1}b^4 + a^{2n-2}b^5}{-a^{2n}b^3 + a^{2n-1}b^4 - 2a^{2n-2}b^5 + a^{2n-3}b^6} \left| \frac{-2a^{2n-4}b^7 + a^{2n-5}b^8}{a^n b^2 - a^{n-2}b^4} \right. \\
 \quad \frac{-2a^{2n-4}b^7 + a^{2n-5}b^8}{+a^{2n-2}b^5 - a^{2n-3}b^6 + 2a^{2n-4}b^7 - a^{2n-5}b^8}
 \end{array}$$

$$\begin{array}{l}
 5. \quad \frac{x^{2a+5} + 2x^{2a+4} - 3x^{2a+3} - 4x^{2a+2} + 2x^{2a+1}}{-x^{2a+5} + 2x^{2a+3}} \left| \frac{x^{a+3} - 2x^{a+1}}{x^{a+2} + 2x^{a+1} - x^a} \right. \\
 \quad \frac{+2x^{2a+4} - x^{2a+3}}{-2x^{2a+4} + 4x^{2a+2}} \\
 \quad \quad \frac{-x^{2a+3} + 2x^{2a+1}}{+x^{2a+3} - 2x^{2a+1}}
 \end{array}$$

$$\begin{array}{l}
 11. \quad \frac{a^{m+x} + a^m b^x + a^x b^m + b^{m+x}}{-a^{m+x} - a^m b^x} \left| \frac{a^x + b^x}{a^m + b^m} \right. \\
 \quad \frac{a^x b^m + b^{m+x}}{-a^x b^m - b^{m+x}}
 \end{array}$$

$$\begin{array}{l}
 6. \quad \frac{a^{x+2} - 2a^x + 8a^{x-1} - 3a^{x-2}}{-a^{x+2} + 2a^{x+1} - 3a^x} \left| \frac{a^x - 2a^{x-1} + 3a^{x-2}}{a^2 + 2a - 1} \right. \\
 \quad \frac{2a^{x+1} - 5a^x + 8a^{x-1}}{-2a^{x+1} + 4a^x - 6a^{x-1}} \\
 \quad \quad \frac{-a^x + 2a^{x-1} - 3a^{x-2}}{+a^x - 2a^{x-1} + 3a^{x-2}}
 \end{array}$$

$$\begin{array}{l}
 12. \quad \frac{a^x - a^{x-1}b + b^n - ab^{n-1}}{-a^x + a^{x-1}b} \left| \frac{a-b}{a^{x-1} - b^{n-1}} \right. \\
 \quad \frac{b^n - ab^{n-1}}{-b^n + ab^{n-1}}
 \end{array}$$

$$\begin{array}{l}
 7. \quad \frac{a^{2x} + 2a^{2x-1} - 4a^{2x-2} + 5a^{2x-3} - 2a^{2x-4}}{-a^{2x} + a^{2x-1} - a^{2x-2}} \left| \frac{a^x - a^{x-1} + a^{x-2}}{a^x + 3a^{x-1} - 2a^{x-2}} \right. \\
 \quad \frac{3a^{2x-1} - 5a^{2x-2} + 5a^{2x-3}}{-3a^{2x-1} + 3a^{2x-2} - 3a^{2x-3}} \\
 \quad \quad \frac{-2a^{2x-2} + 2a^{2x-3} - 2a^{2x-4}}{+2a^{2x-2} - 2a^{2x-3} + 2a^{2x-4}}
 \end{array}$$

$$\begin{array}{l}
 13. \quad \frac{3a^{5m-3} - 23a^{5m-2} + 5a^{5m-1} + 46a^{5m} - 30a^{5m+1}}{-3a^{5m-3} + 24a^{5m-2} - 18a^{5m-1}} \left| \frac{a^{3m-3} - 8a^{3m-2} + 6a^{3m-1}}{3a^{2m} + a^{2m+1} - 5a^{2m+2}} \right. \\
 \quad \frac{+a^{5m-2} - 13a^{5m-1} + 46a^{5m}}{-a^{5m-2} + 8a^{5m-1} - 6a^{5m}} \\
 \quad \quad \frac{-5a^{5m-1} + 40a^{5m} - 30a^{5m+1}}{5a^{5m-1} - 40a^{5m} + 30a^{5m+1}}
 \end{array}$$



$$\begin{array}{r}
 14. \quad 2x^{3a+1}y^{2x-3} - 4x^{3a}y^{2x-2} \qquad -28x^{3a-2}y^{2x} + 30x^{3a-3}y^{2x+1} \quad \left| \begin{array}{l} -x^{a+2}y^{x-1} + 4x^{a+1}y^x - 3x^a y^{x+1} \\ -2x^{2a-1}y^{x-2} - 4x^{2a-2}y^{x-1} - 10x^{2a-3}y^x \end{array} \right. \\
 \hline
 -2x^{3a+1}y^{2x-3} + 8x^{3a}y^{2x-2} - 6x^{3a-1}y^{2x-1} \\
 + 4x^{3a}y^{2x-2} - 6x^{3a-1}y^{2x-1} - 28x^{3a-2}y^{2x} \\
 \hline
 -4x^{3a}y^{2x-2} + 16x^{3a-1}y^{2x-1} - 12x^{3a-2}y^{2x} \\
 \hline
 10x^{3a-1}y^{2x-1} - 40x^{3a-2}y^{2x} + 30x^{3a-3}y^{2x+1} \\
 \hline
 -10x^{3a-1}y^{2x-1} + 40x^{3a-2}y^{2x} - 30x^{3a-3}y^{2x+1}
 \end{array}$$

### EJERCICIO 57

$$1. \quad \frac{1}{6}a^2 + \frac{5}{36}ab - \frac{1}{6}b^2 \quad \left| \begin{array}{l} \frac{1}{3}a + \frac{1}{2}b \\ \frac{1}{2}a - \frac{1}{3}b \end{array} \right. \\
 \hline
 -\frac{1}{6}a^2 - \frac{1}{4}ab \\
 \hline
 -\frac{1}{9}ab - \frac{1}{6}b^2 \\
 \hline
 \frac{1}{9}ab + \frac{1}{6}b^2$$

$$5. \quad \frac{3}{5}m^4 + \frac{1}{10}m^3n - \frac{17}{60}m^2n^2 + \frac{7}{6}mn^3 - n^4 \quad \left| \begin{array}{l} \frac{3}{2}m^2 - mn + 2n^2 \\ \frac{2}{5}m^2 + \frac{1}{3}mn - \frac{1}{2}n^2 \end{array} \right. \\
 \hline
 -\frac{3}{5}m^4 + \frac{2}{5}m^3n - \frac{4}{5}m^2n^2 \\
 \hline
 \frac{1}{2}m^3n - \frac{65}{60}m^2n^2 + \frac{7}{6}mn^3 \\
 \hline
 -\frac{1}{2}m^3n + \frac{1}{3}m^2n^2 - \frac{2}{3}mn^3 \\
 \hline
 -\frac{3}{4}m^2n^2 + \frac{1}{2}mn^3 - n^4 \\
 \hline
 \frac{3}{4}m^2n^2 - \frac{1}{2}mn^3 + n^4$$

$$2. \quad \frac{1}{3}x^2 + \frac{7}{10}xy - \frac{1}{3}y^2 \quad \left| \begin{array}{l} x - \frac{2}{5}y \\ \frac{1}{3}x + \frac{5}{6}y \end{array} \right. \\
 \hline
 -\frac{1}{3}x^2 + \frac{2}{15}xy \\
 \hline
 \frac{5}{6}xy - \frac{1}{3}y^2 \\
 \hline
 -\frac{5}{6}xy + \frac{1}{3}y^2$$

$$6. \quad \frac{3}{4}x^5 + \frac{1}{2}x^4 - \frac{37}{40}x^3 + \frac{2}{3}x^2 + \frac{19}{30}x - \frac{4}{5} \quad \left| \begin{array}{l} 2x^3 - \frac{1}{3}x + 2 \\ \frac{3}{8}x^2 + \frac{1}{4}x - \frac{2}{5} \end{array} \right. \\
 \hline
 -\frac{3}{4}x^5 + \frac{1}{8}x^3 - \frac{3}{4}x^2 \\
 \hline
 \frac{1}{2}x^4 - \frac{4}{5}x^3 - \frac{1}{12}x^2 + \frac{19}{30}x \\
 \hline
 -\frac{1}{2}x^4 + \frac{1}{12}x^2 - \frac{1}{2}x \\
 \hline
 -\frac{4}{5}x^3 + \frac{2}{15}x - \frac{4}{5} \\
 \hline
 \frac{4}{5}x^3 - \frac{2}{15}x + \frac{4}{5}$$

$$3. \quad \frac{1}{3}x^3 - \frac{35}{36}x^2y + \frac{2}{3}xy^2 - \frac{3}{8}y^3 \quad \left| \begin{array}{l} \frac{1}{2}x^2 - \frac{1}{3}xy + \frac{1}{4}y^2 \\ \frac{2}{3}x - \frac{3}{2}y \end{array} \right. \\
 \hline
 -\frac{1}{3}x^3 + \frac{2}{9}x^2y - \frac{1}{6}xy^2 \\
 \hline
 -\frac{3}{4}x^2y + \frac{1}{2}xy^2 - \frac{3}{8}y^3 \\
 \hline
 \frac{3}{4}x^2y - \frac{1}{2}xy^2 + \frac{3}{8}y^3$$

$$4. \quad \frac{1}{16}a^3 - \frac{5}{8}a^2b + \frac{5}{3}ab^2 - b^3 \quad \left| \begin{array}{l} \frac{1}{4}a - \frac{3}{2}b \\ \frac{1}{4}a^2 - ab + \frac{2}{3}b^2 \end{array} \right. \\
 \hline
 -\frac{1}{16}a^3 + \frac{3}{8}a^2b \\
 \hline
 -\frac{1}{4}a^2b + \frac{5}{3}ab^2 \\
 \hline
 \frac{1}{4}a^2b - \frac{3}{2}ab^2 \\
 \hline
 \frac{1}{6}ab^2 - b^3 \\
 \hline
 -\frac{1}{6}ab^2 + b^3$$

$$7. \quad \frac{9}{4}a^4 - a^3x - \frac{1}{12}a^2x^2 + \frac{13}{18}ax^3 - \frac{1}{3}x^4 \quad \left| \begin{array}{l} \frac{3}{2}a^2 - ax + \frac{2}{3}x^2 \\ \frac{3}{2}a^2 + \frac{1}{3}ax - \frac{1}{2}x^2 \end{array} \right. \\
 \hline
 -\frac{9}{4}a^4 + \frac{3}{2}a^3x - a^2x^2 \\
 \hline
 \frac{1}{2}a^3x - \frac{13}{12}a^2x^2 + \frac{13}{18}ax^3 \\
 \hline
 -\frac{1}{2}a^3x + \frac{1}{3}a^2x^2 - \frac{2}{9}ax^3 \\
 \hline
 -\frac{3}{4}a^2x^2 + \frac{1}{2}ax^3 - \frac{1}{3}x^4 \\
 \hline
 \frac{3}{4}a^2x^2 - \frac{1}{2}ax^3 + \frac{1}{3}x^4$$

$$\begin{array}{r}
 8. \quad \frac{1}{14}x^5 - \frac{101}{420}x^4y + \frac{139}{280}x^3y^2 - \frac{1}{2}x^2y^3 + \frac{5}{12}xy^4 \quad \left| \begin{array}{l} \frac{2}{7}x^3 - \frac{1}{5}x^2y + \frac{1}{2}xy^2 \\ \frac{1}{4}x^2 - \frac{2}{3}xy + \frac{5}{6}y^2 \end{array} \right. \\
 \hline
 -\frac{1}{14}x^5 + \frac{1}{20}x^4y - \frac{1}{8}x^3y^2 \\
 \hline
 -\frac{4}{21}x^4y + \frac{13}{35}x^3y^2 - \frac{1}{2}x^2y^3 \\
 + \frac{4}{21}x^4y - \frac{2}{15}x^3y^2 + \frac{1}{3}x^2y^3 \\
 \hline
 \frac{5}{21}x^3y^2 - \frac{1}{6}x^2y^3 + \frac{5}{12}xy^4 \\
 -\frac{5}{21}x^3y^2 + \frac{1}{6}x^2y^3 - \frac{5}{12}xy^4 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 9. \quad \frac{3}{8}x^5 + \frac{21}{40}x^4 - \frac{47}{120}x^3 + \frac{79}{120}x^2 + \frac{1}{10}x - \frac{1}{10} \quad \left| \begin{array}{l} \frac{1}{4}x^3 + \frac{1}{3}x^2 - \frac{1}{4}x + \frac{1}{2} \\ \frac{3}{2}x^2 + \frac{1}{10}x - \frac{1}{5}x \end{array} \right. \\
 \hline
 -\frac{3}{8}x^5 - \frac{1}{2}x^4 + \frac{3}{8}x^3 - \frac{3}{4}x^2 \\
 \hline
 \frac{1}{40}x^4 - \frac{1}{60}x^3 - \frac{11}{120}x^2 + \frac{1}{10}x \\
 -\frac{1}{40}x^4 - \frac{1}{30}x^3 + \frac{1}{40}x^2 - \frac{1}{20}x \\
 \hline
 -\frac{1}{20}x^3 - \frac{1}{15}x^2 + \frac{1}{20}x - \frac{1}{10} \\
 \hline
 \frac{1}{20}x^3 + \frac{1}{15}x^2 - \frac{1}{20}x + \frac{1}{10} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 10. \quad \frac{1}{2}m^5 - \frac{5}{6}m^4n + \frac{99}{40}m^3n^2 - \frac{101}{60}m^2n^3 + \frac{7}{6}mn^4 - \frac{5}{8}n^5 \quad \left| \begin{array}{l} \frac{3}{4}m^3 - \frac{1}{2}m^2n + \frac{2}{5}mn^2 - \frac{1}{4}n^3 \\ \frac{2}{3}m^2 - \frac{2}{3}mn + \frac{5}{2}n^2 \end{array} \right. \\
 \hline
 -\frac{1}{2}m^5 + \frac{1}{3}m^4n - \frac{4}{15}m^3n^2 + \frac{1}{6}m^2n^3 \\
 \hline
 -\frac{1}{2}m^4n + \frac{53}{24}m^3n^2 - \frac{91}{60}m^2n^3 + \frac{7}{6}mn^4 \\
 \frac{1}{2}m^4n - \frac{1}{3}m^3n^2 + \frac{4}{15}m^2n^3 - \frac{1}{6}mn^4 \\
 \hline
 \frac{15}{8}m^3n^2 - \frac{5}{4}m^2n^3 + mn^4 - \frac{5}{8}n^5 \\
 -\frac{15}{8}m^3n^2 + \frac{5}{4}m^2n^3 - mn^4 + \frac{5}{8}n^5 \\
 \hline
 \end{array}$$

## EJERCICIO 58

$$\begin{array}{r}
 1. \quad x^5 - x^4 + x^2 - x + x^3 - x^2 + x \\
 \begin{array}{r}
 1-1+0+1-1 \quad | \quad 1-1+1 \\
 -1+1-1 \quad \quad \quad 1+0-1 \\
 \hline
 -1+1-1 \quad \Rightarrow x^2 - 1 \\
 \hline
 +1-1+1
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 3. \quad a^6 + a^5b - 7a^4b^2 + 12a^3b^2 - 13a^2b^4 + 7ab^5 - b^6 + a^2 - 2ab + b^2 \\
 \begin{array}{r}
 1+1-7+12-13+7-1 \quad | \quad 1-2+1 \\
 -1+2-1 \quad \quad \quad \quad 1+3-2+5-1 \\
 \hline
 3-8+12 \quad \Rightarrow a^4 + 3a^3b - 2a^2b^2 + 5ab^3 - b^4 \\
 \hline
 -3+6-3
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 2. \quad x^7 + x^6 - 11x^5 + 3x^4 - 13x^3 + 19x^2 - 56x + x^3 - 2x^2 - 7 \\
 \begin{array}{r}
 1+1-11+3-13+19+0-56 \quad | \quad 1-2+0-7 \\
 -1+2-0+7 \quad \quad \quad \quad 1+3-5+0+8 \\
 \hline
 3-11+10-13 \quad \Rightarrow x^4 + 3x^3 - 5x^2 + 8 \\
 \hline
 -3+6-0+21 \\
 -5+10+8+19 \\
 +5-10+0-35 \\
 \hline
 8-16+0-56 \\
 \hline
 -8+16-0+56
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 -2+9-13 \\
 2-4+2 \\
 \hline
 5-11+7 \\
 -5+10-5 \\
 \hline
 -1+2-1 \\
 +1-2+1 \\
 \hline
 \end{array}$$

$$4. m^6 - 5m^5n + 2m^4n^2 + 20m^3n^3 - 19m^2n^4 - 10mn^5 - n^6 + m^3 - 4mn^2 - n^3$$

$$\begin{array}{r} 1-5+2+20-19-10-1 \quad | \quad 1+0-4-1 \\ \hline -1-0+4+1 \quad \quad \quad 1-5+6+1 \end{array}$$

$$\begin{array}{r} -5+6+21-19 \\ \hline 5+0-20-5 \end{array} \Rightarrow m^3 - 5m^2n + 6mn^2 + n^3$$

$$\begin{array}{r} 6+1-24-10 \\ \hline -6-0+24+6 \end{array}$$

$$\begin{array}{r} 1+0-4-1 \\ \hline -1-0+4+1 \end{array}$$

$$8. m^{28} - 12m^{24} + 53m^{20} - 127m^{16} + 187m^{12} - 192m^8 + 87m^4 - 45 + m^{12} - 7m^8 + 9m^4 - 15$$

$$\begin{array}{r} 1-12+53-127+187-192+87-45 \quad | \quad 1-7+9-15 \\ \hline -1+7-9+15 \quad \quad \quad 1-5+9-4+3 \end{array}$$

$$\begin{array}{r} -1+7-9+15 \\ \hline -5+44-112+187 \end{array}$$

$$\Rightarrow m^{16} - 5m^{12} + 9m^8 - 4m^4 + 3$$

$$\begin{array}{r} +5-35+45-75 \\ \hline 9-67+112-192 \end{array}$$

$$\begin{array}{r} 9-67+112-192 \\ \hline -9+63-81+135 \end{array}$$

$$\begin{array}{r} -9+63-81+135 \\ \hline -4+31-57+87 \end{array}$$

$$\begin{array}{r} -4+31-57+87 \\ \hline +4-28+36-60 \end{array}$$

$$\begin{array}{r} +4-28+36-60 \\ \hline 3-21+27-45 \end{array}$$

$$\begin{array}{r} 3-21+27-45 \\ \hline -3+21-27+45 \end{array}$$

$$5. x^8 - 2x^6 - 50x^4 + 58x^2 - 15 + x^4 + 6x^2 - 5$$

$$\begin{array}{r} 1-2-50+58-15 \quad | \quad 1+6-5 \\ \hline -1-6+5 \quad \quad \quad 1-8+3 \end{array}$$

$$\begin{array}{r} -1-6+5 \\ \hline -8-45+58 \end{array} \Rightarrow x^4 - 8x^2 + 3$$

$$\begin{array}{r} -8-45+58 \\ \hline +8+48-40 \end{array}$$

$$\begin{array}{r} +8+48-40 \\ \hline 3+18-15 \end{array}$$

$$\begin{array}{r} 3+18-15 \\ \hline -3-18+15 \end{array}$$

$$6. a^{14} - 7a^{12} + 9a^{10} + 23a^8 - 52a^6 + 42a^4 - 20a^2 + a^8 - 4a^6 + 3a^4 - 2a^2$$

$$\begin{array}{r} 1-7+9+23-52+42-20 \quad | \quad 1-4+3-2 \\ \hline -1+4-3+2 \quad \quad \quad 1-3-6+10 \end{array}$$

$$\begin{array}{r} -1+4-3+2 \\ \hline -3+6+25-52 \end{array} \Rightarrow a^6 - 3a^4 - 6a^2 + 10$$

$$\begin{array}{r} -3+6+25-52 \\ \hline 3-12+9-6 \end{array}$$

$$\begin{array}{r} 3-12+9-6 \\ \hline -6+34-58+42 \end{array}$$

$$\begin{array}{r} -6+34-58+42 \\ \hline +6-24+18-12 \end{array}$$

$$\begin{array}{r} +6-24+18-12 \\ \hline 10-40+30-20 \end{array}$$

$$\begin{array}{r} 10-40+30-20 \\ \hline -10+40-30+20 \end{array}$$

$$7. 3x^{15} - 20x^{12} + 51x^9 - 70x^6 + 46x^3 - 20 + 3x^6 - 8x^3 + 10$$

$$\begin{array}{r} 3-20+51-70+46-20 \quad | \quad 3-8+10 \\ \hline -3+8-10 \quad \quad \quad 1-4+3-2 \end{array}$$

$$\begin{array}{r} -3+8-10 \\ \hline -12+41-70 \end{array} \Rightarrow x^9 - 4x^6 + 3x^3 - 2$$

$$\begin{array}{r} -12+41-70 \\ \hline 12-32+40 \end{array}$$

$$\begin{array}{r} 12-32+40 \\ \hline 9-30+46 \end{array}$$

$$\begin{array}{r} 9-30+46 \\ \hline -9+24-30 \end{array}$$

$$\begin{array}{r} -9+24-30 \\ \hline -6+16-20 \end{array}$$

$$\begin{array}{r} -6+16-20 \\ \hline 6-16+20 \end{array}$$

$$9. 2x^7 - 6x^6y - 8x^5y^2 - 20x^4y^3 - 24x^3y^4 - 18x^2y^5 - 4y^7 + 2x^2 + 4y^2$$

$$\begin{array}{r} 2-6-8-20-24-18+0-4 \quad | \quad 2+0+4 \\ \hline -2-0-4 \quad \quad \quad 1-3-6-4+0-1 \end{array}$$

$$\begin{array}{r} -2-0-4 \\ \hline -6-12-20 \end{array} \Rightarrow x^5 - 3x^4y - 6x^3y^2 - 4x^2y^3 - y^5$$

$$\begin{array}{r} -6-12-20 \\ \hline 6+0+12 \end{array}$$

$$\begin{array}{r} 6+0+12 \\ \hline -12-8-24 \end{array}$$

$$\begin{array}{r} -12-8-24 \\ \hline +12+0+24 \end{array}$$

$$\begin{array}{r} +12+0+24 \\ \hline -8+0-18 \end{array}$$

$$\begin{array}{r} -8+0-18 \\ \hline +8+0+16 \end{array}$$

$$\begin{array}{r} +8+0+16 \\ \hline -2+0-4 \end{array}$$

$$\begin{array}{r} -2+0-4 \\ \hline 2+0+4 \end{array}$$

$$10. 6a^9 - 12a^7 + 2a^6 - 36a^5 + 6a^4 - 16a^3 + 38a^2 - 44a + 14 + a^4 - 2a^2 + a - 7$$

$$\begin{array}{r} 6+0-12+2-36+6-16+38-44+14 \quad | \quad 1+0-2+1-7 \\ \hline -6-0+12-6+42 \quad \quad \quad 6+0+0-4+6-2 \end{array}$$

$$\begin{array}{r} -6-0+12-6+42 \\ \hline -4+6+6-16+38 \end{array} \Rightarrow 6a^5 - 4a^2 + 6a - 2$$

$$\begin{array}{r} -4+6+6-16+38 \\ \hline +4+0-8+4-28 \end{array}$$

$$\begin{array}{r} +4+0-8+4-28 \\ \hline 6-2-12+10-44 \end{array}$$

$$\begin{array}{r} 6-2-12+10-44 \\ \hline -6-0+12-6+42 \end{array}$$

$$\begin{array}{r} -6-0+12-6+42 \\ \hline -2+0+4-2+14 \end{array}$$

$$\begin{array}{r} -2+0+4-2+14 \\ \hline +2-0-4+2-14 \end{array}$$

$$\begin{array}{r} +2-0-4+2-14 \\ \hline \end{array}$$

$$11. n^{10} - 6n^8 + 5n^7 + 13n^6 - 23n^5 - 8n^4 + 44n^3 - 12n^2 - 32n + 16 \div n^6 - 3n^4 + 5n^3 - 8n + 4$$

$$\begin{array}{r} 1+0-6+5+13-23-8+44-12-32+16 \quad | \quad 1+0-3+5+0-8+4 \\ -1-0+3-5-0+8-4 \quad \quad \quad 1+0-3+0+4 \end{array}$$

$$\begin{array}{r} -3+0+13-15-12+44-12 \quad \quad \quad \Rightarrow n^4 - 3n^2 + 4 \\ +3+0-9+15+0-24+12 \end{array}$$

$$12. 3x^7 - 4x^6y - 15x^5y^2 + 29x^4y^3 - 13x^3y^4 + 5xy^6 - 3y^7 + x^3 - 5xy^2 + 3y^3$$

$$\begin{array}{r} 4+0-12+20+0-36+16 \quad \quad \quad 3-4-15+29-13+0+5-3 \quad | \quad 1+0-5+3 \\ -4+0+12-20-0+36-16 \quad \quad \quad -3-0+15-9 \quad \quad \quad 3-4+0+0-1 \end{array}$$

$$\begin{array}{r} -4+0+20-13 \quad \quad \quad \Rightarrow 3x^4 - 4x^3y - y^4 \\ +4+0-20+12 \end{array}$$

$$-1+0+5-3$$

$$\underline{1-0-5+3}$$

$$13. x^{16} - 4x^{14}y^2 - 10x^{12}y^4 + 21x^{10}y^6 + 28x^8y^8 - 23x^6y^{10} + 9x^4y^{12} + 33x^2y^{14} - 6y^{16} \div x^6 - 4x^4y^2 - 5x^2y^4 + y^6$$

$$\begin{array}{r} 1-4-10+21+28-23+9+33-6 \quad | \quad 1-4-5+1 \\ -1+4+5-1 \quad \quad \quad 1+0-5+0+3-6 \end{array}$$

$$\begin{array}{r} -5+20+28-23 \quad \Rightarrow x^{10} - 5x^6y^4 + 3x^2y^8 - 6y^{10} \\ +5-20-25+5 \end{array}$$

$$3-18+9+33$$

$$\underline{-3+12+15-3}$$

$$-6+24+30-6$$

$$\underline{+6-24-30+6}$$

$$14. a^{m+2} - 3a^{m+1} - 5a^m + 20a^{m-1} - 25a^{m-3} + a^2 - 5$$

$$\begin{array}{r} 1-3-5+20+0-25 \quad | \quad 1+0-5 \\ -1-0+5 \quad \quad \quad 1-3+0+5 \end{array}$$

$$-3+0+20 \quad \Rightarrow a^m - 3a^{m-1} + 5a^{m-3}$$

$$+3+0-15$$

$$+5+0-25$$

$$\underline{-5-0+25}$$

$$15. 7a^{2x+5} - 35a^{2x+4} + 6a^{2x+3} - 78a^{2x+2} - 5a^{2x+1} - 42a^{2x} - 7a^{2x-1} + 7a^{x+3} + 6a^{x+1} + a^x$$

$$\begin{array}{r} 7-35+6-78-5-42-7 \quad | \quad 7+0+6+1 \\ -7-0-6-1 \quad \quad \quad 1-5+0-7 \end{array}$$

$$\begin{array}{r} -35+0-79-5 \quad \quad \quad \Rightarrow a^{x+2} - 5a^{x+1} - 7a^{x-1} \\ +35+0+30+5 \end{array}$$

$$-49+0-42-7$$

$$\underline{49-0+42+7}$$

$$16. 6x^{2a+3} - 4x^{2a+2} - 28x^{2a+1} + 21x^{2a} - 46x^{2a-1} + 19x^{2a-2} - 12x^{2a-3} - 6x^{2a-4} + 6x^{a+1} - 4x^a + 2x^{a-1} + x^{a-2}$$

$$\begin{array}{r} 6-4-28+21-46+19-12-6 \quad | \quad 6-4+2+1 \\ -6+4-2-1 \quad \quad \quad 1+0-5+0-6 \end{array}$$

$$\begin{array}{r} -30+20-46+19 \quad \quad \quad \Rightarrow x^{a+2} - 5x^a - 6x^{a-2} \\ +30-20+10+5 \end{array}$$

$$-36+24-12-6$$

$$\underline{36-24+12+6}$$

$$17. 6a^{5x+3} - 23a^{5x+2} + 12a^{5x+1} - 34a^{5x} + 22a^{5x-1} - 15a^{5x-2} + a^{2x+2} - 3a^{2x+1} - a^{2x} - 5a^{2x-1}$$

$$\begin{array}{r} 6-23+12-34+22-15 \quad | \quad 1-3-1-5 \\ -6+18+6+30 \quad \quad \quad 6-5+3 \end{array}$$

$$\begin{array}{r} -5+18-4+22 \quad \quad \quad \Rightarrow 6a^{3x+1} - 5a^{3x} + 3a^{3x-1} \\ +5-15-5-25 \end{array}$$

$$3-9-3-15$$

$$\underline{-3+9+3+15}$$

## EJERCICIO 59

$$1. \begin{array}{r} a^2 + b^2 \quad \overline{) a^2} \\ -a^2 \quad \quad \quad 1 + \frac{b^2}{a^2} \\ \hline b^2 \end{array}$$

$$2. \begin{array}{r} a^4 + 2 \quad \overline{) a^3} \\ -a^4 \quad \quad \quad a + \frac{2}{a^3} \\ \hline +2 \end{array}$$

$$3. \begin{array}{r} 9x^3 + 6x^2 + 7 \quad \overline{) 3x^2} \\ -9x^3 \quad \quad \quad 3x + 2 + \frac{7}{3x^2} \\ \hline +6x^2 \\ -6x^2 \\ \hline +7 \end{array}$$

$$4. \begin{array}{r} 16a^4 - 20a^3b + 8a^2b^2 + 7ab^3 \quad \overline{) 4a^2} \\ -16a^4 \quad \quad \quad 4a^2 - 5ab + 2b^2 + \frac{7b^3}{4a} \\ \hline -20a^3b \\ +20a^3b \\ \hline 8a^2b^2 \\ -8a^2b^2 \\ \hline +7ab^3 \end{array}$$

$$9. \begin{array}{r} x^3 - x^2 + 3x + 2 \quad \overline{) x^2 - x + 1} \\ -x^3 + x^2 - x \quad \quad \quad x + \frac{2x+2}{x^2 - x + 1} \\ \hline +2x + 2 \end{array}$$

$$10. \begin{array}{r} x^3 \quad \quad \quad + y^3 \quad \overline{) x - y} \\ -x^3 + x^2y \quad \quad \quad x^2 + xy + y^2 + \frac{2y^3}{x - y} \\ \hline x^2y \\ -x^2y + xy^2 \\ \hline xy^2 + y^3 \\ -xy^2 + y^3 \\ \hline 2y^3 \end{array}$$

$$5. \begin{array}{r} x^2 + 7x + 10 \quad \overline{) x + 6} \\ -x^2 - 6x \quad \quad \quad x + 1 + \frac{4}{x + 6} \\ \hline x + 10 \\ -x - 6 \\ \hline +4 \end{array}$$

$$11. \begin{array}{r} x^5 \quad \quad \quad + y^5 \quad \overline{) x - y} \\ -x^4 + x^4y \quad \quad \quad x^4 + x^3y + x^2y^2 + xy^3 + y^4 + \frac{2y^5}{x - y} \\ \hline x^4y \\ -x^4y + x^3y^2 \\ \hline x^3y^2 \\ -x^3y^2 + x^2y^3 \\ \hline x^2y^3 \\ -x^2y^3 + xy^4 \\ \hline xy^4 + y^5 \\ -xy^4 + y^5 \\ \hline 2y^5 \end{array}$$

$$7. \begin{array}{r} m^4 - 11m^2 + 34 \quad \overline{) m^2 - 3} \\ -m^4 + 3m^2 \quad \quad \quad m^2 - 8 + \frac{10}{m^2 - 3} \\ \hline -8m^2 + 34 \\ 8m^2 - 24 \\ \hline +10 \end{array}$$

$$\begin{array}{r} x^2y^3 \\ -x^2y^3 + xy^4 \\ \hline +xy^4 + y^5 \\ -xy^4 + y^5 \\ \hline 2y^5 \end{array}$$

$$8. \begin{array}{r} x^2 - 6xy + y^2 \quad \overline{) x + y} \\ -x^2 - xy \quad \quad \quad x - 7y + \frac{8y^2}{x + y} \\ \hline -7xy + y^2 \\ +7xy + 7y^2 \\ \hline +8y^2 \end{array}$$

$$12. \begin{array}{r} x^3 + 4x^2 - 5x + 8 \quad \overline{) x^2 - 2x + 1} \\ -x^3 + 2x^2 - x \quad \quad \quad x + 6 + \frac{6x+2}{x^2 - 2x + 1} \\ \hline 6x^2 - 6x + 8 \\ -6x^2 + 12x - 6 \\ \hline 6x + 2 \end{array}$$

$$\begin{array}{r}
 \text{13. } \frac{8a^3 - 6a^2b + 5ab^2 - 9b^3}{-8a^3 + 12a^2b} \quad \frac{2a - 3b}{4a^2 + 3ab + 7b^2 + \frac{12b^3}{2a - 3b}} \quad \text{14. } \frac{x^5 - 3x^4}{-x^5 + 3x^4 - 2x^3} \quad \frac{+9x^2 + 7x - 4}{x^2 - 3x + 2} \quad \frac{x^2 - 3x + 2}{x^3 - 2x + 3 + \frac{20x - 10}{x^2 - 3x + 2}} \\
 \frac{6a^2b + 5ab^2}{-6a^2b + 9ab^2} \quad \frac{-2x^3 + 9x^2 + 7x}{+2x^3 - 6x^2 + 4x} \\
 \frac{14ab^2 - 9b^3}{-14ab^2 + 21b^3} \quad \frac{3x^2 + 11x - 4}{-3x^2 + 9x - 6} \\
 \frac{\quad}{12b^3} \quad \frac{\quad}{20x - 10}
 \end{array}$$

## EJERCICIO 60

Para los problemas del 1 al 9 las literales toman los siguientes valores:

$$a = -1 \quad b = -2 \quad c = -1/2$$

$$\begin{array}{lll}
 \text{1. } a^2 - 2ab + b^2 & \text{2. } 3a^3 - 4a^2b + 3ab^2 - b^3 & \text{3. } a^4 - 3a^3 + 2ac - 3bc \\
 = (-1)^2 - 2(-1) \cdot 2 + 2^2 & = 3(-1)^3 - 4(-1)^2 \cdot 2 + 3(-1)2^2 - 2^3 & = (-1)^4 - 3(-1)^3 + 2(-1)\left(-\frac{1}{2}\right) - 3 \cdot 2\left(-\frac{1}{2}\right) \\
 = 1 + 2 \cdot 2 + 4 = 1 + 4 + 4 = 9 & = -3 - 4 \cdot 2 - 3 \cdot 4 - 8 = -3 - 8 - 12 - 8 = -31 & = 1 + 3 + 2 \cdot \frac{1}{2} + 6 \cdot \frac{1}{2} = 1 + 3 + 1 + 3 = 8
 \end{array}$$

$$\begin{array}{l}
 \text{4. } a^5 - 8a^4c + 16a^3c^2 - 20a^2c^3 + 40ac^4 - c^5 \\
 = (-1)^5 - 8(-1)^4\left(-\frac{1}{2}\right) + 16(-1)^3\left(-\frac{1}{2}\right)^2 - 20(-1)^2\left(-\frac{1}{2}\right)^3 + 40(-1)\left(-\frac{1}{2}\right)^4 - \left(-\frac{1}{2}\right)^5 \\
 = -1 + 8 \cdot \frac{1}{2} - 16 \cdot \frac{1}{4} + 20 \cdot \frac{1}{8} - 40 \cdot \frac{1}{16} + \frac{1}{32} = -1 + 4 - 4 + \frac{5}{2} - \frac{5}{2} + \frac{1}{32} = -1 + \frac{1}{32} = \frac{-32 + 1}{32} = -\frac{31}{32}
 \end{array}$$

$$\begin{array}{ll}
 \text{5. } (a-b)^2 + (b-c)^2 - (a-c)^2 & \text{6. } (b+a)^3 - (b-c)^3 - (a-c)^3 \\
 = (-1-2)^2 + \left[2 - \left(-\frac{1}{2}\right)\right]^2 - \left[-1 - \left(-\frac{1}{2}\right)\right]^2 & = [2+(-1)]^3 - \left[2 - \left(-\frac{1}{2}\right)\right]^3 - \left[-1 - \left(-\frac{1}{2}\right)\right]^3 \\
 = (-3)^2 + \left[2 + \frac{1}{2}\right]^2 - \left[-1 + \frac{1}{2}\right]^2 = 9 + \left(\frac{5}{2}\right)^2 - \left(-\frac{1}{2}\right)^2 & = [2-1]^3 - \left[2 + \frac{1}{2}\right]^3 - \left[-1 + \frac{1}{2}\right]^3 = 1^3 - \left[\frac{5}{2}\right]^3 - \left[-\frac{1}{2}\right]^3 \\
 = 9 + \frac{25}{4} - \frac{1}{4} = 9 + \frac{24}{4} = 9 + 6 = 15 & = 1 - \frac{125}{8} + \frac{1}{8} = 1 - \frac{124}{8} = 1 - \frac{31}{2} = \frac{2-31}{2} = -\frac{29}{2} = -14\frac{1}{2}
 \end{array}$$

$$\begin{array}{ll}
 \text{7. } \frac{ab}{c} + \frac{ac}{b} - \frac{bc}{a} & \text{8. } (a+b+c)^2 - (a-b-c)^2 + c \\
 = \frac{-1 \cdot 2}{-\frac{1}{2}} + \frac{-1\left(-\frac{1}{2}\right)}{2} - \frac{2\left(-\frac{1}{2}\right)}{-1} = \frac{2}{\frac{1}{2}} + \frac{1}{2} - \frac{2}{-1} & = \left[-1 + 2 + \left(-\frac{1}{2}\right)\right]^2 - \left[-1 - 2 - \left(-\frac{1}{2}\right)\right]^2 + \left(-\frac{1}{2}\right) \\
 = 4 + \frac{1}{4} - 1 = 3 + \frac{1}{4} = \frac{12+1}{4} = \frac{13}{4} = 3\frac{1}{4} & = \left[1 - \frac{1}{2}\right]^2 - \left[-3 + \frac{1}{2}\right]^2 - \frac{1}{2} = \left[\frac{1}{2}\right]^2 - \left[-\frac{5}{2}\right]^2 - \frac{1}{2} \\
 & = \frac{1}{4} - \frac{25}{4} - \frac{1}{2} = \frac{1-25-2}{4} = -\frac{26}{4} = -6\frac{1}{2}
 \end{array}$$

$$\begin{array}{l}
 \text{9. } 3(2a+b) - 4a(b+c) - 2c(a-b) \\
 = 3[2(-1)+2] - 4(-1)\left[2 + \left(-\frac{1}{2}\right)\right] - 2\left(-\frac{1}{2}\right)(-1-2) = 3[-2+2] + 4\left[2 - \frac{1}{2}\right] + \frac{2}{2}(-3) = 3 \cdot 0 + 4\left[\frac{3}{2}\right] - \frac{6}{2} = 6 - 3 = 3
 \end{array}$$

Para los problemas 10 al 16 las literales toman los siguientes valores:

$$a = 2 \quad b = 1/3 \quad x = -2 \quad y = -1 \quad m = 3 \quad n = 1/2$$

$$\begin{aligned} 10. \quad & \frac{x^4}{8} - \frac{x^2 y}{2} + \frac{3xy^2}{2} - y^3 \\ & = \frac{(-2)^4}{8} - \frac{(-2)^2(-1)}{2} + \frac{3(-2)(-1)^2}{2} - (-1)^3 \\ & = \frac{16}{8} - \frac{4}{2} + \frac{-6}{2} + 1 = 2 + 2 - 3 + 1 = 2 \end{aligned}$$

$$\begin{aligned} 11. \quad & (a-x)^2 + (x-y)^2 + (x^2-y^2)(m+x-n) \\ & = [2-(-2)]^2 + [-2-(-1)]^2 + [(-2)^2 - (-1)^2] \left[ 3+(-2) - \frac{1}{2} \right] \\ & = [2+2]^2 + [-2+1]^2 + [4-1] \left[ 3-2-\frac{1}{2} \right] = [4]^2 + [-1]^2 + 3 \left[ 1-\frac{1}{2} \right] \\ & = 16 + 1 + 3 \left[ \frac{1}{2} \right] = 17 + \frac{3}{2} = \frac{34+3}{2} = \frac{37}{2} = 18\frac{1}{2} \end{aligned}$$

$$\begin{aligned} 12. \quad & -(x-y) + (x^2+y^2)(x-y-m) + 3b(x+y+n) \\ & = -[-2-(-1)] + [(-2)^2 + (-1)^2] [-2-(-1)-3] + 3 \cdot \frac{1}{3} \left[ -2+(-1) + \frac{1}{2} \right] \\ & = -[-2+1] + [4+1] [-2-1-3] + 1 \left[ -2-1 + \frac{1}{2} \right] \\ & = 1 + 5[-4] + \left[ -3 + \frac{1}{2} \right] = 1 - 20 + \left[ -\frac{5}{2} \right] = -19 - \frac{5}{2} = -\frac{38+5}{2} = -\frac{43}{2} = -21\frac{1}{2} \end{aligned}$$

$$\begin{aligned} 13. \quad & (3x-2y)(2n-4m) + 4x^2y^2 - \frac{x-y}{2} \\ & = [3(-2)-2(-1)] \left[ 2 \cdot \frac{1}{2} - 4 \cdot 3 \right] + 4(-2)^2(-1)^2 - \frac{(-2)-(-1)}{2} \\ & = [-6+2] [1-12] + 4 \cdot 4 \cdot 1 - \frac{-2+1}{2} = -4 [-11] + 16 - \frac{-1}{2} \\ & = 44 + 16 + \frac{1}{2} = 60 + \frac{1}{2} = 60\frac{1}{2} \end{aligned}$$

$$\begin{aligned} 14. \quad & \frac{4x}{3y} - \frac{x^3}{2+y^3} + \left( \frac{1}{n} - \frac{1}{b} \right) x + x^4 - m \\ & = \frac{4(-2)}{3(-1)} - \frac{(-2)^3}{2+(-1)^3} + \left( \frac{1}{\frac{1}{2}} - \frac{1}{\frac{1}{3}} \right) (-2) + (-2)^4 - 3 \\ & = \frac{-8}{-3} - \frac{-8}{2-1} + (2-3)(-2) + 16 - 3 = \frac{8}{3} + 8 + (-1)(-2) + 13 \\ & = \frac{8}{3} + 21 + 2 = \frac{8}{3} + 23 = \frac{8+69}{3} = \frac{77}{3} = 25\frac{2}{3} \end{aligned}$$

$$\begin{aligned} 15. \quad & x^2(x-y+m) - (x-y)(x^2+y^2-n) + (x+y)^2(m^2-2n) \\ & = (-2)^2 [-2-(-1)+3] - [-2-(-1)] \left[ (-2)^2 + (-1)^2 - \frac{1}{2} \right] + [-2+(-1)]^2 \left( 3^2 - 2 \cdot \frac{1}{2} \right) \\ & = 4 [1+1] - [-2+1] \left[ 4+1 - \frac{1}{2} \right] + [-2-1]^2 (9-1) = 4 \cdot 2 - [-1] \left[ 5 - \frac{1}{2} \right] + [-3]^2 (8) = 8 + \frac{9}{2} + 9 \cdot 8 = 80 + \frac{9}{2} = \frac{160+9}{2} = \frac{169}{2} = 84\frac{1}{2} \end{aligned}$$

$$\begin{aligned} 16. \quad & \frac{3a}{x} + \frac{2y}{m} + \frac{3n}{y} - \frac{m}{n} + 2(x^3 - y^2 + 4) = \frac{3 \cdot 2}{-2} + \frac{2(-1)}{3} + \frac{3 \cdot \frac{1}{2}}{-1} - \frac{\frac{3}{1}}{\frac{1}{2}} + 2[(-2)^3 - (-1)^2 + 4] \\ & = -3 - \frac{2}{3} - \frac{3}{2} - 6 + 2[-8-1+4] \\ & = -9 - \frac{4+9}{6} + 2[-5] = -9 - \frac{13}{6} - 10 = -19 - \frac{13}{6} = -\frac{114+13}{6} = -\frac{127}{6} = -21\frac{1}{6} \end{aligned}$$

## EJERCICIO 61

$$\begin{array}{cccc} 1. & 7am & 8am & 9am & 10am \\ & \downarrow & \downarrow & \downarrow & \downarrow \\ & +5^\circ & +2^\circ & -1^\circ & -4^\circ \end{array}$$

$$\begin{array}{ccc} 3. & x^2 - 3xy & x^2 \\ & \frac{3xy - y^2}{x^2 - y^2} & \frac{-x^2 + y^2}{y^2} \quad Rta \end{array}$$

$$\begin{array}{ccc} 4. & 3x^2 - 5x + 6 & \\ & \frac{-3x^2 + 8x - 6}{3x} & Rta \end{array}$$

$$\begin{array}{ccc} 5. & 3 & 2a^2 - 3a + 8 \\ & \frac{2a^2 - 3a + 5}{2a^2 - 3a + 8} & \frac{8a + 5}{2a^2 + 5a + 13} \quad Rta \end{array}$$

$$\begin{aligned} 6. & -3x^2 - \left\{ - \left[ 4x^2 + 5x - (x^2 - (x+6)) \right] \right\} \\ & = -3x^2 - \left\{ - \left[ 4x^2 + 5x - (x^2 - x - 6) \right] \right\} \\ & = -3x^2 - \left\{ - \left[ 4x^2 + 5x - x^2 + x + 6 \right] \right\} \\ & = -3x^2 - \left\{ - \left[ 3x^2 - 6x - 6 \right] \right\} = -3x^2 + 3x^2 + 6x + 6 = 6x + 6 \end{aligned}$$

$$\begin{aligned}
 7. & (x+y)(x-y) - (x+y)^2 \\
 & = x^2 - xy + xy - y^2 - (x+y)(x+y) \\
 & = x^2 - y^2 - (x^2 + 2xy + y^2) \\
 & = x^2 - y^2 - x^2 - 2xy - y^2 \\
 & = -2xy - 2y^2
 \end{aligned}$$

$$\begin{aligned}
 8. & a=2 \quad b=3 \quad c=1 \\
 & 3(a+b) - 4(c-b) + \sqrt{\frac{c-b}{-a}} \\
 & = 3(2+3) - 4(1-3) + \sqrt{\frac{1-3}{-2}} \\
 & = 3 \cdot 5 - 4(-2) + \sqrt{\frac{-2}{-2}} \\
 & = 15 + 8 + \sqrt{1} = 23 + 1 = 24
 \end{aligned}$$

$$\begin{array}{r}
 9. \quad 3x^2 \quad -5y^2 \quad 2x^2 + 5xy + 6y^2 \\
 \hline
 -x^2 + 3xy - y^2 \quad -x^2 - 5xy \\
 \hline
 2x^2 + 3xy - 6y^2 \quad x^2 \quad + 6y^2
 \end{array}$$

$$\begin{array}{r}
 2x^2 + 3xy - 6y^2 \\
 \hline
 x^2 \quad + 6y^2 \\
 \hline
 3x^2 + 3xy \quad Rta
 \end{array}$$

$$\begin{aligned}
 10. & \frac{2}{3}a^2 - \frac{1}{2}ab + \frac{1}{5}b^2 \\
 & \frac{1}{2}a^2 + \frac{3}{4}ab - 2b^2 \\
 & \frac{1}{3}a^4 - \frac{1}{4}a^3b + \frac{1}{10}a^2b^2 \\
 & + \frac{1}{2}a^3b - \frac{3}{8}a^2b^2 + \frac{3}{20}ab^3 \\
 & - \frac{4}{3}a^2b^2 + ab^3 - \frac{2}{5}b^4 \\
 & \hline
 \frac{1}{3}a^4 + \frac{1}{4}a^3b - \frac{193}{120}a^2b^2 + \frac{23}{20}ab^3 - \frac{2}{5}b^4
 \end{aligned}$$

$$\begin{array}{r}
 11. \quad x^5 \quad -x^3 + 5x^2 \\
 \quad -2x^4 \quad +2x^2 - 10x \\
 \quad \quad +6x^3 \quad -6x + 30 \\
 \hline
 x^5 - 2x^4 + 5x^3 + 7x^2 - 16x + 30 \quad | \quad x^2 - 2x + 6 \\
 -x^5 + 2x^4 - 6x^3 \\
 \hline
 \quad -x^3 + 7x^2 - 16x \\
 \quad + x^3 - 2x^2 + 6x \\
 \hline
 \quad \quad 5x^2 - 10x + 30 \\
 \quad \quad -5x^2 + 10x - 30
 \end{array}$$

$$\begin{array}{r}
 12. \quad \frac{1}{4}a^3 \quad -\frac{1}{90}ab^2 + \frac{1}{15}b^3 \quad \left| \quad \frac{1}{2}a + \frac{1}{3}b \right. \\
 \hline
 -\frac{1}{4}a^3 - \frac{1}{6}a^2b \\
 \hline
 \quad -\frac{1}{6}a^2b - \frac{1}{90}ab^2 \\
 \quad \quad \frac{1}{6}a^2b + \frac{1}{9}ab^2 \\
 \quad \quad \quad \frac{1}{10}ab^2 + \frac{1}{15}b^3 \quad -\frac{1}{2}a^2 + \frac{1}{3}ab + \frac{1}{5}b^2 \\
 \quad \quad \quad \quad -\frac{1}{10}ab^2 - \frac{1}{15}b^3 \quad \quad \quad \frac{3+1}{3}ab = \frac{4}{3}ab
 \end{array}$$

$$\begin{array}{r}
 13. \quad -3ab^2 - b^3 \quad a^3 - a^2b + b^3 \\
 \hline
 2a^2b + 3ab^2 - b^3 \quad -2a^2b + 2b^3 \\
 \hline
 2a^2b \quad -2b^3 \quad a^3 - 3a^2b + 3b^3
 \end{array}$$

$$\begin{array}{r}
 a^3 - 3a^2b + 3b^3 \\
 \hline
 a^2 - ab + b^2 \\
 \hline
 a^5 - 3a^4b \quad + 3a^2b^3 \\
 \quad - a^4b + 3a^3b^2 \quad - 3ab^4 \\
 \quad \quad + a^3b^2 - 3a^2b^3 \quad + 3b^5 \\
 \hline
 a^5 - 4a^4b + 4a^3b^2 \quad - 3ab^4 + 3b^5
 \end{array}$$

$$\begin{array}{r}
 14. \quad x^3 - 5x^2 + 4x \\
 \quad - 6x^2 - 6x + 3 \quad 2x^3 - 16x^2 + 5x + 12 \\
 \hline
 \quad - 8x^2 + 8x - 3 \quad -x^3 + 19x^2 - 6x \\
 \hline
 x^3 - 19x^2 + 6x \quad x^3 + 3x^2 - x + 12
 \end{array}$$

$$\begin{array}{r}
 x^3 + 3x^2 - x + 12 \quad | \quad x^2 - x + 3 \\
 \hline
 -x^3 + x^2 - 3x \\
 \hline
 \quad 4x^2 - 4x + 12 \\
 \quad -4x^2 + 4x - 12
 \end{array}$$

$$\begin{aligned}
 15. & (2+x)^2(1+x^2) - (x^2-2)(x^2+x-3) = x^2(3x+10) + 2(3x-1) \\
 & (4+4x+x^2)(1+x^2) - (x^4+x^3-5x^2-2x+6) = 3x^3+10x^2+6x-2 \\
 & 4+5x^2+4x+4x^3-x^3+5x^2+2x-6 = 3x^3+10x^2+6x-2 \\
 & 3x^3+10x^2+6x-2 = 3x^3+10x^2+6x-2
 \end{aligned}$$



$$\begin{aligned}
 16. \quad x &= -2 \quad y = 1 \\
 (x+y)^2 (x-y)^2 + 2(x+y)(x-y) & \\
 &= (-2+1)^2 (-2-1)^2 + 2(-2+1)(-2-1) \\
 &= (-1)^2 (-3)^2 + 2(-1)(-3) \\
 &= 1 \cdot 9 + 2 \cdot 3 = 9 + 6 = 15
 \end{aligned}$$

$$\begin{array}{r}
 17. \quad x^2 + 2x + 8 \\
 \quad x + 4 \quad x^2 + 4x + 6 \\
 \hline
 \quad x - 6 \quad 4x^2 - 8x - 3 \quad Rta \\
 \hline
 x^2 + 4x + 6 \quad 5x^2 - 4x + 3
 \end{array}$$

$$\begin{aligned}
 18. \quad &-\{3a + (-b+a) - 2(a+b)\} & -2[(a+b) - (a-b)] \\
 &= -\{3a - b + a - 2a - 2b\} & = -2[a + b - a + b] \\
 &= -\{2a - 3b\} & = -2[2b] \\
 &= -2a + 3b & = -4b \\
 & & \frac{-4b}{2a - 3b} \\
 & & \hline
 & & 2a - 7b \quad Rta
 \end{aligned}$$

$$\begin{aligned}
 19. \quad 5x + [-(3x - (x - y))] & \quad 8x + [-2x + (-x + y)] \\
 = 5x + [-(3x - x + y)] & = 8x + [-2x - x + y] \\
 = 5x + [-2x - y] & = 8x - 3x + y \\
 = 5x - 2x - y & = 5x + y \\
 = 3x - y & \\
 \frac{5x + y}{3x - y} & \\
 \hline
 15x^2 + 3xy & \\
 \frac{-5xy - y^2}{15x^2 - 2xy - y^2} & \quad Rta
 \end{aligned}$$

$$\begin{aligned}
 20. \quad \frac{1}{4}x^3 + \frac{1}{24}x^2y + \frac{5}{12}xy^2 + \frac{1}{3}y^3 & \quad \left| \frac{1}{2}x^2 - \frac{1}{4}xy + y^2 \right. \\
 -\frac{1}{4}x^3 + \frac{1}{8}x^2y - \frac{1}{2}xy^2 & \quad \left. \frac{1}{2}x + \frac{1}{3}y \right. \\
 \hline
 \frac{1}{6}x^2y - \frac{1}{12}xy^2 + \frac{1}{3}y^3 & \\
 -\frac{1}{6}x^2y + \frac{1}{12}xy^2 - \frac{1}{3}y^3 & \\
 \hline
 \end{aligned}$$

$$\begin{aligned}
 2x + [-5x - (x - y)] & \quad -4x + y \\
 = 2x + [-5x - x + y] & \quad -\frac{1}{2}x - \frac{1}{3}y \\
 = 2x + [-6x + y] & \quad \frac{-\frac{8}{2}x + \frac{3-1}{3}y}{-\frac{9}{2}x + \frac{2}{3}y} \\
 = 2x - 6x + y & \quad Rta \\
 = -4x + y &
 \end{aligned}$$

$$\begin{aligned}
 21. \quad [x^2 - (3x + 2)][x^2 + (-x + 3)] & = x^2(x^2 - 4x + 4) - (7x + 6) \\
 [x^2 - 3x - 2][x^2 - x + 3] & = x^4 - 4x^3 + 4x^2 - 7x - 6 \\
 x^4 - x^3 + 3x^2 - 3x^3 + 3x^2 - 9x - 2x^2 + 2x - 6 & = x^4 - 4x^3 + 4x^2 - 7x - 6 \\
 x^4 - 4x^3 + 4x^2 - 7x - 6 & = x^4 - 4x^3 + 4x^2 - 7x - 6
 \end{aligned}$$

$$\begin{aligned}
 22. \quad [x(x+y) - x(x-y)] & \quad [2(x^2 + y^2) - 3(x^2 - y^2)] \\
 = x^2 + xy - x^2 + xy & = 2x^2 + 2y^2 - 3x^2 + 3y^2 \\
 = 2xy & = -x^2 + 5y^2
 \end{aligned}$$

$$\begin{array}{r}
 -x^2 + 5y^2 \\
 \frac{2xy}{-2x^3y + 10xy^3} \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 -2x^3y + 10xy^3 \\
 \frac{4x^3y - 7xy^3}{2x^3y + 3xy^3} \quad Rta
 \end{array}$$

$$\begin{aligned}
 23. \quad \frac{x^3}{-x^3 + x^2y} & \quad \frac{-y^3(x-y)}{x^2 + xy + y^2} & \quad \frac{x^2 + 3xy - y^2}{x^2 + xy + y^2} \\
 \frac{x^2y}{-x^2y + xy^2} & & \quad \frac{x^4 + 3x^3y - x^2y^2}{x^2 + xy + y^2} \\
 \frac{xy^2}{-xy^2 + y^3} & & \quad \frac{x^4 + 3x^3y - x^2y^2 - xy^3}{+ x^2y^2 + 3xy^3 - y^4} \\
 & & \quad \hline
 & & \quad x^4 + 4x^3y + 3x^2y^2 + 2xy^3 - y^4 \quad Rta
 \end{aligned}$$

$$\begin{aligned}
 24. \quad (x-y)(x^2 + xy + y^2) - (x+y)(x^2 - xy + y^2) & \\
 = x^3 + x^2y + xy^2 - x^2y - xy^2 - y^3 - [x^3 - x^2y + xy^2 + x^2y - xy^2 + y^3] & \\
 = x^3 - y^3 - [x^3 + y^3] & \\
 = x^3 - y^3 - x^3 - y^3 & \\
 = -2y^3 &
 \end{aligned}$$

$$25. \quad a = 4 \quad b = 9 \quad c = 25$$

$$\begin{aligned}
 \sqrt{\frac{ab}{c}} + 2(b-a)\sqrt{\frac{9b}{a^2}} - 3(c-b)\sqrt{\frac{c}{b}} & \\
 = \sqrt{\frac{4 \cdot 9}{25}} + 2(9-4)\sqrt{\frac{9 \cdot 9}{4^2}} - 3(25-9)\sqrt{\frac{25}{9}} & \\
 = \sqrt{\frac{36}{25}} + 2 \cdot 5 \sqrt{\frac{81}{16}} - 3 \cdot 16 \cdot \frac{5}{3} = \frac{6}{5} + 10 \cdot \frac{9}{4} - 48 \cdot \frac{5}{3} & \\
 = \frac{6}{5} + \frac{45}{2} - 80 = \frac{12 + 225 - 800}{10} = \frac{-563}{10} = -56\frac{3}{10} &
 \end{aligned}$$

$$26. \quad x^2 + 3x^2 - 4x - 12 \quad \left| \frac{x+3}{x^2-4} \right. = x - 2$$

$$\begin{array}{r}
 -x^3 - 3x^2 \\
 \hline
 -4x - 12 \\
 \hline
 +4x + 12 \\
 \hline
 x^2 - 4 \quad \left| \frac{x-2}{x^2 + 2x} \right. \\
 \hline
 x^2 - 4 \quad \left| \frac{x-2}{x+2} \right. \quad Rta \\
 \hline
 2x - 4 \\
 \hline
 -2x + 4
 \end{array}$$

$$\begin{aligned}
 27. \quad & 4x^2 - \{3x - (x^2 - (4+x))\} + [x^2 - \{x + (-3)\}] \\
 & = 4x^2 - \{3x - (x^2 - 4 - x)\} + [x^2 - \{x - 3\}] \quad \text{Si } x = -2 \\
 & = 4x^2 - \{3x - x^2 + 4 + x\} + [x^2 - x + 3] \quad 6x^2 - 5x - 1 \\
 & = 4x^2 - 4x + x^2 - 4 + x^2 - x + 3 \quad = 6(-2)^2 - 5(-2) - 1 \\
 & = 6x^2 - 5x - 1 \quad = 6(4) + 10 - 1 \\
 & \quad \quad \quad = 24 + 10 - 1 = 33
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & (a^2 + b^2)(a+b)(a-b) = a^4 - [3a + 2(a+2) - 4(a+1) - a + b^4] \\
 & (a^2 + b^2)(a^2 - ab + ab - b^2) = a^4 - [3a + 2a + 4 - 4a - 4 - a + b^4] \\
 & (a^2 + b^2)(a^2 - b^2) = a^4 - [b^4] \\
 & a^4 - a^2b^2 + a^2b^2 - b^4 = a^4 - b^4 \\
 & a^4 - b^4 = a^4 - b^4
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & \frac{x^2 + 7x - 5}{x^2 - 9} \quad x^4 - 11x^3 + 21x \quad \text{Rta} \\
 & \frac{x^4 + 7x^3 - 5x^2}{-9x^2 - 63x + 45} \quad \frac{18x^3 - 14x^2 - 84x + 45}{x^4 + 7x^3 - 14x^2 - 63x + 45}
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & \frac{3}{x^3 + 5x^2 - 6} \quad -[x^2 + (-3x + 4) - (-x + 3)] \\
 & \frac{x^3 + 5x^2 - 3}{x^3 + 5x^2 - 3} \quad = -[x^2 - 3x + 4 + x - 3] \\
 & \quad \quad \quad = -x^2 + 2x - 1 \\
 & \frac{x^3 + 5x^2 - 3}{x + 1} \quad \frac{x^2 - x + 2}{-x^2 + 2x - 1} \\
 & \frac{x^3 + 5x^2 + x - 2}{x + 1} \quad \text{Rta} \quad \frac{x + 1}{x + 1}
 \end{aligned}$$

## EJERCICIO 62

$$\begin{aligned}
 1. \quad & (m+3)^2 = m^2 + 6m + 9 \\
 2. \quad & (5+x)^2 = 25 + 10x + x^2 \\
 3. \quad & (6a+b)^2 = 36a^2 + 12ab + b^2 \\
 4. \quad & (9+4m)^2 = 81 + 72m + 16m^2 \\
 5. \quad & (7x+11)^2 = 49x^2 + 154x + 121 \\
 6. \quad & (x+y)^2 = x^2 + 2xy + y^2 \\
 7. \quad & (1+3x^2)^2 = 1 + 6x^2 + 9x^4 \\
 8. \quad & (2x+3y)^2 = 4x^2 + 12xy + 9y^2 \\
 9. \quad & (a^2x+by^2)^2 = a^4x^2 + 2a^2xby^2 + b^2y^4
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & (3a^3 + 8b^4)^2 = 9a^6 + 48a^3b^4 + 64b^8 \\
 11. \quad & (4m^5 + 5n^6)^2 = 16m^{10} + 40m^5n^6 + 25n^{12} \\
 12. \quad & (7a^2b^3 + 5x^4)^2 = 49a^4b^6 + 70a^2b^3x^4 + 25x^8 \\
 13. \quad & (4ab^2 + 5xy^3)^2 = 16a^2b^4 + 40ab^2xy^3 + 25x^2y^6 \\
 14. \quad & (8x^2y + 9m^3)^2 = 64x^4y^2 + 144x^2ym^3 + 81m^6 \\
 15. \quad & (x^{10} + 10y^{12})^2 = x^{20} + 20x^{10}y^{12} + 100y^{24} \\
 16. \quad & (a^m + a^n)^2 = a^{2m} + 2a^{m+n} + a^{2n} \\
 17. \quad & (a^x + b^{x+1})^2 = a^{2x} + 2a^x b^{x+1} + b^{2x+2} \\
 18. \quad & (x^{a+1} + y^{x-2})^2 = x^{2a+2} + 2x^{a+1}y^{x-2} + y^{2x-4}
 \end{aligned}$$

## EJERCICIO 63

$$\begin{aligned}
 1. \quad & (a-3)^2 = a^2 - 6a + 9 \\
 2. \quad & (x-7)^2 = x^2 - 14x + 49 \\
 3. \quad & (9-a)^2 = 81 - 18a + a^2 \\
 4. \quad & (2a-3b)^2 = 4a^2 - 12ab + 9b^2 \\
 5. \quad & (4ax-1)^2 = 16a^2x^2 - 8ax + 1 \\
 6. \quad & (a^3 - b^3)^2 = a^6 - 2a^3b^3 + b^6 \\
 7. \quad & (3a^4 - 5b^2)^2 = 9a^8 - 30a^4b^2 + 25b^4
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & (x^2 - 1)^2 = x^4 - 2x^2 + 1 \\
 9. \quad & (x^5 - 3ay^2)^2 = x^{10} - 6ax^5y^2 + 9a^2y^4 \\
 10. \quad & (a^7 - b^7)^2 = a^{14} - 2a^7b^7 + b^{14} \\
 11. \quad & (2m - 3n)^2 = 4m^2 - 12mn + 9n^2 \\
 12. \quad & (10x^3 - 9xy^5)^2 = 100x^6 - 180x^4y^5 + 81x^2y^{10} \\
 13. \quad & (x^m - y^n)^2 = x^{2m} - 2x^m y^n + y^{2n} \\
 14. \quad & (a^{x-2} - 5)^2 = a^{2x-4} - 10a^{x-2} + 25 \\
 15. \quad & (x^{a+1} - 3x^{a-2})^2 = x^{2a+2} - 6x^{2a-1} + 9x^{2a-4}
 \end{aligned}$$

### EJERCICIO 64

- $(x+y)(x-y) = x^2 - y^2$
- $(m-n)(m+n) = m^2 - n^2$
- $(a-x)(x+a) = a^2 - x^2$
- $(x^2+a^2)(x^2-a^2) = x^4 - a^4$
- $(2a-1)(1+2a) = 4a^2 - 1$
- $(n-1)(n+1) = n^2 - 1$
- $(1-3ax)(3ax+1) = 1 - 9a^2x^2$
- $(2m+9)(2m-9) = 4m^2 - 81$
- $(a^3-b^2)(a^3+b^2) = a^6 - b^4$
- $(y^2-3y)(y^2+3y) = y^4 - 9y^2$
- $(1-8xy)(8xy+1) = 1 - 64x^2y^2$
- $(6x^2-m^2x)(6x^2+m^2x) = 36x^4 - m^4x^2$
- $(a^m+b^n)(a^m-b^n) = a^{2m} - b^{2n}$
- $(3x^a-5y^m)(5y^m+3x^a) = 9x^{2a} - 25y^{2m}$
- $(a^{x+1}-2b^{x-1})(2b^{x-1}+a^{x+1}) = a^{2x+2} - 4b^{2x-2}$

### EJERCICIO 65

- $(x+y+z)(x+y-z) = x^2 + 2xy + y^2 - z^2$
- $(x-y+z)(x+y-z) = x^2 - y^2 + 2yz - z^2$
- $(x+y+z)(x-y-z) = x^2 - y^2 - 2yz - z^2$
- $(m+n+1)(m+n-1) = m^2 + 2mn + n^2 - 1$
- $(m-n-1)(m-n+1) = m^2 + n^2 - 2mn - 1$
- $(x+y-2)(x-y+2) = x^2 - y^2 + 4y - 4$
- $(n^2+2n+1)(n^2-2n-1) = n^4 - 4n^2 - 4n - 1$
- $(a^2-2a+3)(a^2+2a+3) = a^4 + 2a^2 + 9$
- $(m^2-m-1)(m^2+m-1) = m^4 - 3m^2 + 1$
- $(2a-b-c)(2a-b+c) = 4a^2 - 4ab + b^2 - c^2$
- $(2x+y-z)(2x-y+z) = 4x^2 - y^2 + 2yz - z^2$
- $(x^2-5x+6)(x^2+5x-6) = x^4 - 25x^2 + 60x - 36$
- $(a^2-ab+b^2)(a^2+b^2+ab) = a^4 + a^2b^2 + b^4$
- $(x^3-x^2-x)(x^3+x^2+x) = x^6 - x^4 - 2x^3 - x^2$

### EJERCICIO 66

- $(a+2)^3 = a^3 + 6a^2 + 12a + 8$
- $(x-1)^3 = x^3 - 3x^2 + 3x - 1$
- $(m+3)^3 = m^3 + 9m^2 + 27m + 27$
- $(n-4)^3 = n^3 - 12n^2 + 48n - 64$
- $(2x+1)^3 = 8x^3 + 12x^2 + 6x + 1$
- $(1-3y)^3 = 1 - 9y + 27y^2 - 27y^3$
- $(2+y^2)^3 = 8 + 12y^2 + 6y^4 + y^6$
- $(1-2n)^3 = 1 - 6n + 12n^2 - 8n^3$
- $(4n+3)^3 = 64n^3 + 144n^2 + 108n + 27$
- $(a^2-2b)^3 = a^6 - 6a^4b + 12a^2b^2 - 8b^3$
- $(2x+3y)^3 = 8x^3 + 36x^2y + 54xy^2 + 27y^3$
- $(1-a^2)^3 = 1 - 3a^2 + 3a^4 - a^6$

### EJERCICIO 67

- $(a+1)(a+2) = a^2 + 3a + 2$
- $(x+2)(x+4) = x^2 + 6x + 8$
- $(x+5)(x-2) = x^2 + 3x - 10$
- $(m-6)(m-5) = m^2 - 11m + 30$
- $(x+7)(x-3) = x^2 + 4x - 21$
- $(x+2)(x-1) = x^2 + x - 2$
- $(x-3)(x-1) = x^2 - 4x + 3$
- $(x-5)(x+4) = x^2 - x - 20$
- $(a-11)(a+10) = a^2 - a - 110$
- $(n-19)(n+10) = n^2 - 9n - 190$
- $(a^2+5)(a^2-9) = a^4 - 4a^2 - 45$
- $(x^2-1)(x^2-7) = x^4 - 8x^2 + 7$
- $(n^2-1)(n^2+20) = n^4 + 19n^2 - 20$
- $(n^3+3)(n^3-6) = n^6 - 3n^3 - 18$
- $(x^3+7)(x^3-6) = x^6 + x^3 - 42$
- $(a^4+8)(a^4-1) = a^8 + 7a^4 - 8$
- $(a^5-2)(a^5+7) = a^{10} + 5a^5 - 14$
- $(a^6+7)(a^6-9) = a^{12} - 2a^6 - 63$
- $(ab+5)(ab-6) = a^2b^2 - ab - 30$
- $(xy^2-9)(xy^2+12) = x^2y^4 + 3xy^2 - 108$
- $(a^2b^2-1)(a^2b^2+7) = a^4b^4 + 6a^2b^2 - 7$
- $(x^3y^3-6)(x^3y^3+8) = x^6y^6 + 2x^3y^3 - 48$
- $(a^x-3)(a^x+8) = a^{2x} + 5a^x - 24$
- $(a^{x+1}-6)(a^{x+1}-5) = a^{2x+2} - 11a^{x+1} + 30$

## EJERCICIO 68

- $(x+2)^2 = x^2 + 4x + 4$
- $(x+2)(x+3) = x^2 + 5x + 6$
- $(x+1)(x-1) = x^2 - 1$
- $(x-1)^2 = x^2 - 2x + 1$
- $(n+3)(n+5) = n^2 + 8n + 15$
- $(m-3)(m+3) = m^2 - 9$
- $(a+b-1)(a+b+1) = a^2 + 2ab + b^2 - 1$
- $(1+b)^3 = 1 + 3b + 3b^2 + b^3$
- $(a^2+4)(a^2-4) = a^4 - 16$
- $(3ab-5x^2)^2 = 9a^2b^2 - 30abx^2 + 25x^4$
- $(ab+3)(3-ab) = 9 - a^2b^2$
- $(1-4ax)^2 = 1 - 8ax + 16a^2x^2$
- $(a^2+8)(a^2-7) = a^4 + a^2 - 56$
- $(x+y+1)(x-y-1) = x^2 - y^2 - 2y - 1$
- $(1-a)(a+1) = 1 - a^2$
- $(m-8)(m+12) = m^2 + 4m - 96$
- $(x^2-1)(x^2+3) = x^4 + 2x^2 - 3$
- $(x^3+6)(x^3-8) = x^6 - 2x^3 - 48$
- $(5x^3+6m^4)^2 = 25x^6 + 60x^3m^4 + 36m^8$

## EJERCICIO 69

- $\frac{x^2-1}{x+1} = x-1$
- $\frac{1-x^2}{1-x} = 1+x$
- $\frac{x^2-y^2}{x+y} = x-y$
- $\frac{y^2-x^2}{y-x} = y+x$
- $\frac{x^2-4}{x+2} = x-2$
- $\frac{9-x^4}{3-x^2} = 3+x^2$

$$7. \frac{a^2-4b^2}{a+2b} = a-2b$$

$$8. \frac{25-36x^4}{5-6x^2} = 5+6x^2$$

$$9. \frac{4x^2-9m^2n^4}{2x+3mn^2} = 2x-3mn^2$$

$$10. \frac{36m^2-49n^2x^4}{6m-7nx^2} = 6m+7nx^2$$

$$11. \frac{81a^6-100b^8}{9a^3+10b^4} = 9a^3-10b^4$$

$$12. \frac{a^4b^6-4x^8y^{10}}{a^2b^3+2x^4y^5} = a^2b^3+2x^4y^5$$

$$13. \frac{x^{2n}-y^{2n}}{x^n+y^n} = x^n-y^n$$

$$20. (x^4-2)(x^4+5) = x^8 + 3x^4 - 10$$

$$21. (1-a+b)(b-a-1) = -1 + a^2 - 2ab + b^2$$

$$22. (a^x+b^n)(a^x-b^n) = a^{2x} - b^{2n}$$

$$23. (x^{a+1}-8)(x^{a+1}+9) = x^{2a+2} - x^{a+1} - 72$$

$$24. (a^2b^2+c^2)(a^2b^2-c^2) = a^4b^4 - c^4$$

$$25. (2a+x)^3 = 8a^3 + 12a^2x + 6ax^2 + x^3$$

$$26. (x^2-11)(x^2-2) = x^4 - 13x^2 + 22$$

$$27. (2a^3-5b^4)^2 = 4a^6 - 20a^3b^4 + 25b^8$$

$$28. (a^3+12)(a^3-15) = a^6 - 3a^3 - 180$$

$$29. (m^2-m+n)(n+m+m^2) = m^4 + 2m^2n + n^2 - m^2$$

$$30. (x^4+7)(x^4-11) = x^8 - 4x^4 - 77$$

$$31. (11-ab)^2 = 121 - 22ab + a^2b^2$$

$$32. (x^2y^3-8)(x^2y^3+6) = x^4y^6 - 2x^2y^3 - 48$$

$$33. (a+b)(a-b)(a^2-b^2) = a^4 - 2a^2b^2 + b^4$$

$$34. (x+1)(x-1)(x^2-2) = x^4 - 3x^2 + 2$$

$$35. (a+3)(a^2+9)(a-3) = a^4 - 81$$

$$36. (x+5)(x-5)(x^2+1) = x^4 - 24x^2 - 25$$

$$37. (a+1)(a-1)(a+2)(a-2) = a^4 - 5a^2 + 4$$

$$38. (a+2)(a-3)(a-2)(a+3) = a^4 - 13a^2 + 36$$

$$14. \frac{a^{2x+2}-100}{a^{x+1}-10} = a^{x+1} + 10$$

$$15. \frac{1-9x^{2m+4}}{1+3x^{m+2}} = 1-3x^{m+2}$$

$$16. \frac{(x+y)^2 - z^2}{(x+y) - z} = x + y + z$$

$$17. \frac{1-(a+b)^2}{1+(a+b)} = 1-a-b$$

$$18. \frac{4-(m+n)^2}{2+(m+n)} = 2-m-n$$

$$19. \frac{x^2-(x-y)^2}{x+(x-y)} = y$$

$$20. \frac{(a+x)^2-9}{(a+x)+3} = a+x-3$$

## EJERCICIO 70

- $\frac{1+a^3}{1+a} = 1-a+a^2$
- $\frac{1-a^3}{1-a} = 1+a+a^2$
- $\frac{x^3+y^3}{x+y} = x^2-xy+y^2$
- $\frac{8a^3-1}{2a-1} = 4a^2+2a+1$
- $\frac{8x^3+27y^3}{2x+3y} = 4x^2-6xy+9y^2$
- $\frac{27m^3-125n^3}{3m-5n} = 9m^2+15m+25n^2$
- $\frac{64a^3+343}{4a+7} = 16a^2-28a+49$
- $\frac{216-125y^3}{6-5y} = 36+30y+25y^2$
- $\frac{1+a^3b^3}{1+ab} = 1-ab+a^2b^2$
- $\frac{729-512b^3}{9-8b} = 81+72b+64b^2$
- $\frac{a^3x^3+b^3}{ax+b} = a^2x^2-axb+b^2$
- $\frac{n^3-m^3x^3}{n-mx} = n^2+nmx+m^2x^2$
- $\frac{x^6-27y^3}{x^2-3y} = x^4+3x^2y+9y^2$
- $\frac{8a^9+y^9}{2a^3+y^3} = 4a^6-2a^3y^3+y^6$
- $\frac{1-x^{12}}{1-x^4} = 1+x^4+x^8$
- $\frac{27x^6+1}{3x^2+1} = 9x^4-3x^2+1$
- $\frac{64a^3+b^9}{4a+b^3} = 16a^2-4ab^3+b^6$
- $\frac{a^6-b^6}{a^2-b^2} = a^4+a^2b^2+b^4$
- $\frac{125-343x^{15}}{5-7x^5} = 25+35x^5+49x^{10}$
- $\frac{n^6+1}{n^2+1} = n^4-n^2+1$

## EJERCICIO 71

- $\frac{x^4-y^4}{x-y} = x^3+x^2y+xy^2+y^3$
- $\frac{m^5+n^5}{m+n} = m^4-m^3n+m^2n^2-mn^3+n^4$
- $\frac{a^5-n^5}{a-n} = a^4+a^3n+a^2n^2+an^3+n^4$
- $\frac{x^6-y^6}{x+y} = x^5-x^4y+x^3y^2-x^2y^3+xy^4-y^5$
- $\frac{a^6-b^6}{a-b} = a^5+a^4b+a^3b^2+a^2b^3+ab^4+b^5$
- $\frac{x^7+y^7}{x+y} = x^6-x^5y+x^4y^2-x^3y^3+x^2y^4-xy^5+y^6$
- $\frac{a^7-m^7}{a-m} = a^6+a^5m+a^4m^2+a^3m^3+a^2m^4+am^5+m^6$
- $\frac{a^8-b^8}{a+b} = a^7-a^6b+a^5b^2-a^4b^3+a^3b^4-a^2b^5+ab^6-b^7$
- $\frac{x^{10}-y^{10}}{x-y} = x^9+x^8y+x^7y^2+x^6y^3+x^5y^4+x^4y^5+x^3y^6+x^2y^7+xy^8+y^9$
- $\frac{m^9+n^9}{m+n} = m^8-m^7n+m^6n^2-m^5n^3+m^4n^4-m^3n^5+m^2n^6-mn^7+n^8$
- $\frac{m^9-n^9}{m-n} = m^8+m^7n+m^6n^2+m^5n^3+m^4n^4+m^3n^5+m^2n^6+mn^7+n^8$
- $\frac{a^{10}-x^{10}}{a+x} = a^9-a^8x+a^7x^2-a^6x^3+a^5x^4-a^4x^5+a^3x^6-a^2x^7+ax^8-x^9$
- $\frac{1-n^5}{1-n} = 1+n+n^2+n^3+n^4$
- $\frac{1-a^6}{1-a} = 1+a+a^2+a^3+a^4+a^5$
- $\frac{1+a^7}{1+a} = 1-a+a^2-a^3+a^4-a^5+a^6$
- $\frac{1-m^8}{1+m} = 1-m+m^2-m^3+m^4-m^5+m^6-m^7$
- $\frac{x^4-16}{x-2} = x^3+2x^2+4x+8$
- $\frac{x^6-64}{x+2} = x^5-2x^4+4x^3-8x^2+16x-32$
- $\frac{x^7-128}{x-2} = x^6+2x^5+4x^4+8x^3+16x^2+32x+64$
- $\frac{a^5+243}{a+3} = a^4-3a^3+9a^2-27a+81$
- $\frac{x^6-729}{x-3} = x^5+3x^4+9x^3+27x^2+81x+243$

22.  $\frac{625-x^4}{x+5} = 125 - 25x + 5x^2 - x^3$
23.  $\frac{m^8-256}{m-2} = m^7 + 2m^6 + 4m^5 + 8m^4 + 16m^3 + 32m^2 + 64m + 128$
24.  $\frac{x^{10}-1}{x-1} = x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1$
25.  $\frac{x^5+243y^5}{x+3y} = x^4 - 3x^3y + 9x^2y^2 - 27xy^3 + 81y^4$
26.  $\frac{16a^4-81b^4}{2a-3b} = 8a^3 + 12a^2b + 18ab^2 + 27b^3$
27.  $\frac{64m^6-729n^6}{2m+3n} = 32m^5 - 48m^4n + 72m^3n^2 - 108m^2n^3 + 162mn^4 + 243n^5$
28.  $\frac{1.024x^{10}-1}{2x-1} = 512x^9 + 256x^8 + 128x^7 + 64x^6 + 32x^5 + 16x^4 + 8x^3 + 4x^2 + 2x + 1$
29.  $\frac{512a^9+b^9}{2a+b} = 256a^8 - 128a^7b + 64a^6b^2 - 32a^5b^3 + 16a^4b^4 - 8a^3b^5 + 4a^2b^6 - 2ab^7 + b^8$
30.  $\frac{a^6-729}{a-3} = a^5 + 3a^4 + 9a^3 + 27a^2 + 81a + 243$

## EJERCICIO 72

1.  $\frac{x^6+y^6}{x^2+y^2} = x^4 - x^2y^2 + y^4$
2.  $\frac{a^8-b^8}{a^2+b^2} = a^6 - a^4b^2 + a^2b^4 - b^6$
3.  $\frac{m^{10}-n^{10}}{m^2-n^2} = m^8 + m^6n^2 + m^4n^4 + m^2n^6 + n^8$
4.  $\frac{a^{12}-b^{12}}{a^3+b^3} = a^9 - a^6b^3 + a^3b^6 - b^9$
5.  $\frac{a^{12}-x^{12}}{a^3-x^3} = a^9 + a^6x^3 + a^3x^6 + x^9$
6.  $\frac{x^{15}+y^{15}}{x^3+y^3} = x^{12} - x^9y^3 + x^6y^6 - x^3y^9 + y^{12}$
7.  $\frac{m^{12}+1}{m^4+1} = m^8 - m^4 + 1$
8.  $\frac{m^{16}-n^{16}}{m^4-n^4} = m^{12} + m^8n^4 + m^4n^8 + n^{12}$
9.  $\frac{a^{18}-b^{18}}{a^3+b^3} = a^{15} - a^{12}b^3 + a^9b^6 - a^6b^9 + a^3b^{12} - b^{15}$
10.  $\frac{x^{20}-y^{20}}{x^5+y^5} = x^{15} - x^{10}y^5 + x^5y^{10} - y^{15}$
11.  $\frac{m^{21}+n^{21}}{m^3+n^3} = m^{18} - m^{15}n^3 + m^{12}n^6 - m^9n^9 + m^6n^{12} - m^3n^{15} + n^{18}$
12.  $\frac{x^{24}-1}{x^6-1} = x^{18} + x^{12} + x^6 + 1$
13.  $\frac{a^{25}+b^{25}}{a^5+b^5} = a^{20} - a^{15}b^5 + a^{10}b^{10} - a^5b^{15} + b^{20}$
14.  $\frac{a^{30}-m^{30}}{a^6-m^6} = a^{24} + a^{18}m^6 + a^{12}m^{12} + a^6m^{18} + m^{24}$

## EJERCICIO 73

1.  $\frac{x^4-1}{1+x^2} = x^2 - 1$
2.  $\frac{8m^3+n^6}{2m+n^2} = 4m^2 - 2mn^2 + n^4$
3.  $\frac{1-a^5}{1-a} = 1+a+a^2+a^3+a^4$
4.  $\frac{x^6-27y^3}{x^2-3y} = x^4 + 3x^2y + 9y^2$
5.  $\frac{x^6-49y^6}{x^3+7y^3} = x^3 - 7y^3$
6.  $\frac{a^{14}-b^{14}}{a^2-b^2} = a^{12} + a^{10}b^2 + a^8b^4 + a^6b^6 + a^4b^8 + a^2b^{10} + b^{12}$

$$7. \frac{1+a^3}{1+a} = 1-a+a^2$$

$$8. \frac{16x^2y^4 - 25m^6}{4xy^2 + 5m^3} = 4xy^2 - 5m^3$$

$$9. \frac{x^{27} + y^{27}}{x^3 + y^3} = x^{24} - x^{21}y^3 + x^{18}y^6 - x^{15}y^9 + x^{12}y^{12} - x^9y^{15} + x^6y^{18} - x^3y^{21} + y^{24}$$

$$10. \frac{a^{27} + y^{27}}{a^9 + y^9} = a^{18} - a^9y^9 + y^{18}$$

$$11. \frac{a^4b^4 - 64x^6}{a^2b^2 + 8x^3} = a^2b^2 - 8x^3$$

$$12. \frac{1 - a^2b^4c^8}{1 - ab^2c^4} = 1 + ab^2c^4$$

$$13. \frac{32x^5 + 243y^5}{2x + 3y} = 16x^4 - 24x^3y + 36x^2y^2 - 54xy^3 + 81y^4$$

$$14. \frac{25 - (a+1)^2}{5 + (a+1)} = 4 - a$$

$$15. \frac{1 - x^{12}}{1 - x^4} = 1 + x^4 + x^8$$

$$16. \frac{64x^6 - 343y^9}{4x^2 - 7y^3} = 16x^4 + 28x^2y^3 + 49y^6$$

$$17. \frac{a^{18} - b^{18}}{a^3 + b^3} = a^{15} - a^{12}b^3 + a^9b^6 - a^6b^9 + a^3b^{12} - b^{15}$$

$$18. \frac{(a+x)^2 - y^2}{(a+x) - y} = a + x + y$$

$$19. \frac{1 + x^{11}}{x + 1} = x^{10} - x^9 + x^8 - x^7 + x^6 - x^5 + x^4 - x^3 + x^2 - x + 1$$

$$20. \frac{x^{40} - y^{40}}{x^8 - y^8} = x^{32} + x^{24}y^8 + x^{16}y^{16} + x^8y^{24} + y^{32}$$

$$21. \frac{9 - 36x^{10}}{3 + 6x^5} = 3 - 6x^5$$

$$22. \frac{x^8 - 256}{x - 2} = x^7 + 2x^6 + 4x^5 + 8x^4 + 16x^3 + 32x^2 + 64x + 128$$

## EJERCICIO 74

$$1. x^2 - 2x + 3 \div x - 1 \\ = 1^2 - 2 \cdot 1 + 3 \\ = 1 - 2 + 3 = 2$$

$$4. a^4 - 5a^3 + 2a^2 - 6 \div a + 3 \\ = (-3)^4 - 5(-3)^3 + 2(-3)^2 - 6 \\ = 81 - 5(-27) + 2 \cdot 9 - 6 \\ = 81 + 135 + 18 - 6 = 228$$

$$7. a^5 - 2a^3 + 2a - 4 \div a - 5 \\ = 5^5 - 2 \cdot 5^3 + 2 \cdot 5 - 4 \\ = 3 \cdot 125 - 2 \cdot 125 + 10 - 4 \\ = 3 \cdot 125 - 250 + 10 - 4 = 2.881$$

$$10. 15x^3 - 11x^2 + 10x + 18 \div 3x + 2 \\ = 15 \left( -\frac{2}{3} \right)^3 - 11 \left( -\frac{2}{3} \right)^2 + 10 \left( -\frac{2}{3} \right) + 18 \\ = 15 \left( -\frac{8}{27} \right) - 11 \cdot \frac{4}{9} - \frac{20}{3} + 18 \\ = -\frac{40}{9} - \frac{44}{9} - \frac{20}{3} + 18 \\ = \frac{-40 - 44 - 60 + 162}{9} = \frac{18}{9} = 2$$

$$2. x^3 - 3x^2 + 2x - 2 \div x + 1 \\ = (-1)^3 - 3(-1)^2 + 2(-1) - 2 \\ = -1 - 3 - 2 - 2 = -8$$

$$5. m^4 + m^3 - m^2 + 5 \div m - 4 \\ = 4^4 + 4^3 - 4^2 + 5 \\ = 256 + 64 - 16 + 5 = 309$$

$$8. 6x^3 + x^2 + 3x + 5 \div 2x + 1 \\ = 6 \left( -\frac{1}{2} \right)^3 + \left( -\frac{1}{2} \right)^2 + 3 \left( -\frac{1}{2} \right) + 5 \\ = 6 \left( -\frac{1}{8} \right) + \frac{1}{4} - \frac{3}{2} + 5 = -\frac{3}{4} + \frac{1}{4} - \frac{3}{2} + 5 \\ = \frac{-3 + 1 - 6 + 20}{4} = \frac{12}{4} = 3$$

$$11. 5x^4 - 12x^3 + 9x^2 - 22x + 21 \div 5x - 2 \\ = 5 \left( \frac{2}{5} \right)^4 - 12 \left( \frac{2}{5} \right)^3 + 9 \left( \frac{2}{5} \right)^2 - 22 \left( \frac{2}{5} \right) + 21 \\ = 5 \cdot \frac{16}{625} - 12 \cdot \frac{8}{125} + 9 \cdot \frac{4}{25} - \frac{44}{5} + 21 \\ = \frac{16}{125} - \frac{96}{125} + \frac{36}{25} - \frac{44}{5} + 21 \\ = -\frac{80}{125} + \frac{36}{25} - \frac{44}{5} + 21 \\ = \frac{-80 + 180 - 1.100 + 2.625}{125} = \frac{1.625}{125} = 13$$

$$3. x^4 - x^3 + 5 \div x - 2 \\ = 2^4 - 2^3 + 5 \\ = 16 - 8 + 5 = 13$$

$$6. x^5 + 3x^4 - 2x^3 + 4x^2 - 2x + 2 \div x + 3 \\ = (-3)^5 + 3(-3)^4 - 2(-3)^3 + 4(-3)^2 - 2(-3) + 2 \\ = -243 + 3 \cdot 81 - 2(-27) + 4 \cdot 9 + 6 + 2 \\ = -243 + 243 + 54 + 36 + 8 = 98$$

$$9. 12x^3 - 21x + 90 \div 3x - 3 \\ = 12 \cdot 1^3 - 21 \cdot 1 + 90 \\ = 12 - 21 + 90 = 81$$

$$12. a^6 + a^4 - 8a^2 + 4a + 1 \div 2a + 3 \\ = \left( -\frac{3}{2} \right)^6 + \left( -\frac{3}{2} \right)^4 - 8 \left( -\frac{3}{2} \right)^2 + 4 \left( -\frac{3}{2} \right) + 1 \\ = \frac{729}{64} + \frac{81}{16} - 8 \cdot \frac{9}{4} - \frac{12}{2} + 1 \\ = \frac{729}{64} + \frac{81}{16} - 18 - 6 + 1 = \frac{729}{64} + \frac{81}{16} - 23 \\ = \frac{729 + 324 - 1.472}{64} = -\frac{419}{64}$$

## EJERCICIO 75

1.  $x^2 - 7x + 5 \div x - 3$

$$\begin{array}{r|l} 1 & -7 & 5 & & 3 \\ \hline & & 3 & -12 & \end{array}$$

$$\begin{array}{r} 1 & -4 & -7 \\ \hline = & x-4 & \text{Res. } -7 \end{array}$$

2.  $a^2 - 5a + 1 \div a + 2$

$$\begin{array}{r|l} 1 & -5 & 1 & & -2 \\ \hline & & -2 & 14 & \end{array}$$

$$\begin{array}{r} 1 & -7 & 15 \\ \hline = & a-7 & \text{Res. } 15 \end{array}$$

3.  $x^3 - x^2 + 2x - 2 \div x + 1$

$$\begin{array}{r|l} 1 & -1 & 2 & -2 & & -1 \\ \hline & & -1 & 2 & -4 & \end{array}$$

$$\begin{array}{r} 1 & -2 & 4 & -6 \\ \hline = & x^2 - 2x + 4 & \text{Res. } -6 \end{array}$$

4.  $x^3 - 2x^2 + x - 2 \div x - 2$

$$\begin{array}{r|l} 1 & -2 & 1 & -2 & & 2 \\ \hline & & 2 & 0 & 2 & \end{array}$$

$$\begin{array}{r} 1 & 0 & 1 & 0 \\ \hline = & x^2 + 1 & \text{Res. } 0 \end{array}$$

5.  $a^3 - 3a^2 - 6a + 3$

$$\begin{array}{r|l} 1 & -3 & 0 & -6 & & -3 \\ \hline & & -3 & 18 & -54 & \end{array}$$

$$\begin{array}{r} 1 & -6 & 18 & -60 \\ \hline = & a^2 - 6a + 18 & \text{Res. } -60 \end{array}$$

6.  $n^4 - 5n^3 + 4n - 48 \div n + 2$

$$\begin{array}{r|l} 1 & -5 & 0 & 4 & -48 & & -2 \\ \hline & & -2 & 14 & -28 & 48 & \end{array}$$

$$\begin{array}{r} 1 & -7 & 14 & -24 & 0 \\ \hline = & n^3 - 7n^2 + 14n - 24 & \text{Res. } 0 \end{array}$$

7.  $x^4 - 3x + 5 \div x - 1$

$$\begin{array}{r|l} 1 & 0 & 0 & -3 & 5 & & 1 \\ \hline & & 1 & 1 & 1 & -2 & \end{array}$$

$$\begin{array}{r} 1 & 1 & 1 & -2 & 3 \\ \hline = & x^3 + x^2 + x - 2 & \text{Res. } 3 \end{array}$$

8.  $x^5 + x^4 - 12x^3 - x^2 - 4x - 2 \div x + 4$

$$\begin{array}{r|l} 1 & 1 & 1 & -12 & -1 & -4 & -2 & & -4 \\ \hline & & -4 & 12 & 0 & 4 & 0 & \end{array}$$

$$\begin{array}{r} 1 & -3 & 0 & -1 & 0 & -2 \\ \hline = & x^4 - 3x^3 - x & \text{Res. } -2 \end{array}$$

9.  $a^5 - 3a^3 + 4a - 6 \div a - 2$

$$\begin{array}{r|l} 1 & 0 & -3 & 0 & 4 & -6 & & 2 \\ \hline & & 2 & 4 & 2 & 4 & 16 & \end{array}$$

$$\begin{array}{r} 1 & 2 & 1 & 2 & 8 & 10 \\ \hline = & a^4 + 2a^3 + a^2 + 2a + 8 & \text{Res. } 10 \end{array}$$

10.  $x^5 - 208x^2 + 2076x - 5$

$$\begin{array}{r|l} 1 & 0 & 0 & -208 & 0 & 2.076 & & 5 \\ \hline & & 5 & 25 & 125 & -415 & -2.075 & \end{array}$$

$$\begin{array}{r} 1 & 5 & 25 & -83 & -415 & 1 \\ \hline = & x^4 + 5x^3 + 25x^2 - 83x - 415 & \text{Res. } 1 \end{array}$$

11.  $x^6 - 3x^5 + 4x^4 - 3x^3 - x^2 + 2x + 3$

$$\begin{array}{r|l} 1 & -3 & 4 & -3 & -1 & 0 & 2 & & -3 \\ \hline & & -3 & 18 & -66 & 207 & -618 & 1.854 & \end{array}$$

$$\begin{array}{r} 1 & -6 & 22 & -69 & 206 & -618 & 1.856 \\ \hline = & x^5 - 6x^4 + 22x^3 - 69x^2 + 206x - 618 & \text{Res. } 1.856 \end{array}$$

12.  $2x^3 - 3x^2 + 7x - 5 \div 2x - 1$

$$\begin{array}{r|l} 2 & -3 & 7 & -5 & & \frac{1}{2} \\ \hline & & 1 & -1 & 3 & \end{array}$$

$$\begin{array}{r} 2 & -2 & 6 & -2 \\ \hline = & x^2 - x + 3 & \text{Res. } -2 \end{array}$$

13.  $3a^3 - 4a^2 + 5a + 6 \div 3a + 2$

$$\begin{array}{r|l} 3 & -4 & 5 & 6 & & -\frac{2}{3} \\ \hline & & -2 & 4 & -6 & \end{array}$$

$$\begin{array}{r} 3 & -6 & 9 & 0 \\ \hline = & a^2 - 2a + 3 & \text{Res. } 0 \end{array}$$

14.  $3x^4 - 4x^3 + 4x^2 - 10x + 8 \div 3x - 1$

$$\begin{array}{r|l} 3 & -4 & 4 & -10 & 8 & & \frac{1}{3} \\ \hline & & 1 & -1 & 1 & -3 & \end{array}$$

$$\begin{array}{r} 3 & -3 & 3 & -9 & 5 \\ \hline = & x^3 - x^2 + x - 3 & \text{Res. } 5 \end{array}$$

15.  $x^6 - x^4 + \frac{15}{8}x^3 + x^2 - 1 \div 2x + 3$

$$\begin{array}{r|l} 1 & 0 & -1 & \frac{15}{8} & 1 & 0 & -1 & & -\frac{3}{2} \\ \hline & & -\frac{3}{2} & \frac{9}{4} & -\frac{15}{8} & 0 & -\frac{3}{2} & \frac{9}{4} & \end{array}$$

$$\begin{array}{r} 1 & -\frac{3}{2} & \frac{5}{4} & 0 & 1 & -\frac{3}{2} & \frac{5}{4} \\ \hline = & \frac{1}{2}x^5 - \frac{3}{4}x^4 + \frac{5}{8}x^3 + \frac{1}{2}x - \frac{3}{4} & \text{Res. } \frac{5}{4} \end{array}$$

## EJERCICIO 76

1.  $x^2 - x - 6 \div x - 3$

**Exacta (6 múltiplo de 3)**

2.  $x^3 + 4x^2 - x - 10 \div x + 2$

**Exacta (10 múltiplo de 2)**

3.  $2x^4 - 5x^3 + 7x^2 - 9x + 3 \div x - 1$

**Inexacta (1 no anula el polinomio)**

4.  $x^5 + x^4 - 5x^3 - 7x + 8 \div x + 3$

**Inexacta (8 no es múltiplo de 3)**

5.  $4x^3 - 8x^2 - 11x - 4 \div 2x - 1$

**Exacta (4 múltiplo de 1)**

6.  $6x^5 + 2x^4 - 3x^3 - x^2 + 3x + 3 \div 3x + 1$

**Inexacta (-1 no anula el polinomio)**

7.  $a + 1$  Es factor de  $a^3 - 2a^2 + 2a + 5$

$$(-1)^3 - 2(-1)^2 + 2(-1) + 5$$

$$= -1 - 2 - 2 + 5 = 0$$

No existe residuo, luego  $a + 1$  divide exactamente al polinomio, por lo que se deduce es un factor de este.

8.  $x - 5$  divide a  $x^5 + 6x^4 + 6x^3 - 5x^2 + 2x - 10$

$$5^5 + 6 \cdot 5^4 + 6 \cdot 5^3 - 5 \cdot 5^2 + 2 \cdot 5 - 10$$

$$= 3125 - 3750 + 750 + 125 + 10 - 10 = 0$$

Al sustituir  $x$  por  $5$  en el polinomio, este se anula, entonces  $x - 5$  divide con exactitud a

$$x^5 + 6x^4 + 6x^3 - 5x^2 + 2x - 10$$



9.  $4x-3$  divide a  $4x^4-7x^3+7x^2-7x+3$

$$4\left(\frac{3}{4}\right)^4 - 7\left(\frac{3}{4}\right)^3 + 7\left(\frac{3}{4}\right)^2 - 7\left(\frac{3}{4}\right) + 3$$

$$= \frac{324}{256} - \frac{189}{64} + \frac{63}{16} - \frac{21}{4} + 3$$

$$= \frac{324 - 756 + 1.008 - 1.344 + 768}{256} = \frac{0}{256} = 0$$

La variable x del dividendo se reemplaza por  $3/4$  ( $4x - 3 = 0$  luego  $x = 3/4$ ) que es el valor de la variable del divisor. Se observa su anulaci3n, por consiguiente,  $4x - 3$  es un divisor exacto de tal polinomio.

10.  $3n + 2$  no es factor de

$3n^5 + 2n^4 - 3n^3 - 2n^2 + 6n + 7$  porque 7 no es m3ltiplo de  $-2/3$ , lo cual significa que al reemplazar tal valor en el polinomio resultará un residuo, por ende la divisi3n no será exacta y  $3n + 2$  no se puede concebir como factor de dicho polinomio.

11.  $2a^3 - 2a^2 - 4a + 16 \div a + 2$

$$\begin{array}{r} -4 \quad 12 \quad -16 \\ 2 \quad -6 \quad 8 \quad 0 \end{array}$$

Exacta, coc.  $2a^2 - 6a + 8$

12.  $a^4 - a^2 + 2a + 2 \div a + 1$

$$\begin{array}{r} -1 \quad 1 \quad 0 \quad -2 \\ 1 \quad -1 \quad 0 \quad 2 \quad 0 \end{array}$$

Exacta, coc.  $a^3 - a^2 + 2$

13.  $x^4 + 5x - 6 \div x - 1$

$$\begin{array}{r} 1 \quad 1 \quad 1 \quad 6 \\ 1 \quad 1 \quad 1 \quad 6 \quad 0 \end{array}$$

Exacta, coc.  $x^3 + x^2 + x + 6$

14.  $x^6 - 39x^4 + 26x^3 - 52x^2 + 29x - 30 \div x - 6$

$$\begin{array}{r} 6 \quad 36 \quad -18 \quad 48 \quad -24 \quad 30 \\ 1 \quad 6 \quad -3 \quad 8 \quad -4 \quad 5 \quad 0 \end{array}$$

Exacta, coc.  $x^5 + 6x^4 - 3x^3 + 8x^2 - 4x + 5$

15.  $a^6 - 4a^5 - a^4 + 4a^3 + a^2 - 8a + 25 \div a - 4$

$$\begin{array}{r} 4 \quad 0 \quad -4 \quad 0 \quad 4 \quad -16 \\ 1 \quad 0 \quad -1 \quad 0 \quad 1 \quad -4 \quad 9 \end{array}$$

Inexacta, coc.  $a^5 - a^3 + a - 4$ ; Res. 9

16.  $16x^4 - 24x^3 + 37x^2 - 24x + 4 \div x - 1$

$$\begin{array}{r} 4 \quad -5 \quad 8 \quad -4 \\ 16 \quad -20 \quad 32 \quad -16 \quad 0 \end{array}$$

Exacta, coc.  $4x^3 - 5x^2 + 8x - 4$

17.  $15n^5 + 25n^4 - 18n^3 - 18n^2 + 17n - 11 \div 3n + 5$

$$\begin{array}{r} -25 \quad 0 \quad 30 \quad -20 \quad 5 \\ 15 \quad 0 \quad -18 \quad 12 \quad -3 \quad -6 \end{array}$$

Inexacta, coc.  $5n^4 - 6n^2 + 4n - 1$ ; Res.  $-6$

18.  $7x^2 - 5x + k \div x - 5$

$$\begin{array}{r} 35 \quad 150 \\ 7 \quad 30 \quad 0 \end{array}$$

$5k = -150$  se anula

19.  $x^3 - 3x^2 + 4x + k \div x - 2$

$$\begin{array}{r} 2 \quad -2 \quad 4 \\ 1 \quad -1 \quad 2 \quad 0 \end{array}$$

$k + 4 = 0$ , luego  $k = -4$

20.  $2a^4 + 25a + k \div a + 3$

$$\begin{array}{r} -6 \quad 18 \quad -54 \quad 87 \\ 2 \quad -6 \quad 18 \quad -29 \quad 0 \end{array}$$

Para  $k = -87$  se cumple que  $k + 87 = 0$

21.  $20x^3 - 7x^2 + 29x + k \div 4x + 1$

$$\begin{array}{r} -5 \quad 3 \quad -8 \\ 20 \quad -12 \quad 32 \quad 0 \end{array}$$

$k - 8 = 0$  entonces  $k = 8$

## EJERCICIO 77

1.  $\frac{x^5+1}{x-1}$  Inexacta Res. 2      9.  $\frac{a^5+32}{a-2}$  Inexacta Res. 64

2.  $\frac{a^4+b^4}{a+b}$  Inexacta Res.  $2b^4$

3.  $\frac{x^8-1}{x^2+1}$  Exacta      10.  $\frac{x^7-128}{x+2}$  Inexacta Res.  $-256$

4.  $\frac{a^{11}+1}{a-1}$  Inexacta Res. 2

5.  $\frac{a^6+b^6}{a^2+b^2}$  Inexacta Res.  $2b^6$       11.  $\frac{16a^4-81b^4}{2a+3b}$  Exacta

6.  $\frac{x^7-1}{x-1}$  Exacta

7.  $\frac{x^3-8}{x+2}$  Inexacta Res.  $-16$       12.  $\frac{a^3x^6+b^9}{ax^2+b^3}$  Exacta

8.  $\frac{x^4-16}{x+2}$  Exacta

## EJERCICIO 78

1.  $5x=8x-15$   
 $5x-8x=-15$   
 $-3x=-15$   
 $x=\frac{-15}{-3}$   
 $x=5$
2.  $4x+1=2$   
 $4x=2-1$   
 $4x=1$   
 $x=\frac{1}{4}$
3.  $y-5=3y-25$   
 $y-3y=-25+5$   
 $-2y=-20$   
 $y=\frac{-20}{-2}$   
 $y=10$
4.  $5x+6=10x+5$   
 $5x-10x=5-6$   
 $-5x=-1$   
 $x=\frac{-1}{-5}$   
 $x=\frac{1}{5}$
5.  $9y-11=-10+12y$   
 $9y-12y=-10+11$   
 $-3y=1$   
 $y=-\frac{1}{3}$
6.  $21-6x=27-8x$   
 $-6x+8x=27-21$   
 $2x=6$   
 $x=\frac{6}{2}$   
 $x=3$
7.  $11x+5x-1=65x-36$   
 $16x=65x-36+1$   
 $16x-65x=-35$   
 $-49x=-35$   
 $x=\frac{-35}{-49}$   
 $x=\frac{5}{7}$
8.  $8x-4+3x=7x+x+14$   
 $11x-4=8x+14$   
 $11x-8x=14+4$   
 $3x=18$   
 $x=\frac{18}{3}$   
 $x=6$
9.  $8x+9-12x=4x-13-5x$   
 $-4x+9=-x-13$   
 $-4x+x=-13-9$   
 $-3x=-22$   
 $x=\frac{-22}{-3}$   
 $x=\frac{22}{3}$
10.  $5y+6y-81=7y+102+65y$   
 $11y-81=72y+102$   
 $11y-72y=102+81$   
 $-61y=183$   
 $y=\frac{183}{-61}$   
 $y=-3$
11.  $16+7x-5+x=11x-3-x$   
 $8x+11=10x-3$   
 $8x-10x=-3-11$   
 $-2x=-14$   
 $x=\frac{-14}{-2}$   
 $x=7$
12.  $3x+101-4x-33=108-16x-100$   
 $-x+68=8-16x$   
 $-x+16x=8-68$   
 $15x=-60$   
 $x=\frac{-60}{15}$   
 $x=-4$
13.  $14-12x+39x-18x=256-60x-657x$   
 $9x+14=-717x+256$   
 $9x+717x=256-14$   
 $726x=242$   
 $x=\frac{242}{726}$   
 $x=\frac{1}{3}$
14.  $8x-15x-30x-51x=53x+31x-172$   
 $-88x=84x-172$   
 $-88x-84x=-172$   
 $-172x=-172$   
 $x=\frac{-172}{-172}$   
 $x=1$

## EJERCICIO 79

1.  $x-(2x+1)=8-(3x+3)$   
 $x-2x-1=8-3x-3$   
 $-x-1=5-3x$   
 $-x+3x=5+1$   
 $2x=6$   
 $x=\frac{6}{2}$   
 $x=3$
2.  $15x-10=6x-(x+2)+(-x+3)$   
 $15x-10=6x-x-2-x+3$   
 $15x-10=4x+1$   
 $15x-4x=10+1$   
 $x=\frac{11}{11}$   
 $x=1$
3.  $(5-3x)-(-4x+6)=(8x+11)-(3x-6)$   
 $5-3x+4x-6=8x+11-3x+6$   
 $x-1=5x+17$   
 $x-5x=17+1$   
 $-4x=18$   
 $x=\frac{18}{-4}$   
 $x=-\frac{9}{2}$

$$\begin{aligned}
 4. \quad & 30x - (-x+6) + (-5x+4) = -(5x+6) + (-8+3x) & 5. \quad & 15x + (-6x+5) - 2 - (-x+3) = -(7x+23) - x + (3-2x) \\
 & 30x + x - 6 - 5x + 4 = -5x - 6 - 8 + 3x & & 15x - 6x + 5 - 2 + x - 3 = -7x - 23 - x + 3 - 2x \\
 & 26x - 2 = -2x - 14 & & 10x = -10x - 20 \\
 & 26x + 2x = -14 + 2 & & 10x + 10x = -20 \\
 & 28x = -12 & & 20x = -20 \\
 & x = -\frac{12}{28} & & x = -\frac{20}{20} \\
 & x = -\frac{3}{7} & & x = -1
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & 3x + [-5x - (x+3)] = 8x + (-5x-9) & 7. \quad & 16x - [3x - (6-9x)] = 30x + [- (3x+2) - (x+3)] \\
 & 3x + [-5x - x - 3] = 8x - 5x - 9 & & 16x - [3x - 6 + 9x] = 30x + [-3x - 2 - x - 3] \\
 & 3x + [-6x - 3] = 3x - 9 & & 16x - [12x - 6] = 30x + [-4x - 5] \\
 & 3x - 6x - 3 = 3x - 9 & & 16x - 12x + 6 = 30x - 4x - 5 \\
 & -3x - 3 = 3x - 9 & & 4x + 6 = 26x - 5 \\
 & -x - 1 = x - 3 & & 4x - 26x = -5 - 6 \\
 & -x - x = -3 + 1 & & -22x = -11 \\
 & -2x = -2 \Rightarrow x = \frac{-2}{-2} = 1 & & x = \frac{-11}{-22} = \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & 9x - (5x+1) - \{2+8x - (7x-5)\} + 9x = 0 & 8. \quad & x - [5+3x - \{5x - (6+x)\}] = -3 \\
 & 9x - 5x - 1 - \{2+8x - 7x + 5\} + 9x = 0 & & x - [5+3x - \{5x - 6 - x\}] = -3 \\
 & 4x - 1 - \{x+7\} + 9x = 0 & & x - [5+3x - \{4x - 6\}] = -3 \\
 & 4x - 1 - x - 7 + 9x = 0 & & x - [5+3x - 4x + 6] = -3 \\
 & 12x - 8 = 0 & & x - [11 - x] = -3 \\
 & 12x = 8 & & x - 11 + x = -3 \\
 & x = \frac{8}{12} & & 2x = -3 + 11 \\
 & x = \frac{2}{3} & & 2x = 8 \Rightarrow x = \frac{8}{2} = 4
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & -\{3x+8 - [-15+6x - (-3x+2)] - (5x+4)\} - 29 = -5 & 10. \quad & 71 + [-5x + (-2x+3)] = 25 - [-(3x+4) - (4x+3)] \\
 & -\{3x+8 - [-15+6x+3x-2-5x-4] - 29\} = -5 & & 71 + [-5x - 2x + 3] = 25 - [-3x - 4 - 4x - 3] \\
 & -\{3x - 21 - [-21 + 4x]\} = -5 & & 71 + [-7x + 3] = 25 - [-7x - 7] \\
 & -\{3x - 21 + 21 - 4x\} = -5 & & 71 - 7x + 3 = 25 + 7x + 7 \\
 & -\{-x\} = -5 & & 74 - 7x = 32 + 7x \\
 & x = -5 & & 74 - 32 = 7x + 7x \\
 & & & 42 = 14x \\
 & & & \frac{42}{14} = x \\
 & & & 3 = x
 \end{aligned}$$

### EJERCICIO 80

$$\begin{aligned}
 1. \quad & x + 3(x-1) = 6 - 4(2x+3) & 2. \quad & 5(x-1) + 16(2x+3) = 3(2x-7) - x & 3. \quad & 2(3x+3) - 4(5x-3) = x(x-3) - x(x+5) \\
 & x + 3x - 3 = 6 - 8x - 12 & & 5x - 5 + 32x + 48 = 6x - 21 - x & & 6x + 6 - 20x + 12 = x^2 - 3x - x^2 - 5x \\
 & 4x - 3 = -8x - 6 & & 37x + 43 = 5x - 21 & & -14x + 18 = -8x \\
 & 4x + 8x = -6 + 3 & & 37x - 5x = -21 - 43 & & -14x + 8x = -18 \\
 & 12x = -3 & & 32x = -64 & & -6x = -18 \\
 & x = \frac{-3}{12} \Rightarrow x = -\frac{1}{4} & & x = \frac{-64}{32} \Rightarrow x = -2 & & x = \frac{-18}{-6} \Rightarrow x = 3
 \end{aligned}$$

$$4. 184 - 7(2x + 5) = 301 + 6(x - 1) - 6$$

$$184 - 14x - 35 = 301 + 6x - 6 - 6$$

$$149 - 14x = 289 + 6x$$

$$149 - 289 = 6x + 14x$$

$$-140 = 20x$$

$$\frac{-140}{20} = x$$

$$-7 = x$$

$$5. 7(18 - x) - 6(3 - 5x) = -(7x + 9) - 3(2x + 5) - 12$$

$$126 - 7x - 18 + 30x = -7x - 9 - 6x - 15 - 12$$

$$108 + 23x = -13x - 36$$

$$23x + 13x = -36 - 108$$

$$36x = -144$$

$$x = \frac{-144}{36}$$

$$x = -4$$

$$6. 3x(x - 3) + 5(x + 7) - x(x + 1) - 2(x^2 + 7) + 4 = 0$$

$$3x^2 - 9x + 5x + 35 - x^2 - x - 2x^2 - 14 + 4 = 0$$

$$-5x + 25 = 0$$

$$-5x = -25$$

$$x = \frac{-25}{-5}$$

$$x = 5$$

$$7. -3(2x + 7) + (-5x + 6) - 8(1 - 2x) - (x - 3) = 0$$

$$-6x - 21 - 5x + 6 - 8 + 16x - x + 3 = 0$$

$$4x - 20 = 0$$

$$4x = 20$$

$$x = \frac{20}{4}$$

$$x = 5$$

$$8. (3x - 4)(4x - 3) = (6x - 4)(2x - 5)$$

$$12x^2 - 9x - 16x + 12 = 12x^2 - 38x + 20$$

$$-25x + 38x = 20 - 12$$

$$13x = 8$$

$$x = \frac{8}{13}$$

$$9. (4 - 5x)(4x - 5) = (10x - 3)(7 - 2x)$$

$$-20x^2 + 41x - 20 = -20x^2 + 76x - 21$$

$$41x - 76x = -21 + 20$$

$$-35x = -1$$

$$x = \frac{-1}{-35}$$

$$x = \frac{1}{35}$$

$$10. (x + 1)(2x + 5) = (2x + 3)(x - 4) + 5$$

$$2x^2 + 7x + 5 = 2x^2 - 5x - 12 + 5$$

$$7x + 5x = -7 - 5$$

$$12x = -12$$

$$x = \frac{-12}{12}$$

$$x = -1$$

$$11. (x - 2)^2 - (3 - x)^2 = 1$$

$$x^2 - 4x + 4 - 9 + 6x - x^2 = 1$$

$$2x - 5 = 1$$

$$2x = 6$$

$$x = \frac{6}{2}$$

$$x = 3$$

$$12. 14 - (5x - 1)(2x + 3) = 17 - (10x + 1)(x - 6)$$

$$14 - (10x^2 + 13x - 3) = 17 - (10x^2 - 59x - 6)$$

$$14 - 10x^2 - 13x + 3 = 17 - 10x^2 + 59x + 6$$

$$-13x - 59x = 6$$

$$-72x = 6$$

$$x = \frac{6}{-72}$$

$$x = -\frac{1}{12}$$

$$13. (x - 2)^2 + x(x - 3) = 3(x + 4)(x - 3) - (x + 2)(x - 1) + 2$$

$$x^2 - 4x + 4 + x^2 - 3x = 3(x^2 + x - 12) - (x^2 + x - 2) + 2$$

$$2x^2 - 7x + 4 = 3x^2 + 3x - 36 - x^2 - x + 2 + 2$$

$$2x^2 - 7x + 4 = 2x^2 + 2x - 36 + 4$$

$$-7x - 2x = -36$$

$$-9x = -36$$

$$x = \frac{-36}{-9}$$

$$x = 4$$

$$14. (3x - 1)^2 - 5(x - 2) - (2x + 3)^2 - (5x + 2)(x - 1) = 0$$

$$9x^2 - 6x + 1 - 5x + 10 - 4x^2 - 12x - 9 - 5x^2 + 3x + 2 = 0$$

$$-20x + 4 = 0$$

$$-20x = -4$$

$$x = \frac{-4}{-20}$$

$$x = \frac{1}{5}$$

$$\begin{aligned}
 15. \quad & 2(x-3)^2 - 3(x+1)^2 + (x-5)(x-3) + 4(x^2 - 5x + 1) = 4x^2 - 12 \\
 & 2x^2 - 12x + 18 - 3x^2 - 6x - 3 + x^2 - 8x + 15 + 4x^2 - 20x + 4 = 4x^2 - 12 \\
 & 4x^2 - 46x + 34 = 4x^2 - 12 \\
 & -46x = -12 - 34 \\
 & -46x = -46 \\
 & x = \frac{-46}{-46} \\
 & x = 1
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & 5(x-2)^2 - 5(x+3)^2 + (2x-1)(5x+2) - 10x^2 = 0 \\
 & 5x^2 - 20x + 20 - 5x^2 - 30x - 45 + 10x^2 - x - 2 - 10x^2 = 0 \\
 & -51x - 27 = 0 \\
 & -51x = 27 \\
 & x = \frac{27}{-51} \\
 & x = -\frac{9}{17}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & 7(x-4)^2 - 3(x+5)^2 = 4(x+1)(x-1) - 2 \\
 & 7x^2 - 56x + 112 - 3x^2 - 30x - 75 = 4x^2 - 4 - 2 \\
 & 4x^2 - 86x + 37 = 4x^2 - 6 \\
 & -86x = -6 - 37 \\
 & -86x = -43 \\
 & x = \frac{-43}{-86} \\
 & x = \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & x^2 - 5x + 15 = x(x-3) - 14 + 5(x-2) + 3(13-2x) \\
 & x^2 - 5x + 15 = x^2 - 3x - 14 + 5x - 10 + 39 - 6x \\
 & -5x + 15 = -4x + 15 \\
 & -5x + 4x = 0 \\
 & -x = 0 \\
 & x = 0
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & 5(1-x)^2 - 6(x^2 - 3x - 7) = x(x-3) - 2x(x+5) - 2 \\
 & 5 - 10x + 5x^2 - 6x^2 + 18x + 42 = x^2 - 3x - 2x^2 - 10x - 2 \\
 & -x^2 + 8x + 47 = -x^2 - 13x - 2 \\
 & 8x + 13x = -2 - 47 \\
 & 21x = -49 \\
 & x = \frac{-49}{21} \\
 & x = -\frac{7}{3}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & 3(5x-6)(3x+2) - 6(3x+4)(x-1) - 3(9x+1)(x-2) = 0 \\
 & 3(15x^2 - 8x - 12) - 6(3x^2 + x - 4) - 3(9x^2 - 17x - 2) = 0 \\
 & 45x^2 - 24x - 36 - 18x^2 - 6x + 24 - 27x^2 + 51x + 6 = 0 \\
 & 21x - 6 = 0 \\
 & 21x = 6 \\
 & x = \frac{6}{21} \\
 & x = \frac{2}{7}
 \end{aligned}$$

## EJERCICIO 81

$$\begin{aligned}
 1. \quad & 14x - (3x-2) - [5x+2-(x-1)] = 0 \\
 & 14x - 3x + 2 - [5x+2-x+1] = 0 \\
 & 11x + 2 - [4x+3] = 0 \\
 & 11x + 2 - 4x - 3 = 0 \\
 & 7x - 1 = 0 \\
 & 7x = 1 \\
 & x = \frac{1}{7}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & (3x-7)^2 - 5(2x+1)(x-2) = -x^2 - [-(3x+1)] \\
 & 9x^2 - 42x + 49 - 5(2x^2 - 3x - 2) = -x^2 - [-3x - 1] \\
 & 9x^2 + x^2 - 42x + 49 - 10x^2 + 15x + 10 = 3x + 1 \\
 & -27x + 59 = 3x + 1 \\
 & -27x - 3x = 1 - 59 \\
 & -30x = -58 \\
 & x = \frac{-58}{-30} \Rightarrow x = \frac{29}{15}
 \end{aligned}$$

$$\begin{aligned}
3. \quad 6x - (2x+1) &= -\{-5x + [ -(-2x-1) ]\} \\
6x - 2x - 1 &= -\{-5x + [2x+1]\} \\
4x - 1 &= -\{-5x + 2x + 1\} \\
4x - 1 &= -\{-3x + 1\} \\
4x - 1 &= 3x - 1 \\
4x - 3x &= -1 + 1 \\
x &= 0
\end{aligned}$$

$$\begin{aligned}
4. \quad 2x + 3(-x^2 - 1) &= -\{3x^2 + 2(x-1) - 3(x+2)\} \\
2x - 3x^2 - 3 &= -\{3x^2 + 2x - 2 - 3x - 6\} \\
2x - 3x^2 - 3 &= -\{3x^2 - x - 8\} \\
2x - 3x^2 - 3 &= -3x^2 + x + 8 \\
2x - x &= 8 + 3 \\
x &= 11
\end{aligned}$$

$$\begin{aligned}
5. \quad x^2 - \{3x + [x(x+1) + 4(x^2-1) - 4x^2]\} &= 0 \\
x^2 - \{3x + [x^2 + x + 4x^2 - 4 - 4x^2]\} &= 0 \\
x^2 - \{3x + [x^2 + x - 4]\} &= 0 \\
x^2 - \{3x + x^2 + x - 4\} &= 0 \\
x^2 - 4x - x^2 + 4 &= 0 \\
-4x &= -4 \\
x &= \frac{-4}{-4} \\
x &= 1
\end{aligned}$$

$$\begin{aligned}
6. \quad 3(2x+1)(-x+3) - (2x+5)^2 &= -\{-3(x+5)\} + 10x^2 \\
3(-2x^2 + 5x + 3) - 4x^2 - 20x - 25 &= -\{-3x - 15\} + 10x^2 \\
-6x^2 + 15x + 9 - 4x^2 - 20x - 25 &= -\{3x + 15 + 10x^2\} \\
-10x^2 - 5x - 16 &= -3x - 15 - 10x^2 \\
-5x + 3x &= 16 - 15 \\
-2x &= 1 \\
x &= -\frac{1}{2}
\end{aligned}$$

$$\begin{aligned}
7. \quad (x+1)(x+2)(x-3) &= (x-2)(x+1)(x+1) \\
(x^2 + 3x + 2)(x-3) &= (x^2 - x - 2)(x+1) \\
x^3 - 3x^2 + 3x^2 - 9x + 2x - 6 &= x^3 + x^2 - x^2 - x - 2x - 2 \\
-7x - 6 &= -3x - 2 \\
-7x + 3x &= -2 + 6 \\
-4x &= 4 \\
x &= \frac{4}{-4} \Rightarrow x = -1
\end{aligned}$$

$$\begin{aligned}
8. \quad (x+2)(x+3)(x-1) &= (x+4)(x+4)(x-4) + 7 \\
(x^2 + 5x + 6)(x-1) &= (x+4)(x^2 - 16) + 7 \\
x^3 - x^2 + 5x^2 - 5x + 6x - 6 &= x^3 - 16x + 4x^2 - 64 + 7 \\
4x^2 + x - 6 &= 4x^2 - 16x - 57 \\
x + 16x &= -57 + 6 \\
17x &= -51 \\
x &= \frac{-51}{17} \Rightarrow x = -3
\end{aligned}$$

$$\begin{aligned}
9. \quad (x+1)^3 - (x-1)^3 &= 6x(x-3) \\
x^3 + 3x^2 + 3x + 1 - (x^3 - 3x^2 + 3x - 1) &= 6x^2 - 18x \\
x^3 + 3x^2 + 3x + 1 - x^3 + 3x^2 - 3x + 1 &= 6x^2 - 18x \\
6x^2 + 2 &= 6x^2 - 18x \\
2 &= -18x \\
\frac{2}{-18} &= x \Rightarrow -\frac{1}{9} = x
\end{aligned}$$

$$\begin{aligned}
10. \quad 3(x-2)^2(x+5) &= 3(x+1)^2(x-1) + 3 \\
3(x^2 - 4x + 4)(x+5) &= 3(x^2 + 2x + 1)(x-1) + 3 \\
(3x^2 - 12x + 12)(x+5) &= (3x^2 + 6x + 3)(x-1) + 3 \\
3x^3 + 15x^2 - 12x^2 - 60x + 12x + 60 &= 3x^3 - 3x^2 + 6x^2 - 6x + 3x - 3 + 3 \\
3x^2 - 48x + 60 &= 3x^2 - 3x \\
-48x + 3x &= -60 \\
-45x &= -60 \\
x &= \frac{-60}{-45} \Rightarrow x = \frac{4}{3}
\end{aligned}$$

## EJERCICIO 82

$$\begin{aligned}
1. \quad x &\rightarrow N^\circ \text{ mayor} \\
x - 8 &\rightarrow N^\circ \text{ menor} \\
x + x - 8 &= 106 \\
2x - 8 &= 106 \\
2x &= 106 + 8 \\
x &= \frac{114}{2} \\
x &= 57 \rightarrow N^\circ \text{ mayor} \\
x - 8 &\Rightarrow 57 - 8 \\
&= 49 \rightarrow N^\circ \text{ menor}
\end{aligned}$$

2.  $x \rightarrow \text{N}^\circ \text{ mayor}$   
 $x-32 \rightarrow \text{N}^\circ \text{ menor}$   
 $x+x-32=540$   
 $2x=540+32$   
 $2x=572$   
 $x=\frac{572}{2}$   
 $x=286 \rightarrow \text{N}^\circ \text{ mayor}$

$x-32 \Rightarrow 286-32$   
 $=254 \rightarrow \text{N}^\circ \text{ menor}$

3.  $A+B=1.154 \text{ bs.}$   
 $A-506=B$   
 $A+A-506=1.154$   
 $2A=1.154+506$   
 $2A=1.660$   
 $A=\frac{1.660}{2}$   
 $A=830 \text{ bs.}$

$A-506=B$   
 $\Rightarrow 830-506=B$   
 $324 \text{ bs.}=B$

4.  $x \rightarrow \text{N}^\circ \text{ mayor}$   
 $x-24 \rightarrow \text{N}^\circ \text{ menor}$   
 $x+x-24=106$   
 $2x=106+24$   
 $x=\frac{130}{2}$   
 $x=65 \rightarrow \text{N}^\circ \text{ mayor}$

$x-24 \Rightarrow 65-24$   
 $=41 \rightarrow \text{N}^\circ \text{ menor}$

5.  $A+B=56 \text{ años}$   
 $A+14=B$   
 $A+A+14=56$   
 $2A=56-14$   
 $A=\frac{42}{2}$   
 $A=21 \text{ años}$

$A+14=B$   
 $21+14=B$   
 $35 \text{ años}=B$

6.  $A+B=1.080 \text{ soles}$   
 $A-1.014=B$   
 $A+A-1.014=1.080$   
 $2A=1.080+1.014$   
 $A=\frac{2.094}{2}$   
 $A=1.047 \text{ soles}$

$A-1.014=B$   
 $\Rightarrow 1.047-1.014=B$   
 $33 \text{ soles}=B$

7.  $x \rightarrow \text{N}^\circ \text{ mayor}$   
 $x-1 \rightarrow \text{N}^\circ \text{ menor}$   
 $x+x-1=103$   
 $2x=103+1$   
 $x=\frac{104}{2}$   
 $x=52 \rightarrow \text{N}^\circ \text{ mayor}$

$x-1 \Rightarrow 52-1$   
 $=51 \rightarrow \text{N}^\circ \text{ menor}$

8.  $x \rightarrow \text{N}^\circ \text{ menor}$   
 $x+1 \rightarrow \text{N}^\circ \text{ medio}$   
 $x+2 \rightarrow \text{N}^\circ \text{ mayor}$   
 $x+x+1+x+2=204$   
 $3x+3=204$   
 $3x=204-3$   
 $x=\frac{201}{3}$   
 $x=67 \rightarrow \text{N}^\circ \text{ menor}$

$x+1 \Rightarrow 67+1$   
 $=68 \rightarrow \text{N}^\circ \text{ medio}$   
 $x+2 \Rightarrow 67+2$   
 $=69 \rightarrow \text{N}^\circ \text{ mayor}$

9.  $x \rightarrow \text{N}^\circ 1$   $x+1 \rightarrow \text{N}^\circ 2$   
 $x+2 \rightarrow \text{N}^\circ 3$   $x+3 \rightarrow \text{N}^\circ 4$   
 $x+x+1+x+2+x+3=74$   
 $4x+6=74$

$4x=74-6$   
 $x=\frac{68}{4}$   
 $x=17 \rightarrow \text{N}^\circ 1$

$x+1 \Rightarrow 17+1$   
 $=18 \rightarrow \text{N}^\circ 2$   
 $x+2 \Rightarrow 17+2$   $x+3 \Rightarrow 17+3$   
 $=19 \rightarrow \text{N}^\circ 3$   $=20 \rightarrow \text{N}^\circ 4$

10.  $2x \rightarrow \text{N}^\circ \text{ menor}$   
 $2x+2 \rightarrow \text{N}^\circ \text{ mayor}$   
 $2x+2x+2=194$   
 $4x=194-2$   
 $x=\frac{192}{4}$   
 $x=48$

$2x \Rightarrow 2 \cdot 48$   
 $=96 \rightarrow \text{N}^\circ \text{ menor}$

$2x+2 \Rightarrow 2 \cdot 48 + 2$   
 $=96 + 2$   
 $=98 \rightarrow \text{N}^\circ \text{ mayor}$

11.  $x \rightarrow \text{N}^\circ \text{ mayor}$   
 $x-1 \rightarrow \text{N}^\circ \text{ medio}$   
 $x-2 \rightarrow \text{N}^\circ \text{ menor}$   
 $x+x-1+x-2=186$   
 $3x-3=186$   
 $3x=189$   
 $x=\frac{189}{3}$   
 $x=63 \rightarrow \text{N}^\circ \text{ mayor}$

$x-1 \Rightarrow 63-1$   
 $=62 \rightarrow \text{N}^\circ \text{ medio}$   
 $x-2 \Rightarrow 63-2$   
 $=61 \rightarrow \text{N}^\circ \text{ menor}$

12.  $\text{caballo} + \text{coche} + \text{arrees} = 325$   
 $\text{coche} + 80 = \text{caballo}$   
 $\text{coche} - 25 = \text{arrees}$   
 $\text{coche} + 80 + \text{coche} + \text{coche} - 25 = 325$   
 $3 \text{ coches} + 55 = 325$   
 $3 \text{ coches} = 270$   
 $\text{coche} = \frac{270}{3}$   
 $\text{coche} = \$90$

$\text{coche} + 80 = \text{caballo}$   
 $\Rightarrow 90 + 80 = \text{caballo}$   
 $\$170 = \text{caballo}$   
 $\text{coche} - 25 = \text{arrees}$   
 $\Rightarrow 90 - 25 = \text{arrees}$   
 $\$65 = \text{arrees}$

13.  $x \rightarrow N^{\circ}$  mayor  
 $x-32 \rightarrow N^{\circ}$  medio  
 $x-65 \rightarrow N^{\circ}$  menor  
 $x+x-32+x-65=200$   
 $3x-97=200$   
 $3x=297$   
 $x=\frac{297}{3}$   
 $x=99 \rightarrow N^{\circ}$  mayor  
 $x-32 \Rightarrow 99-32$   
 $=67 \rightarrow N^{\circ}$  medio  
 $x-65 \Rightarrow 99-65$   
 $=34 \rightarrow N^{\circ}$  menor

14.  $x \rightarrow 1^{\circ}$  cesto  
 $x-10 \rightarrow 2^{\circ}$  cesto  
 $x-15 \rightarrow 3^{\circ}$  cesto  
 $x+x-10+x-15=575$   
 $3x-25=575$   
 $3x=600$   
 $x=\frac{600}{3}$   
 $x=200 \rightarrow 1^{\circ}$  cesto  
 $x-10 \Rightarrow 200-10$   
 $=190 \rightarrow 2^{\circ}$  cesto  
 $x-15 \Rightarrow 200-15$   
 $=185 \rightarrow 3^{\circ}$  cesto

15.  $x \rightarrow$  mayor  
 $x-55 \rightarrow$  medio  
 $x-70 \rightarrow$  menor  
 $x+x-55+x-70=454$   
 $3x-125=454$   
 $3x=454+125$   
 $3x=579$   
 $x=\frac{579}{3}$   
 $x=193 \rightarrow$  mayor  
 $x-55 \Rightarrow 193-55$   
 $=138 \rightarrow$  medio  
 $x-70 \Rightarrow 193-70$   
 $=123 \rightarrow$  menor

16.  $x \rightarrow 1^{\circ}$   
 $x-20 \rightarrow 2^{\circ}$   
 $x-20-40 \rightarrow 3^{\circ}$   
 $\Rightarrow x-60 \rightarrow 3^{\circ}$   
 $x+x-20+x-60=310$   
 $3x=310+80$   
 $3x=390$   
 $x=\frac{390}{3}$   
 $x=130 \rightarrow 1^{\circ}$   
 $x-20 \Rightarrow 130-20$   
 $=110 \rightarrow 2^{\circ}$   
 $x-60 \Rightarrow 130-60$   
 $=70 \rightarrow 3^{\circ}$

17.  $x \rightarrow$  mayor  
 $x-20 \rightarrow$  menor  
 $x-18 \rightarrow$  medio  
 $x+x-20+x-18=88$   
 $3x-38=88$   
 $3x=88+38$   
 $3x=126$   
 $x=\frac{126}{3}$   
 $x=42 \rightarrow$  mayor  
 $x-20 \Rightarrow 42-20$   
 $=22 \rightarrow$  menor  
 $x-18 \Rightarrow 42-18$   
 $=24 \rightarrow$  medio

18.  $x \rightarrow$  mayor  
 $x-36 \rightarrow$  menor  
 $x+x-36=642$   
 $2x-36=642$   
 $2x=642+36$   
 $2x=678$   
 $x=\frac{678}{2}$   
 $x=339 \rightarrow$  mayor  
 $x-36 \Rightarrow 339-36$   
 $=303 \rightarrow$  menor

## EJERCICIO 83

1.  $x \rightarrow$  edad Juan  
 $3x \rightarrow$  edad Pedro  
 $x+3x=40$   
 $4x=40$   
 $x=\frac{40}{4}$   
 $x=10 \rightarrow$  edad Juan  
 $3x \Rightarrow 3 \cdot 10$   
 $=30 \rightarrow$  edad Pedro

2.  $x \rightarrow$  Arreos  
 $4x \rightarrow$  Caballo  
 $x+4x=600$   
 $5x=600$   
 $x=\frac{600}{5}$   
 $x=\$120 \rightarrow$  Arreos  
 $4x \Rightarrow 4 \cdot 120$   
 $=\$480 \rightarrow$  Caballo

3.  $x \rightarrow 1^{\circ}$  piso  
 $\frac{x}{2} \rightarrow 2^{\circ}$  piso  
 $x+\frac{x}{2}=48$   
 $\frac{2x+x}{2}=48$   
 $3x=48 \cdot 2$   
 $3x=96$   
 $x=\frac{96}{3}$   
 $x=32$  Habt.  $\rightarrow 1^{\circ}$  piso  
 $\frac{x}{2} \Rightarrow \frac{32}{2}$   
 $=16$  Habt.  $\rightarrow 2^{\circ}$  piso

4.  $A+B+C=300$   
 $B=2A$   
 $C=3A$   
 $\Rightarrow A+2A+3A=300$   
 $6A=300$   
 $A=\frac{300}{6}$   
 $A=50$  colones  
 $B=2A \Rightarrow 2 \cdot 50$   
 $=100$  colones  
 $C=3A \Rightarrow 3 \cdot 50$   
 $=150$  colones



5.  $A+B+C=133$

$$A = \frac{B}{2}$$

$$C = 2B$$

$$\Rightarrow \frac{B}{2} + B + 2B = 133$$

$$\frac{B}{2} + 3B = 133$$

$$\frac{B+6B}{2} = 133$$

$$7B = 133 \cdot 2$$

$$B = \frac{266}{7}$$

$$B = 38 \text{ Sucres}$$

$$A = \frac{B}{2} \Rightarrow \frac{38}{2}$$

$$= 19 \text{ Sucres}$$

$$C = 2B \Rightarrow 2 \cdot 38$$

$$= 76 \text{ Sucres}$$

6.  $x \rightarrow N^{\circ} \text{ mayor}$

$$\frac{x}{6} \rightarrow N^{\circ} \text{ menor}$$

$$x + \frac{x}{6} = 147$$

$$\frac{6x+x}{6} = 147$$

$$7x = 147 \cdot 6$$

$$7x = 882$$

$$x = \frac{882}{7}$$

$$x = 126 \rightarrow N^{\circ} \text{ mayor}$$

$$\frac{x}{6} \Rightarrow \frac{126}{6}$$

$$= 21 \rightarrow N^{\circ} \text{ menor}$$

7.  $A+B+C=140$

$$B = \frac{A}{2} \Rightarrow 2B = A$$

$$B = \frac{C}{4} \Rightarrow 4B = C$$

$$2B+B+4B=140$$

$$7B=140$$

$$B = \frac{140}{7}$$

$$B = 20 \text{ Quetz}$$

$$A = 2B \Rightarrow 2 \cdot 20$$

$$= 40 \text{ Quetz}$$

$$C = 4B \Rightarrow 4 \cdot 20$$

$$= 80 \text{ Quetz}$$

8.  $x \rightarrow 1^{\circ} \text{ parte}$

$$4x \rightarrow 2^{\circ} \text{ parte}$$

$$5x \rightarrow 3^{\circ} \text{ parte}$$

$$x+4x+5x=850$$

$$10x=850$$

$$x = \frac{850}{10}$$

$$x = 85 \rightarrow 1^{\circ} \text{ parte}$$

$$4x \Rightarrow 4 \cdot 85$$

$$= 340 \rightarrow 2^{\circ} \text{ parte}$$

$$5x \Rightarrow 5 \cdot 85$$

$$= 425 \rightarrow 3^{\circ} \text{ parte}$$

9.  $x \rightarrow N^{\circ} \text{ buscado}$

$$2x = x + 111$$

$$2x - x = 111$$

$$x = 111 \rightarrow N^{\circ} \text{ buscado}$$

10.  $x \rightarrow \text{edad Rosa}$

$$3x + 15 \rightarrow \text{edad María}$$

$$x + 3x + 15 = 59$$

$$4x = 59 - 15$$

$$4x = 44$$

$$x = \frac{44}{4}$$

$$x = 11 \rightarrow \text{edad Rosa}$$

$$3x + 15 \Rightarrow 3 \cdot 11 + 15$$

$$= 33 + 15$$

$$= 48 \rightarrow \text{edad María}$$

11.  $x \rightarrow N^{\circ} \text{ buscado}$

$$8x = x + 21$$

$$8x - x = 21$$

$$7x = 21$$

$$x = \frac{21}{7}$$

$$x = 3 \rightarrow N^{\circ} \text{ buscado}$$

12.  $x \rightarrow \text{Mi edad}$

$$3x + 7 = 100$$

$$3x = 100 - 7$$

$$3x = 93$$

$$x = \frac{93}{3}$$

$$x = 31 \rightarrow \text{Mi edad}$$

13.  $x \rightarrow 1^{\circ} \text{ parte}$

$$\frac{x}{3} \rightarrow 2^{\circ} \text{ parte}$$

$$\frac{4x}{3} \rightarrow 3^{\circ} \text{ parte}$$

$$x + \frac{x}{3} + \frac{4x}{3} = 96$$

$$\frac{3x + x + 4x}{3} = 96$$

$$8x = 96 \cdot 3$$

$$8x = 288$$

$$x = \frac{288}{8}$$

$$x = 36 \rightarrow 1^{\circ} \text{ parte}$$

$$\frac{x}{3} \Rightarrow \frac{36}{3} = 12 \rightarrow 2^{\circ} \text{ parte}$$

$$\frac{4x}{3} \Rightarrow \frac{4 \cdot 36}{3} = 4 \cdot 12 = 48 \rightarrow 3^{\circ} \text{ parte}$$

14.  $x \rightarrow \text{Edad Enrique}$

$$2x \rightarrow \text{Edad Pedro}$$

$$3x \rightarrow \text{Edad Juan}$$

$$6x \rightarrow \text{Edad Eugenio}$$

$$x + 2x + 3x + 6x = 132$$

$$12x = 132$$

$$x = \frac{132}{12}$$

$$x = 11 \rightarrow \text{Edad Enrique}$$

$$2x \Rightarrow 2 \cdot 11 = 22 \rightarrow \text{Edad Pedro}$$

$$3x \Rightarrow 3 \cdot 11 = 33 \rightarrow \text{Edad Juan}$$

$$6x \Rightarrow 6 \cdot 11 = 66 \rightarrow \text{Edad Eugenio}$$

## EJERCICIO 84

1.  $x \rightarrow 1^{\circ} \text{ parte}$

$$3x \rightarrow 2^{\circ} \text{ parte}$$

$$3x - 40 \rightarrow 3^{\circ} \text{ parte}$$

$$x + 3x + 3x - 40 = 254$$

$$7x = 254 + 40$$

$$7x = 294$$

$$x = \frac{294}{7}$$

$$x = 42 \rightarrow 1^{\circ} \text{ parte}$$

$$3x \Rightarrow 3 \cdot 42 = 126 \rightarrow 2^{\circ} \text{ parte}$$

$$3x - 40 \Rightarrow 3 \cdot 42 - 40$$

$$= 126 - 40 = 86 \rightarrow 3^{\circ} \text{ parte}$$

2.  $A+B+C=130$

$C=2A$

$B-15=C \Rightarrow B-15=2A$

$B=2A+15$

$A+2A+15+2A=130$

$5A=130-15$

$5A=115$

$A=\frac{115}{5}$

$A=23 \text{ Balb.}$

$B=2A+15 \Rightarrow 2 \cdot 23+15=46+15=61 \text{ Balb.}$

$C=2A \Rightarrow 2 \cdot 23=46 \text{ Balb.}$

3.  $x \rightarrow 1^\circ \text{ Número}$

$\frac{x-8}{2} \rightarrow 2^\circ \text{ Número}$

$x-18 \rightarrow 3^\circ \text{ Número}$

$x+\frac{x-8}{2}+x-18=238$

$2x+\frac{x-8}{2}=256$

$\frac{4x+x}{2}=256+4$

$5x=260 \cdot 2$

$x=\frac{520}{5}$

$x=104 \rightarrow 1^\circ \text{ Número}$

$\frac{x-8}{2} \Rightarrow \frac{104-8}{2}=\frac{96}{2}=48 \rightarrow 2^\circ \text{ Número}$

$x-18 \Rightarrow 104-18=86 \rightarrow 3^\circ \text{ Número}$

4.  $x \rightarrow \text{Costo traje}$

$\frac{x}{8} \rightarrow \text{Costo sombrero}$

$x-30 \rightarrow \text{Costo bastón}$

$x+\frac{x}{8}+x-30=259$

$2x+\frac{x}{8}=259+30$

$\frac{16x+x}{8}=289$

$17x=289 \cdot 8$

$x=\frac{2.312}{17}$

$x=\$136 \rightarrow \text{Costo traje}$

$\frac{x}{8} \Rightarrow \frac{136}{8}=\$17 \rightarrow \text{Costo sombrero}$

$x-30 \Rightarrow 136-30=\$106 \rightarrow \text{Costo bastón}$

5.  $x \rightarrow 1^\circ \text{ Número}$

$\frac{x-6}{5} \rightarrow 2^\circ \text{ Número}$

$x-6 \rightarrow 3^\circ \text{ Número}$

$x+\frac{x-6}{5}+x-6=72$

$2x+\frac{x-6}{5}=78$

$\frac{10x+x}{5}=78+\frac{6}{5}$

$\frac{11x}{5}=\frac{390+6}{5}$

$11x=396$

$x=\frac{396}{11}$

$x=36 \rightarrow 1^\circ \text{ Número}$

$\frac{x-6}{5} \Rightarrow \frac{36-6}{5}$

$=\frac{30}{5}=6 \rightarrow 2^\circ \text{ Número}$

$x-6 \Rightarrow 36-6=30 \rightarrow 3^\circ \text{ Número}$

6.  $A+B=99$

$B=3A+19$

$A+3A+19=99$

$4A=99-19$

$4A=80$

$A=\frac{80}{4}$

$A=20 \text{ bs.}$

$B=3A+19 \Rightarrow 3 \cdot 20+19$

$=60+19=79 \text{ bs.}$

7.  $x \rightarrow \text{cm de azul}$

$\frac{x-14}{2} \rightarrow \text{cm de blanco}$

$x+\frac{x-14}{2}=74$

$x+\frac{x-14}{2}=74$

$\frac{2x+x}{2}=74+7$

$3x=81 \cdot 2$

$x=\frac{162}{3}$

$x=54 \rightarrow \text{cm de azul}$

$\frac{x-14}{2} \Rightarrow \frac{54-14}{2}$

$=\frac{40}{2}=20 \rightarrow \text{cm de blanco}$

8.  $A+B+C=152$

$B=2A-8 \Rightarrow \frac{B+8}{2}=A$

$B-32=C$

$\frac{B+8}{2}+B+B-32=152$

$\frac{B}{2}+\frac{8}{2}+2B=152+32$

$\frac{B+4B}{2}=184-4$

$5B=180 \cdot 2$

$B=\frac{360}{5}$

$B=\$72$

$A=\frac{B+8}{2} \Rightarrow \frac{72+8}{2}=\frac{80}{2}=\$40$

$C=B-32 \Rightarrow 72-32=\$40$

9.  $x \rightarrow N^\circ \text{ buscado}$

$x-80=220-2x$

$x+2x=220+80$

$3x=300$

$x=\frac{300}{3}$

$x=100 \rightarrow N^\circ \text{ buscado}$

10.  $x \rightarrow \text{Tengo ahora}$

$2x+10=x+60$

$2x-x=60-10$

$x=50 \text{ S/.} \rightarrow \text{Tengo ahora}$

11.  $x \rightarrow \text{Parte separada}$

$x+80 \rightarrow \text{La otra parte}$

$x+x+80=910$

$2x=910-80$

$x=\frac{830}{2}$

$x=415 \text{ cm}$

$\Rightarrow 4,15 \text{ m} \rightarrow \text{Parte separada}$

$x+80 \Rightarrow 415+80=495 \text{ cm}$

$\Rightarrow 4,95 \text{ m} \rightarrow \text{La otra parte}$

12.  $x \rightarrow$  Edad padre

$$\frac{x-3}{3} \rightarrow \text{Edad hijo}$$

$$x + \frac{x-3}{3} = 83$$

$$x + \frac{x}{3} - \frac{3}{3} = 83$$

$$\frac{3x+x}{3} = 83+1$$

$$4x = 84 \cdot 3$$

$$x = \frac{252}{4}$$

$$x = 63 \rightarrow \text{Edad padre}$$

$$\frac{x-3}{3} \rightarrow \frac{63-3}{3} = \frac{60}{3} = 20 \rightarrow \text{Edad hijo}$$

13.  $A+B+C=9.000$

$$B+500=A$$

$$B-800=C$$

$$B+500+B+B-800=9.000$$

$$3B=9.000+300$$

$$B = \frac{9.300}{3}$$

$$B = 3.100 \text{ Votos}$$

$$A = B + 500 \Rightarrow 3.100 + 500 = 3.600 \text{ Votos}$$

$$C = B - 800 \Rightarrow 3.100 - 800 = 2.300 \text{ Votos}$$

14.  $x \rightarrow$  Nº buscado

$$8x - 60 = 60 - 7x$$

$$8x + 7x = 60 + 60$$

$$15x = 120$$

$$x = \frac{120}{15}$$

$$x = 8 \rightarrow \text{Nº buscado}$$

15.  $x \rightarrow$  Edad hombre

$$2x - 17 = 100 - x$$

$$2x + x = 100 + 17$$

$$3x = 117$$

$$x = \frac{117}{3}$$

$$x = 39 \rightarrow \text{Edad hombre}$$

## EJERCICIO 85

1.  $x \rightarrow$  Nº mayor

$$\frac{2x}{3} \rightarrow \text{Nº menor}$$

$$x + \frac{2x}{3} = 100$$

$$\frac{3x+2x}{3} = 100$$

$$5x = 100 \cdot 3$$

$$x = \frac{300}{5}$$

$$x = 60 \rightarrow \text{Nº mayor}$$

$$\frac{2x}{3} \Rightarrow \frac{2 \cdot 60}{3} = 40 \rightarrow \text{Nº menor}$$

2.  $x \rightarrow$  Edad padre

$$\frac{x-15}{2} \rightarrow \text{Edad hijo}$$

$$x + \frac{x-15}{2} = 60$$

$$x + \frac{x}{2} - \frac{15}{2} = 60$$

$$\frac{2x+x}{2} = 60 + \frac{15}{2}$$

$$\frac{3x}{2} = \frac{120+15}{2}$$

$$3x = 135$$

$$x = \frac{135}{3}$$

$$x = 45 \rightarrow \text{Edad padre}$$

$$\frac{x-15}{2} \Rightarrow \frac{45-15}{2} = 15 \rightarrow \text{Edad hijo}$$

3.  $x \rightarrow$  Partemayor

$$x - 232 \rightarrow \text{Partemenor}$$

$$x + x - 232 = 1.080$$

$$2x = 1.080 + 232$$

$$x = \frac{1.312}{2}$$

$$x = 656 \rightarrow \text{Partemayor}$$

$$x - 232 \Rightarrow 656 - 232$$

$$= 424 \rightarrow \text{Partemenor}$$

4.  $A+B=150$

$$A - 46 = B$$

$$A + A - 46 = 150$$

$$2A = 150 + 46$$

$$A = \frac{196}{2}$$

$$A = 98 \text{ Soles}$$

$$B = A - 46 \Rightarrow 98 - 46$$

$$= 52 \text{ Soles}$$

5.  $x \rightarrow$  Ang. mayor

$$\frac{x+45}{2} \rightarrow \text{Ang. menor}$$

$$x + \frac{x+45}{2} = 180$$

$$x + \frac{x}{2} + \frac{45}{2} = 180$$

$$\frac{2x+x}{2} = 180 - \frac{45}{2}$$

$$\frac{3x}{2} = \frac{360-45}{2}$$

$$3x = 315$$

$$x = \frac{315}{3}$$

$$x = 105 \rightarrow \text{Ang. mayor}$$

$$\frac{x+45}{2} \Rightarrow \frac{105+45}{2} = 75 \rightarrow \text{Ang. menor}$$

6.  $x \rightarrow$  Nº mayor

$$\frac{x-88}{3} \rightarrow \text{Nº menor}$$

$$x + \frac{x-88}{3} = 540$$

$$x + \frac{x}{3} - \frac{88}{3} = 540$$

$$\frac{3x+x}{3} = 540 + \frac{88}{3}$$

$$\frac{4x}{3} = \frac{1.620+88}{3}$$

$$4x = 1.708$$

$$x = \frac{1.708}{4}$$

$$x = 427 \rightarrow \text{Nº mayor}$$

$$\frac{x-88}{3} \Rightarrow \frac{427-88}{3}$$

$$= \frac{339}{3} = 113 \rightarrow \text{Nº menor}$$

7.  $x \rightarrow$  Nº mayor

$$\frac{x-12}{4} \rightarrow \text{Nº menor}$$

$$x - \left( \frac{x-12}{4} \right) = 36$$

$$x - \frac{x}{4} + \frac{12}{4} = 36$$

$$\frac{4x-x}{4} = 36 - 3$$

$$3x = 33 \cdot 4$$

$$3x = 132$$

$$x = \frac{132}{3}$$

$$x = 44 \rightarrow \text{Nº mayor}$$

$$\frac{x-12}{4} \Rightarrow \frac{44-12}{4} = 8 \rightarrow \text{Nº menor}$$

8  $x \rightarrow$  Costo perro

$$\frac{x}{8} \rightarrow \text{Costo collar}$$

$$x + \frac{x}{8} = 54$$

$$\frac{8x+x}{8} = 54$$

$$9x = 54 \cdot 8$$

$$9x = 432$$

$$x = \frac{432}{9}$$

$$x = \$48 \rightarrow \text{Costo perro}$$

$$\frac{x}{8} \Rightarrow \frac{48}{8} = \$6 \rightarrow \text{Costo collar}$$

11.  $x \rightarrow$  Parte mayor

$$\frac{x+16}{3} \rightarrow \text{Parte menor}$$

$$x + \frac{x+16}{3} = 160$$

$$x + \frac{x}{3} = 160 - \frac{16}{3}$$

$$\frac{3x+x}{3} = \frac{480-16}{3}$$

$$4x = 464$$

$$x = \frac{464}{4}$$

$$x = 116 \rightarrow \text{Parte mayor}$$

$$\frac{x+16}{3} \Rightarrow \frac{116+16}{3}$$

$$= \frac{132}{3} = 44 \rightarrow \text{Parte menor}$$

9.  $A+B=84$

$$A-16=B+20$$

$$\Rightarrow A-16-20=B$$

$$A-36=B$$

$$A+A-36=84$$

$$2A=84+36$$

$$A = \frac{120}{2}$$

$$A = \$60$$

$$B = A-36 \Rightarrow 60-36 = \$24$$

12.  $x \rightarrow$  N° mayor

$$\frac{x+150}{3} \rightarrow \text{N° menor}$$

$$x + \frac{x+150}{3} = 506$$

$$x + \frac{x}{3} = 506 - \frac{150}{3}$$

$$\frac{3x+x}{3} = \frac{1518-150}{3}$$

$$4x = 1368$$

$$x = \frac{1.368}{4}$$

$$x = 342 \rightarrow \text{N° mayor}$$

$$\frac{x+150}{3} \Rightarrow \frac{342+150}{3}$$

$$= \frac{492}{3} = 164 \rightarrow \text{N° menor}$$

10.  $x \rightarrow$  N° Señoritas

$$\frac{x-15}{2} \rightarrow \text{N° Jovenes}$$

$$x + \frac{x-15}{2} = 60$$

$$x + \frac{x}{2} = 60 + \frac{15}{2}$$

$$\frac{2x+x}{2} = \frac{120+15}{2}$$

$$3x = 135$$

$$x = \frac{135}{3}$$

$$x = 45 \rightarrow \text{N° Señoritas}$$

$$\frac{x-15}{2} \Rightarrow \frac{45-15}{2} = 15 \rightarrow \text{N° jovenes}$$

13.  $x \rightarrow$  Estilográfica

$$x-10 \rightarrow \text{Lapicero}$$

$$x+x-10=18$$

$$2x=28$$

$$x = \frac{28}{2}$$

$$x = 14 \text{ bs.} \rightarrow \text{Estilográfica}$$

$$x-10 \Rightarrow 14-10 = 4 \text{ bs.} \rightarrow \text{Lapicero}$$

14.  $x \rightarrow$  Parte roja

$$x+4 \rightarrow \text{Parte negra}$$

$$x+x+4=84$$

$$2x=80$$

$$x = 40 \text{ cm} \rightarrow \text{Parte roja}$$

$$x+4 \Rightarrow 40+4 = 44 \text{ cm} \rightarrow \text{Parte negra}$$

## EJERCICIO 86

1.  $2x \rightarrow$  Edad actual A

$$x \rightarrow \text{Edad actual B}$$

$$2x-10=3(x-10)$$

$$2x-10=3x-30$$

$$2x-3x=-30+10$$

$$-x=-20$$

$$x=20 \rightarrow \text{Edad actual B}$$

$$2x \Rightarrow 2 \cdot 20 = 40 \rightarrow \text{Edad actual A}$$

2.

$$3x \rightarrow \text{Edad A}$$

$$x \rightarrow \text{Edad B}$$

$$3x+5=2(x+5)$$

$$3x+5=2x+10$$

$$3x-2x=10-5$$

$$x=5 \rightarrow \text{Edad B}$$

$$3x \Rightarrow 3 \cdot 5 = 15 \rightarrow \text{Edad A}$$

3.  $2x \rightarrow$  Tiene A

$$x \rightarrow \text{Tiene B}$$

$$2x-30=x-5$$

$$2x-x=30-5$$

$$x = \$25 \rightarrow \text{Tiene B}$$

$$2x \Rightarrow 2 \cdot 25 = \$50 \rightarrow \text{Tiene A}$$

4.  $\frac{x}{2} \rightarrow$  Tiene A

$$x \rightarrow \text{Tiene B}$$

$$\frac{x}{2} + 66 = 2(x-90)$$

$$\frac{x+132}{2} = 2(x-90)$$

$$x+132=4(x-90)$$

$$x+132=4x-360$$

$$-3x=-492$$

$$x = \frac{-492}{-3}$$

$$x = 164 \text{ colones} \rightarrow \text{Tiene B}$$

$$\frac{x}{2} \Rightarrow \frac{164}{2} = 82 \rightarrow \text{colones Tiene A}$$

5.  $x \rightarrow$  N° var ones

$$\frac{x}{3} \rightarrow \text{N° Srtas}$$

$$\frac{x}{3} + 14 = x - 10$$

$$\frac{x}{3} - x = -10 - 14$$

$$\frac{x-3x}{3} = -24$$

$$-2x = -72$$

$$x = 36 \rightarrow \text{N° var ones}$$

$$\frac{x}{3} \Rightarrow \frac{36}{3} = 12 \rightarrow \text{N° Srtas}$$

6.  $3x \rightarrow$  Edad padre

$$x \rightarrow \text{Edad hijo}$$

$$3x-5=2(x+10)$$

$$3x-5=2x+20$$

$$x=25 \rightarrow \text{Edad hijo}$$

$$3x \Rightarrow 3 \cdot 25 = 75 \rightarrow \text{Edad padre}$$

- 7.**  $x \rightarrow \text{N}^\circ \text{ mayor}$   
 $2x - 56 \rightarrow \text{N}^\circ \text{ menor}$   
 $x + 2x - 56 = 85$   
 $3x = 141$   
 $x = \frac{141}{3}$   
 $x = 47 \rightarrow \text{N}^\circ \text{ mayor}$   
 $2x - 56 \Rightarrow 2 \cdot 47 - 56$   
 $= 94 - 56 = 38 \rightarrow \text{N}^\circ \text{ menor}$
- 8.**  $5x \rightarrow \text{Tiene Enrique}$   
 $x \rightarrow \text{Tiene suhno.}$   
 $5x - 0,5 = x + 0,5$   
 $5x - x = 0,5 + 0,5$   
 $4x = 1$   
 $x = \frac{1}{4}$   
 $x = \$0,25 \rightarrow \text{Tiene suhno}$
- 9.**  $x \rightarrow \text{Bolsa 1}$   
 $x - 400 \rightarrow \text{Bolsa 2}$   
 $x + x - 400 = 1.400$   
 $2x = 1.800$   
 $x = 900 \text{ S/.} \rightarrow \text{Bolsa 1}$   
 $x - 400 \Rightarrow 900 - 400 = 500 \text{ S/.} \rightarrow \text{Bolsa 2}$
- 10.**  $4x \rightarrow \text{Días Trab. Pedro}$   
 $x \rightarrow \text{Días Trab. Enrique}$   
 $4x - 15 = x + 21$   
 $4x - x = 21 + 15$   
 $3x = 36$   
 $x = \frac{36}{3}$   
 $x = 12 \rightarrow \text{Días Trab. Enrique}$   
 $4x \Rightarrow 4 \cdot 12$   
 $= 48 \rightarrow \text{Días Trab. Pedro}$
- 11.**  $2x \rightarrow \text{Edad act. padre}$   
 $x \rightarrow \text{Edad act. hijo}$   
 $2x - 14 = 3(x - 14)$   
 $2x - 14 = 3x - 42$   
 $2x - 3x = -42 + 14$   
 $-x = -28$   
 $x = 28 \rightarrow \text{Edad act. hijo}$   
 $\text{Edades hace 14 años:}$   
 $2x - 14 \Rightarrow 2 \cdot 28 - 14$   
 $= 42 \text{ años} \rightarrow \text{padre}$   
 $x - 14 \Rightarrow 28 - 14$   
 $= 14 \text{ años} \rightarrow \text{hijo}$
- 12.**  $3x \rightarrow \text{Edad actual Juan}$   
 $x \rightarrow \text{Edad actual hijo}$   
 $3x + 22 = 2(x + 22)$   
 $3x = 2x + 44 - 22$   
 $x = 22 \rightarrow \text{Edad actual hijo}$   
 $3x \Rightarrow 3 \cdot 22 = 66 \rightarrow \text{Edad actual Juan}$
- 13.**  $A + B = 84 \Rightarrow A = 84 - B$   
 $A + 80 = 3(B + 4)$   
 $\Rightarrow 84 - B + 80 = 3B + 12$   
 $-B - 3B = 12 - 164$   
 $-4B = -152$   
 $B = \frac{-152}{-4}$   
 $B = \$38$   
 $A = 84 - B \Rightarrow 84 - 38 = \$46$

## EJERCICIO 87

- 1.**  $2x \rightarrow \text{N}^\circ \text{ Sombreros}$   
 $x \rightarrow \text{N}^\circ \text{ trajes}$   
 $4x + 50x = 702$   
 $54x = 702$   
 $x = \frac{702}{54}$   
 $x = 13 \rightarrow \text{N}^\circ \text{ trajes}$   
 $2x \Rightarrow 2 \cdot 13$   
 $= 26 \rightarrow \text{N}^\circ \text{ Sombreros}$
- 2.**  $x \rightarrow \text{Cab.}$   
 $x - 6 \rightarrow \text{Vacas}$   
 $600x + 800(x - 6) = 40.000$   
 $600x + 800x - 4.800 = 40.000$   
 $1.400x = 44.800$   
 $x = \frac{44.800}{1.400}$   
 $x = 32 \rightarrow \text{Cab.}$   
 $x - 6 \Rightarrow 32 - 6 = 26 \rightarrow \text{Vacas}$
- 3.**  $16 - x \rightarrow \text{Pr ob. reslt.}$   
 $x \rightarrow \text{Pr ob. no reslt.}$   
 $12(16 - x) - 5x = 73$   
 $192 - 12x - 5x = 73$   
 $-17x = 73 - 192$   
 $x = \frac{-119}{-17}$   
 $x = 7 \rightarrow \text{Pr ob. no reslt.}$   
 $16 - x \Rightarrow 16 - 7 = 9 \rightarrow \text{Pr ob. reslt.}$
- 4.**  $50 - x \rightarrow \text{Días trab.}$   
 $x \rightarrow \text{Días no trab.}$   
 $3(50 - x) - 2x = 90$   
 $150 - 3x - 2x = 90$   
 $-5x = -60$   
 $x = \frac{-60}{-5}$   
 $x = 12 \rightarrow \text{Días no trab.}$   
 $50 - x \Rightarrow 50 - 12 = 38 \rightarrow \text{Días trab.}$
- 5.**  $35 - x \rightarrow \text{Trajes de 30 Q}$   
 $x \rightarrow \text{Trajes de 25 Q}$   
 $30(35 - x) + 25x = 1.015$   
 $1.050 - 30x + 25x = 1.015$   
 $-5x = 1.015 - 1.050$   
 $x = \frac{-35}{-5}$   
 $x = 7 \rightarrow \text{Trajes de 25 Q}$   
 $35 - x \Rightarrow 35 - 7 = 28 \rightarrow \text{Trajes de 30 Q}$
- 6.**  $x \rightarrow \text{Traje Cal.}$   
 $x - 7 \rightarrow \text{Traje inf.}$   
 $32x + 18(x - 7) = 1.624$   
 $32x + 18x - 126 = 1.624$   
 $50x = 1.750$   
 $x = \frac{1.750}{50}$   
 $x = 35 \text{ balb.} \rightarrow \text{Traje Cal.}$   
 $x - 7 \Rightarrow 35 - 7 = 28 \text{ balb.} \rightarrow \text{Traje inf.}$

7.  $3x \rightarrow N^\circ \text{ Lápices}$

$x \rightarrow N^\circ \text{ cuad.}$

$0,05 \cdot 3x + 0,06x = 1,47$

$0,15x + 0,06x = 1,47$

$0,21x = 1,47$

$x = \frac{1,47}{0,21}$

$x = 7$

$\Rightarrow 7 \rightarrow N^\circ \text{ cuad.}$

$3x \rightarrow 3 \cdot 7 = 21 \rightarrow N^\circ \text{ Lápices}$

8.  $3x + 5 \rightarrow \text{Sac. Frij.}$

$x \rightarrow \text{Sac. azúc.}$

$6(3x + 5) + 5x = 582$

$18x + 30 + 5x = 582$

$23x = 552$

$x = \frac{552}{23}$

$x = 24$

$\Rightarrow 24 \rightarrow \text{Sac. azúc.}$

$3x + 5 \Rightarrow 3 \cdot 24 + 5$

$= 77 \rightarrow \text{Sac. Frij.}$

9.  $80 - x \rightarrow \text{Cedro}$

$x \rightarrow \text{Caoba}$

$0,75(80 - x) + 0,90x = 68,40 \Rightarrow (1.050 - x) - 2x = 1.825$

$60 - 0,75x + 0,90x = 68,40 \Rightarrow 60 - 0,75x + 0,90x = 68,40$

$0,15x = 8,40$

$x = \frac{8,40}{0,15}$

$x = 56$

$\Rightarrow 56 \text{ pies}^3 \rightarrow \text{Caoba}$

$80 - x \Rightarrow 80 - 56$

$= 24 \text{ pies}^3 \rightarrow \text{Cedro}$

10.  $1.050 - x \rightarrow P. mayor$

$x \rightarrow P. menor$

$(1.050 - x) - 2x = 1.825$

$1.50 - 3x - 2x = 1.825$

$-5x = 1.825 - 3.150$

$-5x = -1.325$

$x = \frac{-1.325}{-5}$

$x = 265$

$\Rightarrow 265 \rightarrow P. menor$

$1.050 - x \Rightarrow 1.050 - 265$

$= 785 \rightarrow P. mayor$

## EJERCICIO 88

1.  $x \rightarrow 1^\circ$

$2x \rightarrow 2^\circ$

$x + 2x - 20 \rightarrow 3^\circ$

$\Rightarrow 3x - 20 \rightarrow 3^\circ$

$x + 2x + 3x - 20 = 196$

$6x = 196 + 20$

$x = \frac{216}{6}$

$x = 36 \rightarrow 1^\circ$

$2x \Rightarrow 2 \cdot 36 = 72 \rightarrow 2^\circ$

$3x - 20 \Rightarrow 3 \cdot 36 - 20$

$= 108 - 20 = 88 \rightarrow 3^\circ$

2.  $3x \rightarrow \text{Edad A}$

$x \rightarrow \text{Edad B}$

$3x - 5 = 4(x - 5)$

$3x - 5 = 4x - 20$

$3x - 4x = -20 + 5$

$-x = -15$

$x = 15 \rightarrow \text{Edad B}$

$3x \Rightarrow 3 \cdot 15 = 45 \rightarrow \text{Edad A}$

3.  $x \rightarrow \text{Par zap.}$

$2x + 50 \rightarrow \text{Traje}$

$50(2x + 50) + 35x = 16.000$

$100x + 2.500 + 35x = 16.000$

$135x = 16.000 - 2.500$

$x = \frac{13.500}{135}$

$x = 100 \text{ soles} \rightarrow \text{Par zap.}$

$2x + 50 \Rightarrow 2 \cdot 100 + 50 = 250 \text{ soles} \rightarrow \text{Traje}$

4.  $x \rightarrow \text{Costo casa}$

$\frac{x}{4} = \frac{x}{6} + 2.000$

$\frac{x}{4} = \frac{x + 12.000}{6}$

$6x = 4x + 48.000$

$2x = 48.000$

$x = \frac{48.000}{2}$

$x = 24.000 \text{ bs.} \rightarrow \text{Costo casa}$

5.  $x \rightarrow N^\circ \text{ mayor}$

$\frac{2x - 156}{3} \rightarrow N^\circ \text{ menor}$

$x + \frac{2x - 156}{3} = 108$

$x + \frac{2x}{3} = 108 + \frac{156}{3}$

$\frac{3x + 2x}{3} = \frac{324 + 156}{3}$

$5x = 480$

$x = \frac{480}{5}$

$x = 96 \rightarrow N^\circ \text{ mayor}$

$\frac{2x - 156}{3} \Rightarrow \frac{2 \cdot 96 - 156}{3}$

$= \frac{36}{3} = 12 \rightarrow N^\circ \text{ menor}$

6.  $x \rightarrow \text{Ancho}$

$461 - 11 = 9x$

$450 = 9x$

$\frac{450}{9} = x$

$50 = x$

$\Rightarrow 50 \text{ pies} \rightarrow \text{Ancho}$

7.  $x \rightarrow \text{Gasté}$

$85 - x = 4x$

$85 = 5x$

$\frac{85}{5} = x$

$17 = x$

$\Rightarrow \$17 \rightarrow \text{Gasté}$

8.  $x \rightarrow \text{Edad act. B}$

$2(x - 12) \rightarrow \text{Edad A hace 12 años}$

$2(x - 12) + 24 + 68 = 3(x + 12)$

$2x - 24 + 92 = 3x + 36$

$2x - 3x = 36 - 68$

$-x = -32$

$x = 32 \rightarrow \text{Edad act. B}$

*Edad actual de A:*

$2(x - 12) + 12 \Rightarrow 2(32 - 12) + 12$

$= 2 \cdot 20 + 12 = 52 \text{ años}$

9.  $x \rightarrow \text{mon. 10cts.}$

$22 - x \rightarrow \text{mon. 5cts.}$

$0,10x + 0,05(22 - x) = 1,85$

$0,10x + 1,10 - 0,05x = 1,85$

$0,05x = 1,85 - 1,10$

$0,05x = 0,75$

$x = \frac{0,75}{0,05}$

$x = 15 \rightarrow \text{mon. 10cts.}$

$22 - x \Rightarrow 22 - 15 = 7 \rightarrow \text{mon. 5cts.}$

10.  $x \rightarrow N^\circ \text{ buscado}$

$$12(x-24) = 24(x-27)$$

$$12x - 288 = 24x - 648$$

$$12x - 24x = -648 + 288$$

$$-12x = -360$$

$$x = \frac{-360}{-12}$$

$x = 30 \rightarrow N^\circ \text{ buscado}$

11.  $x \rightarrow c / \text{cab.}$

$$35x = 40(x-10)$$

$$35x = 40x - 400$$

$$-5x = -400$$

$$x = \frac{-400}{-5}$$

$$x = \$80 \rightarrow c / \text{cab.}$$

12.  $x \rightarrow N^\circ \text{ buscado}$

$$3x - 55 = 233 - x$$

$$3x + x = 233 + 55$$

$$4x = 288$$

$$x = \frac{288}{4}$$

$$x = 72 \rightarrow N^\circ \text{ buscado}$$

13.  $x \rightarrow N^\circ \text{ menor}$

$$x+1 \rightarrow N^\circ \text{ medio}$$

$$x+2 \rightarrow N^\circ \text{ mayor}$$

$$2x + 3(x+1) + 4(x+2) = 740$$

$$2x + 3x + 3 + 4x + 8 = 740$$

$9x = 740 - 11$

$$x = \frac{729}{9}$$

$$x = 81$$

$\Rightarrow 81 \rightarrow N^\circ \text{ menor}$

$x+1 \Rightarrow 81+1=82 \rightarrow N^\circ \text{ medio}$

$x+2 \Rightarrow 81+2=83 \rightarrow N^\circ \text{ mayor}$

14.  $x \rightarrow A \text{ caballo}$

$$3x \rightarrow E \text{ auto}$$

$$x-20 \rightarrow A \text{ pie}$$

$$x+3x+x-20=150$$

$$5x=150+20$$

$$x = \frac{170}{5}$$

$$x = 34 \text{ Km} \rightarrow A \text{ caballo}$$

$$3x \Rightarrow 3 \cdot 34 = 102 \text{ Km} \rightarrow E \text{ auto}$$

$$x-20 \Rightarrow 34-20 = 14 \text{ Km} \rightarrow A \text{ pie}$$

15.  $x \rightarrow \text{Parte hijo}$

$$x+2.000 \rightarrow \text{Partehijas}$$

$$3x+2(x+2.000) = 16.500$$

$$3x+2x+4.000 = 16.500$$

$$5x = 12.500$$

$$x = \frac{12.500}{5}$$

$$x = 2.500$$

$\Rightarrow 2.500 \text{ colones} \rightarrow \text{Parte hijo}$

$x+2.000 \Rightarrow 2.500+2.000 = 4.500$

$\Rightarrow 4.500 \text{ colones} \rightarrow \text{Partehijas}$

16.  $x \rightarrow N^\circ \text{ mayor}$

$$x-1 \rightarrow N^\circ \text{ menor}$$

$$x^2 - (x-1)^2 = 31$$

$$x^2 - x^2 + 2x - 1 = 31$$

$$2x = 32$$

$$x = 16 \rightarrow N^\circ \text{ mayor}$$

$x-1 \Rightarrow 16-1=15 \rightarrow N^\circ \text{ menor}$

17.  $3x \rightarrow \text{Edad A}$

$x \rightarrow \text{Edad B}$

$\frac{x}{5} \rightarrow \text{Edad C}$

$x-12 \rightarrow \text{Edad C}$

Luego:

$\frac{x}{5} = x-12$

$x = 5(x-12)$

$x = 5x - 60$

$-4x = -60$

$x = 15 \rightarrow \text{Edad B}$

$3x \Rightarrow 3 \cdot 15 = 45 \rightarrow \text{Edad A}$

$x-12 \Rightarrow 15-12=3 \rightarrow \text{Edad C}$

18.  $x \rightarrow \text{Edad act. A}$

$\frac{x+5}{3} \rightarrow \text{Edad B en 5 años}$

$\frac{x+20}{2} \rightarrow \text{Edad B en 20 años}$

Luego:

$\frac{x+5}{3} + 15 = \frac{x+20}{2}$

$\frac{x+5+45}{3} = \frac{x+20}{2}$

$2(x+50) = 3(x+20)$

$2x+100 = 3x+60$

$-x = -40$

$x = 40 \rightarrow \text{Edad act. A}$

Edad actual de B:

$\frac{x+20}{2} - 20 = \frac{40+20}{2} - 20$

$= 30 - 20 = 10 \text{ años}$

19.  $x \rightarrow \text{Lunes}$

$2x \rightarrow \text{Martes}$

$4x \rightarrow \text{Miercoles}$

$8x \rightarrow \text{Jueves}$

$8x-30 \rightarrow \text{Viernes}$

$8x-20 \rightarrow \text{Sábado}$

$x+2x+4x+8x+8x-30+8x-20=911$

$31x-50=911$

$31x=911+50$

$x = \frac{961}{31}$

$x = \$31 \rightarrow \text{Lunes}$

$2x \Rightarrow 2 \cdot 31 = \$62 \rightarrow \text{Martes}$

$4x \Rightarrow 4 \cdot 31 = \$124 \rightarrow \text{Miercoles}$

$8x \Rightarrow 8 \cdot 31 = \$248 \rightarrow \text{Jueves}$

$8x-30 \Rightarrow 8 \cdot 31 - 30 = \$218 \rightarrow \text{Viernes}$

$8x-20 \Rightarrow 8 \cdot 31 - 20 = \$228 \rightarrow \text{Sábado}$

20.  $x \rightarrow N^\circ 1$

$x-18 \rightarrow N^\circ 2$

$x+x-18=3 \cdot 18$

$2x=54+18$

$x = \frac{72}{2}$

$x=36 \rightarrow N^\circ 1$

$x-18 \Rightarrow 36-18=18 \rightarrow N^\circ 2$

21.  $x \rightarrow \text{Tiene A}$

$3(x-16) \rightarrow \text{Tiene B}$

$x+3(x-16)=36$

$x+3x-48=36$

$4x=84$

$x = \frac{84}{4}$

$x = \$21 \rightarrow \text{Tiene A}$

$3(x-16) \Rightarrow 3(21-16)$

$= 3 \cdot 5 = \$15 \rightarrow \text{Tiene B}$

22.  $3x \rightarrow \text{Tiene A}$

$x \rightarrow \text{Tiene B}$

$\frac{x}{2} \rightarrow \text{Tiene C}$

$3x-1-(x-3) = 2\left(\frac{x}{2}+20\right)$

$3x-1-x+3 = x+40$

$2x-x=40-2$

$x=38 \rightarrow \text{Tiene B}$

$3x \Rightarrow 3 \cdot 38 = \$114 \rightarrow \text{Tiene A}$

$\frac{x}{2} \Rightarrow \frac{38}{2} = \$19 \rightarrow \text{Tiene C}$

23.  $x \rightarrow$  Costo tienda

$$\frac{x}{5} - 800 = \frac{x}{7}$$

$$\frac{x - 4.000}{5} = \frac{x}{7}$$

$$7x - 28.000 = 5x$$

$$2x = 28.000$$

$$x = 14.000$$

$\Rightarrow 14.000$  bs.  $\rightarrow$  Costo tienda

24.  $x \rightarrow$  Cab. peor

$$2(x + 15) \rightarrow \text{Cab. mejor}$$

$$x + 2(x + 15) = 120$$

$$x + 2x + 30 = 120$$

$$3x = 90$$

$$x = \$30 \rightarrow \text{Cab. peor}$$

$$2(x + 15) = 2(30 + 15)$$

$$= 2 \cdot 45 = \$90 \rightarrow \text{Cab. mejor}$$

25.  $x \rightarrow$  queda A

$$3x \rightarrow \text{queda B}$$

$$x + 3x = 160$$

$$4x = 160$$

$$x = 40$$

Como A tenía 80 Q.

$\Rightarrow$  lo que perdió A

$$= 80 - x \Rightarrow 80 - 40 = 40 \text{ Q.}$$

26.  $2x \rightarrow$  Emp. A

$$x \rightarrow \text{Emp. B}$$

$$2(2x - 400) = x + 400$$

$$4x - 800 = x + 400$$

$$3x = 1.200$$

$$x = \$400 \rightarrow \text{Emp. B}$$

$$2x \Rightarrow 2 \cdot 400 = \$800 \rightarrow \text{Emp. A}$$

27.  $4x \rightarrow$  Cab.

$$x \rightarrow \text{Vacas}$$

$$4x + 5 = 3(x + 5)$$

$$4x + 5 = 3x + 15$$

$$x = 10 \rightarrow \text{Vacas}$$

$$4x \Rightarrow 4 \cdot 10 = 40 \rightarrow \text{Cab.}$$

28.  $x \rightarrow$  Lunes

$$x + 6 \rightarrow \text{Martes}$$

$$x + 12 \rightarrow \text{Miercoles}$$

$$x + 18 \rightarrow \text{Jueves}$$

$$4x \rightarrow \text{Jueves}$$

$$x + 18 = 4x$$

$$-3x = -18$$

$$x = \$6 \rightarrow \text{Lunes}$$

$$x + 6 \Rightarrow 6 + 6 = \$12 \rightarrow \text{Martes}$$

$$x + 12 \Rightarrow 6 + 12 = 18 \rightarrow \text{Miercoles}$$

$$4x \Rightarrow 4 \cdot 6 = \$24 \rightarrow \text{Jueves}$$

29.  $x \rightarrow$  Tenía ppio.

$$2x - 50 + 2(2x - 50) - 390 = 0$$

$$2x - 440 + 4x - 100 = 0$$

$$6x = 540$$

$$x = \frac{540}{6}$$

$$x = 90$$

$$\Rightarrow 90 \text{ soles} \rightarrow \text{Tenía ppio.}$$

30.  $2x \rightarrow$  Largo

$$x \rightarrow \text{Ancho}$$

$$(2x - 6)(x + 4) = 2x^2$$

$$2x^2 + 2x - 24 = 2x^2$$

$$2x = 24$$

$$x = 12m \rightarrow \text{Ancho}$$

$$2x \Rightarrow 2 \cdot 12 = 24m \rightarrow \text{Largo}$$

31.  $3x \rightarrow$  Padre hace 5 años

$$x \rightarrow \text{Hijo hace 5 años}$$

$$3x + 10 = 2(x + 10)$$

$$3x + 10 = 2x + 20$$

$$x = 10 \text{ años}$$

Edad actual Padre:

$$3x + 5 \Rightarrow 3 \cdot 10 + 5 = 35 \text{ años}$$

Edad actual Hijo:

$$x + 5 \Rightarrow 10 + 5 = 15 \text{ años}$$

32.  $3x \rightarrow$  Edad A en 4 años

$$x \rightarrow \text{Edad B en 4 años}$$

$$3x - 6 = 5(x - 6)$$

$$3x - 6 = 5x - 30$$

$$-2x = -24$$

$$x = 12 \text{ años}$$

Edad Actual A:

$$3x - 4 \Rightarrow 3 \cdot 12 - 4 = 32 \text{ años}$$

Edad Actual B:

$$x - 4 \Rightarrow 12 - 4 = 8 \text{ años}$$

## EJERCICIO 89

1.  $a^2 + ab = a(a + b)$

2.  $b + b^2 = b(1 + b)$

3.  $x^2 + x = x(x + 1)$

4.  $3a^3 - a^2 = a^2(3a - 1)$

5.  $x^3 - 4x^4 = x^3(1 - 4x)$

6.  $5m^2 + 15m^3 = 5m^2(1 + 3m)$

7.  $ab - bc = b(a - c)$

8.  $x^2y + x^2z = x^2(y + z)$

9.  $2a^2x + 6ax^2 = 2ax(a + 3x)$

10.  $8m^2 - 12mn = 4m(2m - 3n)$

11.  $9a^3x^2 - 18ax^3 = 9ax^2(a^2 - 2x)$

12.  $15c^3d^2 + 60c^2d^3 = 15c^2d^2(c + 4d)$

13.  $35m^2n^3 - 70m^3 = 35m^2(n^3 - 2m)$

14.  $abc + abc^2 = abc(1 + c)$

15.  $24a^2xy^2 - 36x^2y^4 = 12xy^2(2a^2 - 3xy^2)$

16.  $a^3 + a^2 + a = a(a^2 + a + 1)$

17.  $4x^2 - 8x + 2 = 2(2x^2 - 4x + 1)$

18.  $15y^3 + 20y^2 - 5y = 5y(3y^2 + 4y - 1)$

19.  $a^3 - a^2x + ax^2 = a(a^2 - ax + x^2)$

20.  $2a^2x + 2ax^2 - 3ax$   
 $= ax(2a + 2x - 3)$

21.  $x^3 + x^5 - x^7 = x^3(1 + x^2 - x^4)$

22.  $14x^2y^2 - 28x^3 + 56x^4$   
 $= 14x^2(y^2 - 2x + 4x^2)$

23.  $34ax^2 + 51a^2y - 68ay^2$   
 $= 17a(2x^2 + 3ay - 4y^2)$

24.  $96 - 48mn^2 + 144n^3$   
 $= 48(2 - mn^2 + 3n^3)$

25.  $a^2b^2c^2 - a^2c^2x^2 + a^2c^2y^2$   
 $= a^2c^2(b^2 - x^2 + y^2)$



$$26. 55m^2n^3x + 110m^2n^3x^2 - 220m^2y^3 \\ = 55m^2(n^3x + 2n^3x^2 - 4y^3)$$

$$27. 93a^3x^2y - 62a^2x^3y^2 - 124a^2x \\ = 31a^2x(3axy - 2x^2y^2 - 4)$$

$$28. x - x^2 + x^3 - x^4 = x(1 - x + x^2 - x^3)$$

$$29. a^6 - 3a^4 + 8a^3 - 4a^2 = a^2(a^4 - 3a^2 + 8a - 4)$$

$$30. 25x^7 - 10x^5 + 15x^3 - 5x^2 \\ = 5x^2(5x^5 - 2x^3 + 3x - 1)$$

$$31. x^{15} - x^{12} + 2x^9 - 3x^6 = x^6(x^9 - x^6 + 2x^3 - 3)$$

$$32. 9a^2 - 12ab + 15a^3b^2 - 24ab^3 \\ = 3a(3a - 4b + 5a^2b^2 - 8b^3)$$

$$33. 16x^3y^2 - 8x^2y - 24x^4y^2 - 40x^2y^3 \\ = 8x^2y(2xy - 1 - 3x^2y - 5y^2)$$

$$34. 12m^2n + 24m^3n^2 - 36m^4n^3 + 48m^5n^4 \\ = 12m^2n(1 + 2mn - 3m^2n^2 + 4m^3n^3)$$

$$35. 100a^2b^3c - 150ab^2c^2 + 50ab^3c^3 - 200abc^2 \\ = 50abc(2ab^2 - 3bc + b^2c^2 - 4c)$$

$$36. x^5 - x^4 + x^3 - x^2 + x = x(x^4 - x^3 + x^2 - x + 1)$$

$$37. a^2 - 2a^3 + 3a^4 - 4a^5 + 6a^6 \\ = a^2(1 - 2a + 3a^2 - 4a^3 + 6a^4)$$

$$38. 3a^2b + 6ab - 5a^3b^2 + 8a^2bx + 4ab^2m \\ = ab(3a + 6 - 5a^2b + 8ax + 4bm)$$

$$39. a^{20} - a^{16} + a^{12} - a^8 + a^4 - a^2 \\ = a^2(a^{18} - a^{14} + a^{10} - a^6 + a^2 - 1)$$

## EJERCICIO 90

$$1. a(x+1) + b(x+1) = (x+1)(a+b)$$

$$2. x(a+1) - 3(a+1) = (a+1)(x-3)$$

$$3. 2(x-1) + y(x-1) = (x-1)(2+y)$$

$$4. m(a-b) + (a-b)n = (a-b)(m+n)$$

$$5. 2x(n-1) - 3y(n-1) = (n-1)(2x-3y)$$

$$6. a(n+2) + n + 2 = (n+2)(a+1)$$

$$7. x(a+1) - a - 1 = (a+1)(x-1)$$

$$8. a^2 + 1 - b(a^2 + 1) = (a^2 + 1)(1-b)$$

$$9. 3x(x-2) - 2y(x-2) = (x-2)(3x-2y)$$

$$10. 1 - x + 2a(1-x) = (1-x)(1+2a)$$

$$11. 4x(m-n) + n - m = (m-n)(4x-1)$$

$$12. -m - n + x(m+n) = (m+n)(x-1)$$

$$13. a^3(a-b+1) - b^2(a-b+1) = (a-b+1)(a^3 - b^2)$$

$$14. 4m(a^2 + x - 1) + 3n(x - 1 + a^2) = (a^2 + x - 1)(4m + 3n)$$

$$15. x(2a+b+c) - 2a - b - c \\ = x(2a+b+c) - (2a+b+c) = (2a+b+c)(x-1)$$

$$16. (x+y)(n+1) - 3(n+1) = (n+1)(x+y-3)$$

$$17. (x+1)(x-2) + 3y(x-2) = (x-2)(x+1+3y)$$

$$18. (a+3)(a+1) - 4(a+1) = (a+1)(a+3-4) = (a+1)(a-1)$$

$$19. (x^2 + 2)(m-n) + 2(m-n) = (m-n)(x^2 + 4)$$

$$20. a(x-1) - (a+2)(x-1) = (x-1)(a-a-2) = -2(x-1)$$

$$21. 5x(a^2 + 1) + (x+1)(a^2 + 1) = (a^2 + 1)(6x+1)$$

$$22. (a+b)(a-b) - (a-b)(a-b) \\ = (a-b)(a+b-a+b) = 2b(a-b)$$

$$23. (m+n)(a-2) + (m-n)(a-2) = 2m(a-2)$$

$$24. (x+m)(x+1) - (x+1)(x-n) \\ = (x+1)(x+m-x+n) = (x+1)(m+n)$$

$$25. (x-3)(x-4) + (x-3)(x+4) = (x-3)2x$$

$$26. (a+b-1)(a^2+1) - a^2 - 1 = (a^2+1)(a+b-1)$$

$$27. (a+b-c)(x-3) - (b-c-a)(x-3) \\ = (x-3)(a+b-c+a-b+c) = (x-3)2a$$

$$28. 3x(x-1) - 2y(x-1) + z(x-1) = (x-1)(3x-2y+z)$$

$$29. a(n+1) - b(n+1) - n - 1 = (n+1)(a-b-1)$$

$$30. x(a+2) - a - 2 + 3(a+2) = (a+2)(x+2)$$

$$31. (1+3a)(x+1) - 2a(x+1) + 3(x+1) = (x+1)(a+4)$$

$$32. (3x+2)(x+y-z) - (3x+2) - (x+y-1)(3x+2) \\ = (3x+2)(x+y-z-1-x-y+1) = -z(3x+2)$$

## EJERCICIO 91

1.  $a^2 + ab + ax + bx$

$$\begin{aligned} &= (a^2 + ab) + (ax + bx) \\ &= a(a+b) + x(a+b) \\ &= (a+b)(a+x) \end{aligned}$$

2.  $am - bm + an - bn$

$$\begin{aligned} &= (am - bm) + (an - bn) \\ &= m(a-b) + n(a-b) \\ &= (a-b)(m+n) \end{aligned}$$

3.  $ax - 2bx - 2ay + 4by$

$$\begin{aligned} &= (ax - 2bx) - (2ay - 4by) \\ &= x(a-2b) - 2y(a-2b) \\ &= (a-2b)(x-2y) \end{aligned}$$

4.  $a^2x^2 - 3bx^2 + a^2y^2 - 3by^2$

$$\begin{aligned} &= (a^2x^2 - 3bx^2) + (a^2y^2 - 3by^2) \\ &= x^2(a^2 - 3b) + y^2(a^2 - 3b) \\ &= (a^2 - 3b)(x^2 + y^2) \end{aligned}$$

5.  $3m - 2n - 2nx^4 + 3mx^4$

$$\begin{aligned} &= (3m + 3mx^4) - (2n + 2nx^4) \\ &= 3m(1 + x^4) - 2n(1 + x^4) \\ &= (1 + x^4)(3m - 2n) \end{aligned}$$

6.  $x^2 - a^2 + x - a^2x$

$$\begin{aligned} &= -(a^2 + a^2x) + (x^2 + x) \\ &= -a^2(1+x) + x(x+1) \\ &= (x+1)(x-a^2) \end{aligned}$$

7.  $4a^3 - 1 - a^2 + 4a$

$$\begin{aligned} &= (4a^3 + 4a) - (1 + a^2) \\ &= 4a(a^2 + 1) - (1 + a^2) \\ &= (a^2 + 1)(4a - 1) \end{aligned}$$

8.  $x + x^2 - xy^2 - y^2$

$$\begin{aligned} &= (x + x^2) - (xy^2 + y^2) \\ &= x(1+x) - y^2(x+1) \\ &= (x+1)(x-y^2) \end{aligned}$$

9.  $3abx^2 - 2y^2 - 2x^2 + 3aby^2$

$$\begin{aligned} &= (3abx^2 + 3aby^2) - (2y^2 + 2x^2) \\ &= 3ab(x^2 + y^2) - 2(x^2 + y^2) \\ &= (x^2 + y^2)(3ab - 2) \end{aligned}$$

10.  $3a - b^2 + 2b^2x - 6ax$

$$\begin{aligned} &= (3a - 6ax) - (b^2 - 2b^2x) \\ &= 3a(1-2x) - b^2(1-2x) \\ &= (1-2x)(3a - b^2) \end{aligned}$$

11.  $4a^3x - 4a^2b + 3bm - 3amx$

$$\begin{aligned} &= (4a^3x - 4a^2b) + (3bm - 3amx) \\ &= 4a^2(ax - b) + 3m(b - ax) \\ &= 4a^2(ax - b) - 3m(ax - b) \\ &= (ax - b)(4a^2 - 3m) \end{aligned}$$

12.  $6ax + 3a + 1 + 2x$

$$\begin{aligned} &= (6ax + 3a) + (1 + 2x) \\ &= 3a(2x + 1) + (2x + 1) \\ &= (2x + 1)(3a + 1) \end{aligned}$$

13.  $3x^3 - 9ax^2 - x + 3a$

$$\begin{aligned} &= (3x^3 - x) - (9ax^2 - 3a) \\ &= x(3x^2 - 1) - 3a(3x^2 - 1) \\ &= (3x^2 - 1)(x - 3a) \end{aligned}$$

14.  $2a^2x - 5a^2y + 15by - 6bx$

$$\begin{aligned} &= (2a^2x - 5a^2y) + (15by - 6bx) \\ &= a^2(2x - 5y) + 3b(5y - 2x) \\ &= a^2(2x - 5y) - 3b(2x - 5y) \\ &= (2x - 5y)(a^2 - 3b) \end{aligned}$$

15.  $2x^2y + 2xz^2 + y^2z^2 + xy^3$

$$\begin{aligned} &= (2x^2y + xy^3) + (2xz^2 + y^2z^2) \\ &= xy(2x + y^2) + z^2(2x + y^2) \\ &= (2x + y^2)(xy + z^2) \end{aligned}$$

16.  $6m - 9n + 21nx - 14mx$

$$\begin{aligned} &= (6m - 14mx) - (9n - 21nx) \\ &= 2m(3 - 7x) - 3n(3 - 7x) \\ &= (3 - 7x)(2m - 3n) \end{aligned}$$

17.  $n^2x - 5a^2y^2 - n^2y^2 + 5a^2x$

$$\begin{aligned} &= (n^2x - n^2y^2) - (5a^2y^2 - 5a^2x) \\ &= n^2(x - y^2) - 5a^2(y^2 - x) \\ &= n^2(x - y^2) + 5a^2(x - y^2) \\ &= (x - y^2)(n^2 + 5a^2) \end{aligned}$$

18.  $1 + a + 3ab + 3b$

$$\begin{aligned} &= (1 + a) + (3ab + 3b) \\ &= (1 + a) + 3b(a + 1) \\ &= (1 + a)(3b + 1) \end{aligned}$$

19.  $4am^3 - 12amn - m^2 + 3n$

$$\begin{aligned} &= (4am^3 - 12amn) - (m^2 - 3n) \\ &= 4am(m^2 - 3n) - (m^2 - 3n) \\ &= (m^2 - 3n)(4am - 1) \end{aligned}$$

20.  $20ax - 5bx - 2by + 8ay$

$$\begin{aligned} &= (20ax + 8ay) - (5bx + 2by) \\ &= 4a(5x + 2y) - b(5x + 2y) \\ &= (5x + 2y)(4a - b) \end{aligned}$$

21.  $3 - x^2 + 2abx^2 - 6ab$

$$\begin{aligned} &= (3 - x^2) + (2abx^2 - 6ab) \\ &= (3 - x^2) + 2ab(x^2 - 3) \\ &= (3 - x^2) - 2ab(3 - x^2) \\ &= (3 - x^2)(1 - 2ab) \end{aligned}$$

22.  $a^3 + a^2 + a + 1$

$$\begin{aligned} &= (a^3 + a^2) + (a + 1) \\ &= a^2(a + 1) + (a + 1) \\ &= (a + 1)(a^2 + 1) \end{aligned}$$

23.  $3a^2 - 7b^2x + 3ax - 7ab^2$

$$\begin{aligned} &= (3a^2 + 3ax) - (7b^2x + 7ab^2) \\ &= 3a(a + x) - 7b^2(x + a) \\ &= (a + x)(3a - 7b^2) \end{aligned}$$

24.  $2am - 2an + 2a - m + n - 1$

$$\begin{aligned} &= (2am - 2an + 2a) - (m - n + 1) \\ &= 2a(m - n + 1) - (m - n + 1) \\ &= (2a - 1)(m - n + 1) \end{aligned}$$

$$25. 3ax - 2by - 2bx - 6a + 3ay + 4b$$

$$= (3ax - 6a + 3ay) - (2by + 2bx - 4b)$$

$$= 3a(x - 2 + y) - 2b(y + x - 2)$$

$$= (x + y - 2)(3a - 2b)$$

$$26. a^3 + a + a^2 + 1 + x^2 + a^2x^2$$

$$= (a^3 + a^2 + a^2x^2) + (a + 1 + x^2)$$

$$= a^2(a + 1 + x^2) + (a + 1 + x^2)$$

$$= (a^2 + 1)(a + 1 + x^2)$$

$$27. 3a^3 - 3a^2b + 9ab^2 - a^2 + ab - 3b^2$$

$$= (3a^3 - 3a^2b + 9ab^2) - (a^2 - ab + 3b^2)$$

$$= 3a(a^2 - ab + 3b^2) - (a^2 - ab + 3b^2)$$

$$= (3a - 1)(a^2 - ab + 3b^2)$$

$$28. 2x^3 - nx^2 + 2xz^2 - nz^2 - 3ny^2 + 6xy^2$$

$$= -(nx^2 + nz^2 + 3ny^2) + (2x^3 + 2xz^2 + 6xy^2)$$

$$= -n(x^2 + z^2 + 3y^2) + 2x(x^2 + z^2 + 3y^2)$$

$$= (2x - n)(x^2 + 3y^2 + z^2)$$

$$29. 3x^3 + 2axy + 2ay^2 - 3xy^2 - 2ax^2 - 3x^2y$$

$$= (3x^3 - 3xy^2 - 3x^2y) + (2axy + 2ay^2 - 2ax^2)$$

$$= 3x(x^2 - y^2 - xy) + 2a(xy + y^2 - x^2)$$

$$= 3x(x^2 - y^2 - xy) - 2a(-xy - y^2 + x^2)$$

$$= (3x - 2a)(x^2 - xy - y^2)$$

$$30. a^2b^3 - n^4 + a^2b^3x^2 - n^4x^2 - 3a^2b^3x + 3n^4x$$

$$= (a^2b^3 + a^2b^3x^2 - 3a^2b^3x) - (n^4 + n^4x^2 - 3n^4x)$$

$$= a^2b^3(1 + x^2 - 3x) - n^4(1 + x^2 - 3x)$$

$$= (a^2b^3 - n^4)(1 + x^2 - 3x)$$

## EJERCICIO 92

$$1. a^2 - 2ab + b^2 = (a - b)^2$$

$$2. a^2 + 2ab + b^2 = (a + b)^2$$

$$3. x^2 - 2x + 1 = (x - 1)^2$$

$$4. y^4 + 2y^2 + 1 = (y^2 + 1)^2$$

$$5. a^2 - 10a + 25 = (a - 5)^2$$

$$6. 9 - 6x + x^2 = (3 - x)^2$$

$$7. 16 + 40x^2 + 25x^4 = (4 + 5x^2)^2$$

$$8. 1 - 14a + 49a^2 = (1 - 7a)^2$$

$$9. 36 + 12m^2 + m^4 = (6 + m^2)^2$$

$$10. 1 - 2a^3 + a^6 = (1 - a^3)^2$$

$$11. a^8 + 18a^4 + 81 = (a^4 + 9)^2$$

$$12. a^6 - 2a^3b^3 + b^6 = (a^3 - b^3)^2$$

$$13. 4x^2 - 12xy + 9y^2 = (2x - 3y)^2$$

$$14. 9b^2 - 30a^2b + 25a^4 = (3b - 5a^2)^2$$

$$15. 1 + 14x^2y + 49x^4y^2 = (1 + 7x^2y)^2$$

$$16. 1 - 2a^5 + a^{10} = (1 - a^5)^2$$

$$17. 49m^6 - 70am^3n^2 + 25a^2n^4$$

$$= (7m^3 - 5an^2)^2$$

$$18. 100x^{10} - 60a^4x^5y^6 + 9a^8y^{12}$$

$$= (10x^5 - 3a^4y^6)^2$$

$$19. 121 + 198x^6 + 81x^{12} = (11 + 9x^6)^2$$

$$20. a^2 - 24am^2x^2 + 144m^4x^4$$

$$= (a - 12m^2x^2)^2$$

$$21. 16 - 104x^2 + 169x^4 = (4 - 13x^2)^2$$

$$22. 400x^{10} + 40x^5 + 1 = (20x^5 + 1)^2$$

$$23. \frac{a^2}{4} - ab + b^2 = \left(\frac{a}{2} - b\right)^2$$

$$24. 1 + \frac{2b}{3} + \frac{b^2}{9} = \left(1 + \frac{b}{3}\right)^2$$

$$25. a^4 - a^2b^2 + \frac{b^4}{4} = \left(a^2 - \frac{b^2}{2}\right)^2$$

$$26. \frac{1}{25} - \frac{x^2}{3} + \frac{25x^4}{36} = \left(\frac{1}{5} - \frac{5x^2}{6}\right)^2$$

$$27. 16x^6 - 2x^3y^2 + \frac{y^4}{16} = \left(4x^3 - \frac{y^2}{4}\right)^2$$

$$28. \frac{n^2}{9} + 2mn + 9m^2 = \left(\frac{n}{3} + 3m\right)^2$$

$$29. a^2 + 2a(a + b) + (a + b)^2$$

$$= (a + a + b)^2 = (2a + b)^2$$

$$30. 4 - 4(1 - a) + (1 - a)^2$$

$$= (2 - 1 + a)^2 = (1 + a)^2$$

$$31. 4m^2 - 4m(n - m) + (n - m)^2$$

$$= (2m - n + m)^2 = (3m - n)^2$$

$$32. (m - n)^2 + 6(m - n) + 9$$

$$= (m - n + 3)^2$$

$$33. (a + x)^2 - 2(a + x)(x + y) + (x + y)^2$$

$$= (a + x - x - y)^2 = (a - y)^2$$

$$34. (m + n)^2 - 2(a - m)(m + n) + (a - m)^2$$

$$= (m + n - a + m)^2 = (2m + n - a)^2$$

$$35. 4(1 + a)^2 - 4(1 + a)(b - 1) + (b - 1)^2$$

$$= (2 + 2a - b + 1)^2 = (2a - b + 3)^2$$

$$36. 9(x - y)^2 + 12(x - y)(x + y) + 4(x + y)^2$$

$$= (3x - 3y + 2x + 2y)^2 = (5x - y)^2$$

### EJERCICIO 93

- $x^2 - y^2 = (x+y)(x-y)$
- $a^2 - 1 = (a+1)(a-1)$
- $a^2 - 4 = (a+2)(a-2)$
- $9 - b^2 = (3+b)(3-b)$
- $1 - 4m^2 = (1+2m)(1-2m)$
- $16 - n^2 = (4+n)(4-n)$
- $a^2 - 25 = (a+5)(a-5)$
- $1 - y^2 = (1+y)(1-y)$
- $4a^2 - 9 = (2a+3)(2a-3)$
- $25 - 36x^4 = (5+6x^2)(5-6x^2)$
- $1 - 49a^2b^2 = (1+7ab)(1-7ab)$
- $4x^2 - 81y^4 = (2x+9y^2)(2x-9y^2)$
- $a^2b^8 - c^2 = (ab^4 + c)(ab^4 - c)$
- $100 - x^2y^6 = (10+xy^3)(10-xy^3)$
- $a^{10} - 49b^{12} = (a^5 + 7b^6)(a^5 - 7b^6)$
- $25x^2y^4 - 121 = (5xy^2 + 11)(5xy^2 - 11)$
- $100m^2n^4 - 169y^6$   
 $= (10mn^2 + 13y^3)(10mn^2 - 13y^3)$
- $a^2m^4n^6 - 144 = (am^2n^3 + 12)(am^2n^3 - 12)$
- $196x^2y^4 - 225z^{12}$   
 $= (14xy^2 + 15z^6)(14xy^2 - 15z^6)$
- $256a^{12} - 289b^4m^{10}$   
 $= (16a^6 + 17b^2m^5)(16a^6 - 17b^2m^5)$
- $1 - 9a^2b^4c^6d^8 = (1 + 3ab^2c^3d^4)(1 - 3ab^2c^3d^4)$
- $361x^{14} - 1 = (19x^7 + 1)(19x^7 - 1)$
- $\frac{1}{4} - 9a^2 = \left(\frac{1}{2} + 3a\right)\left(\frac{1}{2} - 3a\right)$
- $1 - \frac{a^2}{25} = \left(1 + \frac{a}{5}\right)\left(1 - \frac{a}{5}\right)$
- $\frac{1}{16} - \frac{4x^2}{49} = \left(\frac{1}{4} + \frac{2x}{7}\right)\left(\frac{1}{4} - \frac{2x}{7}\right)$
- $\frac{a^2}{36} - \frac{x^6}{25} = \left(\frac{a}{6} + \frac{x^3}{5}\right)\left(\frac{a}{6} - \frac{x^3}{5}\right)$

- $\frac{x^2}{100} - \frac{y^2z^4}{81} = \left(\frac{x}{10} + \frac{yz^2}{9}\right)\left(\frac{x}{10} - \frac{yz^2}{9}\right)$
- $\frac{x^6}{49} - \frac{4a^{10}}{121} = \left(\frac{x^3}{7} + \frac{2a^5}{11}\right)\left(\frac{x^3}{7} - \frac{2a^5}{11}\right)$
- $100m^2n^4 - \frac{1}{16}x^8 = \left(10mn^2 + \frac{1}{4}x^4\right)\left(10mn^2 - \frac{1}{4}x^4\right)$
- $a^{2n} - b^{2n} = (a^n + b^n)(a^n - b^n)$
- $4x^{2n} - \frac{1}{9} = \left(2x^n + \frac{1}{3}\right)\left(2x^n - \frac{1}{3}\right)$
- $a^{4n} - 225b^4 = (a^{2n} + 15b^2)(a^{2n} - 15b^2)$
- $16x^{6m} - \frac{y^{2n}}{49} = \left(4x^{3m} + \frac{y^n}{7}\right)\left(4x^{3m} - \frac{y^n}{7}\right)$
- $49a^{10n} - \frac{b^{12x}}{81} = \left(7a^{5n} + \frac{b^{6x}}{9}\right)\left(7a^{5n} - \frac{b^{6x}}{9}\right)$
- $a^{2n}b^{4n} - \frac{1}{25} = \left(a^n b^{2n} + \frac{1}{5}\right)\left(a^n b^{2n} - \frac{1}{5}\right)$
- $\frac{1}{100} - x^{2n} = \left(\frac{1}{10} + x^n\right)\left(\frac{1}{10} - x^n\right)$

### EJERCICIO 94

- $(x+y)^2 - a^2 = (x+y+a)(x+y-a)$
- $4 - (a+1)^2 = (2+a+1)(2-a-1) = (3+a)(1-a)$
- $9 - (m+n)^2 = (3+m+n)(3-m-n)$
- $(m-n)^2 - 16 = (m-n+4)(m-n-4)$
- $(x-y)^2 - 4z^2 = (x-y+2z)(x-y-2z)$
- $(a+2b)^2 - 1 = (a+2b+1)(a+2b-1)$
- $1 - (x-2y)^2 = (1+x-2y)(1-x+2y)$
- $(x+2a)^2 - 4x^2$   
 $= (x+2a+2x)(x+2a-2x) = (3x+2a)(2a-x)$
- $(a+b)^2 - (c+d)^2 = (a+b+c+d)(a+b-c-d)$
- $(a-b)^2 - (c-d)^2 = (a-b+c-d)(a-b-c+d)$

$$11. (x+1)^2 - 16x^2 \\ = (x+1+4x)(x+1-4x) = (5x+1)(1-3x)$$

$$12. 64m^2 - (m-2n)^2 \\ = (8m+m-2n)(8m-m+2n) = (9m-2n)(7m+2n)$$

$$13. (a-2b)^2 - (x+y)^2 = (a-2b+x+y)(a-2b-x-y)$$

$$14. (2a-c)^2 - (a+c)^2 \\ = (2a-c+a+c)(2a-c-a-c) = (3a)(a-2c)$$

$$15. (x+1)^2 - 4x^2 \\ = (x+1+2x)(x+1-2x) = (3x+1)(1-x)$$

$$16. 36x^2 - (a+3x)^2 \\ = (6x+a+3x)(6x-a-3x) = (9x+a)(3x-a)$$

$$17. a^6 - (a-1)^2 = (a^3+a-1)(a^3-a+1)$$

$$18. (a-1)^2 - (m-2)^2 \\ = (a-1+m-2)(a-1-m+2) = (a+m-3)(a-m+1)$$

$$19. (2x-3)^2 - (x-5)^2 \\ = (2x-3+x-5)(2x-3-x+5) = (3x-8)(x+2)$$

$$20. 1 - (5a+2x)^2 = (1+5a+2x)(1-5a-2x)$$

$$21. (7x+y)^2 - 81 = (7x+y+9)(7x+y-9)$$

$$22. m^6 - (m^2-1)^2 = (m^3+m^2-1)(m^3-m^2+1)$$

$$23. 16a^{10} - (2a^2+3)^2 = (4a^5+2a^2+3)(4a^5-2a^2-3)$$

$$24. (x-y)^2 - (c+d)^2 = (x-y+c+d)(x-y-c-d)$$

$$25. (2a+b-c)^2 - (a+b)^2 \\ = (2a+b-c+a+b)(2a+b-c-a-b) \\ = (3a+2b-c)(a-c)$$

$$26. 100 - (x-y+z)^2 = (10+x-y+z)(10-x+y-z)$$

$$27. x^2 - (y-x)^2 = (x+y-x)(x-y+x) = (y)(2x-y)$$

$$28. (2x+3)^2 - (5x-1)^2 \\ = (2x+3+5x-1)(2x+3-5x+1) = (7x+2)(4-3x)$$

$$29. (x-y+z)^2 - (y-z+2x)^2 \\ = (x-y+z+y-z+2x)(x-y+z-y-z-2x) \\ = (3x)(2z-2y-x)$$

$$30. (2x+1)^2 - (x+4)^2 \\ = (2x+1+x+4)(2x+1-x-4) = (3x+5)(x-3)$$

$$31. (a+2x+1)^2 - (x+a-1)^2 \\ = (a+2x+1+x+a-1)(a+2x+1-x-a+1) \\ = (2a+3x)(x+2)$$

$$32. 4(x+a)^2 - 49y^2 = (2x+2a+7y)(2x+2a-7y)$$

$$33. 25(x-y)^2 - 4(x+y)^2 \\ = (5x-5y+2x+2y)(5x-5y-2x-2y) \\ = (7x-3y)(3x-7y)$$

$$34. 36(m+n)^2 - 121(m-n)^2 \\ = (6m+6n+11m-11n)(6m+6n-11m+11n) \\ = (17m-5n)(17n-5m)$$

## EJERCICIO 95

$$1. a^2 + 2ab + b^2 - x^2 \quad 4. a^2 - 2a + 1 - b^2 \quad 7. a^2 + 4 - 4a - 9b^2 \quad 10. 4x^2 + 25y^2 - 36 + 20xy \\ = (a+b)^2 - x^2 \quad = (a-1)^2 - b^2 \quad = (a-2)^2 - 9b^2 \quad = (2x+5y)^2 - 36 \\ = (a+b+x)(a+b-x) \quad = (a-1+b)(a-1-b) \quad = (a+3b-2)(a-3b-2) \quad = (2x+5y+6)(2x+5y-6)$$

$$2. x^2 - 2xy + y^2 - m^2 \quad 5. n^2 + 6n + 9 - c^2 \quad 8. x^2 + 4y^2 - 4xy - 1 \quad 11. 9x^2 - 1 + 16a^2 - 24ax \\ = (x-y)^2 - m^2 \quad = (n+3)^2 - c^2 \quad = (x-2y)^2 - 1 \quad = (3x-4a)^2 - 1 \\ = (x-y+m)(x-y-m) \quad = (n+3+c)(n+3-c) \quad = (x-2y+1)(x-2y-1) \quad = (3x-4a+1)(3x-4a-1)$$

$$3. m^2 + 2mn + n^2 - 1 \quad 6. a^2 + x^2 + 2ax - 4 \quad 9. a^2 - 6ay + 9y^2 - 4x^2 \quad 12. 1 + 64a^2b^2 - x^4 - 16ab \\ = (m+n)^2 - 1 \quad = (a+x)^2 - 4 \quad = (a-3y)^2 - 4x^2 \quad = (8ab-1)^2 - x^4 \\ = (m+n+1)(m+n-1) \quad = (a+x+2)(a+x-2) \quad = (a-3y+2x)(a-3y-2x) \quad = (8ab-1+x^2)(8ab-1-x^2)$$

13.  $a^2 - b^2 - 2bc - c^2$   
 $= a^2 - (b^2 + 2bc + c^2)$   
 $= a^2 - (b+c)^2$   
 $= (a+b+c)(a-b-c)$
14.  $1 - a^2 + 2ax - x^2$   
 $= 1 - (a^2 - 2ax + x^2)$   
 $= 1 - (a-x)^2$   
 $= (1+a-x)(1-a+x)$
15.  $m^2 - x^2 - 2xy - y^2$   
 $= m^2 - (x^2 + 2xy + y^2)$   
 $= m^2 - (x+y)^2$   
 $= (m+x+y)(m-x-y)$
16.  $c^2 - a^2 + 2a - 1$   
 $= c^2 - (a^2 - 2a + 1)$   
 $= c^2 - (a-1)^2$   
 $= (c+a-1)(c-a+1)$
17.  $9 - n^2 - 25 - 10n$   
 $= 9 - (n^2 + 10n + 25)$   
 $= 9 - (n+5)^2$   
 $= (3+n+5)(3-n-5)$   
 $= -(n+8)(n+2)$
18.  $4a^2 - x^2 + 4x - 4$   
 $= 4a^2 - (x^2 - 4x + 4)$   
 $= 4a^2 - (x-2)^2$   
 $= (2a+x-2)(2a-x+2)$
19.  $1 - a^2 - 9n^2 - 6an$   
 $= 1 - (a^2 + 6an + 9n^2)$   
 $= 1 - (a+3n)^2$   
 $= (a+3n+1)(1-a-3n)$
20.  $25 - x^2 - 16y^2 + 8xy$   
 $= 25 - (x^2 - 8xy + 16y^2)$   
 $= 25 - (x-4y)^2$   
 $= (5+x-4y)(5-x+4y)$
21.  $9x^2 - a^2 - 4m^2 + 4am$   
 $= 9x^2 - (a^2 - 4am + 4m^2)$   
 $= 9x^2 - (a-2m)^2$   
 $= (3x+a-2m)(3x-a+2m)$
22.  $16x^2y^2 + 12ab - 4a^2 - 9b^2$   
 $= 16x^2y^2 - (4a^2 - 12ab + 9b^2)$   
 $= 16x^2y^2 - (2a-3b)^2$   
 $= (4xy+2a-3b)(4xy-2a+3b)$
23.  $-a^2 + 25m^2 - 1 - 2a$   
 $= 25m^2 - (a^2 + 2a + 1)$   
 $= 25m^2 - (a+1)^2$   
 $= (5m+a+1)(5m-a-1)$
24.  $49x^4 - 25x^2 - 9y^2 + 30xy$   
 $= 49x^4 - (25x^2 - 30xy + 9y^2)$   
 $= 49x^4 - (5x-3y)^2$   
 $= (7x^2+5x-3y)(7x^2-5x+3y)$
25.  $a^2 - 2ab + b^2 - c^2 - 2cd - d^2$   
 $= (a-b)^2 - (c+d)^2$   
 $= (a-b+c+d)(a-b-c-d)$
26.  $x^2 + 2xy + y^2 - m^2 + 2mn - n^2$   
 $= (x+y)^2 - (m-n)^2$   
 $= (x+y+m-n)(x+y-m+n)$
27.  $a^2 + 4b^2 + 4ab - x^2 - 2ax - a^2$   
 $= (a^2 + 4ab + 4b^2) - (x^2 + 2ax + a^2)$   
 $= (a+2b)^2 - (x+a)^2$   
 $= (a+2b+x+a)(a+2b-x-a)$   
 $= (2a+2b+x)(2b-x)$
28.  $x^2 + 4a^2 - 4ax - y^2 - 9b^2 + 6by$   
 $= (x^2 - 4ax + 4a^2) - (y^2 - 6by + 9b^2)$   
 $= (x-2a)^2 - (y-3b)^2$   
 $= (x-2a+y-3b)(x-2a-y+3b)$
29.  $m^2 - x^2 + 9n^2 + 6mn - 4ax - 4a^2$   
 $= (m^2 + 6mn + 9n^2) - (x^2 + 4ax + 4a^2)$   
 $= (m+3n)^2 - (x+2a)^2$   
 $= (m+3n+x+2a)(m+3n-x-2a)$
30.  $9x^2 + 4y^2 - a^2 - 12xy - 25b^2 - 10ab$   
 $= (9x^2 - 12xy + 4y^2) - (a^2 + 10ab + 25b^2)$   
 $= (3x-2y)^2 - (a+5b)^2$   
 $= (3x-2y+a+5b)(3x-2y-a-5b)$
31.  $2am - x^2 - 9 + a^2 + m^2 - 6x$   
 $= (a^2 + 2am + m^2) - (x^2 + 6x + 9)$   
 $= (a+m)^2 - (x+3)^2$   
 $= (a+m+x+3)(a+m-x-3)$
32.  $x^2 - 9a^4 + 6a^2b + 1 + 2x - b^2$   
 $= (x^2 + 2x + 1) - (b^2 - 6a^2b + 9a^4)$   
 $= (x+1)^2 - (b-3a^2)^2$   
 $= (x+1+b-3a^2)(x+1-b+3a^2)$
33.  $16a^2 - 1 - 10m + 9x^2 - 24ax - 25m^2$   
 $= (16a^2 - 24ax + 9x^2) - (25m^2 + 10m + 1)$   
 $= (4a-3x)^2 - (5m+1)^2$   
 $= (4a-3x+5m+1)(4a-3x-5m-1)$
34.  $9m^2 - a^2 + 2acd - c^2d^2 + 100 - 60m$   
 $= -(a^2 - 2acd + c^2d^2) + (9m^2 - 60m + 100)$   
 $= (3m-10)^2 - (a-cd)^2$   
 $= (3m-10+a-cd)(3m-10-a+cd)$
35.  $4a^2 - 9x^2 + 49b^2 - 30xy - 25y^2 - 28ab$   
 $= (4a^2 - 28ab + 49b^2) - (9x^2 + 30xy + 25y^2)$   
 $= (2a-7b)^2 - (3x+5y)^2$   
 $= (2a-7b+3x+5y)(2a-7b-3x-5y)$
36.  $225a^2 - 169b^2 + 1 + 30a + 26bc - c^2$   
 $= (225a^2 + 30a + 1) - (169b^2 - 26bc + c^2)$   
 $= (15a+1)^2 - (13b-c)^2$   
 $= (15a+1+13b-c)(15a+1-13b+c)$
37.  $x^2 - y^2 + 4 + 4x - 1 - 2y$   
 $= (x^2 + 4x + 4) - (y^2 + 2y + 1)$   
 $= (x+2)^2 - (y+1)^2$   
 $= (x+2+y+1)(x+2-y-1)$   
 $= (x+y+3)(x-y+1)$
38.  $a^2 - 16 - x^2 + 36 + 12a - 8x$   
 $= (a^2 + 12a + 36) - (x^2 + 8x + 16)$   
 $= (a+6)^2 - (x+4)^2$   
 $= (a+6+x+4)(a+6-x-4)$   
 $= (a+x+10)(a-x+2)$

## EJERCICIO 96

1.  $a^4 + a^2 + 1$

$$\frac{+a^2 \quad -a^2}{(a^4 + 2a^2 + 1) - a^2}$$
$$= (a^2 + 1)^2 - a^2$$
$$= (a^2 + a + 1)(a^2 - a + 1)$$

2.  $m^4 + m^2n^2 + n^4$

$$\frac{+m^2n^2 \quad -m^2n^2}{m^4 + 2m^2n^2 + n^4 - m^2n^2}$$
$$= (m^2 + n^2)^2 - m^2n^2$$
$$= (m^2 + n^2 + mn)(m^2 + n^2 - mn)$$

3.  $x^8 + 3x^4 + 4$

$$\frac{+x^4 \quad -x^4}{x^8 + 4x^4 + 4 - x^4}$$
$$= (x^4 + 2)^2 - x^4$$
$$= (x^4 + x^2 + 2)(x^4 - x^2 + 2)$$

4.  $a^4 + 2a^2 + 9$

$$\frac{+4a^2 \quad -4a^2}{a^4 + 6a^2 + 9 - 4a^2}$$
$$= (a^2 + 3)^2 - 4a^2$$
$$= (a^2 + 2a + 3)(a^2 - 2a + 3)$$

5.  $a^4 - 3a^2b^2 + b^4$

$$\frac{+a^2b^2 \quad -a^2b^2}{a^4 - 2a^2b^2 + b^4 - a^2b^2}$$
$$= (a^2 - b^2)^2 - a^2b^2$$
$$= (a^2 + ab - b^2)(a^2 - ab - b^2)$$

6.  $x^4 - 6x^2 + 1$

$$\frac{+4x^2 \quad -4x^2}{x^4 - 2x^2 + 1 - 4x^2}$$
$$= (x^2 - 1)^2 - 4x^2$$
$$= (x^2 + 2x - 1)(x^2 - 2x - 1)$$

7.  $4a^4 + 3a^2b^2 + 9b^4$

$$\frac{+9a^2b^2 \quad -9a^2b^2}{4a^4 + 12a^2b^2 + 9b^4 - 9a^2b^2}$$
$$= (2a^2 + 3b^2)^2 - 9a^2b^2$$
$$= (2a^2 + 3ab + 3b^2)(2a^2 - 3ab + 3b^2)$$

8.  $4x^4 - 29x^2 + 25$

$$\frac{+9x^2 \quad -9x^2}{4x^4 - 20x^2 + 25 - 9x^2}$$
$$= (2x^2 - 5)^2 - 9x^2$$
$$= (2x^2 + 3x - 5)(2x^2 - 3x - 5)$$

9.  $x^8 + 4x^4y^4 + 16y^8$

$$\frac{+4x^4y^4 \quad -4x^4y^4}{x^8 + 8x^4y^4 + 16y^8 - 4x^4y^4}$$
$$= (x^4 + 4y^4)^2 - 4x^4y^4$$
$$= (x^4 + 2x^2y^2 + 4y^4)(x^4 - 2x^2y^2 + 4y^4)$$

10.  $16m^4 - 25m^2n^2 + 9n^4$

$$\frac{+m^2n^2 \quad -m^2n^2}{16m^4 - 24m^2n^2 + 9n^4 - m^2n^2}$$
$$= (4m^2 - 3n^2)^2 - m^2n^2$$
$$= (4m^2 + mn - 3n^2)(4m^2 - mn - 3n^2)$$

11.  $25a^4 + 54a^2b^2 + 49b^4$

$$\frac{+16a^2b^2 \quad -16a^2b^2}{25a^4 + 70a^2b^2 + 49b^4 - 16a^2b^2}$$
$$= (5a^2 + 7b^2)^2 - 16a^2b^2$$
$$= (5a^2 + 4ab + 7b^2)(5a^2 - 4ab + 7b^2)$$

12.  $36x^4 - 109x^2y^2 + 49y^4$

$$\frac{+25x^2y^2 \quad -25x^2y^2}{36x^4 - 84x^2y^2 + 49y^4 - 25x^2y^2}$$
$$= (6x^2 - 7y^2)^2 - 25x^2y^2$$
$$= (6x^2 + 5xy - 7y^2)(6x^2 - 5xy - 7y^2)$$

13.  $81m^8 + 2m^4 + 1$

$$\frac{+16m^4 \quad -16m^4}{81m^8 + 18m^4 + 1 - 16m^4}$$
$$= (9m^4 + 1)^2 - 16m^4$$
$$= (9m^4 + 4m^2 + 1)(9m^4 - 4m^2 + 1)$$

14.  $c^4 - 45c^2 + 100$

$$\frac{+25c^2 \quad -25c^2}{c^4 - 20c^2 + 100 - 25c^2}$$
$$= (c^2 - 10)^2 - 25c^2$$
$$= (c^2 + 5c - 10)(c^2 - 5c - 10)$$

15.  $4a^8 - 53a^4b^4 + 49b^8$

$$\frac{+25a^4b^4 \quad -25a^4b^4}{4a^8 - 28a^4b^4 + 49b^8 - 25a^4b^4}$$
$$= (2a^4 - 7b^4)^2 - 25a^4b^4$$
$$= (2a^4 + 5a^2b^2 - 7b^4)(2a^4 - 5a^2b^2 - 7b^4)$$

16.  $49 + 76n^2 + 64n^4$

$$\frac{+36n^2 \quad -36n^2}{49 + 112n^2 + 64n^4 - 36n^2}$$
$$= (7 + 8n^2)^2 - 36n^2$$
$$= (8n^2 + 6n + 7)(8n^2 - 6n + 7)$$

17.  $25x^4 - 139x^2y^2 + 81y^4$

$$\frac{+49x^2y^2 \quad -49x^2y^2}{25x^4 - 90x^2y^2 + 81y^4 - 49x^2y^2}$$
$$= (5x^2 - 9y^2)^2 - 49x^2y^2$$
$$= (5x^2 + 7xy - 9y^2)(5x^2 - 7xy - 9y^2)$$

18.  $49x^8 + 76x^4y^4 + 100y^8$

$$\frac{+64x^4y^4 \quad -64x^4y^4}{49x^8 + 140x^4y^4 + 100y^8 - 64x^4y^4}$$
$$= (7x^4 + 10y^4)^2 - 64x^4y^4$$
$$= (7x^4 + 8x^2y^2 + 10y^4)(7x^4 - 8x^2y^2 + 10y^4)$$

19.  $4 - 108x^2 + 121x^4$

$$\frac{+64x^2 \quad -64x^2}{4 - 44x^2 + 121x^4 - 64x^2}$$
$$= (2 - 11x^2)^2 - 64x^2$$
$$= (2 + 8x - 11x^2)(2 - 8x - 11x^2)$$

20.  $121x^4 - 133x^2y^4 + 36y^8$

$$\frac{+x^2y^4 \quad -x^2y^4}{121x^4 - 132x^2y^4 + 36y^8 - x^2y^4}$$
$$= (11x^2 - 6y^4)^2 - x^2y^4$$
$$= (11x^2 + xy^2 - 6y^4)(11x^2 - xy^2 - 6y^4)$$

$$\begin{aligned}
 21. & \frac{144 + 23n^6 + 9n^{12}}{+ 49n^6} - 49n^6 \\
 & \frac{144 + 72n^6 + 9n^{12} - 49n^6}{+ 49n^6} \\
 & = (12 + 3n^6)^2 - 49n^6 \\
 & = (12 + 7n^3 + 3n^6)(12 - 7n^3 + 3n^6)
 \end{aligned}$$

$$\begin{aligned}
 22. & \frac{16 - 9c^4 + c^8}{+ c^4} - c^4 \\
 & \frac{16 - 8c^4 + c^8 - c^4}{+ c^4} \\
 & = (4 - c^4)^2 - c^4 \\
 & = (4 + c^2 - c^4)(4 - c^2 - c^4)
 \end{aligned}$$

$$\begin{aligned}
 23. & \frac{64a^4 - 169a^2b^4 + 81b^8}{+ 25a^2b^4} - 25a^2b^4 \\
 & \frac{64a^4 - 144a^2b^4 + 81b^8 - 25a^2b^4}{+ 25a^2b^4} \\
 & = (8a^2 - 9b^4)^2 - 25a^2b^4 \\
 & = (8a^2 + 5ab - 9b^4)(8a^2 - 5ab - 9b^4)
 \end{aligned}$$

$$\begin{aligned}
 24. & \frac{225 + 5m^2 + m^4}{+ 25m^2} - 25m^2 \\
 & \frac{225 + 30m^2 + m^4 - 25m^2}{+ 25m^2} \\
 & = (15 + m^2)^2 - 25m^2 \\
 & = (m^2 + 5m + 15)(m^2 - 5m + 15)
 \end{aligned}$$

$$\begin{aligned}
 25. & \frac{1 - 126a^2b^4 + 169a^4b^8}{+ 100a^2b^4} - 100a^2b^4 \\
 & \frac{1 - 26a^2b^4 + 169a^4b^8 - 100a^2b^4}{+ 100a^2b^4} \\
 & = (1 - 13a^2b^4)^2 - 100a^2b^4 \\
 & = (1 + 10ab^2 - 13a^2b^4)(1 - 10ab^2 - 13a^2b^4)
 \end{aligned}$$

$$\begin{aligned}
 26. & \frac{x^4y^4 + 21x^2y^2 + 121}{+ x^2y^2} - x^2y^2 \\
 & \frac{x^4y^4 + 22x^2y^2 + 121 - x^2y^2}{+ x^2y^2} \\
 & = (x^2y^2 + 11)^2 - x^2y^2 \\
 & = (x^2y^2 + xy + 11)(x^2y^2 - xy + 11)
 \end{aligned}$$

$$\begin{aligned}
 27. & \frac{49c^8 + 75c^4m^2n^2 + 196m^4n^4}{+ 121c^4m^2n^2} - 121c^4m^2n^2 \\
 & \frac{49c^8 + 196c^4m^2n^2 + 196m^4n^4 - 121c^4m^2n^2}{+ 121c^4m^2n^2} \\
 & = (7c^4 + 14m^2n^2)^2 - 121c^4m^2n^2 \\
 & = (7c^4 + 11c^2mn + 14m^2n^2)(7c^4 - 11c^2mn + 14m^2n^2)
 \end{aligned}$$

$$\begin{aligned}
 28. & \frac{81a^4b^8 - 292a^2b^4x^8 + 256x^{16}}{+ 4a^2b^4x^8} - 4a^2b^4x^8 \\
 & \frac{81a^4b^8 - 288a^2b^4x^8 + 256x^{16} - 4a^2b^4x^8}{+ 4a^2b^4x^8} \\
 & = (9a^2b^4 - 16x^8)^2 - 4a^2b^4x^8 \\
 & = (9a^2b^4 + 2ab^2x^4 - 16x^8)(9a^2b^4 - 2ab^2x^4 - 16x^8)
 \end{aligned}$$

## EJERCICIO 97

$$\begin{aligned}
 1. & \frac{x^4}{+ 16x^2y^2} + 64y^4 - 16x^2y^2 \\
 & \frac{x^4 + 16x^2y^2 + 64y^4 - 16x^2y^2}{+ 16x^2y^2} \\
 & = (x^2 + 8y^2)^2 - 16x^2y^2 \\
 & = (x^2 + 4xy + 8y^2)(x^2 - 4xy + 8y^2)
 \end{aligned}$$

$$\begin{aligned}
 2. & \frac{4x^8}{+ 4x^4y^4} + y^8 - 4x^4y^4 \\
 & \frac{4x^8 + 4x^4y^4 + y^8 - 4x^4y^4}{+ 4x^4y^4} \\
 & = (2x^4 + y^4)^2 - 4x^4y^4 \\
 & = (2x^4 + 2x^2y^2 + y^4)(2x^4 - 2x^2y^2 + y^4)
 \end{aligned}$$

$$\begin{aligned}
 3. & \frac{a^4}{+ 36a^2b^2} + 324b^4 - 36a^2b^2 \\
 & \frac{a^4 + 36a^2b^2 + 324b^4 - 36a^2b^2}{+ 36a^2b^2} \\
 & = (a^2 + 18b^2)^2 - 36a^2b^2 \\
 & = (a^2 + 6ab + 18b^2)(a^2 - 6ab + 18b^2)
 \end{aligned}$$

$$\begin{aligned}
 4. & \frac{4m^4}{+ 36m^2n^2} + 81n^4 - 36m^2n^2 \\
 & \frac{4m^4 + 36m^2n^2 + 81n^4 - 36m^2n^2}{+ 36m^2n^2} \\
 & = (2m^2 + 9n^2)^2 - 36m^2n^2 \\
 & = (2m^2 + 6mn + 9n^2)(2m^2 - 6mn + 9n^2)
 \end{aligned}$$

$$\begin{aligned}
 5. & \frac{4}{+ 100x^4} + 625x^8 - 100x^4 \\
 & \frac{4 + 100x^4 + 625x^8 - 100x^4}{+ 100x^4} \\
 & = (2 + 25x^4)^2 - 100x^4 \\
 & = (25x^4 + 10x^2 + 2)(25x^4 - 10x^2 + 2)
 \end{aligned}$$

$$\begin{aligned}
 6. & \frac{64}{+ 16a^6} + a^{12} - 16a^6 \\
 & \frac{64 + 16a^6 + a^{12} - 16a^6}{+ 16a^6} \\
 & = (8 + a^6)^2 - 16a^6 \\
 & = (a^6 + 4a^3 + 8)(a^6 - 4a^3 + 8)
 \end{aligned}$$



$$\begin{aligned}
 7.1 \quad & \frac{+4n^2}{+4n^2} - \frac{-4n^2}{-4n^2} \\
 & \frac{1+4n^2+4n^4-4n^2}{(1+2n^2)^2-4n^2} \\
 & = (2n^2+2n+1)(2n^2-2n+1)
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \frac{64x^8}{+16x^4y^4} + \frac{y^8}{-16x^4y^4} \\
 & \frac{64x^8+16x^4y^4+y^8-16x^4y^4}{(8x^4+y^4)^2-16x^4y^4} \\
 & = (8x^4+4x^2y^2+y^4)(8x^4-4x^2y^2+y^4)
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \frac{81a^4}{+144a^2b^2} + \frac{64b^4}{-144a^2b^2} \\
 & \frac{81a^4+144a^2b^2+64b^4-144a^2b^2}{(9a^2+8b^2)^2-144a^2b^2} \\
 & = (9a^2+12ab+8b^2)(9a^2-12ab+8b^2)
 \end{aligned}$$

## EJERCICIO 98

$$1. x^2+7x+10=(x+5)(x+2)$$

$$2. x^2-5x+6=(x-3)(x-2)$$

$$3. x^2+3x-10=(x+5)(x-2)$$

$$4. x^2+x-2=(x+2)(x-1)$$

$$5. a^2+4a+3=(a+3)(a+1)$$

$$6. m^2+5m-14=(m+7)(m-2)$$

$$7. y^2-9y+20=(y-5)(y-4)$$

$$8. x^2-x-6=(x-3)(x+2)$$

$$9. x^2-9x+8=(x-8)(x-1)$$

$$10. c^2+5c-24=(c+8)(c-3)$$

$$11. x^2-3x+2=(x-2)(x-1)$$

$$12. a^2+7a+6=(a+6)(a+1)$$

$$13. y^2-4y+3=(y-3)(y-1)$$

$$14. n^2-8n+12=(n-6)(n-2)$$

$$15. x^2+10x+21=(x+7)(x+3)$$

$$16. a^2+7a-18=(a+9)(a-2)$$

$$17. m^2-12m+11=(m-11)(m-1)$$

$$18. x^2-7x-30=(x-10)(x+3)$$

$$19. n^2+6n-16=(n+8)(n-2)$$

$$20. a^2-21a+20=(a-20)(a-1)$$

$$21. y^2+y-30=(y+6)(y-5)$$

$$22. a^2-11a+28=(a-7)(a-4)$$

$$23. n^2-6n-40=(n-10)(n+4)$$

$$24. x^2-5x-36=(x-9)(x+4)$$

$$25. a^2-2a-35=(a-7)(a+5)$$

$$26. x^2+14x+13=(x+13)(x+1)$$

$$27. a^2-14a+33=(a-11)(a-3)$$

$$28. m^2+13m-30=(m+15)(m-2)$$

$$29. c^2-13c-14=(c-14)(c+1)$$

$$30. x^2+15x+56=(x+8)(x+7)$$

$$31. x^2-15x+54=(x-9)(x-6)$$

$$32. a^2+7a-60=(a+12)(a-5)$$

$$\begin{aligned}
 33. \quad & \frac{x^2-17x-60}{60} \left| \begin{array}{l} 2 \\ 2 \\ 3 \\ 5 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 2 \cdot 5 = 20 \\ 3 \cdot 1 = 3 \\ 5 \Rightarrow 20 - 3 = 17 \\ = (x-20)(x+3) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 34. \quad & \frac{x^2+8x-180}{180} \left| \begin{array}{l} 2 \\ 2 \\ 3 \\ 3 \\ 5 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 3 \cdot 3 = 18 \\ 3 \cdot 5 = 10 \\ 3 \Rightarrow 18 - 10 = 8 \\ 5 = (x+18)(x-10) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & \frac{m^2-20m-300}{300} \left| \begin{array}{l} 2 \\ 2 \\ 3 \\ 5 \\ 5 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 3 \cdot 5 = 30 \\ 3 \cdot 5 = 10 \\ 5 \Rightarrow 30 - 10 = 20 \\ 5 = (m-30)(m+10) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 36. \quad & \frac{x^2+x-132}{132} \left| \begin{array}{l} 2 \\ 2 \\ 3 \\ 11 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 2 \cdot 3 = 12 \\ 3 \cdot 11 = 11 \\ 11 \Rightarrow 12 - 11 = 1 \\ = (x+12)(x-11) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 37. \quad & \frac{m^2-2m-168}{168} \left| \begin{array}{l} 2 \\ 2 \\ 2 \\ 3 \\ 7 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 2 \cdot 3 = 12 \\ 2 \cdot 7 = 14 \\ 3 \Rightarrow 14 - 12 = 2 \\ 7 = (m-14)(m+12) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 38. \quad & \frac{c^2+24c+135}{135} \left| \begin{array}{l} 3 \\ 3 \\ 3 \\ 5 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 3 \\ 3 \cdot 3 = 9 \\ 3 \cdot 5 = 15 \\ 5 \Rightarrow 15 + 9 = 24 \\ = (c+15)(c+9) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 39. \quad & \frac{m^2-41m+400}{400} \left| \begin{array}{l} 2 \\ 2 \\ 2 \\ 2 \\ 5 \\ 5 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2^4 = 16 \\ 2 \cdot 5 = 25 \\ 2 \Rightarrow 25 + 16 = 41 \\ 5 = (m-25)(m-16) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 40. \quad & \frac{a^2+a-380}{380} \left| \begin{array}{l} 2 \\ 2 \\ 5 \\ 19 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2^2 \cdot 5 = 20 \\ 5 \cdot 19 = 19 \\ 19 \Rightarrow 20 - 19 = 1 \\ = (a+20)(a-19) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 41. \quad & \frac{x^2+12x-364}{364} \left| \begin{array}{l} 2 \\ 2 \\ 7 \\ 13 \\ 1 \end{array} \right. \\
 & \begin{array}{l} 2 \\ 2 \cdot 13 = 26 \\ 7 \cdot 7 = 14 \\ 13 \Rightarrow 26 - 14 = 12 \\ = (x+26)(x-14) \end{array}
 \end{aligned}$$

42.  $a^2 + 42a + 432$

$$\begin{array}{r|l} 432 & 2 \\ 216 & 2 \quad 2^3 \cdot 3 = 24 \\ 108 & 2 \quad 2 \cdot 3^2 = 18 \\ 54 & 2 \Rightarrow 24 + 18 = 42 \\ 27 & 3 = (a+24)(a+18) \\ 9 & 3 \\ 3 & 3 \\ 1 & \end{array}$$

43.  $m^2 - 30m - 675$

$$\begin{array}{r|l} 675 & 3 \\ 225 & 5 \quad 3 \cdot 5 \cdot 3 = 45 \\ 45 & 3 \quad 3 \cdot 5 = 15 \\ 15 & 3 \Rightarrow 45 - 15 = 30 \\ 5 & 5 = (m-45)(m+15) \\ 1 & \end{array}$$

44.  $y^2 + 50y + 336$

$$\begin{array}{r|l} 336 & 3 \\ 112 & 2 \quad 3 \cdot 7 \cdot 2 = 42 \\ 56 & 2 \quad 2^3 = 8 \\ 28 & 2 \Rightarrow 42 + 8 = 50 \\ 14 & 2 = (y+42)(y+8) \\ 7 & 7 \\ 1 & \end{array}$$

45.  $x^2 - 2x - 528$

$$\begin{array}{r|l} 528 & 2 \\ 264 & 2 \quad 2^3 \cdot 3 = 24 \\ 132 & 2 \quad 2 \cdot 11 = 22 \\ 66 & 2 \Rightarrow 24 - 22 = 2 \\ 33 & 3 = (x-24)(x+22) \\ 11 & 11 \\ 1 & \end{array}$$

46.  $n^2 + 43n + 432$

$$\begin{array}{r|l} 432 & 2 \\ 216 & 2 \quad 2^4 = 16 \\ 108 & 2 \quad 3^3 = 27 \\ 54 & 2 \Rightarrow 16 + 27 = 43 \\ 27 & 3 = (n+16)(n+27) \\ 9 & 3 \\ 3 & 3 \\ 1 & \end{array}$$

47.  $c^2 - 4c - 320$

$$\begin{array}{r|l} 320 & 2 \\ 160 & 2 \quad 2^4 = 16 \\ 80 & 2 \quad 2^2 \cdot 5 = 20 \\ 40 & 2 \Rightarrow 20 - 16 = 4 \\ 20 & 2 = (c-20)(c+16) \\ 10 & 2 \\ 5 & 5 \\ 1 & \end{array}$$

48.  $m^2 - 8m - 1.008$

$$\begin{array}{r|l} 1.008 & 2 \\ 504 & 2 \quad 2^2 \cdot 7 = 28 \\ 252 & 2 \quad 2^2 \cdot 3^2 = 36 \\ 126 & 2 \Rightarrow 36 - 28 = 8 \\ 63 & 3 = (m-36)(m+28) \\ 21 & 3 \\ 7 & 7 \\ 1 & \end{array}$$

## EJERCICIO 99

1.  $x^4 + 5x^2 + 4 = (x^2 + 4)(x^2 + 1)$

2.  $x^6 - 6x^3 - 7 = (x^3 - 7)(x^3 + 1)$

3.  $x^8 - 2x^4 - 80 = (x^4 - 10)(x^4 + 8)$

4.  $x^2y^2 + xy - 12 = (xy + 4)(xy - 3)$

5.  $(4x)^2 - 2(4x) - 15 = (4x - 5)(4x + 3)$

6.  $(5x)^2 + 13(5x) + 42 = (5x + 7)(5x + 6)$

7.  $x^2 + 2ax - 15a^2 = (x + 5a)(x - 3a)$

8.  $a^2 - 4ab - 21b^2 = (a - 7b)(a + 3b)$

9.  $(x - y)^2 + 2(x - y) - 24 = (x - y + 6)(x - y - 4)$

10.  $-x^2 + 4x + 5 = -(x^2 - 4x - 5) = -(x - 5)(x + 1) = (5 - x)(x + 1)$

11.  $x^{10} + x^5 - 20 = (x^5 + 5)(x^5 - 4)$

12.  $m^2 + mn - 56n^2 = (m + 8n)(m - 7n)$

13.  $x^4 + 7ax^2 - 60a^2$

$$= (x^2 + 12a)(x^2 - 5a)$$

14.  $(2x)^2 - 4(2x) + 3$

$$= (2x - 3)(2x - 1)$$

15.  $(m - n)^2 + 5(m - n) - 24$

$$= (m - n + 8)(m - n - 3)$$

16.  $x^8 + x^4 - 240$

$$\begin{array}{r|l} 240 & 2 \\ 120 & 2 \quad 2^4 = 16 \\ 60 & 2 \quad 3 \cdot 5 = 15 \\ 30 & 2 \Rightarrow 16 - 15 = 1 \\ 15 & 3 = (x^4 + 16)(x^4 - 15) \\ 5 & 5 \\ 1 & \end{array}$$

17.  $-y^2 + 2y + 15$

$$= -(y^2 - 2y - 15)$$

$$= -(y - 5)(y + 3) = (5 - y)(y + 3)$$

18.  $a^4b^4 - 2a^2b^2 - 99$

$$\begin{array}{r|l} 99 & 3 \quad 3 \cdot 3 = 9 \\ 33 & 3 \quad 11 \cdot 1 = 11 \\ 11 & 11 \Rightarrow 11 - 9 = 2 \\ 1 & = (a^2b^2 - 11)(a^2b^2 + 9) \end{array}$$

19.  $c^2 + 11cd + 28d^2$

$$= (c + 7d)(c + 4d)$$

20.  $25x^2 - 5(5x) - 84$

$$\begin{array}{r|l} 84 & 2 \\ 42 & 2 \quad 2^2 \cdot 3 = 12 \\ 21 & 3 \quad 7 \cdot 1 = 7 \\ 7 & 7 \Rightarrow 12 - 7 = 5 \\ 1 & = (5x - 12)(5x + 7) \end{array}$$

21.  $a^2 - 21ab + 98b^2$

$$\begin{array}{r|l} 98 & 2 \quad 2 \cdot 7 = 14 \\ 49 & 7 \quad 7 \cdot 1 = 7 \\ 7 & 7 \Rightarrow 14 + 7 = 21 \\ 1 & = (a - 14b)(a - 7b) \end{array}$$

$$22. x^4y^4 + x^2y^2 - 132$$

$$\begin{array}{l|l} 132 & 2 \\ 66 & 2 \quad 2 \cdot 2 \cdot 3 = 12 \\ 33 & 3 \quad 11 \cdot 1 = 11 \\ 11 & 11 \Rightarrow 12 - 11 = 1 \\ 1 & = (x^2y^2 + 12)(x^2y^2 - 11) \end{array}$$

$$23. -x^4 + 2x^2 + 48$$

$$\begin{aligned} &= -(x^4 - 2x^2 - 48) \\ &= -(x^2 - 8)(x^2 + 6) = (8 - x^2)(x^2 + 6) \end{aligned}$$

$$24. (c+d)^2 - 18(c+d) + 65$$

$$= (c+d-13)(c+d-5)$$

$$25. a^2 + 2axy - 440x^2y^2$$

$$\begin{array}{l|l} 440 & 2 \\ 220 & 2 \quad 2^2 \cdot 5 = 20 \\ 110 & 2 \quad 11 \cdot 2 = 22 \\ 55 & 5 \Rightarrow 22 - 20 = 2 \\ 11 & 11 = (a + 22xy)(a - 20xy) \\ 1 & \end{array}$$

$$26. m^6n^6 - 21m^3n^3 + 104$$

$$\begin{array}{l|l} 104 & 2 \\ 52 & 2 \quad 2^3 = 8 \\ 26 & 2 \quad 13 \cdot 1 = 13 \\ 13 & 13 \Rightarrow 13 + 8 = 21 \\ 1 & = (m^3n^3 - 13)(m^3n^3 - 8) \end{array}$$

$$27. -n^2 + 5n + 14$$

$$\begin{aligned} &= -(n^2 - 5n - 14) \\ &= -(n-7)(n+2) = (7-n)(n+2) \end{aligned}$$

$$28. x^6 + x^3 - 930$$

$$\begin{array}{l|l} 930 & 2 \\ 465 & 5 \quad 2 \cdot 5 \cdot 3 = 30 \\ 93 & 3 \quad 31 \cdot 1 = 31 \\ 31 & 31 \Rightarrow 31 - 30 = 1 \\ 1 & = (x^3 + 31)(x^3 - 30) \end{array}$$

$$29. (4x^2)^2 - 8(4x^2) - 105$$

$$\begin{array}{l|l} 105 & 5 \\ 21 & 3 \quad 5 \cdot 3 = 15 \\ 7 & 7 \quad 7 \cdot 1 = 7 \\ 1 & \Rightarrow 15 - 7 = 8 \\ & = (4x^2 - 15)(4x^2 + 7) \end{array}$$

$$30. x^4 + 5abx^2 - 36a^2b^2$$

$$= (x^2 + 9ab)(x^2 - 4ab)$$

$$31. a^4 - a^2b^2 - 156b^4$$

$$\begin{array}{l|l} 156 & 2 \\ 78 & 2 \quad 2^2 \cdot 3 = 12 \\ 39 & 3 \quad 13 \cdot 1 = 13 \\ 13 & 13 \Rightarrow 13 - 12 = 1 \\ 1 & = (a^2 - 13b^2)(a^2 + 12b^2) \end{array}$$

$$32. -x^2 + 4ax + 21a^2$$

$$\begin{aligned} &= -(x^2 - 4ax - 21a^2) \\ &= -(x-7a)(x+3a) \\ &= (7a-x)(x+3a) \end{aligned}$$

$$33. x^8y^8 - 15x^4y^4 - 100a^2$$

$$= (x^4y^4 - 20a)(x^4y^4 + 5a)$$

$$34. (a-1)^2 + 3(a-1) - 108$$

$$\begin{array}{l|l} 108 & 2 \\ 54 & 2 \quad 2^2 \cdot 3 = 12 \\ 27 & 3 \quad 3^2 = 9 \\ 9 & 3 \Rightarrow 12 - 9 = 3 \\ 3 & 3 = (a-1+12)(a-1-9) \\ 1 & = (a+11)(a-10) \end{array}$$

$$35. m^2 + abcm - 56a^2b^2c^2$$

$$= (m + 8abc)(m - 7abc)$$

$$36. (7x^2)^2 + 24(7x^2) + 128$$

$$\begin{array}{l|l} 128 & 4 \\ 32 & 4 \quad 4^2 = 16 \\ 8 & 4 \quad 4 \cdot 2 = 8 \\ 2 & 2 \Rightarrow 16 + 8 = 24 \\ 1 & = (7x^2 + 16)(7x^2 + 8) \end{array}$$

## EJERCICIO 100

$$1. 2x^2 + 3x - 2$$

$$\begin{aligned} &= 4x^2 + 3(2x) - 4 \\ &= \frac{(2x+4)(2x-1)}{2} \\ &= (x+2)(2x-1) \end{aligned}$$

$$2. 3x^2 - 5x - 2$$

$$\begin{aligned} &= 9x^2 - 5(3x) - 6 \\ &= \frac{(3x-6)(3x+1)}{3} \\ &= (x-2)(3x+1) \end{aligned}$$

$$3. 6x^2 + 7x + 2$$

$$\begin{aligned} &= 36x^2 + 7(6x) + 12 \\ &= \frac{(6x+4)(6x+3)}{2 \cdot 3} \\ &= (3x+2)(2x+1) \end{aligned}$$

$$4. 5x^2 + 13x - 6$$

$$\begin{aligned} &= 25x^2 + 13(5x) - 30 \\ &= \frac{(5x+15)(5x-2)}{5} \\ &= (x+3)(5x-2) \end{aligned}$$

$$5. 6x^2 - 5x - 6$$

$$\begin{aligned} &= 36x^2 - 5(6x) - 36 \\ &= \frac{(6x-9)(6x+4)}{3 \cdot 2} \\ &= (2x-3)(3x+2) \end{aligned}$$

$$6. 12x^2 - x - 6$$

$$\begin{aligned} &= 144x^2 - 1(12x) - 72 \\ &= \frac{(12x-9)(12x+8)}{3 \cdot 4} \\ &= (4x-3)(3x+2) \end{aligned}$$

$$7. 4a^2 + 15a + 9$$

$$\begin{aligned} &= 16a^2 + 15(4a) + 36 \\ &= \frac{(4a+12)(4a+3)}{4} \\ &= (a+3)(4a+3) \end{aligned}$$

$$8. 10a^2 + 11a + 3$$

$$\begin{aligned} &= 100a^2 + 11(10a) + 30 \\ &= \frac{(10a+6)(10a+5)}{2 \cdot 5} \\ &= (5a+3)(2a+1) \end{aligned}$$

$$9. 12m^2 - 13m - 35$$

$$\begin{aligned} &= 144m^2 - 13(12m) - 420 \\ 420 & \left| \begin{array}{l} 4 \quad 4 \cdot 7 = 28 \\ 105 \quad 5 \quad 5 \cdot 3 = 15 \\ 21 \quad 3 \Rightarrow 28 - 15 = 13 \\ 7 \quad 7 = \frac{(12m-28)(12m+15)}{4 \cdot 3} \\ 1 \quad = (3m-7)(4m+5) \end{array} \right. \end{aligned}$$

$$10. 20y^2 + y - 1$$

$$\begin{aligned} &= 400y^2 + 1(20y) - 20 \\ &= \frac{(20y+5)(20y-4)}{5 \cdot 4} \\ &= (4y+1)(5y-1) \end{aligned}$$

$$11. 8a^2 - 14a - 15$$

$$\begin{aligned} &= 64a^2 - 14(8a) - 120 \\ 120 & \left| \begin{array}{l} 2 \\ 60 \quad 2 \quad 2 \cdot 2 \cdot 5 = 20 \\ 30 \quad 2 \quad 2 \cdot 3 = 6 \\ 15 \quad 3 \Rightarrow 20 - 6 = 14 \\ 5 \quad 5 = \frac{(8a-20)(8a+6)}{4 \cdot 2} \\ 1 \quad = (2a-5)(4a+3) \end{array} \right. \end{aligned}$$

$$12. 7x^2 - 44x - 35$$

$$= 49x^2 - 44(7x) - 245$$

$$\begin{array}{r|l} 245 & 5 \\ 49 & 7 \quad 7 \cdot 7 = 49 \\ 7 & 7 \quad 5 \cdot 1 = 5 \\ 1 & \Rightarrow 49 - 5 = 44 \\ & = \frac{(7x-49)(7x+5)}{7} \\ & = (x-7)(7x+5) \end{array}$$

$$13. 15m^2 + 16m - 15$$

$$= 225m^2 + 16(15m) - 225$$

$$\begin{array}{r|l} 225 & 5 \\ 45 & 5 \quad 5 \cdot 5 = 25 \\ 9 & 3 \quad 3 \cdot 3 = 9 \\ 3 & 3 \Rightarrow 25 - 9 = 16 \\ 1 & = \frac{(15m+25)(15m-9)}{5 \cdot 3} \\ & = (3m+5)(5m-3) \end{array}$$

$$14. 2a^2 + 5a + 2$$

$$= 4a^2 + 5(2a) + 4$$

$$= \frac{(2a+4)(2a+1)}{2}$$

$$= (a+2)(2a+1)$$

$$15. 12x^2 - 7x - 12$$

$$= 144x^2 - 7(12x) - 144$$

$$\begin{array}{r|l} 144 & 2 \\ 72 & 2 \quad 2^4 = 16 \\ 36 & 2 \quad 3^2 = 9 \\ 18 & 2 \Rightarrow 16 - 9 = 7 \\ 9 & 3 = \frac{(12x-16)(12x+9)}{4 \cdot 3} \\ 3 & 3 = (3x-4)(4x+3) \\ 1 & \end{array}$$

$$16. 9a^2 + 10a + 1$$

$$= 81a^2 + 10(9a) + 9$$

$$= \frac{(9a+9)(9a+1)}{9}$$

$$= (a+1)(9a+1)$$

$$17. 20n^2 - 9n - 20$$

$$= 400n^2 - 9(20) - 400$$

$$\begin{array}{r|l} 400 & 2 \\ 200 & 2 \quad 2^4 = 16 \\ 100 & 2 \quad 5^2 = 25 \\ 50 & 2 \Rightarrow 25 - 16 = 9 \\ 25 & 5 = \frac{(20n-25)(20n+16)}{5 \cdot 4} \\ 5 & 5 = (4n-5)(5n+4) \\ 1 & \end{array}$$

$$18. 21x^2 + 11x - 2$$

$$= 441x^2 + 11(21x) - 42$$

$$= \frac{(21x+14)(21x-3)}{7 \cdot 3}$$

$$= (3x+2)(7x-1)$$

$$19. 15m^2 + m - 6$$

$$= 225m^2 + 15m - 90$$

$$= \frac{(15m+10)(15m-9)}{5 \cdot 3}$$

$$= (3m+2)(5m-3)$$

$$20. 15a^2 - 8a - 12$$

$$= 225a^2 - 8(15a) - 180$$

$$\begin{array}{r|l} 180 & 2 \\ 90 & 2 \quad 2 \cdot 3^2 = 18 \\ 45 & 5 \quad 5 \cdot 2 = 10 \\ 9 & 3 \Rightarrow 18 - 10 = 8 \\ 3 & 3 = \frac{(15a-18)(15a+10)}{3 \cdot 5} \\ 1 & = (5a-6)(3a+2) \end{array}$$

$$21. 9x^2 + 37x + 4$$

$$= 81x^2 + 37(9x) + 36$$

$$= \frac{(9x+36)(9x+1)}{9}$$

$$= (x+4)(9x+1)$$

$$22. 20n^2 + 44n - 15$$

$$= 400n^2 + 44(20n) - 300$$

$$\begin{array}{r|l} 300 & 2 \\ 150 & 2 \quad 2 \cdot 5^2 = 50 \\ 75 & 5 \quad 2 \cdot 3 = 6 \\ 15 & 5 \Rightarrow 50 - 6 = 44 \\ 3 & 3 = \frac{(20n+50)(20n-6)}{10 \cdot 2} \\ 1 & = (2n+5)(10n-3) \end{array}$$

$$23. 14m^2 - 31m - 10$$

$$= 196m^2 - 31(14m) - 140$$

$$\begin{array}{r|l} 140 & 2 \\ 70 & 2 \quad 5 \cdot 7 = 35 \\ 35 & 5 \quad 2 \cdot 2 = 4 \\ 7 & 7 \Rightarrow 35 - 4 = 31 \\ 1 & = \frac{(14m-35)(14m+4)}{7 \cdot 2} \\ & = (2m-5)(7m+2) \end{array}$$

$$24. 2x^2 + 29x + 90$$

$$= 4x^2 + 29(2x) + 180$$

$$\begin{array}{r|l} 180 & 2 \\ 90 & 2 \quad 2^2 \cdot 5 = 20 \\ 45 & 3 \quad 3^2 = 9 \\ 15 & 3 \Rightarrow 20 + 9 = 29 \\ 5 & 5 = \frac{(2x+20)(2x+9)}{2} \\ 1 & = (2x+10)(2x+9) \end{array}$$

$$25. 20a^2 - 7a - 40$$

$$= 400a^2 - 7(20a) - 800$$

$$\begin{array}{r|l} 800 & 4 \\ 200 & 4 \quad 4^2 \cdot 2 = 32 \\ 50 & 5 \quad 5^2 = 25 \\ 10 & 5 \Rightarrow 32 - 25 = 7 \\ 2 & 2 = \frac{(20a-32)(20a+25)}{4 \cdot 5} \\ 1 & = (5a-8)(4a+5) \end{array}$$

$$26. 4n^2 + n - 33$$

$$= 16n^2 + 4n - 132$$

$$\begin{array}{r|l} 132 & 2 \\ 66 & 2 \quad 2^2 \cdot 3 = 12 \\ 33 & 3 \quad 11 \cdot 1 = 11 \\ 11 & 11 \Rightarrow 12 - 11 = 1 \\ 1 & = \frac{(4n+12)(4n-11)}{4} \\ & = (n+3)(4n-11) \end{array}$$

$$27. 30x^2 + 13x - 10$$

$$= 900x^2 + 13(30x) - 300$$

$$\begin{array}{r|l} 300 & 2 \\ 150 & 2 \quad 5^2 = 25 \\ 75 & 5 \quad 2^2 \cdot 3 = 12 \\ 15 & 5 \Rightarrow 25 - 12 = 13 \\ 3 & 3 = \frac{(30x+25)(30x-12)}{5 \cdot 6} \\ 1 & = (6x+5)(5x-2) \end{array}$$

### EJERCICIO 101

$$\begin{aligned}
 1. \quad & 6x^4 + 5x^2 - 6 \\
 & = (6x^2)^2 + 5(6x^2) - 36 \\
 & = \frac{(6x^2 + 9)(6x^2 - 4)}{3 \cdot 2} \\
 & = (2x^2 + 3)(3x^2 - 2)
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 5x^6 + 4x^3 - 12 \\
 & = (5x^3)^2 + 4(5x^3) - 60 \\
 & = \frac{(5x^3 + 10)(5x^3 - 6)}{5} \\
 & = (x^3 + 2)(5x^3 - 6)
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 10x^8 + 29x^4 + 10 \\
 & = (10x^4)^2 + 29(10x^4) + 100 \\
 & = \frac{(10x^4 + 25)(10x^4 + 4)}{5 \cdot 2} \\
 & = (2x^4 + 5)(5x^4 + 2)
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & 6a^2x^2 + 5ax - 21 \\
 & (6ax)^2 + 5(6ax) - 126 \\
 \begin{array}{l|l} 126 & 2 \\ 63 & 3 \quad 2 \cdot 7 = 14 \\ 21 & 7 \quad 3 \cdot 3 = 9 \\ 3 & 3 \Rightarrow 14 - 9 = 5 \\ 1 & \end{array} \\
 & = \frac{(6ax + 14)(6ax - 9)}{2 \cdot 3} \\
 & = (3ax + 7)(2ax - 3)
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & 20x^2y^2 + 9xy - 20 \\
 & = (20xy)^2 + 9(20xy) - 400 \\
 \begin{array}{l|l} 400 & 2 \\ 200 & 2 \quad 5^2 = 25 \\ 100 & 2 \quad 2^4 = 16 \\ 50 & 2 \Rightarrow 25 - 16 = 9 \\ 25 & 5 = \frac{(20xy + 25)(20xy - 16)}{5 \cdot 4} \\ 5 & 5 = (4xy + 5)(5xy - 4) \\ 1 & \end{array}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & 15x^2 - ax - 2a^2 \\
 & = (15x)^2 - a(15x) - 30a^2 \\
 & = \frac{(15x - 6a)(15x + 5a)}{3 \cdot 5} \\
 & = (5x - 2a)(3x + a)
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & -10x^2 - 7x + 12 \\
 & = -(10x^2 + 7x - 12) \\
 & = -[(10x)^2 + 7(10x) - 120]
 \end{aligned}$$

$$\begin{array}{l|l} 120 & 2 \\ 60 & 2 \quad 5 \cdot 3 = 15 \\ 30 & 2 \quad 2^3 = 8 \\ 15 & 5 \Rightarrow 15 - 8 = 7 \\ 3 & 3 = \frac{-[(10x + 15)(10x - 8)]}{5 \cdot 2} \\ 1 & = -(2x + 3)(5x - 4) \\ & = (2x + 3)(4 - 5x)
 \end{array}$$

$$\begin{aligned}
 8. \quad & 21x^2 - 29xy - 72y^2 \\
 & = 441x^2 - 29(21xy) - 1.512y^2
 \end{aligned}$$

$$\begin{array}{l|l} 1.512 & 2 \\ 756 & 2 \quad 2^3 \cdot 7 = 56 \\ 378 & 2 \quad 3^3 = 27 \\ 189 & 3 \Rightarrow 56 - 27 = 29 \\ 63 & 3 = \frac{(21x - 56y)(21x + 27y)}{7 \cdot 3} \\ 21 & 3 = (3x - 8y)(7x + 9y) \\ 7 & 7 \\ 1 &
 \end{array}$$

$$\begin{aligned}
 9. \quad & 6m^2 - 13am - 15a^2 \\
 & = 36m^2 - 13(6am) - 90a^2 \\
 & = \frac{(6m - 18a)(6m + 5a)}{6} \\
 & = (m - 3a)(6m + 5a)
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & 14x^4 - 45x^2 - 14 \\
 & = (14x^2)^2 - 45(14x^2) - 196
 \end{aligned}$$

$$\begin{array}{l|l} 196 & 2 \\ 98 & 2 \quad 7 \cdot 7 = 49 \\ 49 & 7 \quad 2 \cdot 2 = 4 \\ 7 & 7 \Rightarrow 49 - 4 = 45 \\ 1 & = \frac{(14x^2 - 49)(14x^2 + 4)}{7 \cdot 2} \\ & = (2x^2 - 7)(7x^2 + 2)
 \end{array}$$

$$\begin{aligned}
 11. \quad & 30a^2 - 13ab - 3b^2 \\
 & = 900a^2 - 13(30ab) - 90b^2 \\
 & = \frac{(30a - 18b)(30a + 5b)}{6 \cdot 5} \\
 & = (5a - 3b)(6a + b)
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & 7x^6 - 33x^3 - 10 \\
 & = (7x^3)^2 - 33(7x^3) - 70 \\
 & = \frac{(7x^3 - 35)(7x^3 + 2)}{7}
 \end{aligned}$$

$$= (x^3 - 5)(7x^3 + 2)$$

$$\begin{aligned}
 13. \quad & -3a^2 + 13a + 30 \\
 & = -(3a^2 - 13a - 30) \\
 & = -(9a^2 - 13(3a) - 90) \\
 & = -\frac{(3a - 18)(3a + 5)}{3} \\
 & = -(a - 6)(3a + 5) \\
 & = (6 - a)(3a + 5)
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & -6x^8 + 7x^4 + 5 \\
 & = -(6x^8 - 7x^4 - 5) \\
 & = -((6x^4)^2 - 7(6x^4) - 30) \\
 & = -\frac{(6x^4 - 10)(6x^4 + 3)}{2 \cdot 3}
 \end{aligned}$$

$$= -(3x^4 - 5)(2x^4 + 1)$$

$$\begin{aligned}
 15. \quad & 6a^2 - ax - 15x^2 \\
 & = 36a^2 - 6ax - 90x^2 \\
 & = \frac{(6a - 10x)(6a + 9x)}{2 \cdot 3} \\
 & = (3a - 5x)(2a + 3x)
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & 4x^2 + 7mnx - 15m^2n^2 \\
 & = (4x)^2 + 7mn(4x) - 60m^2n^2 \\
 & = \frac{(4x + 12mn)(4x - 5mn)}{4} \\
 & = (x + 3mn)(4x - 5mn)
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & 18a^2 + 17ay - 15y^2 \\
 & = (18a)^2 + 17y(18a) - 270y^2
 \end{aligned}$$

$$\begin{array}{l|l} 270 & 2 \\ 135 & 5 \quad 3^3 = 27 \\ 27 & 3 \quad 5 \cdot 2 = 10 \\ 9 & 3 \Rightarrow 27 - 10 = 17 \\ 3 & 3 = \frac{(18a + 27y)(18a - 10y)}{9 \cdot 2} \\ 1 & = (2a + 3y)(9a - 5y)
 \end{array}$$

$$18. -8x^4 + 2x^2 + 15$$

$$= -(8x^4 - 2x^2 - 15)$$

$$= -\left((8x^2)^2 - 2(8x^2) - 120\right)$$

$$= -\frac{(8x^2 - 12)(8x^2 + 10)}{4 \cdot 2}$$

$$= -(2x^2 - 3)(4x^2 + 5)$$

$$= (3 - 2x^2)(4x^2 + 5)$$

$$19. -25x^8 + 5x^4 + 6$$

$$= -(25x^8 - 5x^4 - 6)$$

$$= -\left((25x^4)^2 - 5(25x^4) - 150\right)$$

$$= -\frac{(25x^4 - 15)(25x^4 + 10)}{5 \cdot 5}$$

$$= -(5x^4 - 3)(5x^4 + 2)$$

$$= (3 - 5x^4)(5x^4 + 2)$$

$$20. 30x^{10} - 91x^5 - 30$$

$$= (30x^5)^2 - 91(30x^5) - 900$$

$$= \frac{(30x^5 - 100)(30x^5 + 9)}{10 \cdot 3}$$

$$= (3x^5 - 10)(10x^5 + 3)$$

$$21. 30m^2 + 17am - 21a^2$$

$$= (30m)^2 + 17a(30m) - 630a^2$$

$$630 \quad \left| \begin{array}{l} 2 \\ 315 \end{array} \right.$$

$$5 \quad 5 \cdot 7 = 35$$

$$63 \quad 3 \quad 2 \cdot 3^2 = 18$$

$$21 \quad 3 \Rightarrow 35 - 18 = 17$$

$$7 \quad 7 \quad = \frac{(30m + 35a)(30m - 18a)}{5 \cdot 6}$$

$$1 \quad = (6m + 7a)(5m - 3a)$$

$$23. -6y^2 + 11xy - 4x^2$$

$$= -(6y^2 - 11xy + 4x^2)$$

$$= -\left((6y)^2 - 11x(6y) + 24x^2\right)$$

$$= -\frac{(6y - 8x)(6y - 3x)}{2 \cdot 3}$$

$$= -(3y - 4x)(2y - x)$$

$$= (4x - 3y)(2y - x)$$

$$24. -20a^2 + 27ab - 9b^2$$

$$= -(20a^2 - 27ab + 9b^2)$$

$$= -\left((20a)^2 - 27b(20a) + 180b^2\right)$$

$$180 \quad \left| \begin{array}{l} 2 \\ 90 \end{array} \right.$$

$$2 \quad 2^2 \cdot 3 = 12$$

$$45 \quad 5 \quad 5 \cdot 3 = 15$$

$$9 \quad 3 \Rightarrow 15 + 12 = 27$$

$$3 \quad 3 \quad = -\frac{(20a - 15b)(20a - 12b)}{5 \cdot 4}$$

$$1 \quad = -(4a - 3b)(5a - 3b)$$

$$= (4a - 3b)(3b - 5a)$$

## EJERCICIO 102

$$1. a^3 + 3a^2 + 3a + 1 = (a + 1)^3$$

$$2. 27 - 27x + 9x^2 - x^3 = (3 - x)^3$$

$$3. m^3 + 3m^2n + 3mn^2 + n^3 = (m + n)^3$$

$$4. 1 - 3a + 3a^2 - a^3 = (1 - a)^3$$

$$5. 8 + 12a^2 + 6a^4 + a^6 = (2 + a^2)^3$$

$$6. 125x^3 + 75x^2 + 15x + 1 = (5x + 1)^3$$

$$7. 8a^3 - 36a^2b + 54ab^2 - 27b^3 = (2a - 3b)^3$$

$$8. 27m^3 + 108m^2n + 144mn^2 + 64n^3 = (3m + 4n)^3$$

$$9. x^3 - 3x^2 + 3x + 1 = \text{No es cubo perfecto}$$

$$10. 1 + 12a^2b - 6ab - 8a^3b^3 = \text{No es cubo perfecto}$$

$$11. 125a^3 + 150a^2b + 60ab^2 + 8b^3 = (5a + 2b)^3$$

$$12. 8 + 36x + 54x^2 + 27x^3 = (2 + 3x)^3$$

$$13. 8 - 12a^2 - 64a^4 - a^6 = \text{No es cubo perfecto}$$

$$14. a^6 + 3a^4b^3 + 3a^2b^6 + b^9 = (a^2 + b^3)^3$$

$$15. x^9 - 9x^6y^4 + 27x^3y^8 - 27y^{12} = (x^3 - 3y^4)^3$$

$$16. 64x^3 + 240x^2y + 300xy^2 + 125y^3 = (4x + 5y)^3$$

$$17. 216 - 756a^2 + 882a^4 - 343a^6 = (6 - 7a^2)^3$$

$$18. 125x^{12} + 600x^8y^5 + 960x^4y^{10} + 512y^{15} = (5x^4 + 8y^5)^3$$

$$19. a^{18} + 3a^{12} + 3a^6 + 1 = (a^6 + 1)^3$$

$$20. m^3 - 3am^2n + 3a^2mn^2 - a^3n^3 = (m - an)^3$$

$$21. 1 + 18a^2b^3 + 108a^4b^6 + 216a^6b^9 = (1 + 6a^2b^3)^3$$

$$22. 64x^9 - 240x^6y^4 + 300x^3y^8 - 125y^{12} = (4x^3 - 5y^4)^3$$

### EJERCICIO 103

- $1 + a^3 = (1+a)(1-a+a^2)$
- $1 - a^3 = (1-a)(1+a+a^2)$
- $x^3 + y^3 = (x+y)(x^2 - xy + y^2)$
- $m^3 - n^3 = (m-n)(m^2 + mn + n^2)$
- $a^3 - 1 = (a-1)(a^2 + a + 1)$
- $y^3 + 1 = (y+1)(y^2 - y + 1)$
- $y^3 - 1 = (y-1)(y^2 + y + 1)$
- $8x^3 - 1 = (2x-1)(4x^2 + 2x + 1)$
- $1 - 8x^3 = (1-2x)(1+2x+4x^2)$
- $x^3 - 27 = (x-3)(x^2 + 3x + 9)$
- $a^3 + 27 = (a+3)(a^2 - 3a + 9)$
- $8x^3 + y^3 = (2x+y)(4x^2 - 2xy + y^2)$
- $27a^3 - b^3 = (3a-b)(9a^2 + 3ab + b^2)$
- $64 + a^6 = (4+a^2)(16-4a^2+a^4)$
- $a^3 - 125 = (a-5)(a^2 + 5a + 25)$
- $1 - 216m^3 = (1-6m)(1+6m+36m^2)$
- $8a^3 + 27b^6 = (2a+3b^2)(4a^2 - 6ab^2 + 9b^4)$
- $x^6 - b^9 = (x^2 - b^3)(x^4 + x^2b^3 + b^6)$
- $8x^3 - 27y^3 = (2x-3y)(4x^2 + 6xy + 9y^2)$
- $1 + 343n^3 = (1+7n)(1-7n+49n^2)$
- $64a^3 - 729 = (4a-9)(16a^2 + 36a + 81)$
- $a^3b^3 - x^6 = (ab-x^2)(a^2b^2 + abx^2 + x^4)$
- $512 + 27a^9 = (8+3a^3)(64-24a^3+9a^6)$
- $x^6 - 8y^{12} = (x^2 - 2y^4)(x^4 + 2x^2y^4 + 4y^8)$
- $1 + 729x^6 = (1+9x^2)(1-9x^2+81x^4)$
- $27m^3 + 64n^9 = (3m+4n^3)(9m^2 - 12mn^3 + 16n^6)$
- $343x^3 + 512y^6 = (7x+8y^2)(49x^2 - 56xy^2 + 64y^4)$
- $x^3y^6 - 216y^9 = (xy^2 - 6y^3)(x^2y^4 + 6xy^5 + 36y^6)$
- $a^3b^3x^3 + 1 = (abx+1)(a^2b^2x^2 - abx+1)$
- $x^9 + y^9 = (x^3+y^3)(x^6 - x^3y^3 + y^6)$
- $1.000x^3 - 1 = (10x-1)(100x^2 + 10x + 1)$
- $a^6 + 125b^{12} = (a^2 + 5b^4)(a^4 - 5a^2b^4 + 25b^8)$
- $x^{12} + y^{12} = (x^4 + y^4)(x^8 - x^4y^4 + y^8)$
- $1 - 27a^3b^3 = (1-3ab)(1+3ab+9a^2b^2)$
- $8x^6 + 729 = (2x^2+9)(4x^4 - 18x^2 + 81)$
- $a^3 + 8b^{12} = (a+2b^4)(a^2 - 2ab^4 + 4b^8)$
- $8x^9 - 125y^3z^6 = (2x^3 - 5yz^2)(4x^6 + 10x^3yz^2 + 25y^2z^4)$
- $27m^6 + 343n^9 = (3m^2 + 7n^3)(9m^4 - 21m^2n^3 + 49n^6)$
- $216 - x^{12} = (6-x^4)(36+6x^4+x^8)$

### EJERCICIO 104

- $1 + (x+y)^3 = (1+x+y)[1 - (x+y) + (x+y)^2]$   
 $= (1+x+y)(1-x-y+x^2+2xy+y^2)$
- $1 - (a+b)^3 = [1 - (a+b)][1 + (a+b) + (a+b)^2]$   
 $= (1-a-b)(1+a+b+a^2+2ab+b^2)$
- $27 + (m-n)^3 = (3+m-n)[9 - 3(m-n) + (m-n)^2]$   
 $= (3+m-n)(9-3m+3n+m^2-2mn+n^2)$
- $(x-y)^3 - 8 = (x-y-2)[(x-y)^2 + 2(x-y)+4]$   
 $= (x-y-2)(x^2 - 2xy + y^2 + 2x - 2y + 4)$
- $(x+2y)^3 + 1 = (x+2y+1)[(x+2y)^2 - (x+2y)+1]$   
 $= (x+2y+1)(x^2 + 4xy + 4y^2 - x - 2y + 1)$
- $1 - (2a-b)^3 = [1 - (2a-b)][1 + (2a-b) + (2a-b)^2]$   
 $= (1-2a+b)(1+2a-b+4a^2-4ab+b^2)$
- $a^3 + (a+1)^3 = (a+a+1)[a^2 - a(a+1) + (a+1)^2]$   
 $= (2a+1)(a^2 - a^2 - a + a^2 + 2a + 1)$   
 $= (2a+1)(a^2 + a + 1)$
- $8a^3 - (a-1)^3 = [2a - (a-1)][4a^2 + 2a(a-1) + (a-1)^2]$   
 $= (2a-a+1)(4a^2 + 2a^2 - 2a + a^2 - 2a + 1)$   
 $= (a+1)(7a^2 - 4a + 1)$

$$\begin{aligned}
 9. \quad & 27x^3 - (x-y)^3 \\
 &= [3x - (x-y)][9x^2 + 3x(x-y) + (x-y)^2] \\
 &= (3x - x + y)(9x^2 + 3x^2 - 3xy + x^2 - 2xy + y^2) \\
 &= (2x+y)(13x^2 - 5xy + y^2)
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & (2a-b)^3 - 27 \\
 &= (2a-b-3)[(2a-b)^2 + 3(2a-b)+9] \\
 &= (2a-b-3)(4a^2 - 4ab + b^2 + 6a - 3b + 9)
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & x^6 - (x+2)^3 \\
 &= [x^2 - (x+2)][x^4 + x^2(x+2) + (x+2)^2] \\
 &= (x^2 - x - 2)(x^4 + x^3 + 2x^2 + x^2 + 4x + 4) \\
 &= (x^2 - x - 2)(x^4 + x^3 + 3x^2 + 4x + 4)
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & (a+1)^3 + (a-3)^3 \\
 &= (a+1+a-3)[(a+1)^2 - (a-3)(a+1) + (a-3)^2] \\
 &= (2a-2)(a^2 + 2a + 1 - a^2 + 2a + 3 + a^2 - 6a + 9) \\
 &= (2a-2)(a^2 - 2a + 13)
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & (x-1)^3 - (x+2)^3 \\
 &= [x-1-(x+2)][(x-1)^2 + (x-1)(x+2) + (x+2)^2] \\
 &= (x-1-x-2)(x^2 - 2x + 1 + x^2 + x - 2 + x^2 + 4x + 4) \\
 &= -3(3x^2 + 3x + 3) = -9(x^2 + x + 1)
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & (x-y)^3 - (x+y)^3 \\
 &= [(x-y) - (x+y)][(x-y)^2 + (x-y)(x+y) + (x+y)^2] \\
 &= (x-y-x-y)(x^2 - 2xy + y^2 + x^2 - y^2 + x^2 + 2xy + y^2) \\
 &= -2y(3x^2 + y^2)
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & (m-2)^3 + (m-3)^3 \\
 &= [(m-2) + (m-3)][(m-2)^2 - (m-2)(m-3) + (m-3)^2] \\
 &= (m-2+m-3)(m^2 - 4m + 4 - m^2 + 5m - 6 + m^2 - 6m + 9) \\
 &= (2m-5)(m^2 - 5m + 7)
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & (2x-y)^3 + (3x+y)^3 \\
 &= [(2x-y) + (3x+y)][(2x-y)^2 - (2x-y)(3x+y) + (3x+y)^2] \\
 &= (2x-y+3x+y)(4x^2 - 4xy + y^2 - 6x^2 + xy + y^2 + 9x^2 + 6xy + y^2) \\
 &= (5x)(7x^2 + 3xy + 3y^2)
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & 8(a+b)^3 + (a-b)^3 \\
 &= [2(a+b) + (a-b)][4(a+b)^2 - 2(a+b)(a-b) + (a-b)^2] \\
 &= (2a+2b+a-b)(4a^2 + 8ab + 4b^2 - 2a^2 + 2b^2 + a^2 - 2ab + b^2) \\
 &= (3a+b)(3a^2 + 6ab + 7b^2)
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & 64(m+n)^3 - 125 \\
 &= [4(m+n) - 5][16(m+n)^2 + 4(m+n)(5) + 25] \\
 &= (4m+4n-5)(16m^2 + 32mn + 16n^2 + 20m + 20n + 25)
 \end{aligned}$$

### EJERCICIO 105

$$1. \quad a^5 + 1 = (a+1)(a^4 - a^3 + a^2 - a + 1)$$

$$2. \quad a^5 - 1 = (a-1)(a^4 + a^3 + a^2 + a + 1)$$

$$3. \quad 1 - x^5 = (1-x)(1+x+x^2+x^3+x^4)$$

$$4. \quad a^7 + b^7 = (a+b)(a^6 - a^5b + a^4b^2 - a^3b^3 + a^2b^4 - ab^5 + b^6)$$

$$5. \quad m^7 - n^7 = (m-n)(m^6 + m^5n + m^4n^2 + m^3n^3 + m^2n^4 + mn^5 + n^6)$$

$$6. \quad a^5 + 243 = (a+3)(a^4 - 3a^3 + 9a^2 - 27a + 81)$$

$$7. \quad 32 - m^5 = (2-m)(16 + 8m + 4m^2 + 2m^3 + m^4)$$

$$8. \quad 1 + 243x^5 = (1+3x)(1-3x+9x^2-27x^3+81x^4)$$

$$9. \quad x^7 + 128 = (x+2)(x^6 - 2x^5 + 4x^4 - 8x^3 + 16x^2 - 32x + 64)$$

$$10. \quad 243 - 32b^5 = (3-2b)(81 + 54b + 36b^2 + 24b^3 + 16b^4)$$

$$11. \quad a^5 + b^5c^5 = (a+bc)(a^4 - a^3bc + a^2b^2c^2 - ab^3c^3 + b^4c^4)$$

$$12. \quad m^7 - a^7x^7 = (m-ax)(m^6 + m^5ax + m^4a^2x^2 + m^3a^3x^3 + m^2a^4x^4 + ma^5x^5 + a^6x^6)$$

$$13. \quad 1 + x^7 = (1+x)(1-x+x^2-x^3+x^4-x^5+x^6)$$

$$14. \quad x^7 - y^7 = (x-y)(x^6 + x^5y + x^4y^2 + x^3y^3 + x^2y^4 + xy^5 + y^6)$$

$$15. \quad a^7 + 2.187 = (a+3)(a^6 - 3a^5 + 9a^4 - 27a^3 + 81a^2 - 243a + 729)$$

$$16. \quad 1 - 128a^7 = (1-2a)(1+2a+4a^2+8a^3+16a^4+32a^5+64a^6)$$

$$17. \quad x^{10} + 32y^5 = (x^2 + 2y)(x^8 - 2x^6y + 4x^4y^2 - 8x^2y^3 + 16y^4)$$

$$18. \quad 1 + 128x^4 = (1+2x^2)(1-2x^2+4x^4-8x^6+16x^8-32x^{10}+64x^{12})$$



## EJERCICIO 106

$$1. 5a^2 + a = a(5a + 1)$$

$$2. m^2 + 2mx + x^2 = (m + x)^2$$

$$3. a^2 + a - ab - b = (a^2 + a) - (ab - b) \\ = a(a + 1) - b(a + 1) \\ = (a + 1)(a - b)$$

$$4. x^2 - 36 = x^2 - 6^2 = (x + 6)(x - 6)$$

$$5. 9x^2 - 6xy + y^2 = (3x - y)^2$$

$$6. x^2 - 3x - 4 = (x - 1)(x + 4)$$

$$7. 6x^2 - x - 2 \\ = 36x^2 - 6x - 12 \\ = \frac{(6x - 4)(6x + 3)}{3 \cdot 2} \\ = (3x - 2)(2x + 1)$$

$$8. 1 + x^3 = (1 + x)(1 - x + x^2)$$

$$9. 27a^3 - 1 = (3a - 1)(9a^2 + 3a + 1)$$

$$10. x^5 + m^5 = (x + m)(x^4 - x^3m + x^2m^2 - xm^3 + m^4)$$

$$11. a^3 - 3a^2b + 5ab^2 = a(a^2 - 3ab + 5b^2)$$

$$12. 2xy - 6y + xz - 3z \\ = 2y(x - 3) + z(x - 3) = (x - 3)(2y + z)$$

$$13. 1 - 4b + 4b^2 = (1 - 2b)^2$$

$$14. 4x^4 + 3x^2y^2 + y^4 \\ + x^2y^2 - x^2y^2 \\ 4x^4 + 4x^2y^2 + y^4 - x^2y^2 \\ = (2x^2 + y^2)^2 - x^2y^2 \\ = (2x^2 + xy + y^2)(2x^2 - xy + y^2)$$

$$15. x^8 - 6x^4y^4 + y^8 \\ + 2x^4y^4 - 4x^4y^4 \\ x^8 - 2x^4y^4 + y^8 - 4x^4y^4 \\ = (x^4 - y^4)^2 - 4x^4y^4 \\ = (x^4 + 2x^2y^2 - y^4)(x^4 - 2x^2y^2 - y^4)$$

$$16. a^2 - a - 30 = (a - 6)(a + 5)$$

$$17. 15m^2 + 11m - 14 \\ = 225m^2 + 11(15m) - 210 \\ = \frac{(15m + 21)(15m - 10)}{3 \cdot 5} \\ = (5m + 7)(3m - 2)$$

$$18. a^6 + 1 = (a^2 + 1)(a^4 - a^2 + 1)$$

$$19. 8m^3 - 27y^6 = (2m - 3y^2)(4m^2 + 6my^2 + 9y^4)$$

$$20. 16a^2 - 24ab + 9b^2 = (4a - 3b)^2$$

$$21. 1 + a^7 = (1 + a)(1 - a + a^2 - a^3 + a^4 - a^5 + a^6)$$

$$22. 8a^3 - 12a^2 + 6a - 1 = (2a - 1)^3$$

$$23. 1 - m^2 = (1 + m)(1 - m)$$

$$24. x^4 + 4x^2 - 21 = (x^2 + 7)(x^2 - 3)$$

$$25. 125a^6 + 1 = (5a^2 + 1)(25a^4 - 5a^2 + 1)$$

$$26. a^2 + 2ab + b^2 - m^2 \\ = (a + b)^2 - m^2 = (a + b + m)(a + b - m)$$

$$27. 8a^2b + 16a^3b - 24a^2b^2 = 8a^2b(1 + 2a - 3b)$$

$$28. x^5 - x^4 + x - 1 \\ = (x^5 - x^4) + (x - 1) = x^4(x - 1) + (x - 1) = (x^4 + 1)(x - 1)$$

$$29. 6x^2 + 19x - 20 \\ = 36x^2 + 19(6x) - 120 \\ \begin{array}{r|l} 120 & 2 \\ 60 & 2 \quad 2^3 \cdot 3 = 24 \\ 30 & 2 \quad 5 \cdot 1 = 5 \\ 15 & 3 \quad \Rightarrow 24 - 5 = 19 \\ 5 & 5 \quad = \frac{(6x + 24)(6x - 5)}{6} \\ 1 & = (x + 4)(6x - 5) \end{array}$$

$$30. 25x^4 - 81y^2 = (5x^2 + 9y)(5x^2 - 9y)$$

$$31. 1 - m^3 = (1 - m)(1 + m + m^2)$$

$$32. x^2 - a^2 + 2xy + y^2 + 2ab - b^2 \\ = (x^2 + 2xy + y^2) - (a^2 - 2ab + b^2) \\ = (x + y)^2 - (a - b)^2 \\ = (x + y + a - b)(x + y - a + b)$$

$$33. 21m^5n - 7m^4n^2 + 7m^3n^3 - 7m^2n = 7m^2n(3m^3 - m^2n + mn^2 - 1)$$

$$34. a(x + 1) - b(x + 1) + c(x + 1) = (a - b + c)(x + 1)$$

$$35. 4 + 4(x - y) + (x - y)^2 = (2 + x - y)^2$$

$$36. 1 - a^2b^4 = (1 + ab^2)(1 - ab^2)$$

$$37. b^2 + 12ab + 36a^2 = (b + 6a)^2$$

$$38. x^6 + 4x^3 - 77 = (x^3 + 11)(x^3 - 7)$$

$$\begin{aligned}
 39. \quad & 15x^4 - 17x^2 - 4 \\
 & = (15x^2)^2 - 17(15x^2) - 60 \\
 & = \frac{(15x^2 - 20)(15x^2 + 3)}{5 \cdot 3} \\
 & = (3x^2 - 4)(5x^2 + 1)
 \end{aligned}$$

$$\begin{aligned}
 40. \quad & 1 + (a - 3b)^3 \\
 & = (1 + a - 3b)[1 - (a - 3b) + (a - 3b)^2] \\
 & = (1 + a - 3b)(1 - a + 3b + a^2 - 6ab + 9b^2)
 \end{aligned}$$

$$\begin{aligned}
 41. \quad & x^4 + x^2 + 25 \\
 & \quad + 9x^2 \quad - 9x^2 \\
 & \frac{x^4 + 10x^2 + 25 - 9x^2}{x^4 + 10x^2 + 25 - 9x^2} \\
 & = (x^2 + 5)^2 - 9x^2 \\
 & = (x^2 + 3x + 5)(x^2 - 3x + 5)
 \end{aligned}$$

$$\begin{aligned}
 42. \quad & a^8 - 28a^4 + 36 \\
 & \quad + 16a^4 \quad - 16a^4 \\
 & \frac{a^8 - 12a^4 + 36 - 16a^4}{a^8 - 12a^4 + 36 - 16a^4} \\
 & = (a^4 - 6)^2 - 16a^4 \\
 & = (a^4 + 4a^2 - 6)(a^4 - 4a^2 - 6)
 \end{aligned}$$

$$43. \quad 343 + 8a^3 = (7 + 2a)(49 - 14a + 4a^2)$$

$$44. \quad 12a^2bx - 15a^2by = 3a^2b(4x - 5y)$$

$$45. \quad x^2 + 2xy - 15y^2 = (x + 5y)(x - 3y)$$

$$\begin{aligned}
 46. \quad & 6am - 4an - 2n + 3m \\
 & = (6am + 3m) - (4an + 2n) \\
 & = 3m(2a + 1) - 2n(2a + 1) \\
 & = (3m - 2n)(2a + 1)
 \end{aligned}$$

$$47. \quad 81a^6 - 4b^2c^8 = (9a^3 + 2bc^4)(9a^3 - 2bc^4)$$

$$48. \quad 16 - (2a + b)^2 = (4 + 2a + b)(4 - 2a - b) \quad 68. \quad a^2 - x^2 - a - x = (a^2 - x^2) - (a + x) = (a + x)(a - x) - (a + x) = (a + x)(a - x - 1)$$

$$\begin{aligned}
 49. \quad & 20 - x - x^2 \\
 & = -(x^2 + x - 20) \\
 & = -(x + 5)(x - 4) \\
 & = (x + 5)(4 - x)
 \end{aligned}$$

$$50. \quad n^2 + n - 42 = (n + 7)(n - 6)$$

$$\begin{aligned}
 51. \quad & a^2 - d^2 + n^2 - c^2 - 2an - 2cd \\
 & = (a^2 - 2an + n^2) - (c^2 + 2cd + d^2) \\
 & = (a - n)^2 - (c + d)^2 \\
 & = (a - n + c + d)(a - n - c - d)
 \end{aligned}$$

$$52. \quad 1 + 216x^9 = (1 + 6x^3)(1 - 6x^3 + 36x^6)$$

$$53. \quad x^3 - 64 = (x - 4)(x^2 + 4x + 16)$$

$$54. \quad x^3 - 64x^4 = x^3(1 - 64x)$$

$$55. \quad 18ax^5y^3 - 36x^4y^3 - 54x^2y^8 = 18x^2y^3(ax^3 - 2x^2 - 3y^5)$$

$$56. \quad 49a^2b^2 - 14ab + 1 = (7ab - 1)$$

$$57. \quad (x + 1)^2 - 81 = (x + 1 + 9)(x + 1 - 9) = (x + 10)(x - 8)$$

$$58. \quad a^2 - (b + c)^2 = (a + b + c)(a - b - c)$$

$$59. \quad (m + n)^2 - 6(m + n) + 9 = (m + n - 3)^2$$

$$60. \quad 7x^2 + 31x - 20 = (7x)^2 + 31(7x) - 140$$

140	2	
70	2	7 \cdot 5 = 35
35	5	2^2 = 4
7	7	\Rightarrow 35 - 4 = 31
1		= \frac{(7x + 35)(7x - 4)}{7}
		= (x + 5)(7x - 4)

$$61. \quad 9a^3 + 63a - 45a^2 = 9a(a^2 + 7 - 5a)$$

$$62. \quad ax + a - x - 1 = (ax + a) - (x + 1) = a(x + 1) - (x + 1) = (a - 1)(x + 1)$$

$$63. \quad 81x^4 + 25y^2 - 90x^2y = 81x^4 - 90x^2y + 25y^2 = (9x^2 - 5y)^2$$

$$64. \quad 1 - 27b^2 + b^4$$

1	25b^2	- 25b^2
1 - 2b^2 + b^4	- 25b^2	- 25b^2
= (1 - b^2)^2	- 25b^2	
= (1 + 5b - b^2)(1 - 5b - b^2)		

$$65. \quad m^4 + m^2n^2 + n^4$$

m^4	+ m^2n^2	- m^2n^2
m^4 + 2m^2n^2 + n^4	- m^2n^2	- m^2n^2
= (m^2 + n^2)^2	- m^2n^2	
= (m^2 + mn + n^2)(m^2 - mn + n^2)		

$$66. \quad c^4 - 4d^4 = (c^2 + 2d^2)(c^2 - 2d^2)$$

$$67. \quad 15x^4 - 15x^3 + 20x^2 = 5x^2(3x^2 - 3x + 4)$$

$$69. \quad x^4 - 8x^2 - 240$$

240	4	
60	4	4 \cdot 5 = 20
15	3	4 \cdot 3 = 12
5	5	\Rightarrow 20 - 12 = 8
1		= (x^2 - 20)(x^2 + 12)

$$70. \quad 6m^4 + 7m^2 - 20$$

= (6m^2)^2	+ 7(6m^2)	- 120
120	4	
30	3	4 \cdot 2 = 8
10	5	5 \cdot 3 = 15
2	2	\Rightarrow 15 - 8 = 7
1		= \frac{(6m^2 + 15)(6m^2 - 8)}{3 \cdot 2}
		= (2m^2 + 5)(3m^2 - 4)

71.  $9n^2 + 4a^2 - 12an \Rightarrow 9n^2 - 12an + 4a^2$   
 $= (3n - 2a)^2$
72.  $2x^2 + 2 = 2(x^2 + 1)$
73.  $7a(x+y-1) - 3b(x+y-1) = (7a-3b)(x+y-1)$
74.  $x^2 + 3x - 18 = (x+6)(x-3)$
75.  $(a+m)^2 - (b+n)^2 = (a+m+b+n)(a+m-b-n)$
76.  $x^3 + 6x^2y + 12xy^2 + 8y^3 = (x+2y)^3$
77.  $8a^2 - 22a - 21$   
 $= (8a)^2 - 22(8a) - 168$   

168		4	
42		2	3 · 2 = 6
21		3	4 · 7 = 28
7		7	⇒ 28 - 6 = 22
1			$= \frac{(8a-28)(8a+6)}{4 \cdot 2}$

  
 $= (2a-7)(4a+3)$
78.  $1 + 18ab + 81a^2b^2 = (1+9ab)^2$
79.  $4a^6 - 1 = (2a^3 + 1)(2a^3 - 1)$
80.  $x^6 - 4x^3 - 480$   

480		4	
120		3	5 · 4 = 20
40		4	4 · 3 · 2 = 24
10		5	⇒ 24 - 20 = 4
2		2	$= (x^3 - 24)(x^3 + 20)$
1			
81.  $ax - bx + b - a - by + ay$   
 $= (ax + ay - a) - (bx + by - b)$   
 $= a(x+y-1) - b(x+y-1)$   
 $= (a-b)(x+y-1)$
82.  $6am - 3m - 2a + 1$   
 $= (6am - 3m) - (2a - 1)$   
 $= 3m(2a-1) - (2a-1) = (3m-1)(2a-1)$
83.  $15 + 14x - 8x^2$   
 $= -(8x^2 - 14x - 15)$   
 $= -[(8x)^2 - 14(8x) - 120]$   

120		4	
30		3	4 · 5 = 20
10		5	3 · 2 = 6
2		2	⇒ 20 - 6 = 14
1			$= -\frac{(8x-20)(8x+6)}{4 \cdot 2}$

  
 $= -(2x-5)(4x+3)$   
 $= (5-2x)(4x+3)$
84.  $a^{10} - a^8 + a^6 + a^4 = a^4(a^6 - a^4 + a^2 + 1)$
85.  $2x(a-1) - a + 1 = 2x(a-1) - (a-1) = (a-1)(2x-1)$
86.  $(m+n)(m-n) + 3n(m-n) = (m-n)(m+n+3n) = (m-n)(m+4n)$
87.  $a^2 - b^3 + 2b^3x^2 - 2a^2x^2$   
 $= -(b^3 - 2b^3x^2) + (a^2 - 2a^2x^2)$   
 $= -b^3(1-2x^2) + a^2(1-2x^2) = (1-2x^2)(a^2 - b^3)$
88.  $2am - 3b - c - cm - 3bm + 2a$   
 $= (2am - cm - 3bm) - (3b + c - 2a)$   
 $= m(2a - c - 3b) - (3b + c - 2a)$   
 $= m(2a - 3b - c) + (2a - 3b - c)$   
 $= (2a - 3b - c)(m+1)$
89.  $x^2 - \frac{2}{3}x + \frac{1}{9} = \left(x - \frac{1}{3}\right)^2$
90.  $4a^{2n} - b^{4n}$   
 $= (2a^n + b^{2n})(2a^n - b^{2n})$
91.  $81x^2 - (a+x)^2 = (9x+a+x)(9x-a-x) = (10x+a)(8x-a)$
92.  $a^2 + 9 - 6a - 16x^2$   
 $= (a^2 - 6a + 9) - 16x^2 = (a-3)^2 - 16x^2 = (a-3+4x)(a-4x-3)$
93.  $9a^2 - x^2 - 4 + 4x$   
 $= 9a^2 - (x^2 - 4x + 4) = 9a^2 - (x-2)^2 = (3a+x-2)(3a-x+2)$
94.  $9x^2 - y^2 + 3x - y$   
 $= (9x^2 - y^2) + (3x - y) = (3x+y)(3x-y) + (3x-y) = (3x-y)(3x+y+1)$
95.  $x^2 - x - 72 = (x-9)(x+8)$
96.  $36a^4 - 120a^2b^2 + 49b^4$   
 $\frac{36a^4 - 84a^2b^2 + 49b^4 - 36a^2b^2}{36a^4 - 84a^2b^2 + 49b^4 - 36a^2b^2}$   
 $= (6a^2 - 7b^2)^2 - 36a^2b^2$   
 $= (6a^2 + 6ab - 7b^2)(6a^2 - 6ab - 7b^2)$
97.  $a^2 - m^2 - 9n^2 - 6mn + 4ab + 4b^2$   
 $= (a^2 + 4ab + 4b^2) - (m^2 + 6mn + 9n^2)$   
 $= (a+2b)^2 - (m+3n)^2$   
 $= (a+2b+m+3n)(a+2b-m-3n)$
98.  $1 - \frac{4}{9}a^8 = \left(1 + \frac{2}{3}a^4\right)\left(1 - \frac{2}{3}a^4\right)$
99.  $81a^8 + 64b^{12}$   
 $\frac{81a^8 + 144a^4b^6 + 64b^{12} - 144a^4b^6}{81a^8 + 144a^4b^6 + 64b^{12} - 144a^4b^6}$   
 $= (9a^4 + 8b^6)^2 - 144a^4b^6$   
 $= (9a^4 - 12a^2b^3 + 8b^6)(9a^4 + 12a^2b^3 + 8b^6)$
100.  $49x^2 - 77x + 30$   
 $= (49x)^2 - 77(49x) + 1.470$   

1.470		7	
210		7	
30		5	
6		6	7 · 5 = 35
1			7 · 6 = 42

  
 $\Rightarrow 42 + 35 = 77$   
 $= \frac{(49x-35)(49x-42)}{7 \cdot 7}$   
 $= (7x-5)(7x-6)$
101.  $x^2 - 2abx - 35a^2b^2$   
 $\frac{x^2 - 2abx + a^2b^2 - 36a^2b^2}{x^2 - 2abx + a^2b^2 - 36a^2b^2}$   
 $= (x-ab)^2 - 36a^2b^2$   
 $= (x-ab+6ab)(x-ab-6ab)$   
 $= (x+5ab)(x-7ab)$

$$102. 125x^3 - 225x^2 + 135x - 27 = (5x - 3)^3$$

$$103. (a-2)^2 - (a+3)^2 \\ = (a-2+a+3)(a-2-a-3) = (2a+1)(-5)$$

$$104. 4a^2m + 12a^2n - 5bm - 15bn \\ = (4a^2m + 12a^2n) - (5bm + 15bn) \\ = 4a^2(m+3n) - 5b(m+3n) = (m+3n)(4a^2 - 5b)$$

$$105. 1 + 6x^3 + 9x^6 = (1 + 3x^3)^2$$

$$106. a^4 + 3a^2b - 40b^2 = (a^2 + 8b)(a^2 - 5b)$$

$$107. m^3 + 8a^3x^3 = (m + 2ax)(m^2 - 2axm + 4a^2x^2)$$

$$108. 1 - 9x^2 + 24xy - 16y^2 \\ = -[(9x^2 - 24xy + 16y^2) - 1] \\ = -[(3x - 4y)^2 - 1] \\ = -[(3x - 4y + 1)(3x - 4y - 1)] \\ = (3x - 4y + 1)(1 + 4y - 3x)$$

$$109. 1 + 11x + 24x^2 \\ = (24x)^2 + 11(24x) + 24 \\ = \frac{(24x + 8)(24x + 3)}{8 \cdot 3} \\ = (3x + 1)(8x + 1)$$

$$110. 9x^2y^3 - 27x^3y^3 - 9x^5y^3 = 9x^2y^3(1 - 3x - x^3)$$

$$111. (a^2 + b^2 - c^2)^2 - 9x^2y^2 \\ = (a^2 + b^2 - c^2 + 3xy)(a^2 + b^2 - c^2 - 3xy)$$

$$112. 8(a+1)^3 - 1 \\ = [2(a+1) - 1][4(a+1)^2 + 2(a+1) + 1] \\ = (2a + 2 - 1)(4a^2 + 8a + 4 + 2a + 2 + 1) \\ = (2a + 1)(4a^2 + 10a + 7)$$

$$113. 100x^4y^6 - 121m^4 \\ = (10x^2y^3 + 11m^2)(10x^2y^3 - 11m^2)$$

$$114. (a^2 + 1)^2 + 5(a^2 + 1) - 24 \\ = (a^2 + 1 + 8)(a^2 + 1 - 3) = (a^2 + 9)(a^2 - 2)$$

$$115. 1 + 1.000x^6 = (1 + 10x^2)(1 - 10x^2 + 100x^4)$$

$$116. 49a^2 - x^2 - 9y^2 + 6xy \\ = -[(x^2 - 6xy + 9y^2) - 49a^2] \\ = -[(x - 3y)^2 - 49a^2] \\ = -(7a + x - 3y)(-7a + x - 3y) \\ = (7a + x - 3y)(7a - x + 3y)$$

$$117. x^4 - y^2 + 4x^2 + 4 - 4yz - 4z^2 \\ = (x^4 + 4x^2 + 4) - (y^2 + 4yz + 4z^2) \\ = (x^2 + 2)^2 - (y + 2z)^2 \\ = (x^2 + 2 + y + 2z)(x^2 + 2 - y - 2z)$$

$$118. a^3 - 64 = (a - 4)(a^2 + 4a + 16)$$

$$119. a^5 + x^5 = (a + x)(a^4 - a^3x + a^2x^2 - ax^3 + x^4)$$

$$120. a^6 - 3a^3b - 54b^2 = (a^3 - 9b)(a^3 + 6b)$$

$$121. 165 + 4x - x^2 \\ = -(x^2 - 4x - 165) \\ \begin{array}{r|l} 165 & 5 \\ 33 & 3 \quad 5 \cdot 3 = 15 \\ 11 & 11 \quad 11 \cdot 1 = 11 \\ 1 & \Rightarrow 15 - 11 = 4 \\ & = -(x - 15)(x + 11) \\ & = (15 - x)(x + 11) \end{array}$$

$$122. a^4 + a^2 + 1 \\ \frac{+a^2 \quad -a^2}{a^4 + 2a^2 + 1 - a^2} \\ = (a^2 + 1)^2 - a^2 \\ = (a^2 + a + 1)(a^2 - a + 1)$$

$$123. \frac{x^2}{4} - \frac{y^6}{81} = \left(\frac{x}{2} + \frac{y^3}{9}\right)\left(\frac{x}{2} - \frac{y^3}{9}\right)$$

$$124. 16x^2 + \frac{8xy}{5} + \frac{y^2}{25} = \left(4x + \frac{y}{5}\right)^2$$

$$125. a^4b^4 + 4a^2b^2 - 96 \\ \frac{+100 - 100}{a^4b^4 + 4a^2b^2 + 4 - 100} \\ = (a^2b^2 + 2)^2 - 100 \\ = (a^2b^2 + 2 + 10)(a^2b^2 + 2 - 10) \\ = (a^2b^2 + 12)(a^2b^2 - 8)$$

$$\begin{aligned}
 126. \quad & 8a^2x + 7y + 21by - 7ay - 8a^3x + 24a^2bx \\
 & = (7y + 21by - 7ay) + (8a^2x - 8a^3x + 24a^2bx) \\
 & = 7y(1 + 3b - a) + 8a^2x(1 - a + 3b) \\
 & = (1 + 3b - a)(7y + 8a^2x)
 \end{aligned}$$

$$\begin{array}{l|l}
 127. \quad x^4 + 11x^2 - 390 & \\
 390 & 3 \\
 130 & 2 \quad 13 \cdot 2 = 26 \\
 65 & 5 \quad 5 \cdot 3 = 15 \\
 13 & 13 \Rightarrow 26 - 15 = 11 \\
 1 & \Rightarrow (x^2 + 26)(x^2 - 15)
 \end{array}$$

$$\begin{aligned}
 128. \quad & 7 + 33m - 10m^2 \\
 & = -(10m^2 - 33m - 7) \\
 & = -[(10m)^2 - 33(10m) - 70] \\
 & = -\frac{(10m - 35)(10m + 2)}{5 \cdot 2} \\
 & = -(2m - 7)(5m + 1) \\
 & = (7 - 2m)(5m + 1)
 \end{aligned}$$

$$\begin{aligned}
 129. \quad & 4(a+b)^2 - 9(c+d)^2 \\
 & = [2(a+b) + 3(c+d)][2(a+b) - 3(c+d)] \\
 & = (2a + 2b + 3c + 3d)(2a + 2b - 3c - 3d)
 \end{aligned}$$

$$130. \quad 729 - 125x^3y^{12} = (9 - 5xy^4)(81 + 45xy^4 + 25x^2y^8)$$

$$131. \quad (x+y)^2 + x+y = (x+y)^2 + (x+y) = (x+y)(x+y+1)$$

$$\begin{aligned}
 132. \quad & 4 - (a^2 + b^2) + 2ab \\
 & \quad 4 - a^2 - b^2 + 2ab \\
 & \quad \quad \quad + b^2 \quad \quad - b^2 \\
 & \quad \quad \quad \hline
 & \quad 4 - a^2 \quad + 2ab - b^2 \\
 & = 4 - (a^2 - 2ab + b^2) \\
 & = 4 - (a-b)^2 \\
 & = (2+a-b)(2-a+b)
 \end{aligned}$$

$$\begin{aligned}
 133. \quad & x^3 - y^3 + x - y \\
 & = (x^3 - y^3) + (x - y) \\
 & = (x-y)(x^2 + xy + y^2) + (x-y) = (x-y)(x^2 + xy + y^2 + 1)
 \end{aligned}$$

$$\begin{aligned}
 134. \quad & a^2 - b^2 + a^3 - b^3 \\
 & = (a^2 - b^2) + (a^3 - b^3) \\
 & = (a+b)(a-b) + (a-b)(a^2 + ab + b^2) \\
 & = (a-b)(a+b+a^2+ab+b^2)
 \end{aligned}$$

### EJERCICIO 107

$$\begin{aligned}
 1. \quad & 3ax^2 - 3a \\
 & = 3a(x^2 - 1) = 3a(x+1)(x-1)
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 3x^2 - 3x - 6 \\
 & = 3(x^2 - x - 2) = 3(x-2)(x+1)
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 2a^2x - 4abx + 2b^2x \\
 & = 2x(a^2 - 2ab + b^2) \\
 & = 2x(a-b)^2 = 2x(a-b)(a-b)
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & 2a^3 - 2 \\
 & = 2(a^3 - 1) = 2(a-1)(a^2 + a + 1)
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & a^3 - 3a^2 - 28a \\
 & = a(a^2 - 3a - 28) = a(a-7)(a+4)
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & x^3 - 4x + x^2 - 4 \\
 & = (x^3 + x^2) - (4x + 4) \\
 & = x^2(x+1) - 4(x+1) \\
 & = (x^2 - 4)(x+1) = (x+2)(x-2)(x+1)
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & 3ax^3 + 3ay^3 \\
 & = 3a(x^3 + y^3) \\
 & = 3a(x+y)(x^2 - xy + y^2)
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & 4ab^2 - 4abn + an^2 \\
 & = a(4b^2 - 4bn + n^2) = a(2b-n)^2
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & x^4 - 3x^2 - 4 \\
 & = (x^2 - 4)(x^2 + 1) \\
 & = (x+2)(x-2)(x^2 + 1)
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & a^3 - a^2 - a + 1 \\
 & = (a^3 - a^2) - (a - 1) \\
 & = a^2(a-1) - (a-1) \\
 & = (a-1)(a^2 - 1) \\
 & = (a-1)(a+1)(a-1)
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & 2ax^2 - 4ax + 2a \\
 & = 2a(x^2 - 2x + 1) = 2a(x-1)^2
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & x^3 - x + x^2y - y \\
 & = (x^3 - x) + (x^2y - y) \\
 & = x(x^2 - 1) + y(x^2 - 1) \\
 & = (x^2 - 1)(x+y) = (x+1)(x-1)(x+y)
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & 2a^3 + 6a^2 - 8a \\
 & = 2a(a^2 + 3a - 4) = 2a(a+4)(a-1)
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & 16x^3 - 48x^2y + 36xy^2 \\
 & = 4x(4x^2 - 12xy + 9y^2) = 4x(2x - 3y)^2
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & 3x^3 - x^2y - 3xy^2 + y^3 \\
 & = (3x^3 - x^2y) - (3xy^2 - y^3) \\
 & = x^2(3x - y) - y^2(3x - y) \\
 & = (3x - y)(x^2 - y^2) = (3x - y)(x+y)(x-y)
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & 5a^4 + 5a \\
 & = 5a(a^3 + 1) = 5a(a+1)(a^2 - a + 1)
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & 6ax^2 - ax - 2a \\
 &= a(6x^2 - x - 2) \\
 &= a(36x^2 - 6x - 12) \\
 &= \frac{a(6x-4)(6x+3)}{2 \cdot 3} \\
 &= a(3x-2)(2x+1)
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & n^4 - 81 \\
 &= (n^2 - 9)(n^2 + 9) = (n+3)(n-3)(n^2 + 9)
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & 8ax^2 - 2a \\
 &= 2a(4x^2 - 1) = 2a(2x-1)(2x+1)
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & ax^3 + 10ax^2 + 25ax \\
 &= ax(x^2 + 10x + 25) = ax(x+5)(x+5)
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & x^3 - 6x^2 - 7x \\
 &= x(x^2 - 6x - 7) \\
 &= x(x^2 - 6x - 7 + 16 - 16) \\
 &= x(x^2 - 6x + 9 - 16) \\
 &= x[(x-3)^2 - 4^2] \\
 &= x(x-3+4)(x-3-4) \\
 &= x(x+1)(x-7)
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & m^3 + 3m^2 - 16m - 48 \\
 &= (m^3 + 3m^2) - (16m + 48) \\
 &= m^2(m+3) - 16(m+3) \\
 &= (m+3)(m^2 - 16) \\
 &= (m+3)(m-4)(m+4)
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & x^3 - 6x^2y + 12xy^2 - 8y^3 \\
 &= (x-2y)^3 = (x-2y)(x-2y)(x-2y)
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & (a+b)(a^2 - b^2) - (a^2 - b^2) \\
 &= (a^2 - b^2)(a+b-1) \\
 &= (a+b)(a-b)(a+b-1)
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & 32a^5x - 48a^3bx + 18ab^2x \\
 &= 2ax(16a^4 - 24a^2b + 9b^2) \\
 &= 2ax(4a^2 - 3b)^2 \\
 &= 2ax(4a^2 - 3b)(4a^2 - 3b)
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & x^4 - x^3 + x^2 - x \\
 &= x(x^3 - x^2 + x - 1) \\
 &= x[x^2(x-1) + (x-1)] = x[(x-1)(x^2+1)]
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & 4x^2 + 32x - 36 \\
 &= 16x^2 + 32(4x) - 144 \\
 & \begin{array}{l|l} 144 & 2 \\ 72 & 2 \quad 2^2 = 4 \\ 36 & 4 \quad 4 \cdot 3 \cdot 3 = 36 \\ 9 & 3 \Rightarrow 36 - 4 = 32 \\ 3 & 3 = \frac{(4x+36)(4x-4)}{4} \\ 1 & = (x+9)(4x-4) \\ & = 4(x+9)(x-1) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & a^4 - (a+2)^2 \\
 &= (a^2 + a + 2)(a^2 - a - 2) \\
 &= (a^2 + a + 2)(a-2)(a+1)
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & x^6 - 25x^3 - 54 \\
 &= (x^3 - 27)(x^3 + 2) \\
 &= (x-3)(x^2 + 3x + 9)(x^3 + 2)
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & a^6 + a \\
 &= a(a^5 + 1) \\
 &= a(a+1)(a^4 - a^3 + a^2 - a + 1)
 \end{aligned}$$

$$\begin{aligned}
 31. \quad & a^3b + 2a^2bx + abx^2 - aby^2 \\
 &= ab(a^2 + 2ax + x^2 - y^2) \\
 &= ab[(a+x)^2 - y^2] \\
 &= ab(a+x+y)(a+x-y)
 \end{aligned}$$

$$\begin{aligned}
 32. \quad & 3abm^2 - 3ab \\
 &= 3ab(m^2 - 1) \\
 &= 3ab(m+1)(m-1)
 \end{aligned}$$

$$\begin{aligned}
 33. \quad & 81x^4y + 3xy^4 \\
 &= 3xy(27x^3 + y^3) \\
 &= 3xy(3x+y)(9x^2 - 3xy + y^2)
 \end{aligned}$$

$$\begin{aligned}
 34. \quad & a^4 - a^3 + a - 1 \\
 &= (a^4 - a^3) + (a - 1) \\
 &= a^3(a-1) + (a-1) \\
 &= (a-1)(a^3 + 1) \\
 &= (a-1)(a+1)(a^2 - a + 1)
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & x - 3x^2 - 18x^3 \\
 &= x(1 - 3x - 18x^2) \\
 &= -x(18x^2 + 3x - 1) \\
 &= -x[(18x)^2 + 3(18x) - 18] \\
 &= \frac{-x(18x+6)(18x-3)}{6 \cdot 3} \\
 &= -x(3x+1)(6x-1) \\
 &= x(3x+1)(1-6x)
 \end{aligned}$$

$$\begin{aligned}
 36. \quad & 6ax - 2bx + 6ab - 2b^2 \\
 &= (6ax - 2bx) + (6ab - 2b^2) \\
 &= 2x(3a - b) + 2b(3a - b) \\
 &= (3a - b)(2x + 2b) \\
 &= 2(x+b)(3a - b)
 \end{aligned}$$

$$\begin{aligned}
 37. \quad & am^3 - 7am^2 + 12am \\
 &= am(m^2 - 7m + 12) \\
 &= am(m-4)(m-3)
 \end{aligned}$$

$$\begin{aligned}
 38. \quad & 4a^2x^3 - 4a^2 \\
 &= 4a^2(x^3 - 1) \\
 &= 4a^2(x-1)(x^2 + x + 1)
 \end{aligned}$$

$$\begin{aligned}
 39. \quad & 28x^3y - 7xy^3 \\
 &= 7xy(4x^2 - y^2) \\
 &= 7xy(2x-y)(2x+y)
 \end{aligned}$$

$$\begin{aligned}
 40. \quad & 3abx^2 - 3abx - 18ab \\
 &= 3ab(x^2 - x - 6) \\
 &= 3ab(x-3)(x+2)
 \end{aligned}$$

$$\begin{aligned}
 41. \quad & x^4 - 8x^2 - 128 \\
 & \begin{array}{l|l} 128 & 4 \\ 32 & 4 \quad 4 \cdot 4 = 16 \\ 8 & 4 \quad 4 \cdot 2 = 8 \\ 2 & 2 \Rightarrow 16 - 8 = 8 \\ 1 & = (x^2 - 16)(x^2 + 8) \\ & = (x+4)(x-4)(x^2 + 8) \end{array}
 \end{aligned}$$

$$\begin{aligned}
 42. \quad & 18x^2y + 60xy^2 + 50y^3 \\
 &= 2y(9x^2 + 30xy + 25y^2) \\
 &= 2y(3x+5y)(3x+5y)
 \end{aligned}$$

$$\begin{aligned}
 43. & (x^2 - 2xy)(a+1) + y^2(a+1) \\
 &= (a+1)(x^2 - 2xy + y^2) \\
 &= (a+1)(x-y)(x-y)
 \end{aligned}$$

$$\begin{aligned}
 44. & x^3 + 2x^2y - 3xy^2 \\
 &= x(x^2 + 2xy - 3y^2) \\
 &= x(x+3y)(x-y)
 \end{aligned}$$

$$\begin{aligned}
 45. & a^2x - 4b^2x + 2a^2y - 8b^2y \\
 &= (a^2x - 4b^2x) + (2a^2y - 8b^2y) \\
 &= x(a^2 - 4b^2) + 2y(a^2 - 4b^2) \\
 &= (a^2 - 4b^2)(x + 2y) \\
 &= (a - 2b)(a + 2b)(x + 2y)
 \end{aligned}$$

$$\begin{aligned}
 46. & 45a^2x^4 - 20a^2 \\
 &= 5a^2(9x^4 - 4) \\
 &= 5a^2(3x^2 + 2)(3x^2 - 2)
 \end{aligned}$$

$$\begin{aligned}
 47. & a^4 - (a - 12)^2 \\
 &= (a^2 + a - 12)(a^2 - a + 12) \\
 &= (a + 4)(a - 3)(a^2 - a + 12)
 \end{aligned}$$

$$\begin{aligned}
 48. & bx^2 - b - x^2 + 1 \\
 &= (bx^2 - x^2) - (b - 1) \\
 &= x^2(b - 1) - (b - 1) \\
 &= (b - 1)(x^2 - 1) \\
 &= (b - 1)(x + 1)(x - 1)
 \end{aligned}$$

$$\begin{aligned}
 49. & 2x^4 + 6x^3 - 56x^2 \\
 &= 2x^2(x^2 + 3x - 28) \\
 &= 2x^2(x + 7)(x - 4)
 \end{aligned}$$

$$\begin{aligned}
 50. & 30a^2 - 55a - 50 \\
 &= (30a)^2 - 55(30a) - 1.500 \\
 & \begin{array}{l|l}
 1.500 & 2 \\
 750 & 2 \quad 5 \cdot 2^2 = 20 \\
 375 & 5 \quad 5^2 \cdot 3 = 75 \\
 75 & 5 \Rightarrow 75 - 20 = 55 \\
 15 & 5 = \frac{(30a - 75)(30a + 20)}{15 \cdot 2} \\
 3 & 3 = (2a - 5)(15a + 10) \\
 1 & = 5(2a - 5)(3a + 2)
 \end{array}
 \end{aligned}$$

$$\begin{aligned}
 51. & 9(x - y)^3 - (x - y) \\
 &= (x - y)[9(x - y)^2 - 1] \\
 &= (x - y)[3(x - y) + 1][3(x - y) - 1] \\
 &= (x - y)(3x - 3y + 1)(3x - 3y - 1)
 \end{aligned}$$

$$\begin{aligned}
 52. & 6a^2x - 9a^3 - ax^2 \\
 &= a(6ax - 9a^2 - x^2) \\
 &= -a(x^2 - 6ax + 9a^2) \\
 &= -a(x - 3a)(x - 3a) \\
 &= a(3a - x)(x - 3a)
 \end{aligned}$$

$$\begin{aligned}
 53. & 64a - 125a^4 \\
 &= a(64 - 125a^3) \\
 &= a(4 - 5a)(16 + 20a + 25a^2)
 \end{aligned}$$

$$\begin{aligned}
 54. & 70x^4 + 26x^3 - 24x^2 \\
 &= 2x^2(35x^2 + 13x - 12) \\
 &= 2x^2[(35x)^2 + 13(35x) - 420] \\
 & \begin{array}{l|l}
 420 & 2 \\
 210 & 2 \\
 105 & 5 \\
 21 & 3 \\
 7 & 7 \\
 1 & \\
 \hline
 2^2 \cdot 7 = 28 & \\
 3 \cdot 5 = 15 & \\
 \hline
 \Rightarrow 28 - 15 = 13 & \\
 \hline
 = \frac{(35x + 28)(35x - 15)}{7 \cdot 5} & \\
 \hline
 = 2x^2(5x + 4)(7x - 3) &
 \end{array}
 \end{aligned}$$

$$\begin{aligned}
 55. & a^7 + 6a^6 - 55a^3 \\
 &= a^3(a^4 + 6a^3 - 55) \\
 &= a^3(a^2 + 11)(a^2 - 5)
 \end{aligned}$$

$$\begin{aligned}
 56. & 16a^5b - 56a^3b^3 + 49ab^5 \\
 &= ab(16a^4 - 56a^2b^2 + 49b^4) \\
 &= ab(4a^2 - 7b^2)^2
 \end{aligned}$$

$$\begin{aligned}
 57. & 7x^6 + 32a^2x^4 - 15a^4x^2 \\
 &= x^2(7x^4 + 32a^2x^2 - 15a^4) \\
 &= x^2[(7x^2)^2 + 32a^2(7x^2) - 105a^4]
 \end{aligned}$$

$$\begin{array}{l|l}
 105 & 5 \\
 21 & 3 \quad 5 \cdot 7 = 35 \\
 7 & 7 \quad 3 \cdot 1 = 3 \\
 1 & \Rightarrow 35 - 3 = 32 \\
 \hline
 & = \frac{x^2(7x^2 + 35a^2)(7x^2 - 3a^2)}{7} \\
 & = x^2(x^2 + 5a^2)(7x^2 - 3a^2)
 \end{array}$$

$$\begin{aligned}
 58. & x^{2m+2} - x^2y^{2n} \\
 &= (x^{m+1} + xy^n)(x^{m+1} - xy^n) \\
 &= x(x^m + y^n)x(x^m - y^n) \\
 &= x^2(x^m + y^n)(x^m - y^n)
 \end{aligned}$$

$$\begin{aligned}
 59. & 2x^4 + 5x^3 - 54x - 135 \\
 &= (2x^4 - 54x) + (5x^3 - 135) \\
 &= 2x(x^3 - 27) + 5(x^3 - 27) \\
 &= (x^3 - 27)(2x + 5) \\
 &= (x - 3)(x^2 + 3x + 9)(2x + 5)
 \end{aligned}$$

$$\begin{aligned}
 60. & ax^3 + ax^2y + axy^2 - 2ax^2 - 2axy - 2ay^2 \\
 &= a(x^3 + x^2y + xy^2 - 2x^2 - 2xy - 2y^2) \\
 &= a[(x^3 + x^2y + xy^2) - (2x^2 + 2xy + 2y^2)] \\
 &= a[x(x^2 + xy + y^2) - 2(x^2 + xy + y^2)] \\
 &= a(x - 2)(x^2 + xy + y^2)
 \end{aligned}$$

$$\begin{aligned}
 61. & (x + y)^4 - 1 \\
 &= [(x + y)^2 + 1][(x + y)^2 - 1] \\
 &= (x^2 + 2xy + y^2 + 1)(x + y + 1)(x + y - 1)
 \end{aligned}$$

$$\begin{aligned}
 62. & 3a^5 + 3a^3 + 3a \\
 &= 3a(a^4 + a^2 + 1) \\
 &= 3a(a^4 + a^2 + 1 + a^2 - a^2) \\
 &= 3a[(a^4 + 2a^2 + 1) - a^2] \\
 &= 3a[(a^2 + 1)^2 - a^2] \\
 &= 3a(a^2 + a + 1)(a^2 - a + 1)
 \end{aligned}$$

## EJERCICIO 108

1.  $1 - a^8$

$$\begin{aligned} &= (1 + a^4)(1 - a^4) \\ &= (1 + a^4)(1 + a^2)(1 - a^2) \\ &= (1 + a^4)(1 + a^2)(1 + a)(1 - a) \end{aligned}$$

2.  $a^6 - 1$

$$\begin{aligned} &= (a^3 + 1)(a^3 - 1) \\ &= (a + 1)(a^2 - a + 1)(a - 1)(a^2 + a + 1) \end{aligned}$$

3.  $x^4 - 41x^2 + 400$

$$\begin{array}{l|l} 400 & 4 \\ 100 & 5 \quad 4^2 = 16 \\ 20 & 5 \quad 5^2 = 25 \\ 4 & 4 \Rightarrow 25 + 16 = 41 \\ 1 & \end{array}$$

$$\begin{aligned} &= (x^2 - 25)(x^2 - 16) \\ &= (x + 5)(x - 5)(x + 4)(x - 4) \end{aligned}$$

4.  $a^4 - 2a^2b^2 + b^4$

$$\begin{aligned} &= (a^2 - b^2)^2 \\ &= [(a + b)(a - b)]^2 = (a + b)^2(a - b)^2 \end{aligned}$$

5.  $x^5 + x^3 - 2x$

$$\begin{aligned} &= x(x^4 + x^2 - 2) \\ &= x(x^2 + 2)(x^2 - 1) \\ &= x(x^2 + 2)(x + 1)(x - 1) \end{aligned}$$

6.  $2x^4 + 6x^3 - 2x - 6$

$$\begin{aligned} &= (2x^4 + 6x^3) - (2x + 6) \\ &= 2x^3(x + 3) - 2(x + 3) \\ &= (2x^3 - 2)(x + 3) \\ &= 2(x^3 - 1)(x + 3) \\ &= 2(x - 1)(x^2 + x + 1)(x + 3) \end{aligned}$$

7.  $3x^4 - 243$

$$\begin{aligned} &= 3(x^4 - 81) \\ &= 3(x^2 + 9)(x^2 - 9) \\ &= 3(x^2 + 9)(x + 3)(x - 3) \end{aligned}$$

8.  $16x^4 - 8x^2y^2 + y^4$

$$\begin{aligned} &= (4x^2 - y^2)^2 \\ &= [(2x + y)(2x - y)]^2 \\ &= (2x + y)(2x - y)(2x + y)(2x - y) \end{aligned}$$

9.  $9x^4 + 9x^3y - x^2 - xy$

$$\begin{aligned} &= (9x^4 + 9x^3y) - (x^2 + xy) \\ &= 9x^3(x + y) - x(x + y) \\ &= (9x^3 - x)(x + y) \\ &= x(9x^2 - 1)(x + y) \\ &= x(3x + 1)(3x - 1)(x + y) \end{aligned}$$

10.  $12ax^4 + 33ax^2 - 9a$

$$\begin{aligned} &= 3a(4x^4 + 11x^2 - 3) \\ &= 3a[(4x^2)^2 + 11(4x^2) - 12] \\ &= \frac{3a(4x^2 + 12)(4x^2 - 1)}{4} \\ &= 3a(x^2 + 3)(4x^2 - 1) \\ &= 3a(x^2 + 3)(2x + 1)(2x - 1) \end{aligned}$$

11.  $x^8 - y^8$

$$\begin{aligned} &= (x^4 + y^4)(x^4 - y^4) \\ &= (x^4 + y^4)(x^2 + y^2)(x^2 - y^2) \\ &= (x^4 + y^4)(x^2 + y^2)(x + y)(x - y) \end{aligned}$$

12.  $x^6 - 7x^3 - 8$

$$\begin{aligned} &= (x^3 - 8)(x^3 + 1) \\ &= (x - 2)(x^2 + 2x + 4)(x^3 + 1) \\ &= (x - 2)(x^2 + 2x + 4)(x + 1)(x^2 - x + 1) \end{aligned}$$

13.  $64 - x^6$

$$\begin{aligned} &= (8 + x^3)(8 - x^3) \\ &= (2 + x)(4 - 2x + x^2)(2 - x)(4 + 2x + x^2) \end{aligned}$$

14.  $a^5 - a^3b^2 - a^2b^3 + b^5$

$$\begin{aligned} &= (a^5 - a^3b^2) - (a^2b^3 - b^5) \\ &= a^3(a^2 - b^2) - b^3(a^2 - b^2) \\ &= (a^2 - b^2)(a^3 - b^3) \\ &= (a + b)(a - b)(a - b)(a^2 + ab + b^2) \end{aligned}$$

15.  $8x^4 + 6x^2 - 2$

$$\begin{aligned} &= 2(4x^4 + 3x^2 - 1) \\ &= 2[(4x^2)^2 + 3(4x^2) - 4] \\ &= \frac{2(4x^2 + 4)(4x^2 - 1)}{4} \end{aligned}$$

$$= 2(x^2 + 1)(4x^2 - 1) = 2(x^2 + 1)(2x + 1)(2x - 1)$$

16.  $a^4 - 25a^2 + 144$

$$\begin{array}{l|l} 144 & 4 \\ 36 & 4 \quad 4^2 = 16 \\ 9 & 3 \quad 3^2 = 9 \\ 3 & 3 \Rightarrow 16 + 9 = 25 \\ 1 & \end{array}$$

$$\begin{aligned} &= (a^2 - 16)(a^2 - 9) \\ &= (a + 4)(a - 4)(a + 3)(a - 3) \end{aligned}$$

17.  $a^2x^3 - a^2y^3 + 2ax^3 - 2ay^3$

$$\begin{aligned} &= (a^2x^3 - a^2y^3) + (2ax^3 - 2ay^3) \\ &= a^2(x^3 - y^3) + 2a(x^3 - y^3) \\ &= (a^2 + 2a)(x^3 - y^3) \\ &= a(a + 2)(x - y)(x^2 + xy + y^2) \end{aligned}$$

18.  $a^4 + 2a^3 - a^2 - 2a$

$$\begin{aligned} &= (a^4 + 2a^3) - (a^2 + 2a) \\ &= a^3(a + 2) - a(a + 2) \\ &= (a^3 - a)(a + 2) \\ &= a(a^2 - 1)(a + 2) \\ &= a(a + 1)(a - 1)(a + 2) \end{aligned}$$

19.  $1 - 2a^3 + a^6$

$$\begin{aligned} &= (a^3 - 1)^2 \\ &= [(a - 1)(a^2 + a + 1)]^2 \\ &= (a - 1)^2(a^2 + a + 1)^2 \end{aligned}$$

20.  $m^6 - 729$

$$\begin{aligned} &= (m^2 - 9)(m^4 + 9m^2 + 81) \\ &= (m + 3)(m - 3)(m^4 + 9m^2 + 81 + 9m^2 - 9m^2) \\ &= (m + 3)(m - 3)[(m^4 + 18m^2 + 81) - 9m^2] \\ &= (m + 3)(m - 3)[(m^2 + 9)^2 - 9m^2] \\ &= (m + 3)(m - 3)(m^2 + 3m + 9)(m^2 - 3m + 9) \end{aligned}$$

21.  $x^5 - x$

$$\begin{aligned} &= x(x^4 - 1) \\ &= x(x^2 + 1)(x^2 - 1) \\ &= x(x^2 + 1)(x + 1)(x - 1) \end{aligned}$$



$$\begin{aligned}
22. \quad & x^5 - x^3y^2 + x^2y^3 - y^5 \\
& = (x^5 - x^3y^2) + (x^2y^3 - y^5) \\
& = x^3(x^2 - y^2) + y^3(x^2 - y^2) \\
& = (x^3 + y^3)(x^2 - y^2) \\
& = (x + y)(x^2 - xy + y^2)(x + y)(x - y) \\
23. \quad & a^4b - a^3b^2 - a^2b^3 + ab^4 \\
& = (a^4b - a^3b^2) - (a^2b^3 - ab^4) \\
& = a^3b(a - b) - ab^3(a - b) \\
& = (a^3b - ab^3)(a - b) \\
& = ab(a^2 - b^2)(a - b) \\
& = ab(a + b)(a - b)(a - b) \\
24. \quad & 5a^4 - 3 \cdot 125 \\
& = 5(a^4 - 625) \\
& = 5(a^2 + 25)(a^2 - 25) \\
& = 5(a^2 + 25)(a + 5)(a - 5) \\
25. \quad & (a^2 + 2a)^2 - 2(a^2 + 2a) - 3 \\
& = (a^2 + 2a)^2 - 2(a^2 + 2a) - 3 + 4 - 4 \\
& = \left[ (a^2 + 2a)^2 - 2(a^2 + 2a) + 1 \right] - 4 \\
& = (a^2 + 2a - 1)^2 - 4 \\
& = (a^2 + 2a - 1 + 2)(a^2 + 2a - 1 - 2) \\
& = (a^2 + 2a + 1)(a^2 + 2a - 3) \\
& = (a + 1)^2(a^2 + 2a - 3 + 4 - 4) \\
& = (a + 1)^2[(a^2 + 2a + 1) - 4] \\
& = (a + 1)^2[(a + 1)^2 - 4] \\
& = (a + 1)^2(a + 1 + 2)(a + 1 - 2) \\
& = (a + 1)^2(a + 3)(a - 1) \\
26. \quad & a^2x^3 + 2ax^3 - 8a^2 - 16a \\
& = (a^2x^3 + 2ax^3) - (8a^2 + 16a) \\
& = ax^3(a + 2) - 8a(a + 2) \\
& = (ax^3 - 8a)(a + 2) \\
& = a(x^3 - 8)(a + 2) \\
& = a(x - 2)(x^2 + 2x + 4)(a + 2) \\
27. \quad & 1 - a^6b^6 \\
& = (1 - a^3b^3)(1 + a^3b^3) \\
& = (1 - ab)(1 + ab + a^2b^2)(1 + a^3b^3) \\
& = (1 - ab)(1 + ab + a^2b^2)(1 + ab)(1 - ab + a^2b^2) \\
28. \quad & 5ax^3 + 10ax^2 - 5ax - 10a \\
& = (5ax^3 + 10ax^2) - (5ax + 10a) \\
& = 5ax^2(x + 2) - 5a(x + 2) \\
& = (5ax^2 - 5a)(x + 2) \\
& = 5a(x^2 - 1)(x + 2) \\
& = 5a(x + 1)(x - 1)(x + 2) \\
29. \quad & a^2x^2 + b^2y^2 - b^2x^2 - a^2y^2 \\
& = (a^2x^2 - b^2x^2) + (b^2y^2 - a^2y^2) \\
& = x^2(a^2 - b^2) + y^2(b^2 - a^2) \\
& = x^2(a^2 - b^2) - y^2(a^2 - b^2) \\
& = (a^2 - b^2)(x^2 - y^2) \\
& = (a + b)(a - b)(x + y)(x - y) \\
30. \quad & x^8 + x^4 - 2 \\
& = (x^4 + 2)(x^4 - 1) \\
& = (x^4 + 2)(x^2 + 1)(x^2 - 1) \\
& = (x^4 + 2)(x^2 + 1)(x + 1)(x - 1) \\
31. \quad & a^4 + a^3 - 9a^2 - 9a \\
& = (a^4 + a^3) - (9a^2 + 9a) \\
& = a^3(a + 1) - 9a(a + 1) \\
& = (a^3 - 9a)(a + 1) \\
& = a(a^2 - 9)(a + 1) \\
& = a(a + 3)(a - 3)(a + 1) \\
32. \quad & a^2x^2 + a^2x - 6a^2 - x^2 - x + 6 \\
& = (a^2x^2 + a^2x - 6a^2) - (x^2 + x - 6) \\
& = a^2(x^2 + x - 6) - (x^2 + x - 6) \\
& = (a^2 - 1)(x^2 + x - 6) \\
& = (a + 1)(a - 1)(x + 3)(x - 2) \\
33. \quad & 16m^4 - 25m^2 + 9 \\
& = (16m^2)^2 - 25(16m^2) + 144 \\
& \quad \quad \quad \begin{array}{l|l} 144 & 4 \\ 36 & 4 \quad 4^2 = 16 \\ 9 & 3 \quad 3^2 = 9 \\ 3 & 3 \Rightarrow 16 + 9 = 25 \\ 1 & \end{array} \\
& = \frac{(16m^2 - 16)(16m^2 - 9)}{16} \\
& = (m^2 - 1)(16m^2 - 9) \\
& = (m + 1)(m - 1)(4m + 3)(4m - 3) \\
34. \quad & 3abx^2 - 12ab + 3bx^2 - 12b \\
& = (3abx^2 + 3bx^2) - (12ab + 12b) \\
& = 3bx^2(a + 1) - 12b(a + 1) \\
& = (3bx^2 - 12b)(a + 1) \\
& = 3b(x^2 - 4)(a + 1) \\
& = 3b(x + 2)(x - 2)(a + 1) \\
35. \quad & 3a^3m + 9am - 30m + 3a^2 + 9a - 30 \\
& = (3a^3m + 9am - 30m) + (3a^2 + 9a - 30) \\
& = 3m(a^2 + 3a - 10) + 3(a^2 + 3a - 10) \\
& = (3m + 3)(a^2 + 3a - 10) \\
& = 3(m + 1)(a + 5)(a - 2) \\
36. \quad & a^3x^2 - 5a^3x + 6a^3 + x^2 - 5x + 6 \\
& = (a^3x^2 - 5a^3x + 6a^3) + (x^2 - 5x + 6) \\
& = a^3(x^2 - 5x + 6) + (x^2 - 5x + 6) \\
& = (a^3 + 1)(x^2 - 5x + 6) \\
& = (a + 1)(a^2 - a + 1)(x - 3)(x - 2) \\
37. \quad & x^2(x^2 - y^2) - (2x - 1)(x^2 - y^2) \\
& = (x^2 - y^2)[x^2 - (2x - 1)] \\
& = (x + y)(x - y)(x^2 - 2x + 1) \\
& = (x + y)(x - y)(x - 1)^2 \\
38. \quad & a(x^3 + 1) + 3ax(x + 1) \\
& = a(x + 1)(x^2 - x + 1) + 3ax(x + 1) \\
& = (x + 1)[a(x^2 - x + 1) + 3ax] \\
& = (x + 1)(ax^2 - ax + a + 3ax) \\
& = (x + 1)(ax^2 + 2ax + a) \\
& = a(x + 1)(x^2 + 2x + 1) \\
& = a(x + 1)(x + 1)^2 = a(x + 1)^3
\end{aligned}$$

## EJERCICIO 109

1.  $x^9 - xy^8$   
 $= x(x^8 - y^8)$   
 $= x(x^4 - y^4)(x^4 + y^4)$   
 $= x(x^2 + y^2)(x^2 - y^2)(x^4 + y^4)$   
 $= x(x^2 + y^2)(x + y)(x - y)(x^4 + y^4)$
2.  $x^5 - 40x^3 + 144x$   
 $= x(x^4 - 40x^2 + 144)$   
 $= x(x^2 - 36)(x^2 - 4)$   
 $= x(x - 6)(x + 6)(x + 2)(x - 2)$
3.  $a^6 + a^3b^3 - a^4 - ab^3$   
 $= (a^6 + a^3b^3) - (a^4 + ab^3)$   
 $= a^3(a^3 + b^3) - a(a^3 + b^3)$   
 $= (a^3 - a)(a^3 + b^3)$   
 $= a(a^2 - 1)(a + b)(a^2 - ab + b^2)$   
 $= a(a + 1)(a - 1)(a + b)(a^2 - ab + b^2)$
4.  $4x^4 - 8x^2 + 4$   
 $= 4(x^4 - 2x^2 + 1)$   
 $= 4(x^2 - 1)(x^2 - 1)$   
 $= 4(x + 1)^2(x - 1)^2$
5.  $a^7 - ab^6$   
 $= a(a^6 - b^6)$   
 $= a(a^3 + b^3)(a^3 - b^3)$   
 $= a(a + b)(a^2 - ab + b^2)(a - b)(a^2 + ab + b^2)$
6.  $2a^4 - 2a^3 - 4a^2 - 2a^2b^2 + 2ab^2 + 4b^2$   
 $= (2a^4 - 2a^3 - 4a^2) - (2a^2b^2 - 2ab^2 - 4b^2)$   
 $= 2a^2(a^2 - a - 2) - 2b^2(a^2 - a - 2)$   
 $= 2(a^2 - a - 2)(a^2 - b^2)$   
 $= 2(a - 2)(a + 1)(a + b)(a - b)$
7.  $x^6 + 5x^5 - 81x^2 - 405x$   
 $= (x^6 + 5x^5) - (81x^2 + 405x)$   
 $= x^5(x + 5) - 81x(x + 5)$   
 $= (x^5 - 81x)(x + 5)$   
 $= x(x^4 - 81)(x + 5)$   
 $= x(x^2 - 9)(x^2 + 9)(x + 5)$   
 $= x(x + 3)(x - 3)(x^2 + 9)(x + 5)$
8.  $3 - 3a^6$   
 $= 3(1 - a^6)$   
 $= 3(1 - a^3)(1 + a^3)$   
 $= 3(1 - a)(1 + a + a^2)(1 + a)(1 - a + a^2)$
9.  $4ax^2(a^2 - 2ax + x^2) - a^3 + 2a^2x - ax^2$   
 $= 4ax^2(a - x)^2 - a(a^2 - 2ax + x^2)$   
 $= 4ax^2(a - x)^2 - a(a - x)^2$   
 $= (4ax^2 - a)(a - x)^2$   
 $= a(4x^2 - 1)(a - x)^2$   
 $= a(2x + 1)(2x - 1)(a - x)^2$
10.  $x^7 + x^4 - 81x^3 - 81$   
 $= (x^7 + x^4) - (81x^3 + 81)$   
 $= x^4(x^3 + 1) - 81(x^3 + 1)$   
 $= (x^4 - 81)(x^3 + 1)$   
 $= (x^2 + 9)(x^2 - 9)(x + 1)(x^2 - x + 1)$   
 $= (x^2 + 9)(x + 3)(x - 3)(x + 1)(x^2 - x + 1)$
11.  $x^{17} - x$   
 $= x(x^{16} - 1)$   
 $= x(x^8 + 1)(x^8 - 1)$   
 $= x(x^8 + 1)(x^4 + 1)(x^4 - 1)$   
 $= x(x^8 + 1)(x^4 + 1)(x^2 + 1)(x^2 - 1)$   
 $= x(x^8 + 1)(x^4 + 1)(x^2 + 1)(x + 1)(x - 1)$
12.  $3x^6 - 75x^4 - 48x^2 + 1.200$   
 $= (3x^6 - 75x^4) - (48x^2 - 1.200)$   
 $= 3x^4(x^2 - 25) - 48(x^2 - 25)$   
 $= (3x^4 - 48)(x^2 - 25)$   
 $= 3(x^4 - 16)(x + 5)(x - 5)$   
 $= 3(x^2 + 4)(x^2 - 4)(x + 5)(x - 5)$   
 $= 3(x^2 + 4)(x + 2)(x - 2)(x + 5)(x - 5)$
13.  $a^6x^2 - x^2 + a^6x - x$   
 $= (a^6x^2 - x^2) + (a^6x - x)$   
 $= x^2(a^6 - 1) + x(a^6 - 1)$   
 $= (x^2 + x)(a^6 - 1)$   
 $= x(x + 1)(a^3 - 1)(a^3 + 1)$   
 $= x(x + 1)(a - 1)(a^2 + a + 1)(a + 1)(a^2 - a + 1)$
14.  $(a^2 - ax)(x^4 - 82x^2 + 81)$   
 $= a(a - x)(x^2 - 81)(x^2 - 1)$   
 $= a(a - x)(x + 9)(x - 9)(x + 1)(x - 1)$

## EJERCICIO 110

1.  $x^3 + x^2 - x - 1$   

$$\begin{array}{cccc|c} 1 & 1 & -1 & -1 & +1 \\ & 1 & 2 & 1 & \\ \hline 1 & 2 & 1 & 0 & \end{array}$$
  
 $= (x^2 + 2x + 1)(x - 1)$   
 $= (x + 1)^2(x - 1)$
2.  $x^3 - 4x^2 + x + 6$   

$$\begin{array}{cccc|c} 1 & -4 & 1 & 6 & -1 \\ & -1 & 5 & -6 & \\ \hline 1 & -5 & 6 & 0 & \end{array}$$
  
 $= (x^2 - 5x + 6)(x + 1)$   
 $= (x - 3)(x - 2)(x + 1)$
3.  $a^3 - 3a^2 - 4a + 12$   

$$\begin{array}{cccc|c} 1 & -3 & -4 & 12 & +2 \\ & 2 & -2 & -12 & \\ \hline 1 & -1 & -6 & 0 & \end{array}$$
  
 $= (a^2 - a - 6)(a - 2)$   
 $= (a - 3)(a + 2)(a - 2)$
4.  $m^3 - 12m + 16$   

$$\begin{array}{cccc|c} 1 & 0 & -12 & 16 & +2 \\ & 2 & 4 & -16 & \\ \hline 1 & 2 & -8 & 0 & \end{array}$$
  
 $= (m^2 + 2m - 8)(m - 2)$   
 $= (m + 4)(m - 2)(m - 2)$   
 $= (m + 4)(m - 2)^2$

$$\begin{array}{r|l}
 2x^3 - x^2 - 18x + 9 & \\
 2 & -1 & -18 & 9 & +3 \\
 \hline
 & 6 & 15 & -9 & \\
 \hline
 2 & 5 & -3 & 0 & \\
 \hline
 \end{array}$$

$$= (2x^2 + 5x - 3)(x - 3)$$

$$\begin{array}{r|l}
 2x^2 + 5x - 3 & \\
 2 & 5 & -3 & -3 \\
 \hline
 & -6 & 3 & \\
 \hline
 2 & -1 & 0 & \\
 \hline
 \end{array}$$

$$= (2x - 1)(x - 3)(x + 3)$$

$$\begin{array}{r|l}
 a^3 + a^2 - 13a - 28 & \\
 1 & 1 & -13 & -28 & +4 \\
 \hline
 & 4 & 20 & 28 & \\
 \hline
 1 & 5 & 7 & 0 & \\
 \hline
 \end{array}$$

$$= (a^2 + 5a + 7)(a - 4)$$

$$\begin{array}{r|l}
 x^3 + 2x^2 + x + 2 & \\
 1 & 2 & 1 & 2 & -2 \\
 \hline
 & -2 & 0 & 2 & \\
 \hline
 1 & 0 & 1 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 + 1)(x + 2)$$

$$\begin{array}{r|l}
 n^3 - 7n + 6 & \\
 1 & 0 & -7 & 6 & +1 \\
 \hline
 & 1 & 1 & -6 & \\
 \hline
 1 & 1 & -6 & 0 & \\
 \hline
 \end{array}$$

$$= (n^2 + n - 6)(n - 1)$$

$$= (n + 3)(n - 2)(n - 1)$$

$$\begin{array}{r|l}
 x^3 - 6x^2 + 32 & \\
 1 & -6 & 0 & 32 & -2 \\
 \hline
 & -2 & 16 & -32 & \\
 \hline
 1 & -8 & 16 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 - 8x + 16)(x + 2)$$

$$= (x - 4)^2(x + 2)$$

$$\begin{array}{r|l}
 6x^3 + 23x^2 + 9x - 18 & \\
 6 & 23 & 9 & -18 & -3 \\
 \hline
 & -18 & -15 & 18 & \\
 \hline
 6 & 5 & -6 & 0 & \\
 \hline
 \end{array}$$

$$= (6x^2 + 5x - 6)(x + 3)$$

$$= [(6x)^2 + 5(6x) - 36](x + 3)$$

$$= \frac{(6x + 9)(6x - 4)(x + 3)}{3 \cdot 2}$$

$$= (2x + 3)(3x - 2)(x + 3)$$

$$\begin{array}{r|l}
 x^4 - 4x^3 + 3x^2 + 4x - 4 & \\
 1 & -4 & 3 & 4 & -4 & +1 \\
 \hline
 & 1 & -3 & 0 & 4 & \\
 \hline
 1 & -3 & 0 & 4 & 0 & \\
 \hline
 \end{array}$$

$$= (x^3 - 3x^2 + 4)(x - 1)$$

$$\begin{array}{r|l}
 x^3 - 3x^2 + 4 & \\
 1 & -3 & 0 & 4 & -1 \\
 \hline
 & -1 & 4 & -4 & \\
 \hline
 1 & -4 & 4 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 - 4x + 4)(x - 1)(x + 1)$$

$$= (x - 2)^2(x - 1)(x + 1)$$

$$\begin{array}{r|l}
 x^4 - 2x^3 - 13x^2 + 14x + 24 & \\
 1 & -2 & -13 & 14 & 24 & +2 \\
 \hline
 & 2 & 0 & -26 & -24 & \\
 \hline
 1 & 0 & -13 & -12 & 0 & \\
 \hline
 \end{array}$$

$$= (x^3 - 13x - 12)(x - 2)$$

$$\begin{array}{r|l}
 x^3 - 13x - 12 & \\
 1 & 0 & -13 & -12 & -1 \\
 \hline
 & -1 & 1 & 12 & \\
 \hline
 1 & -1 & -12 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 - x - 12)(x - 2)(x + 1)$$

$$= (x - 4)(x + 3)(x - 2)(x + 1)$$

$$\begin{array}{r|l}
 a^4 - 15a^2 - 10a + 24 & \\
 1 & 0 & -15 & -10 & 24 & +1 \\
 \hline
 & 1 & 1 & -14 & -24 & \\
 \hline
 1 & 1 & -14 & -24 & 0 & \\
 \hline
 \end{array}$$

$$= (a^3 + a^2 - 14a - 24)(a - 1)$$

$$\begin{array}{r|l}
 a^3 + a^2 - 14a - 24 & \\
 1 & 1 & -14 & -24 & -2 \\
 \hline
 & -2 & 2 & 24 & \\
 \hline
 1 & -1 & -12 & 0 & \\
 \hline
 \end{array}$$

$$= (a^2 - a - 12)(a - 1)(a + 2)$$

$$= (a - 4)(a + 3)(a - 1)(a + 2)$$

$$\begin{array}{r|l}
 n^4 - 27n^2 - 14n + 120 & \\
 1 & 0 & -27 & -14 & 120 & +2 \\
 \hline
 & 2 & 4 & -46 & -120 & \\
 \hline
 1 & 2 & -23 & -60 & 0 & \\
 \hline
 \end{array}$$

$$= (n^3 + 2n^2 - 23n - 60)(n - 2)$$

$$\begin{array}{r|l}
 n^3 + 2n^2 - 23n - 60 & \\
 1 & 2 & -23 & -60 & -3 \\
 \hline
 & -3 & 3 & 60 & \\
 \hline
 1 & -1 & -20 & 0 & \\
 \hline
 \end{array}$$

$$= (n^2 - n - 20)(n - 2)(n + 3)$$

$$= (n - 5)(n + 4)(n - 2)(n + 3)$$

$$\begin{array}{r|l}
 x^4 + 6x^3 + 3x + 140 & \\
 1 & 6 & 0 & 3 & 140 & -4 \\
 \hline
 & -4 & -8 & 32 & -140 & \\
 \hline
 1 & 2 & -8 & 35 & 0 & \\
 \hline
 \end{array}$$

$$= (x^3 + 2x^2 - 8x + 35)(x + 4)$$

$$\begin{array}{r|l}
 x^3 + 2x^2 - 8x + 35 & \\
 1 & 2 & -8 & 35 & -5 \\
 \hline
 & -5 & 15 & -35 & \\
 \hline
 1 & -3 & 7 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 - 3x + 7)(x + 4)(x + 5)$$

$$\begin{array}{r|l}
 8a^4 - 18a^3 - 75a^2 + 46a + 120 & \\
 8 & -18 & -75 & 46 & 120 & -2 \\
 \hline
 & -16 & 68 & 14 & -120 & \\
 \hline
 8 & -34 & -7 & 60 & 0 & \\
 \hline
 \end{array}$$

$$= (8a^3 - 34a^2 - 7a + 60)(a + 2)$$

$$\begin{array}{r|l}
 8a^3 - 34a^2 - 7a + 60 & \\
 8 & -34 & -7 & 60 & +4 \\
 \hline
 & 32 & -8 & -60 & \\
 \hline
 8 & -2 & -15 & 0 & \\
 \hline
 \end{array}$$

$$= (8a^2 - 2a - 15)(a + 2)(a - 4)$$

$$= [(8a)^2 - 2(8a) - 120](a + 2)(a - 4)$$

$$\begin{array}{r|l}
 120 & 4 \\
 30 & 3 \cdot 4 = 12 \\
 10 & 2 \cdot 5 = 10 \\
 5 & 5 \Rightarrow 12 - 10 = 2 \\
 1 & \\
 \hline
 \end{array}$$

$$= \frac{(8a - 12)(8a + 10)(a + 2)(a - 4)}{4 \cdot 2}$$

$$= (2a - 3)(4a + 5)(a + 2)(a - 4)$$

$$\begin{array}{r|l}
 x^4 - 22x^2 - 75 & \\
 1 & 0 & -22 & 0 & -75 & +5 \\
 \hline
 & 5 & 25 & 15 & 75 & \\
 \hline
 1 & 5 & 3 & 15 & 0 & \\
 \hline
 \end{array}$$

$$= (x^3 + 5x^2 + 3x + 15)(x - 5)$$

$$\begin{array}{r|l}
 x^3 + 5x^2 + 3x + 15 & \\
 1 & 5 & 3 & 15 & -5 \\
 \hline
 & -5 & 0 & -15 & \\
 \hline
 1 & 0 & 3 & 0 & \\
 \hline
 \end{array}$$

$$= (x^2 + 3)(x - 5)(x + 5)$$

$$\begin{aligned}
18. & 15x^4 + 94x^3 - 5x^2 - 164x + 60 \\
& \begin{array}{r|l}
15 & 94 & -5 & -164 & 60 & +1 \\
& 15 & 109 & 104 & -60 & \\
\hline
15 & 109 & 104 & -60 & 0 & \\
\hline
= & (15x^3 + 109x^2 + 104x - 60)(x-1) \\
& \begin{array}{r|l}
15 & 109 & 104 & -60 & +6 \\
& -90 & -114 & 60 & \\
\hline
15 & 19 & -10 & 0 & \\
\hline
= & (15x^2 + 19x - 10)(x-1)(x+6) \\
& = [(15x)^2 + 19(15x) - 150](x-1)(x+6) \\
& = \frac{(15x+25)(15x-6)(x-1)(x+6)}{5 \cdot 3} \\
& = (3x+5)(5x-2)(x-1)(x+6)
\end{array}
\end{array}
\end{aligned}$$

$$\begin{aligned}
19. & x^5 - 21x^3 + 16x^2 + 108x - 144 \\
& \begin{array}{r|l}
1 & 0 & -21 & 16 & 108 & -144 \\
& 2 & 4 & -34 & -36 & 144 \\
\hline
1 & 2 & -17 & -18 & 72 & 0 \\
\hline
= & (x^4 + 2x^3 - 17x^2 - 18x + 72)(x-2) \\
& \begin{array}{r|l}
1 & 2 & -17 & -18 & 72 \\
& -3 & 3 & 42 & -72 \\
\hline
1 & -1 & -14 & 24 & 0 \\
\hline
= & (x^3 - x^2 - 14x + 24)(x-2)(x+3) \\
& \begin{array}{r|l}
1 & -1 & -14 & 24 \\
& 2 & 2 & -24 \\
\hline
1 & 1 & -12 & 0 \\
\hline
= & (x^2 + x - 12)(x-2)(x+3)(x-2) \\
& = (x+4)(x-3)(x-2)(x+3)(x-2) \\
& = (x+4)(x-3)(x+3)(x-2)^2
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
20. & a^5 - 23a^3 - 6a^2 + 112a + 96 \\
& \begin{array}{r|l}
1 & 0 & -23 & -6 & 112 & 96 \\
& -1 & 1 & 22 & -16 & -96 \\
\hline
1 & -1 & -22 & 16 & 96 & 0 \\
\hline
= & (a^4 - a^3 - 22a^2 + 16a + 96)(a+1) \\
& \begin{array}{r|l}
1 & -1 & -22 & 16 & 96 \\
& -2 & 6 & 32 & -96 \\
\hline
1 & -3 & -16 & 48 & 0 \\
\hline
= & (a^3 - 3a^2 - 16a + 48)(a+1)(a+2) \\
& \begin{array}{r|l}
1 & -3 & -16 & 48 \\
& 3 & 0 & -48 \\
\hline
1 & 0 & -16 & 0 \\
\hline
= & (a^2 - 16)(a+1)(a+2)(a-3) \\
& = (a+4)(a-4)(a+1)(a+2)(a-3)
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
21. & 4x^5 + 3x^4 - 108x^3 - 25x^2 + 522x + 360 \\
& \begin{array}{r|l}
4 & 3 & -108 & -25 & 522 & 360 \\
& -8 & 10 & 196 & -342 & -360 \\
\hline
4 & -5 & -98 & 171 & 180 & 0 \\
\hline
= & (4x^4 - 5x^3 - 98x^2 + 171x + 180)(x+2) \\
& \begin{array}{r|l}
4 & -5 & -98 & 171 & 180 \\
& 12 & 21 & -231 & -180 \\
\hline
4 & 7 & -77 & -60 & 0 \\
\hline
= & (4x^3 + 7x^2 - 77x - 60)(x+2)(x-3) \\
& \begin{array}{r|l}
4 & 7 & -77 & -60 \\
& 16 & 92 & 60 \\
\hline
4 & 23 & 15 & 0 \\
\hline
= & (4x^2 + 23x + 15)(x+2)(x-3)(x-4) \\
& = [(4x)^2 + 23(4x) + 60](x+2)(x-3)(x-4) \\
& = [(4x+20)(4x+3)(x+2)(x-3)(x-4)] \div 4 \\
& = (x+5)(4x+3)(x+2)(x-3)(x-4)
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
22. & n^5 - 30n^3 - 25n^2 - 36n - 180 \\
& \begin{array}{r|l}
1 & 0 & -30 & -25 & -36 & -180 \\
& -2 & 4 & 52 & -54 & 180 \\
\hline
1 & -2 & -26 & 27 & -90 & 0 \\
\hline
= & (n^4 - 2n^3 - 26n^2 + 27n - 90)(n+2) \\
& \begin{array}{r|l}
1 & -2 & -26 & 27 & -90 \\
& -5 & 35 & -45 & 90 \\
\hline
1 & -7 & 9 & -18 & 0 \\
\hline
= & (n^3 - 7n^2 + 9n - 18)(n+2)(n+5) \\
& \begin{array}{r|l}
1 & -7 & 9 & -18 \\
& 6 & -6 & 18 \\
\hline
1 & -1 & 3 & 0 \\
\hline
= & (n^2 - n + 3)(n+2)(n+5)(n-6)
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
23. & 6x^5 - 13x^4 - 81x^3 + 112x^2 + 180x - 144 \\
& \begin{array}{r|l}
6 & -13 & -81 & 112 & 180 & -144 \\
& 12 & -2 & -166 & -108 & 144 \\
\hline
6 & -1 & -83 & -54 & 72 & 0 \\
\hline
= & (6x^4 - x^3 - 83x^2 - 54x + 72)(x-2) \\
& \begin{array}{r|l}
6 & -1 & -83 & -54 & 72 \\
& -18 & 57 & 78 & -72 \\
\hline
6 & -19 & -26 & 24 & 0 \\
\hline
= & (6x^3 - 19x^2 - 26x + 24)(x-2)(x+3) \\
& \begin{array}{r|l}
6 & -19 & -26 & 24 \\
& 24 & 20 & -24 \\
\hline
6 & 5 & -6 & 0 \\
\hline
= & (6x^2 + 5x - 6)(x-2)(x+3)(x-4) \\
& = [(6x)^2 + 5(6x) - 36](x-2)(x+3)(x-4) \\
& = \frac{(6x+9)(6x-4)(x-2)(x+3)(x-4)}{3 \cdot 2} \\
& = (2x+3)(3x-2)(x-2)(x+3)(x-4)
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
24. & x^5 - 25x^3 + x^2 - 25 \\
& \begin{array}{r|l}
1 & 0 & -25 & 1 & 0 & -25 \\
& -1 & 1 & 24 & -25 & 25 \\
\hline
1 & -1 & -24 & 25 & -25 & 0 \\
\hline
= & (x^4 - x^3 - 24x^2 + 25x - 25)(x+1) \\
& \begin{array}{r|l}
1 & -1 & -24 & 25 & -25 \\
& 5 & 20 & -20 & 25 \\
\hline
1 & 4 & -4 & 5 & 0 \\
\hline
= & (x^3 + 4x^2 - 4x + 5)(x+1)(x-5) \\
& \begin{array}{r|l}
1 & 4 & -4 & 5 \\
& -5 & 5 & -5 \\
\hline
1 & -1 & 1 & 0 \\
\hline
= & (x^2 - x + 1)(x+1)(x-5)(x+5)
\end{array}
\end{array}
\end{array}$$

$$\begin{aligned}
25. & 2a^5 - 8a^4 + 3a - 12 \\
& \begin{array}{r|l}
2 & -8 & 0 & 0 & 3 & -12 \\
& 8 & 0 & 0 & 0 & 12 \\
\hline
2 & 0 & 0 & 0 & 3 & 0 \\
\hline
= & (2a^4 + 3)(a-4)
\end{array}$$

$$\begin{aligned}
26. & x^5 + 2x^4 - 15x^3 - 3x^2 - 6x + 45 \\
& \begin{array}{r|l}
1 & 2 & -15 & -3 & -6 & 45 \\
& 3 & 15 & 0 & -9 & -45 \\
\hline
1 & 5 & 0 & -3 & -15 & 0 \\
\hline
= & (x^4 + 5x^3 - 3x - 15)(x-3) \\
& \begin{array}{r|l}
1 & 5 & 0 & -3 & -15 \\
& -5 & 0 & 0 & 15 \\
\hline
1 & 0 & 0 & -3 & 0 \\
\hline
= & (x^3 - 3)(x-3)(x+5)
\end{array}
\end{array}$$

$$\begin{aligned}
27. & x^6 + 6x^5 + 4x^4 - 42x^3 - 113x^2 - 108x - 36 \\
& \begin{array}{r|l}
1 & 6 & 4 & -42 & -113 & -108 & -36 \\
& -1 & -5 & 1 & 41 & 72 & 36 \\
\hline
1 & 5 & -1 & -41 & -72 & -36 & 0 \\
\hline
= & (x^5 + 5x^4 - x^3 - 41x^2 - 72x - 36)(x+1) \\
& \begin{array}{r|l}
1 & 5 & -1 & -41 & -72 & -36 \\
& -1 & -4 & 5 & 36 & 36 \\
\hline
1 & 4 & -5 & -36 & -36 & 0 \\
\hline
= & (x^4 + 4x^3 - 5x^2 - 36x - 36)(x+1)(x+1) \\
& \begin{array}{r|l}
1 & 4 & -5 & -36 & -36 \\
& -2 & -4 & 18 & 36 \\
\hline
1 & 2 & -9 & -18 & 0 \\
\hline
= & (x^3 + 2x^2 - 9x - 18)(x+1)^2(x+2) \\
& \begin{array}{r|l}
1 & 2 & -9 & -18 \\
& -2 & 0 & 18 \\
\hline
1 & 0 & -9 & 0 \\
\hline
= & (x^2 - 9)(x+1)^2(x+2)^2 \\
& = (x+3)(x-3)(x+1)^2(x+2)^2
\end{array}
\end{array}
\end{array}$$

28.  $a^6 - 32a^4 + 18a^3 + 247a^2 - 162a - 360$

$$\begin{array}{r|l} 1 & 0 & -32 & 18 & 247 & -162 & -360 & -1 \\ & -1 & 1 & 31 & -49 & -198 & 360 & \\ \hline 1 & -1 & -31 & 49 & 198 & -360 & 0 & \\ = & (a^5 - a^4 - 31a^3 + 49a^2 + 198a - 360)(a+1) \\ 1 & -1 & -31 & 49 & 198 & -360 & & +2 \\ & 2 & 2 & -58 & -18 & 360 & & \\ \hline 1 & 1 & -29 & -9 & 180 & 0 & & \\ = & (a^4 + a^3 - 29a^2 - 9a + 180)(a+1)(a-2) \\ 1 & 1 & -29 & -9 & 180 & & & +3 \\ & 3 & 12 & -51 & -180 & & & \\ \hline 1 & 4 & -17 & -60 & 0 & & & \\ = & (a^3 + 4a^2 - 17a - 60)(a+1)(a-2)(a-3) \\ 1 & 4 & -17 & -60 & & & & -3 \\ & -3 & -3 & 60 & & & & \\ \hline 1 & 1 & -20 & 0 & & & & \\ = & (a^2 + a - 20)(a+1)(a-2)(a-3)(a+3) \\ = & (a+5)(a-4)(a+1)(a-2)(a-3)(a+3) \end{array}$$

30.  $2x^6 - 10x^5 - 34x^4 + 146x^3 + 224x^2 - 424x - 480$

$$\begin{array}{r|l} 2 & -10 & -34 & 146 & 224 & -424 & -480 & -1 \\ & -2 & 12 & 22 & -168 & -56 & 480 & \\ \hline 2 & -12 & -22 & 168 & 56 & -480 & 0 & \\ = & (2x^5 - 12x^4 - 22x^3 + 168x^2 + 56x - 480)(x+1) \\ 2 & -12 & -22 & 168 & 56 & -480 & & -2 \\ & -4 & 32 & -20 & -296 & 480 & & \\ \hline 2 & -16 & 10 & 148 & -240 & 0 & & \\ = & (2x^4 - 16x^3 + 10x^2 + 148x - 240)(x+1)(x+2) \\ 2 & -16 & 10 & 148 & -240 & & & +2 \\ & 4 & -24 & -28 & 240 & & & \\ \hline 2 & -12 & -14 & 120 & 0 & & & \\ = & (2x^3 - 12x^2 - 14x + 120)(x+1)(x+2)(x-2) \\ 2 & -12 & -14 & 120 & & & & +4 \\ & 8 & -16 & -120 & & & & \\ \hline 2 & -4 & -30 & 0 & & & & \\ = & (2x^2 - 4x - 30)(x+1)(x+2)(x-2)(x-4) \\ = & [(2x)^2 - 4(2x) - 60](x+1)(x+2)(x-2)(x-4) \\ = & \frac{(2x-10)(2x+6)(x+1)(x+2)(x-2)(x-4)}{2} \\ = & (x-5)(2x+6)(x+1)(x+2)(x-2)(x-4) \\ = & 2(x-5)(x+3)(x+1)(x+2)(x-2)(x-4) \end{array}$$

29.  $x^6 - 41x^4 + 184x^2 - 144$

$$\begin{array}{r|l} 1 & 0 & -41 & 0 & 184 & 0 & -144 & +1 \\ & 1 & 1 & -40 & -40 & 144 & 144 & \\ \hline 1 & 1 & -40 & -40 & 144 & 144 & 0 & \\ = & (x^5 + x^4 - 40x^3 - 40x^2 + 144x + 144)(x-1) \\ 1 & 1 & -40 & -40 & 144 & 144 & & -1 \\ & -1 & 0 & 40 & 0 & -144 & & \\ \hline 1 & 0 & -40 & 0 & 144 & 0 & & \\ = & (x^4 - 40x^2 + 144)(x-1)(x+1) \\ = & (x^2 - 36)(x^2 - 4)(x-1)(x+1) \\ = & (x+6)(x-6)(x+2)(x-2)(x-1)(x+1) \end{array}$$

31.  $a^6 - 8a^5 + 6a^4 + 103a^3 - 344a^2 + 396a - 144$

$$\begin{array}{r|l} 1 & -8 & 6 & 103 & -344 & 396 & -144 & +2 \\ & 2 & -12 & -12 & 182 & -324 & 144 & \\ \hline 1 & -6 & -6 & 91 & -162 & 72 & 0 & \\ = & (a^5 - 6a^4 - 6a^3 + 91a^2 - 162a + 72)(a-2) \\ 1 & -6 & -6 & 91 & -162 & 72 & & +2 \\ & 2 & -8 & -28 & 126 & -72 & & \\ \hline 1 & -4 & -14 & 63 & -36 & 0 & & \\ = & (a^4 - 4a^3 - 14a^2 + 63a - 36)(a-2)(a-2) \\ 1 & -4 & -14 & 63 & -36 & & & +3 \\ & 3 & -3 & -51 & 36 & & & \\ \hline 1 & -1 & -17 & 12 & 0 & & & \\ = & (a^3 - a^2 - 17a + 12)(a-2)^2(a-3) \\ 1 & -1 & -17 & 12 & & & & -4 \\ & -4 & 20 & -12 & & & & \\ \hline 1 & -5 & 3 & 0 & & & & \\ = & (a^2 - 5a + 3)(a-2)^2(a-3)(a+4) \end{array}$$

32.  $x^7 - 20x^5 - 2x^4 + 64x^3 + 40x^2 - 128$

$$\begin{array}{r|l} 1 & 0 & -20 & -2 & 64 & 40 & 0 & -128 & +2 \\ & 2 & 4 & -32 & -68 & -8 & 64 & 128 & \\ \hline 1 & 2 & -16 & -34 & -4 & 32 & 64 & 0 & \\ = & (x^6 + 2x^5 - 16x^4 - 34x^3 - 4x^2 + 32x + 64)(x-2) \\ 1 & 2 & -16 & -34 & -4 & 32 & 64 & & -2 \\ & -2 & 0 & 32 & 4 & 0 & -64 & & \\ \hline 1 & 0 & -16 & -2 & 0 & 32 & 0 & & \\ = & (x^5 - 16x^3 - 2x^2 + 32)(x-2)(x+2) \\ 1 & 0 & -16 & -2 & 0 & 32 & & & +4 \\ & 4 & 16 & 0 & -8 & -32 & & & \\ \hline 1 & 4 & 0 & -2 & -8 & 0 & & & \\ = & (x^4 + 4x^3 - 2x - 8)(x-2)(x+2)(x-4) \\ 1 & 4 & 0 & -2 & -8 & & & & -4 \\ & -4 & 0 & 0 & 8 & & & & \\ \hline 1 & 0 & 0 & -2 & 0 & & & & \\ = & (x^3 - 2)(x-2)(x+2)(x-4)(x+4) \end{array}$$

## EJERCICIO 111

1.  $a^2x, ax^2$  mcd  $ax$

2.  $ab^2c, a^2bc$  mcd  $abc$

3.  $2x^2y, x^2y^3$  mcd  $x^2y$

4.  $6a^2b^3, 15a^3b^4$

$$\begin{array}{c|c|c} 6 & 3 & 15 \\ 2 & 2 & 5 \\ 1 & & 1 \end{array}$$

$3 \cdot 2 = 6 \quad 3 \cdot 5 = 15$

mcd  $3 \Rightarrow 3a^2b^3$

5.  $8am^3n, 20x^2m^2$

$$\begin{array}{c|c|c} 8 & 2 & 20 \\ 4 & 2 & 10 \\ 2 & 2 & 5 \\ 1 & 1 & 1 \end{array}$$

$2^3 = 8 \quad 2^2 \cdot 5 = 20$

mcd  $2^2 = 4$

$\Rightarrow 4m^2$

6.  $18mn^2, 27a^2m^3n^4$

$$\begin{array}{c|c|c} 18 & 3 & 27 \\ 6 & 3 & 9 \\ 2 & 2 & 3 \\ 1 & 1 & 1 \end{array}$$

$3^2 \cdot 2 = 18 \quad 3^3 = 27$

mcd  $3^2 = 9$

$\Rightarrow 9mn^2$

7.  $15a^2b^3c, 24ab^2x, 36b^4x^2$

$$\begin{array}{c|c|c|c} 15 & 5 & 24 & 3 & 36 & 3 \\ 3 & 3 & 8 & 4 & 12 & 4 \\ 1 & & 2 & 2 & 3 & 3 \\ & & 1 & & 1 & \end{array}$$

$5 \cdot 3 = 15 \quad 3 \cdot 4 \cdot 2 = 24 \quad 3^2 \cdot 4 = 36$

mcd  $3 \Rightarrow 3b^2$

8.  $12x^2yz^3, 18xy^2z, 24x^3yz^2$

$$\begin{array}{c|c|c|c} 12 & 3 & 18 & 3 & 24 & 3 \\ 4 & 2 & 6 & 3 & 8 & 4 \\ 2 & 2 & 2 & 2 & 2 & 2 \\ 1 & 1 & 1 & 1 & 1 & \end{array}$$

$3 \cdot 2^2 = 12 \quad 3^2 \cdot 2 = 18 \quad 3 \cdot 4 \cdot 2 = 24$

mcd  $3 \cdot 2 \Rightarrow 6xyz$

9.  $28a^2b^3c^4, 35a^3b^4c^5, 42a^4b^5c^6$

$$\begin{array}{c|c|c|c} 28 & 7 & 35 & 7 & 42 & 7 \\ 4 & 4 & 5 & 5 & 6 & 6 \\ 1 & 1 & 1 & 1 & 1 & \end{array}$$

$7 \cdot 4 = 28 \quad 7 \cdot 5 = 35 \quad 7 \cdot 6 = 42$

mcd  $7 \Rightarrow 7a^2b^3c^4$

10.  $72x^3y^4z^4, 96x^2y^2z^3, 120x^4y^5z^7$

$$\begin{array}{c|c|c|c} 72 & 8 & 96 & 8 & 120 & 8 \\ 9 & 3 & 12 & 3 & 15 & 3 \\ 3 & 3 & 4 & 4 & 5 & 5 \\ 1 & 1 & 1 & 1 & 1 & \end{array}$$

$8 \cdot 3^2 = 72 \quad 8 \cdot 3 \cdot 4 = 96 \quad 8 \cdot 3 \cdot 5 = 120$

mcd  $8 \cdot 3 \Rightarrow 24x^2y^2z^3$

11.  $42am^2n, 56m^3n^2x, 70m^4n^2y$

$$\begin{array}{c|c|c|c} 42 & 14 & 56 & 14 & 70 & 14 \\ 3 & 3 & 4 & 4 & 5 & 5 \\ 1 & 1 & 1 & 1 & 1 & \end{array}$$

$14 \cdot 3 = 42 \quad 14 \cdot 4 = 56 \quad 14 \cdot 5 = 70$

mcd  $14 \Rightarrow 14m^2n$

12.  $75a^4b^3c^2, 150a^5b^7x^2, 225a^3b^6y^2$

$$\begin{array}{c|c|c|c} 75 & 15 & 150 & 15 & 225 & 15 \\ 5 & 5 & 10 & 5 & 15 & 5 \\ 1 & & 2 & 2 & 3 & 3 \\ & & 1 & 1 & 1 & \end{array}$$

$15 \cdot 5 = 75 \quad 15 \cdot 5 \cdot 2 = 150 \quad 15 \cdot 5 \cdot 3 = 225$

mcd  $15 \cdot 5 \Rightarrow 75a^3b^3$

13.  $4a^2b, 8a^3b^2, 2a^2bc, 10ab^3c^2$

$$\begin{array}{c|c|c|c} 4 & 2 & 8 & 2 & 2 & 10 & 2 \\ 2 & 2 & 4 & 4 & 1 & 5 & 5 \\ 1 & 1 & 1 & 1 & 1 & 1 & \end{array}$$

$2^2 = 4 \quad 2 \cdot 4 = 8 \quad 2 = 2 \quad 2 \cdot 5 = 10$

mcd  $2 \Rightarrow 2ab$

14.  $38a^2x^6y^4, 76mx^4y^7, 95x^5y^6$

$$\begin{array}{c|c|c|c} 38 & 19 & 76 & 19 & 95 & 19 \\ 2 & 2 & 4 & 4 & 5 & 5 \\ 1 & 1 & 1 & 1 & 1 & \end{array}$$

$19 \cdot 2 = 38 \quad 19 \cdot 4 = 76 \quad 19 \cdot 5 = 95$

mcd  $19 \Rightarrow 19x^4y^4$

## EJERCICIO 112

1.  $2a^2 + 2ab = 2a(a+b)$

$4a^2 - 4ab = 2^2a(a-b)$

mcd  $2a$

2.  $6x^3y - 6x^2y = 2 \cdot 3x^2y(x-1)$

$9x^3y^2 + 18x^2y^2 = 3^2x^2y^2(x+2)$

mcd  $3x^2y$

3.  $12a^2b^3 = 4 \cdot 3a^2b^3$

$4a^3b^2 - 8a^2b^3 = 4a^2b^2(a-2b)$

mcd  $4a^2b^2$

4.  $ab + b = b(a+1)$

$a^2 + a = a(a+1)$

mcd  $a+1$

5.  $x^2 - x = x(x-1)$

$x^3 - x^2 = x^2(x-1)$

mcd  $x(x-1)$

6.  $30ax^2 - 15x^3 = 5 \cdot 3x^2(2a-x)$

$10axy^2 - 20x^2y^2 = 5 \cdot 2xy^2(a-2x)$

mcd  $5x$

7.  $18a^2x^3y^4 = 6 \cdot 3a^2x^3y^4$

$6a^2x^2y^4 - 18a^2xy^4 = 6a^2xy^4(x-3)$

mcd  $6a^2xy^4$

8.  $5a^2 - 15a = 5a(a-3)$

$a^3 - 3a^2 = a^2(a-3)$

mcd  $a(a-3)$

9.  $3x^3 + 15x^2 = 3x^2(x+5)$

$ax^2 + 5ax = ax(x+5)$

mcd  $x(x+5)$

10.  $a^2 - b^2 = (a+b)(a-b)$

$a^2 - 2ab + b^2 = (a-b)^2$

mcd  $(a-b)$

11.  $m^3 + n^3 = (m+n)(m^2 - mn + n^2)$

$3am + 3an = 3a(m+n)$

mcd  $m+n$

12.  $x^2 - 4 = (x+2)(x-2)$

$x^3 - 8 = (x-2)(x^2 + 2x + 4)$

mcd  $x-2$

13.  $2ax^2 + 4ax = 2ax(x+2)$   
 $x^3 - x^2 - 6x = x(x^2 - x - 6) = x(x-3)(x+2)$   
*mcd*  $x(x+2)$
14.  $9x^2 - 1 = (3x+1)(3x-1)$   
 $9x^2 - 6x + 1 = (3x-1)^2$   
*mcd*  $3x-1$
15.  $4a^2 + 4ab + b^2 = (2a+b)^2$   
 $2a^2 - 2ab + ab - b^2 = (2a^2 - 2ab) + (ab - b^2)$   
 $= 2a(a-b) + b(a-b)$   
 $= (2a+b)(a-b)$   
*mcd*  $2a+b$
16.  $3x^2 + 3x - 60 = 3(x^2 + x - 20)$   
 $= 3(x+5)(x-4)$   
 $6x^2 - 18x - 24 = 6(x^2 - 3x - 4)$   
 $= 3 \cdot 2(x-4)(x+1)$   
*mcd*  $3(x-4)$
17.  $8x^3 + y^3 = (2x+y)(4x^2 - 2xy + y^2)$   
 $4ax^2 - ay^2 = a(4x^2 - y^2)$   
 $= a(2x+y)(2x-y)$   
*mcd*  $2x+y$
18.  $2a^3 - 12a^2b + 18ab^2 = 2a(a^2 - 6ab + 9b^2)$   
 $= 2a(a-3b)^2$   
 $a^3x - 9ab^2x = ax(a^2 - 9b^2)$   
 $= ax(a+3b)(a-3b)$   
*mcd*  $a(a-3b)$
19.  $ac + ad - 2bc - 2bd = (ac + ad) - (2bc + 2bd)$   
 $= a(c+d) - 2b(c+d)$   
 $= (a-2b)(c+d)$   
 $2c^2 + 4cd + 2d^2 = 2(c^2 + 2cd + d^2)$   
 $= 2(c+d)^2$   
*mcd*  $c+d$
20.  $3a^2m^2 + 6a^2m - 45a^2 = 3a^2(m^2 + 2m - 15)$   
 $= 3a^2(m+5)(m-3)$   
 $6am^2x + 24amx - 30ax = 6ax(m^2 - 4m - 5)$   
 $= 3 \cdot 2ax(m+5)(m-1)$   
*mcd*  $3a(m+5)$
21.  $4x^4 - y^2 = (2x^2 + y)(2x^2 - y)$   
 $(2x^2 + y)^2 = (2x^2 + y)(2x^2 + y)$   
*mcd*  $2x^2 + y$
22.  $3x^5 - 3x = 3x(x^4 - 1) = 3x(x^2 + 1)(x^2 - 1)$   
 $= 3x(x^2 + 1)(x+1)(x-1)$   
 $9x^3 - 9x = 9x(x^2 - 1) = 3^2x(x+1)(x-1)$   
*mcd*  $3x(x+1)(x-1)$
23.  $a^2 + ab = a(a+b)$   
 $ab + b^2 = b(a+b)$   
 $a^3 + a^2b = a^2(a+b)$   
*mcd*  $a+b$
24.  $2x^3 - 2x^2 = 2x^2(x-1)$   
 $3x^2 - 3x = 3x(x-1)$   
 $4x^3 - 4x^2 = 4x^2(x-1)$   
*mcd*  $x(x-1)$
25.  $x^4 - 9x^2 = x^2(x^2 - 9) = x^2(x+3)(x-3)$   
 $x^4 - 5x^3 + 6x^2 = x^2(x^2 - 5x + 6) = x^2(x-3)(x-2)$   
 $x^4 - 6x^3 + 9x^2 = x^2(x^2 - 6x + 9) = x^2(x-3)^2$   
*mcd*  $x^2(x-3)$
26.  $a^3b + 2a^2b^2 + ab^3 = ab(a^2 + 2ab + b^2) = ab(a+b)^2$   
 $a^4b - a^2b^3 = a^2b(a^2 - b^2) = a^2b(a+b)(a-b)$   
*mcd*  $ab(a+b)$
27.  $2x^2 + 2x - 4 = 2(x^2 + x - 2) = 2(x+2)(x-1)$   
 $2x^2 - 8x + 6 = 2(x^2 - 4x + 3) = 2(x-3)(x-1)$   
 $2x^3 - 2 = 2(x^2 - 1) = 2(x+1)(x-1)$   
*mcd*  $2(x-1)$
28.  $ax^3 - 2ax^2 - 8ax = ax(x^2 - 2x - 8) = ax(x-4)(x+2)$   
 $ax^2 - ax - 6a = a(x^2 - x - 6) = a(x-3)(x+2)$   
 $a^2x^3 - 3a^2x^2 - 10a^2x = a^2x(x^2 - 3x - 10) = a^2x(x-5)(x+2)$   
*mcd*  $a(x+2)$
29.  $2an^4 - 16an^2 + 32a = 2a(n^4 - 8n^2 + 16)$   
 $= 2a(n^2 - 4)(n^2 - 4) = 2a(n+2)^2(n-2)^2$   
 $2an^3 - 8an = 2an(n^2 - 4) = 2an(n+2)(n-2)$   
 $2a^2n^3 + 16a^2 = 2a^2(n^3 + 8) = 2a^2(n+2)(n^2 - 2n + 4)$   
*mcd*  $2a(n+2)$

$$\begin{aligned}
 30. \quad & 4a^2 + 8a - 12 = 4(a^2 + 2a - 3) = 2^2(a+3)(a-1) \\
 & 2a^2 - 6a + 4 = 2(a^2 - 3a + 2) = 2(a-2)(a-1) \\
 & 6a^2 + 18a - 24 = 6(a^2 + 3a - 4) = 3 \cdot 2(a+4)(a-1) \\
 & \text{mcd } 2(a-1)
 \end{aligned}$$

$$\begin{aligned}
 31. \quad & 4a^2 - b^2 = (2a+b)(2a-b) \\
 & 8a^3 + b^3 = (2a+b)(4a^2 - 2ab + b^2) \\
 & 4a^2 + 4ab + b^2 = (2a+b)^2 \\
 & \text{mcd } 2a+b
 \end{aligned}$$

$$\begin{aligned}
 32. \quad & x^2 - 2x - 8 = (x-4)(x+2) \\
 & x^2 - x - 12 = (x-4)(x+3) \\
 & x^3 - 9x^2 + 20x = x(x^2 - 9x + 20) = x(x-5)(x-4) \\
 & \text{mcd } x-4
 \end{aligned}$$

$$\begin{aligned}
 33. \quad & a^2 + a = a(a+1) \\
 & a^3 - 6a^2 - 7a = a(a^2 - 6a - 7) = a(a-7)(a+1) \\
 & a^6 + a = a(a^5 + 1) = a(a+1)(a^4 - a^3 + a^2 - a + 1) \\
 & \text{mcd } a(a+1)
 \end{aligned}$$

$$\begin{aligned}
 34. \quad & x^3 + 27 = (x+3)(x^2 - 3x + 9) \\
 & 2x^2 - 6x + 18 = 2(x^2 - 3x + 9) \\
 & x^4 - 3x^3 + 9x^2 = x^2(x^2 - 3x + 9) \\
 & \text{mcd } x^2 - 3x + 9
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & x^2 + ax - 6a^2 = (x+3a)(x-2a) \\
 & x^2 + 2ax - 3a^2 = (x+3a)(x-a) \\
 & x^2 + 6ax + 9a^2 = (x+3a)^2 \\
 & \text{mcd } x+3a
 \end{aligned}$$

$$\begin{aligned}
 36. \quad & 54x^3 + 250 = 2(27x^3 + 125) = 2(3x+5)(9x^2 - 15x + 25) \\
 & 18ax^2 - 50a = 2a(9x^2 - 25) = 2a(3x+5)(3x-5) \\
 & 18x^2 + 60x + 50 = 2(9x^2 + 30x + 25) = 2(3x+5)^2 \\
 & \text{mcd } 2(3x+5)
 \end{aligned}$$

$$\begin{aligned}
 37. \quad & (x^2 - 1)^2 = [(x+1)(x-1)]^2 \\
 & x^2 - 4x - 5 = (x-5)(x+1) \\
 & x^4 - 1 = (x^2 + 1)(x^2 - 1) = (x^2 + 1)(x+1)(x-1) \\
 & \text{mcd } x+1
 \end{aligned}$$

$$\begin{aligned}
 38. \quad & 4ax^2 - 28ax = 4ax(x-7) \\
 & a^2x^3 - 8a^2x^2 + 7a^2x = a^2x(x^2 - 8x + 7) = a^2x(x-7)(x-1) \\
 & ax^4 - 15ax^3 + 56ax^2 = ax^2(x^2 - 15x + 56) = ax^2(x-8)(x-7) \\
 & \text{mcd } ax(x-7)
 \end{aligned}$$

$$\begin{aligned}
 39. \quad & 3a^2 - 6a = 3a(a-2) \\
 & a^3 - 4a = a(a^2 - 4) = a(a+2)(a-2) \\
 & a^2b - 2ab = ab(a-2) \\
 & a^2 - a - 2 = (a-2)(a+1) \\
 & \text{mcd } a-2
 \end{aligned}$$

$$\begin{aligned}
 40. \quad & 3x^2 - x = x(3x-1) \\
 & 27x^3 - 1 = (3x-1)(9x^2 + 3x + 1) \\
 & 9x^2 - 6x + 1 = (3x-1)^2 \\
 & 3ax - a + 6x - 2 = (3ax - a) + (6x - 2) \\
 & = a(3x-1) + 2(3x-1) \\
 & = (a+2)(3x-1) \\
 & \text{mcd } 3x-1
 \end{aligned}$$

$$41. \quad a^4 - 1 = (a^2 + 1)(a^2 - 1) = (a^2 + 1)(a+1)(a-1)$$

$$\begin{aligned}
 a^3 + a^2 + a + 1 &= (a^3 + a^2) + (a+1) \\
 &= a^2(a+1) + (a+1) = (a^2+1)(a+1) \\
 a^3x + a^2x + ax + x &= (a^3x + a^2x) + (ax + x) \\
 &= a^2x(a+1) + x(a+1) \\
 &= (a^2x+x)(a+1) = x(a^2+1)(a+1)
 \end{aligned}$$

$$\begin{aligned}
 a^5 + a^3 + a^2 + 1 &= (a^5 + a^3) + (a^2 + 1) \\
 &= a^3(a^2+1) + (a^2+1) \\
 &= (a^3+1)(a^2+1) = (a+1)(a^2-a+1)(a^2+1) \\
 & \text{mcd } (a^2+1)(a+1)
 \end{aligned}$$

$$42. \quad 2m^2 + 4mn + 2n^2 = 2(m^2 + 2mn + n^2) = 2(m+n)^2$$

$$\begin{aligned}
 m^3 + m^2n + mn^2 + n^3 &= m^2(m+n) + n^2(m+n) \\
 &= (m^2+n^2)(m+n)
 \end{aligned}$$

$$m^3 + n^3 = (m+n)(m^2 - mn + n^2)$$

$$\begin{aligned}
 m^3 - mn^2 &= m(m^2 - n^2) \\
 &= m(m+n)(m-n)
 \end{aligned}$$

$$\text{mcd } m+n$$



$$\begin{aligned}
 43. \quad a^3 - 3a^2 + 3a - 1 &= (a^3 - 1) - 3a(a - 1) \\
 &= (a - 1)(a^2 + a + 1) - 3a(a - 1) \\
 &= (a - 1)(a^2 + a + 1 - 3a) \\
 &= (a - 1)(a^2 - 2a + 1) = (a - 1)(a - 1)^2 \\
 a^2 - 2a + 1 &= (a - 1)^2 \\
 a^3 - a &= a(a^2 - 1) = a(a + 1)(a - 1) \\
 a^2 - 4a + 3 &= (a - 3)(a - 1) \\
 \text{mcd } a - 1
 \end{aligned}$$

$$\begin{aligned}
 44. \quad 16a^3x + 54x &= 2x(8a^3 + 27) \\
 &= 2x(2a + 3)(4a^2 - 6a + 9)
 \end{aligned}$$

$$\begin{aligned}
 12a^2x^2 - 42ax^2 - 90x^2 &= 6x^2(2a^2 - 7a - 15) \\
 &= 6x^2[(2a)^2 - 7(2a) - 30] \\
 &= [6x^2(2a - 10)(2a + 3)] \div 2 \\
 &= 3 \cdot 2x^2(a - 5)(2a + 3)
 \end{aligned}$$

$$\begin{aligned}
 32a^3x + 24a^2x - 36ax &= 4ax(8a^2 + 6a - 9) \\
 &= 4ax[(8a)^2 + 6(8a) - 72] \\
 &= [4ax(8a + 12)(8a - 6)] \div 4 \\
 &= 2^2ax(2a + 3)(8a - 6) \\
 &= 2^3ax(2a + 3)(4a - 3)
 \end{aligned}$$

$$\begin{aligned}
 32a^4x - 144a^2x + 162x &= 2x(16a^4 - 72a^2 + 81) \\
 &= 2x(4a^2 - 9)^2 \\
 &= 2x[(2a + 3)(2a - 3)]^2 \\
 \text{mcd } 2x(2a + 3)
 \end{aligned}$$

$$\begin{aligned}
 45. \quad (xy + y^2)^2 &= x^2y^2 + 2xy^3 + y^4 \\
 &= y^2(x^2 + 2xy + y^2) = y^2(x + y)^2 \\
 x^2y - 2xy^2 - 3y^3 &= y(x^2 - 2xy - 3y^2) = y(x - 3y)(x + y) \\
 ax^3y + ay^4 &= ay(x^3 + y^3) = ay(x + y)(x^2 - xy + y^2) \\
 x^2y - y^3 &= y(x^2 - y^2) = y(x + y)(x - y) \\
 \text{mcd } y(x + y)
 \end{aligned}$$

$$\begin{aligned}
 46. \quad 2a^2 - am + 4a - 2m &= (2a^2 - am) + (4a - 2m) \\
 &= a(2a - m) + 2(2a - m) \\
 &= (a + 2)(2a - m) \\
 2am^2 - m^3 &= m^2(2a - m) \\
 6a^2 + 5am - 4m^2 &= [(6a)^2 + 5m(6a) - 24m^2] \\
 &= [(6a + 8m)(6a - 3m)] \div 2 \cdot 3 \\
 &= (3a + 4m)(2a - m) \\
 16a^2 + 72am - 40m^2 &= 8(2a^2 + 9am - 5m^2) \\
 &= 8[(2a)^2 + 9m(2a) - 10m^2] \\
 &= 8[(2a + 10m)(2a - m)] \div 2 \\
 &= 8(a + 5m)(2a - m) \\
 \text{mcd } 2a - m
 \end{aligned}$$

$$\begin{aligned}
 47. \quad 12ax - 6ay + 24bx - 12by &= (12ax - 6ay) + (24bx - 12by) \\
 &= 6a(2x - y) + 12b(2x - y) \\
 &= (6a + 12b)(2x - y) \\
 &= 3 \cdot 2(a + 2b)(2x - y)
 \end{aligned}$$

$$\begin{aligned}
 3a^3 + 24b^3 &= 3(a^3 + 8b^3) \\
 &= 3(a + 2b)(a^2 - 2ab + 4b^2)
 \end{aligned}$$

$$\begin{aligned}
 9a^2 + 9ab - 18b^2 &= 9(a^2 + ab - 2b^2) \\
 &= 3^2(a + 2b)(a - b)
 \end{aligned}$$

$$\begin{aligned}
 12a^2 + 24ab &= 12a(a + 2b) = 4 \cdot 3a(a + 2b) \\
 \text{mcd } 3(a + 2b)
 \end{aligned}$$

$$\begin{aligned}
 48. \quad 5a^2 + 5ax + 5ay + 5xy &= 5a(a + x) + 5y(a + x) \\
 &= (5a + 5y)(a + x) = 5(a + y)(a + x)
 \end{aligned}$$

$$\begin{aligned}
 15a^3 - 15ax^2 + 15a^2y - 15x^2y &= 15a^2(a + y) - 15x^2(a + y) \\
 &= (15a^2 - 15x^2)(a + y) \\
 &= 15(a^2 - x^2)(a + y) \\
 &= 5 \cdot 3(a + x)(a - x)(a + y)
 \end{aligned}$$

$$\begin{aligned}
 20a^3 - 20ay^2 + 20a^2x - 20xy^2 &= 20a^2(a + x) - 20y^2(a + x) \\
 &= (20a^2 - 20y^2)(a + x) \\
 &= 20(a^2 - y^2)(a + x) \\
 &= 5 \cdot 4(a + y)(a - y)(a + x)
 \end{aligned}$$

$$\text{mcd } 5(a + y)(a + x)$$



$$8. (ax^4 + 3ax^3 - 2ax^2 + 6ax - 8a) \div a ;$$

$$\begin{array}{r} (x^4 + 4x^3 - x^2 - 4x) \div x \\ x^4 + 3x^3 - 2x^2 + 6x - 8 \quad | \quad x^3 + 4x^2 - x - 4 \\ - x^4 - 4x^3 + x^2 + 4x \\ \hline - x^3 - x^2 + 10x - 8 \quad (-1) \\ x^3 + 4x^2 - x - 4 \quad | \quad x^3 + x^2 - 10x + 8 \\ - x^3 - x^2 + 10x - 8 \quad 1 \\ \hline 3x^2 + 9x - 12 \quad (\div 3) \\ x^3 + x^2 - 10x + 8 \quad | \quad x^2 + 3x - 4 \\ - x^3 - 3x^2 + 4x \quad x \\ \hline - 2x^2 - 6x + 8 \quad (\div -2) \\ x^2 + 3x - 4 \quad | \quad x^2 + 3x - 4 \\ - x^2 - 3x + 4 \quad 1 \quad \text{mcd } x^2 + 3x - 4 \end{array}$$

$$9. 3(2m^4 - 4m^3 - m^2 + 6m - 3) ;$$

$$\begin{array}{r} (3m^5 - 6m^4 + 8m^3 - 10m^2 + 5m) \div m \\ 6m^4 - 12m^3 - 3m^2 + 18m - 9 \quad | \quad 3m^4 - 6m^3 + 8m^2 - 10m + 5 \\ - 6m^4 + 12m^3 - 16m^2 + 20m - 10 \quad 2 \\ \hline - 19m^2 + 38m - 19 \quad (\div -19) \\ 3m^4 - 6m^3 + 8m^2 - 10m + 5 \quad | \quad m^2 - 2m + 1 \\ - 3m^4 + 6m^3 - 3m^2 \quad 3m^2 \\ \hline 5m^2 - 10m + 5 \quad (\div 5) \\ m^2 - 2m + 1 \quad | \quad m^2 - 2m + 1 \\ - m^2 + 2m - 1 \quad 1 \quad \text{mcd } m^2 - 2m + 1 \end{array}$$

10. Factor común  $a$

$$\begin{array}{r} 7(3a^5 - 6a^4 + 16a^3 - 2a^2 + 5a) \quad ; \quad 3(7a^5 - 14a^4 + 33a^3 + 4a^2 - 10a) \\ = 21a^5 - 42a^4 + 112a^3 - 14a^2 + 35a \quad ; \quad = 21a^5 - 42a^4 + 99a^3 + 12a^2 - 30a \\ 21a^4 - 42a^3 + 112a^2 - 14a + 35 \quad | \quad 21a^4 - 42a^3 + 99a^2 + 12a - 30 \\ - 21a^4 + 42a^3 - 99a^2 - 12a + 30 \quad 1 \\ \hline 13a^2 - 26a + 65 \quad (\div 13) \\ 21a^4 - 42a^3 + 99a^2 + 12a - 30 \quad | \quad a^2 - 2a + 5 \\ - 21a^4 + 42a^3 - 105a^2 \quad 21a^2 \\ \hline - 6a^2 + 12a - 30 \quad (\div -6) \\ a^2 - 2a + 5 \quad | \quad a^2 - 2a + 5 \\ - a^2 + 2a - 5 \quad 1 \quad \text{mcd } a(a^2 - 2a + 5) \end{array}$$

$$11. (45ax^3 + 75ax^2 - 18ax - 30a) \div 3a ;$$

$$\begin{array}{r} (24ax^3 + 40ax^2 - 30ax - 50a) \div 2a \\ 4(15x^3 + 25x^2 - 6x - 10) \quad ; \quad 5(12x^3 + 20x^2 - 15x - 25) \\ 60x^3 + 100x^2 - 24x - 40 \quad | \quad 60x^3 + 100x^2 - 75x - 125 \quad (\div 5) \\ - 60x^3 - 100x^2 + 75x + 125 \quad 1 \\ \hline 51x + 85 \quad (\div 17) \\ 12x^3 + 20x^2 - 15x - 25 \quad | \quad 3x + 5 \\ - 12x^3 - 20x^2 \quad 4x^2 \\ \hline - 15x - 25 \quad (\div -5) \\ 3x + 5 \quad | \quad 3x + 5 \\ - 3x - 5 \quad 1 \quad \text{mcd } a(3x + 5) \end{array}$$

12. Factor común 2:

$$\begin{array}{r} 2x^3 + 2ax^2 + 2a^2x + 2a^3 \quad ; \quad 10x^3 + 4ax^2 + 10a^2x + 4a^3 \\ 5x^3 + 2ax^2 + 5a^2x + 2a^3 \quad | \quad x^3 + ax^2 + a^2x + a^3 \\ - 5x^3 - 5ax^2 - 5a^2x - 5a^3 \quad 5 \\ \hline - 3ax^2 - 3a^3 \quad (\div -3a) \\ x^3 + ax^2 + a^2x + a^3 \quad | \quad x^2 + a^2 \\ - x^3 - a^2x \quad x \\ \hline ax^2 + a^3 \quad (\div a) \\ x^2 + a^2 \quad | \quad x^2 + a^2 \\ - x^2 - a^2 \quad 1 \quad \text{mcd } 2(x^2 + a^2) \end{array}$$

13. Factor común 3 :

$$\begin{aligned} & 9x^3 + 15ax^2 + 3a^2x - 3a^3 ; \\ & 12x^3 + 21ax^2 + 6a^2x - 3a^3 \quad (3) \\ & \frac{12x^3 + 21ax^2 + 6a^2x - 3a^3}{-12x^3 - 20ax^2 - 4a^2x + 4a^3} \quad \left| \frac{3x^3 + 5ax^2 + a^2x - a^3}{4} \right. \\ & \frac{\phantom{12x^3 + 21ax^2 + 6a^2x - 3a^3}}{ax^2 + 2a^2x + a^3} \quad (\div a) \\ & \frac{3x^3 + 5ax^2 + a^2x - a^3}{-3x^3 - 6ax^2 - 3a^2x} \quad \left| \frac{x^2 + 2ax + a^2}{3x} \right. \\ & \frac{\phantom{3x^3 + 5ax^2 + a^2x - a^3}}{-ax^2 - 2a^2x - a^3} \quad (\div -a) \\ & \frac{x^2 + 2ax + a^2}{-x^2 - 2ax - a^2} \quad \left| \frac{x^2 + 2ax + a^2}{1} \right. \\ & \phantom{\frac{x^2 + 2ax + a^2}{-x^2 - 2ax - a^2}} \quad \text{mcd } 3(x^2 + 2ax + a^2) \end{aligned}$$

14. Factor común 2ab:

$$\begin{aligned} & 8a^4b + 4a^3b^2 + 4ab^4 ; 12a^4b - 18a^3b^2 + 12a^2b^3 - 6ab^4 \\ & 3(4a^3 + 2a^2b + 2b^3) \quad 6a^3 - 9a^2b + 6ab^2 - 3b^3 \\ & \frac{12a^3 + 6a^2b + 6b^3}{-12a^3 + 18a^2b - 12ab^2 + 6b^3} \quad \left| \frac{6a^3 - 9a^2b + 6ab^2 - 3b^3}{2} \right. \\ & \frac{\phantom{12a^3 + 6a^2b + 6b^3}}{24a^2b - 12ab^2 + 12b^3} \quad (\div 12b) \\ & \frac{6a^3 - 9a^2b + 6ab^2 - 3b^3}{-6a^3 + 3a^2b - 3ab^2} \quad \left| \frac{2a^2 - ab + b^2}{3a} \right. \\ & \frac{\phantom{6a^3 - 9a^2b + 6ab^2 - 3b^3}}{-6a^2b + 3ab^2 - 3b^3} \quad (\div -3b) \\ & \frac{2a^2 - ab + b^2}{-2a^2 + ab - b^2} \quad \left| \frac{2a^2 - ab + b^2}{1} \right. \\ & \phantom{\frac{2a^2 - ab + b^2}{-2a^2 + ab - b^2}} \quad \text{mcd } 2ab(2a^2 - ab + b^2) \end{aligned}$$

15. Factor común  $3a^2n^2$ :

$$\begin{aligned} & 9a^5n^2 - 33a^4n^3 + 27a^3n^4 - 6a^2n^5 ; \\ & 9a^5n^2 + 12a^4n^3 - 21a^3n^4 + 6a^2n^5 \\ & \frac{3a^3 - 11a^2n + 9an^2 - 2n^3}{-3a^3 - 4a^2n + 7an^2 - 2n^3} \quad \left| \frac{3a^3 + 4a^2n - 7an^2 + 2n^3}{1} \right. \quad (5) \\ & \frac{\phantom{3a^3 - 11a^2n + 9an^2 - 2n^3}}{-15a^2n + 16an^2 - 4n^3} \quad (\div -n) \\ & \frac{15a^3 + 20a^2n - 35an^2 + 10n^3}{-15a^3 + 16a^2n - 4an^2} \quad \left| \frac{15a^2 - 16an + 4n^2}{a} \right. \quad (12) \\ & \frac{\phantom{15a^3 + 20a^2n - 35an^2 + 10n^3}}{36a^2n - 39an^2 + 10n^3} \quad (\div n) \\ & \frac{180a^2 - 192an + 48n^2}{-180a^2 + 195an - 50n^2} \quad \left| \frac{36a^2 - 39an + 10n^2}{5} \right. \\ & \frac{\phantom{180a^2 - 192an + 48n^2}}{3an - 2n^2} \quad (\div n) \\ & \frac{36a^2 - 39an + 10n^2}{-36a^2 + 24an} \quad \left| \frac{3a - 2n}{12a} \right. \\ & \frac{\phantom{36a^2 - 39an + 10n^2}}{-15an + 10n^2} \quad (\div -5n) \\ & \frac{3a - 2n}{-3a + 2n} \quad \left| \frac{3a - 2n}{1} \right. \\ & \phantom{\frac{3a - 2n}{-3a + 2n}} \quad \text{mcd } 3a^2n^2(3a - 2n) \end{aligned}$$

$$16. \frac{a^7 - a^6 + a^4 - a^2 + 1}{-a^7 + 2a^6 - a^5 - a^3 + a^2} + 1 \quad \left| \frac{a^5 - 2a^4 + a^3 + a - 1}{a^2} \right. \quad (a)$$

$$\frac{a^6 - 2a^5 + a^4 + a^2 - a}{-a^6 + a^5 - a^4 + a^3 - a^2 - 1} \quad \left| \frac{a^6 - a^5 + a^4 - a^3 + a^2 + 1}{-1} \right. \quad (1)$$

$$\frac{-a^5 + a^3 - a - 1}{a^6 - a^5 + a^4 - a^3 + a^2 + 1} + 1 \quad \left| \frac{a^5 - a^3 + a + 1}{a} \right. \quad (-1)$$

$$\frac{-a^6 + a^4 - a^2 - a}{-a^5 + 2a^4 - a^3 - a + 1} \quad \left| \frac{a^5 - 2a^4 + a^3 + a - 1}{-1} \right. \quad (-1)$$

$$\frac{a^5 - 2a^4 + a^3 + a - 1}{2a^4 - 2a^3 + 2} \quad \left| \frac{a^4 - a^3 + 1}{2} \right. \quad (\div 2)$$

$$\frac{-a^5 + a^4 - a}{-a^4 + a^3 - 1} \quad \left| \frac{a^4 - a^3 + 1}{-1} \right. \quad (-1)$$

$$\frac{a^4 - a^3 + 1}{-a^4 + a^3 - 1} \quad \left| \frac{a^4 - a^3 + 1}{1} \right. \quad \text{mcd } a^4 - a^3 + 1$$

17. Factor común 2a :

$$\begin{aligned} & 6ax^4 - 4ax^3 + 6ax^2 - 10ax + 4a ; \\ & 36ax^4 - 24ax^3 - 18ax^2 + 48ax - 24a \\ & 18x^4 - 12x^3 - 9x^2 + 24x - 12 \quad \left| \frac{3x^4 - 2x^3 + 3x^2 - 5x + 2}{9} \right. \quad (9) \\ & \frac{-18x^4 + 12x^3 - 18x^2 + 30x - 12}{-27x^3 + 54x - 24} \quad \left| \frac{-18x^4 + 12x^3 - 18x^2 + 30x - 12}{-1} \right. \quad (-1) \end{aligned}$$

$$\frac{27x^4 - 18x^3 + 27x^2 - 45x + 18}{-27x^4 + 54x^3 - 24x^2} \quad \left| \frac{27x^2 - 54x + 24}{x^2} \right. \quad (4x)$$

$$\frac{36x^3 + 3x^2 - 45x + 18}{108x^3 - 216x^2 + 96x} \quad \left| \frac{12x^3 + x^2 - 15x + 6}{9} \right. \quad (25)$$

$$\frac{-108x^3 - 9x^2 + 135x - 54}{-225x^2 + 231x - 54} \quad \left| \frac{-108x^3 - 9x^2 + 135x - 54}{-9} \right. \quad (\div -3)$$

$$\frac{300x^3 + 25x^2 - 375x + 150}{-300x^3 + 308x^2 - 72x} \quad \left| \frac{75x^2 - 77x + 18}{4x} \right. \quad (111)$$

$$\frac{333x^2 - 447x + 150}{8.325x^2 - 8.547x + 1.998} \quad \left| \frac{333x^2 - 447x + 150}{3} \right. \quad (\div 3)$$

$$\frac{-8.325x^2 + 11.175x - 3.750}{2.628x - 1.752} \quad \left| \frac{111x^2 - 149x + 50}{75} \right. \quad (2.628)$$

$$\frac{291.708x^2 - 391.572x + 131.400}{-291.708x^2 + 194.472x} \quad \left| \frac{2.628x - 1.752}{111x} \right. \quad (\div 876)$$

$$\frac{-197.100x + 131.400}{3x - 2} \quad \left| \frac{-197.100x + 131.400}{1} \right. \quad (\div -65.700)$$

$$\frac{3x - 2}{-3x + 2} \quad \left| \frac{3x - 2}{1} \right. \quad \text{mcd } 2a(3x - 2)$$

## EJERCICIO 114

1. 
$$\begin{array}{r} 2x^3 - 5x^2 - 6x + 9 \\ -2x^3 + 5x^2 + 3x \\ \hline -3x + 9 \quad (+-3) \\ 2x^2 - 5x - 3 \\ -2x^2 + 6x \\ \hline x - 3 \\ x^3 - 2x^2 - 5x + 6 \\ -x^3 + 3x^2 \\ \hline x^2 - 5x + 6 \\ x^2 - 3x \\ +5x - 6 \\ \hline 2x - 6 \quad (+2) \\ x^2 - 5x + 6 \\ -x^2 + 2x \\ \hline -3x + 6 \quad (+-3) \\ x - 3 \\ -x + 3 \\ \hline 1 \quad mcd \quad x - 3 \end{array}$$
2. 
$$\begin{array}{r} 8x^3 + 6x^2y - 3xy^2 - y^3 \\ -8x^3 + 4x^2y + 8xy^2 - 4y^3 \\ \hline 10x^2y + 5xy^2 - 5y^3 \quad (+5y) \\ 2x^3 - x^2y - 2xy^2 + y^3 \\ -2x^3 - x^2y + xy^2 \\ \hline -2x^2y - xy^2 + y^3 \quad (+-y) \\ 2x^2 + xy - y^2 \\ -2x^2 - xy + y^2 \\ \hline 0 \\ 6x^2 - xy - y^2 \\ -6x^2 - 3xy + 3y^2 \\ \hline -4xy + 2y^2 \quad (+-2y) \\ 2x^2 + xy - y^2 \\ -2x^2 + xy \\ \hline 2xy - y^2 \quad (+y) \\ 2x - y \\ -2x + y \\ \hline 1 \quad mcd \quad 2x - y \end{array}$$
3. 
$$\begin{array}{r} (x^4 + x^3 - x^2 - x) \div x \\ (2x^3 + 2x^2 - 2x - 2) \div 2 \\ x^3 + x^2 - x - 1 \\ -x^3 - x^2 + x + 1 \\ \hline 0 \\ 5x^3 - 5x^2 + 2x - 2 \\ -5x^3 - 5x^2 + 5x + 5 \\ \hline -10x^2 + 7x + 3 \quad (-1) \\ 10x^3 + 10x^2 - 10x - 10 \\ -10x^3 + 7x^2 + 3x \\ \hline 17x^2 - 7x - 10 \\ 170x^2 - 119x - 51 \\ -170x^2 + 70x + 100 \\ \hline -49x + 49 \quad (+-49) \\ 17x^2 - 7x - 10 \\ -17x^2 + 17x \\ \hline 10x - 10 \quad (+10) \\ x - 1 \\ -x + 1 \\ \hline 1 \quad mcd \quad x - 1 \end{array}$$
4. 
$$\begin{array}{r} 3a^4 + 9a^3x + 4a^2x^2 - 3ax^3 + 2x^4 \\ -3a^4 - 9a^3x - 3a^2x^2 + 9ax^3 + 6x^4 \\ \hline a^2x^2 + 6ax^3 + 8x^4 \quad (+x^2) \\ a^4 + 3a^3x + a^2x^2 - 3ax^3 - 2x^4 \\ -a^4 - 6a^3x - 8a^2x^2 \\ \hline -3a^3x - 7a^2x^2 - 3ax^3 - 2x^4 \quad (+-x) \\ 3a^3 + 18a^2x + 24ax^2 \\ -3a^3 - 7a^2x - 3ax^2 - 2x^3 \\ \hline 11a^2x + 21ax^2 - 2x^3 \quad (+x) \\ 33a^3 + 77a^2x + 33ax^2 + 22x^3 \\ -33a^3 - 63a^2x + 6ax^2 \\ \hline 14a^2x + 39ax^2 + 22x^3 \quad (+x) \\ 154a^2 + 294ax - 28x^2 \\ -154a^2 - 429ax - 242x^2 \\ \hline -135ax - 270x^2 \quad (+-135x) \\ 14a^2 + 39ax + 22x^2 \\ -14a^2 - 28ax \\ \hline 11ax + 22x^2 \quad (+11x) \\ 4a^3 + 8a^2x - ax^2 - 2x^3 \\ -4a^3 - 8a^2x \\ \hline -ax^2 - 2x^3 \quad (+-x^2) \\ a + 2x \\ -a - 2x \\ \hline 1 \quad mcd \quad a + 2x \end{array}$$
5. **Factor común x**  

$$\begin{array}{r} 2(2x^5 + 2x^4 - 2x^2 - 2x) \\ 4x^4 + 4x^3 - 4x - 4 \\ -4x^4 + 4x^3 - 3x^2 + 3x \\ \hline 8x^3 - 3x^2 - x - 4 \\ 8x^3 - 8x^2 + 6x - 6 \\ -8x^3 + 3x^2 + x + 4 \\ \hline -5x^2 + 7x - 2 \quad (-1) \\ 40x^3 - 15x^2 - 5x - 20 \\ -40x^3 + 56x^2 - 16x \\ \hline 41x^2 - 21x - 20 \\ 205x^2 - 287x + 82 \\ -205x^2 + 105x + 100 \\ \hline -182x + 182 \quad (+-182) \\ 41x^2 - 21x - 20 \\ -41x^2 + 41x \\ \hline 20x - 20 \quad (+20) \\ 3x^6 - 4x^4 - 3x^3 + 4x \\ -3x^6 + 3x^5 \\ \hline 3x^5 - 4x^4 - 3x^3 + 4x \end{array}$$

Continúa.

**Continuación.**

$$\begin{array}{r}
 5. \quad 3x^5 - 3x^4 \quad \left| \begin{array}{l} 3x^5 - 4x^4 - 3x^3 + 4x \end{array} \right. (\div x) \\
 \underline{-3x^5 + 4x^4 + 3x^3 - 4x} \quad 1 \\
 \quad \quad \quad x^4 + 3x^3 - 4x \quad (\div x) \\
 \quad \quad \quad 3x^4 - 4x^3 - 3x^2 \quad + 4 \quad \left| \begin{array}{l} x^3 + 3x^2 - 4 \end{array} \right. (13) \\
 \underline{-3x^4 + 9x^3} \quad + 12x \quad \quad 3x \\
 \quad \quad \quad -13x^3 - 3x^2 + 12x + 4 \quad (\div -1) \\
 \quad \quad \quad 13x^3 + 39x^2 \quad - 52 \quad \left| \begin{array}{l} 13x^3 + 3x^2 - 12x - 4 \end{array} \right. (3) \\
 \underline{-13x^3 - 3x^2 + 12x + 4} \quad 1 \\
 \quad \quad \quad 36x^2 + 12x - 48 \quad (\div 12) \\
 \quad \quad \quad 39x^3 + 9x^2 - 36x - 12 \quad \left| \begin{array}{l} 3x^2 + x - 4 \end{array} \right. \\
 \underline{-39x^3 - 13x^2 + 52x} \quad 13x \\
 \quad \quad \quad -4x^2 + 16x - 12 \quad (\div -4) \\
 \quad \quad \quad 3x^2 + x - 4 \quad \left| \begin{array}{l} x^2 - 4x + 3 \end{array} \right. \\
 \underline{-3x^2 + 12x - 9} \quad 3 \\
 \quad \quad \quad 13x - 13 \quad (\div 13) \\
 \quad \quad \quad x^2 - 4x + 3 \quad \left| \begin{array}{l} x - 1 \end{array} \right. \\
 \underline{-x^2 + x} \quad x \\
 \quad \quad \quad -3x + 3 \quad (\div -3) \\
 \quad \quad \quad x - 1 \quad \left| \begin{array}{l} x - 1 \end{array} \right. \\
 \underline{-x + 1} \quad 1 \quad \quad \quad mcd \quad x(x-1)
 \end{array}$$

$$\begin{array}{l}
 16. \quad 3x^3, 6x^2, 9x^4y^2 \quad mcm \quad 18x^4y^2 \\
 17. \quad 9a^5bx, 12ab^2x^2, 18a^3b^3x \quad mcm \quad 36a^3b^3x^2 \\
 18. \quad 10m^2, 15mn^2, 20n^3 \quad mcm \quad 60m^2n^3 \\
 19. \quad 18a^3, 24b^2, 36ab^3 \quad mcm \quad 72a^3b^3 \\
 20. \quad 20m^2n^3, 24m^3n, 30mn^2 \\
 \begin{array}{r|l}
 20 & 24 & 30 & 6 \\
 20 & 4 & 5 & 5 \cdot 6 \cdot 4 = 120 \\
 4 & 4 & 1 & 4 \Rightarrow mcm \quad 120m^3n^3 \\
 1 & 1 & & 
 \end{array}
 \end{array}$$

$$\begin{array}{l}
 21. \quad ab^2, bc^2, a^2c^3, b^3c^3 \quad mcm \quad a^2b^3c^3 \\
 22. \quad 2x^2y, 8xy^3, 4a^2x^3, 12a^3 \quad mcm \quad 24a^3x^3y^3 \\
 23. \quad 6a^2, 9x, 12ay^2, 18x^3y \quad mcm \quad 36a^2x^3y^2 \\
 24. \quad 15mn^2, 10m^2, 20n^3, 25mn^4 \\
 \begin{array}{r|l}
 15 & 10 & 20 & 25 & 5 \\
 3 & 2 & 4 & 5 & 5 \cdot 3 \cdot 2^2 = 300 \\
 3 & 2 & 4 & 1 & 3 \Rightarrow mcm \quad 300m^2n^4 \\
 1 & 2 & 4 & & 2 \\
 & 1 & 2 & & 2 \\
 & & & & 1
 \end{array}
 \end{array}$$

**EJERCICIO 115**

1.  $a^2, ab^2 \quad mcm \quad a^2b^2$
2.  $x^2y, xy^2 \quad mcm \quad x^2y^2$
3.  $ab^2c, a^2bc \quad mcm \quad a^2b^2c$
4.  $a^2x^3, a^3bx^2 \quad mcm \quad a^3bx^3$
5.  $6m^2n, 4m^3 \quad mcm \quad 12m^3n$
6.  $9ax^3y, 15x^2y^5 \quad mcm \quad 45ax^3y^5$
7.  $a^3, ab^2, a^2b \quad mcm \quad a^3b^2$
8.  $x^2y, xy^2, xy^3z \quad mcm \quad x^2y^3z$
9.  $2ab^2, 4a^2b, 8a^3 \quad mcm \quad 8a^3b^2$
10.  $3x^2y^3z, 4x^3y^3z^2, 6x^4 \quad mcm \quad 12x^4y^3z^2$
11.  $6m^2n^2, 9m^2n^3, 12m^3n \quad mcm \quad 36m^3n^3$
12.  $3a^2, 4b^2, 8x^2 \quad mcm \quad 24a^2b^2x^2$
13.  $5x^2, 10xy, 15xy^2 \quad mcm \quad 30x^2y^2$
14.  $ax^3y^2, a^3xy, a^2x^2y^3 \quad mcm \quad a^3x^3y^3$
15.  $4ab, 6a^2, 3b^2 \quad mcm \quad 12a^2b^2$

$$\begin{array}{l}
 25. \quad 24a^2x^3, 36a^2y^4, 40x^2y^5, 60a^3y^6 \\
 \begin{array}{r|l}
 24 & 36 & 40 & 60 & 2 \\
 12 & 18 & 20 & 30 & 2 \\
 6 & 9 & 10 & 15 & 3 \quad 2^3 \cdot 3^2 \cdot 5 = 360 \\
 2 & 3 & 10 & 5 & 5 \Rightarrow mcm \quad 360a^3x^3y^6 \\
 2 & 3 & 2 & 1 & 3 \\
 2 & 1 & 2 & & 2 \\
 1 & & & & 1
 \end{array} \\
 26. \quad 3a^3, 8ab, 10b^2, 12a^2b^3, 16a^2b^2 \\
 \begin{array}{r|l}
 3 & 8 & 10 & 12 & 16 & 2 \\
 3 & 4 & 5 & 6 & 8 & 2 \\
 3 & 2 & 5 & 3 & 4 & 2 \quad 2^4 \cdot 3 \cdot 5 = 240 \\
 3 & 1 & 5 & 3 & 2 & 2 \Rightarrow mcm \quad 240a^3b^3 \\
 3 & & 5 & 3 & 1 & 3 \\
 1 & & 5 & 1 & & 5 \\
 & & & & & 1
 \end{array}
 \end{array}$$

## EJERCICIO 116

1.  $2a = 2a$   
 $4x - 8 = 2^2(x - 2)$   
*mcm*  $4a(x - 2)$
2.  $ab - b^2 = b(a - b)$   
 $3b^2 = 3b^2$   
*mcm*  $3b^2(a - b)$
3.  $x^2y + xy^2 = xy(x + y)$   
 $x^2y = x^2y$   
*mcm*  $x^2y(x + y)$
4.  $4 + 8a = 2^2(1 + 2a)$   
 $8 = 2^3$   
*mcm*  $2^3(1 + 2a) = 8(1 + 2a)$
5.  $6a^2b = 2 \cdot 3a^2b$   
 $3a^2b^2 + 6ab^3 = 3ab^2(a + 2b)$   
*mcm*  $6a^2b^2(a + 2b)$
6.  $14x^2 = 7 \cdot 2x^2$   
 $6x^2 + 4xy = 2x(3x + 2y)$   
*mcm*  $14x^2(3x + 2y)$
7.  $9m = 3^2m$   
 $6mn^2 - 12mn = 2 \cdot 3mn(n - 2)$   
*mcm*  $2 \cdot 3^2mn(n - 2)$   
 $\Rightarrow 18mn(n - 2)$
8.  $15 = 5 \cdot 3$   
 $3x + 6 = 3(x + 2)$   
*mcm*  $15(x + 2)$
9.  $10 = 5 \cdot 2$   
 $5 - 15b = 5(1 - 3b)$   
*mcm*  $10(1 - 3b)$
10.  $4ax - 12ay = 2^2a(x - 3y)$   
 $36a^2 = 2^2 \cdot 3^2a^2$   
*mcm*  $2^2 \cdot 3^2a^2(x - 3y)$   
 $\Rightarrow 36a^2(x - 3y)$
11.  $12xy^2 = 2^2 \cdot 3xy^2$   
 $2ax^2y^3 + 5x^2y^3 = x^2y^3(2a + 5)$   
*mcm*  $12x^2y^3(2a + 5)$
12.  $mn^3 - mn^2 = mn^2(n - 1)$   
 $mn = mn$   
 $m^2 = m^2$   
*mcm*  $m^2n^2(n - 1)$
13.  $3a^2 - 6ab = 3a(a - 2b)$   
 $2a^2 = 2a^2$   
 $6ab = 2 \cdot 3ab$   
*mcm*  $6a^2b(a - 2b)$
14.  $5x^5 - 5x^4 = 5x^4(x - 1)$   
 $xy^2 = xy^2$   
 $x^2y^3 = x^2y^3$   
*mcm*  $5x^4y^3(x - 1)$
15.  $27a^4b + 81a^3b^2 = 3^3a^3b(a + 3b)$   
 $9a^2 = 3^2a^2$   
 $18b^3 = 2 \cdot 3^2b^3$   
*mcm*  $2 \cdot 3^3a^3b^3(a + 3b)$   
 $\Rightarrow 54a^3b^3(a + 3b)$
16.  $9x^3y + 9xy^3 = 3^2xy(x^2 + y^2)$   
 $10 = 5 \cdot 2$   
 $6x^2 = 2 \cdot 3x^2$   
*mcm*  $5 \cdot 2 \cdot 3^2x^2y(x^2 + y^2)$   
 $\Rightarrow 90x^2y(x^2 + y^2)$
17.  $x^2y - xy = xy(x - 1)$   
 $x^3 + x^2 = x^2(x + 1)$   
 $4x = 2^2x$   
*mcm*  $2^2x^2y(x - 1)(x + 1)$   
 $\Rightarrow 4x^2y(x^2 - 1)$
18.  $6m^2 + 18m = 2 \cdot 3m(m + 3)$   
 $8m - 24 = 2^3(m - 3)$   
 $24 = 2^3 \cdot 3$   
*mcm*  $2^3 \cdot 3m(m + 3)(m - 3)$   
 $\Rightarrow 24m(m^2 - 9)$
19.  $3ax + 3a = 3a(x + 1)$   
 $2a^2b^2 = 2a^2b^2$   
 $6x - 18 = 2 \cdot 3(x - 3)$   
*mcm*  $6a^2b^2(x + 1)(x - 3)$
20.  $x^2 + 4x + 4 = (x + 2)^2$   
 $x^3 + x^2 - 2x = x(x^2 + x - 2)$   
 $= x(x + 2)(x - 1)$   
 $x^2 = x^2$   
*mcm*  $x^2(x + 2)^2(x - 1)$
21.  $9a^2x - 18a^2y = 3^2a^2(x - 2y)$   
 $x^2 - 4xy + 4y^2 = (x - 2y)^2$   
 $6ab = 2 \cdot 3ab$   
*mcm*  $3^2 \cdot 2a^2b(x - 2y)^2$   
 $\Rightarrow 18a^2b(x - 2y)^2$
22.  $9x^4 - 36x^2 = 3^2x^2(x^2 - 4)$   
 $= 3^2x^2(x + 2)(x - 2)$   
 $3x^3 - 3x^2 - 18x = 3x(x^2 - x - 6)$   
 $= 3x(x - 3)(x + 2)$   
 $6x^3 = 2 \cdot 3x^3$   
*mcm*  $2 \cdot 3^2x^3(x + 2)(x - 2)(x - 3)$   
 $\Rightarrow 18x^3(x^2 - 4)(x - 3)$
23.  $4x^3 - 12x^2y + 9xy^2 = x(4x^2 - 12xy + 9y^2)$   
 $= x(2x - 3y)^2$   
 $2x^4 - 3x^3y = x^3(2x - 3y)$   
 $a^2x^2 = a^2x^2$   
*mcm*  $a^2x^3(2x - 3y)^2$
24.  $9x^2 - 45x = 3^2x(x - 5)$   
 $12x^2y^2 = 3 \cdot 2^2x^2y^2$   
 $8x^3 = 2^3x^3$   
*mcm*  $3^2 \cdot 2^3x^3y^2(x - 5)$   
 $\Rightarrow 72x^3y^2(x - 5)$
25.  $n^2x^2 + n^2y^2 = n^2(x^2 + y^2)$   
 $nx^2 + 2nxy + ny^2 = n(x^2 + 2xy + y^2)$   
 $= n(x + y)^2$   
 $2n = 2n$   
 $an^3 = an^3$   
*mcm*  $2an^3(x + y)^2(x^2 + y^2)$
26.  $4x^3 + 24x^2 + 36x = 2^2x(x^2 + 6x + 9)$   
 $= 2^2x(x + 3)^2$   
 $2x^3 - 8x^2 + 8x = 2x(x^2 - 4x + 4)$   
 $= 2x(x - 2)^2$   
 $x^3 + x^2 - 6x = x(x^2 + x - 6)$   
 $= x(x + 3)(x - 2)$   
 $8x^2 = 2^3x^2$   
*mcm*  $8x^2(x + 3)^2(x - 2)^2$

$$27. \quad 6x^3 + 6x^2 = 2 \cdot 3x^2(x+1)$$

$$2x^2 - 2x + 2 = 2(x^2 - x + 1)$$

$$x^3 + 1 = (x+1)(x^2 - x + 1)$$

$$3x^3 = 3x^3$$

$$mcm \quad 2 \cdot 3x^3(x+1)(x^2 - x + 1)$$

$$\Rightarrow 6x^3(x+1)(x^2 - x + 1)$$

$$29. \quad 5ab^3 - 5b^4 = 5b^3(a-b)$$

$$12a^2 - 24ab + 12b^2 = 2^2 \cdot 3(a^2 - 2ab + b^2)$$

$$= 2^2 \cdot 3(a-b)^2$$

$$6a^2b = 2 \cdot 3a^2b$$

$$4b = 2^2b$$

$$2a = 2a$$

$$mcm = 5 \cdot 2^2 \cdot 3a^2b^3(a-b)^2 \Rightarrow 60a^2b^3(a-b)^2$$

$$28. \quad ax - a + bx - b = a(x-1) + b(x-1) = (a+b)(x-1)$$

$$a^2 + 2ab + b^2 = (a+b)^2$$

$$4xy^2 = 2^2xy^2$$

$$3x^3 - 3x^2 = 3x^2(x-1)$$

$$mcm \quad 2^2 \cdot 3x^2y^2(a+b)^2(x-1) \Rightarrow 12x^2y^2(a+b)^2(x-1)$$

$$30. \quad 14x + 14 = 7 \cdot 2(x+1)$$

$$x^2 + 2x + 1 = (x+1)^2$$

$$7x^2 + 7 = 7(x^2 + 1)$$

$$28x = 7 \cdot 2^2x$$

$$x^2 + 1 = (x^2 + 1)$$

$$mcm \quad 28x(x+1)^2(x^2 + 1)$$

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$$1. \quad 6x - 6 = 2 \cdot 3(x-1)$$

$$3x + 3 = 3(x+1)$$

$$mcm \quad 2 \cdot 3(x-1)(x+1)$$

$$\Rightarrow 6(x^2 - 1)$$

$$2. \quad 10x^2 - 40 = 5 \cdot 2(x^2 - 4)$$

$$= 5 \cdot 2(x+2)(x-2)$$

$$5x + 10 = 5(x+2)$$

$$mcm \quad 5 \cdot 2(x+2)(x-2)$$

$$\Rightarrow 10(x^2 - 4)$$

$$3. \quad x^2 - 4y^2 = (x+2y)(x-2y)$$

$$x^3 + 2x^2y = x^2(x+2y)$$

$$mcm \quad x^2(x+2y)(x-2y)$$

$$\Rightarrow x^2(x^2 - 4y^2)$$

$$4. \quad x^2 - 6x + 9 = (x-3)^2$$

$$3a^2x - 9a^2 = 3a^2(x-3)$$

$$mcm \quad 3a^2(x-3)^2$$

$$5. \quad 4a^2 - 12ab + 9b^2 = (2a - 3b)^2$$

$$4a^2 - 9b^2 = (2a + 3b)(2a - 3b)$$

$$mcm \quad (2a + 3b)(2a - 3b)^2$$

$$6. \quad a^3 + 2a^2b + ab^2 = a(a^2 + 2ab + b^2)$$

$$= a(a+b)^2$$

$$a^3 + a^2b = a^2(a+b)$$

$$mcm \quad a^2(a+b)^2$$

$$7. \quad 2bx^2 + 6bx - 8b = 2b(x^2 + 3x - 4)$$

$$= 2b(x+4)(x-1)$$

$$3ax + 12a = 3a(x+4)$$

$$mcm \quad 2b \cdot 3a(x+4)(x-1)$$

$$\Rightarrow 6ab(x+4)(x-1)$$

$$8. \quad x^2 + 2x - 15 = (x+5)(x-3)$$

$$x^3 - 25x = x(x^2 - 25)$$

$$= x(x+5)(x-5)$$

$$mcm \quad x(x+5)(x-5)(x-3)$$

$$\Rightarrow x(x^2 - 25)(x-3)$$

$$9. \quad (x-1)^2 = (x-1)^2$$

$$x^2 - 1 = (x+1)(x-1)$$

$$mcm \quad (x+1)(x-1)^2$$

$$10. \quad (x+1)^2 = (x+1)^2$$

$$x^2 + 1 = x^2 + 1$$

$$mcm \quad (x^2 + 1)(x+1)^2$$

$$11. \quad x^3 + y^3 = (x+y)(x^2 - xy + y^2)$$

$$(x+y)^3 = (x+y)^3$$

$$mcm \quad (x+y)^3(x^2 - xy + y^2)$$

$$12. \quad x^3 - y^3 = (x-y)(x^2 + xy + y^2)$$

$$(x-y)^3 = (x-y)^3$$

$$mcm \quad (x-y)^3(x^2 + xy + y^2)$$

$$13. \quad 4x^2 - 7x - 2 = (4x-2) - 7(4x) - 8$$

$$= [(4x-8)(4x+1)] + 4$$

$$= (x-2)(4x+1)$$

$$x^2 + 3x - 10 = (x+5)(x-2)$$

$$mcm \quad (x-2)(4x+1)(x+5)$$

$$14. \quad a^2 + a - 30 = (a+6)(a-5)$$

$$a^2 + 3a - 18 = (a+6)(a-3)$$

$$mcm \quad (a+6)(a-3)(a-5)$$

$$15. \quad x^4 + 2x^3 - 15x^2 = x^2(x^2 + 2x - 15)$$

$$= x^2(x+5)(x-3)$$

$$x^3 - 9x + 5x^2 - 45 = x(x^2 - 9) + 5(x^2 - 9)$$

$$= (x+5)(x^2 - 9)$$

$$= (x+5)(x+3)(x-3)$$

$$mcm \quad x^2(x+5)(x+3)(x-3)$$

$$\Rightarrow x^2(x+5)(x^2 - 9)$$



16.  $x^6 - 4x^3 - 32 = (x^3 - 8)(x^3 + 4)$   
 $= (x - 2)(x^2 + 2x + 4)(x^3 + 4)$   
 $ax^4 + 2ax^3 + 4ax^2 = ax^2(x^2 + 2x + 4)$   
*mcm*  $ax^2(x - 2)(x^2 + 2x + 4)(x^3 + 4)$
17.  $12(x^2 - y^2) = 2^2 \cdot 3(x + y)(x - y)$   
 $8(x - y)^2 = 2^3(x - y)^2$   
*mcm*  $2^3 \cdot 3(x + y)(x - y)^2 \Rightarrow 24(x + y)(x - y)^2$
18.  $5(x + y)^2 = 5(x + y)^2$   
 $10(x^2 + y^2) = 5 \cdot 2(x^2 + y^2)$   
*mcm*  $10(x^2 + y^2)(x + y)^2$
19.  $6a(m + n)^3 = 2 \cdot 3a(m + n)^3$   
 $4a^2b(m^3 + n^3) = 2^2 a^2 b(m + n)(m^2 - mn + n^2)$   
*mcm*  $2^2 \cdot 3a^2 b(m + n)^3(m^2 - mn + n^2)$   
 $\Rightarrow 12a^2 b(m + n)^3(m^2 - mn + n^2)$
20.  $ax(m - n)^3 = ax(m - n)^3$   
 $x^3(m^3 - n^3) = x^3(m - n)(m^2 + mn + n^2)$   
*mcm*  $ax^3(m - n)^3(m^2 + mn + n^2)$
21.  $2a^2 + 2a = 2a(a + 1)$   
 $3a^2 - 3a = 3a(a - 1)$   
 $a^4 - a^2 = a^2(a^2 - 1) = a^2(a + 1)(a - 1)$   
*mcm*  $2 \cdot 3a^2(a + 1)(a - 1) \Rightarrow 6a^2(a^2 - 1)$
22.  $x^2 + 2x = x(x + 2)$   
 $x^3 - 2x^2 = x^2(x - 2)$   
 $x^2 - 4 = (x + 2)(x - 2)$   
*mcm*  $x^2(x - 2)(x + 2) \Rightarrow x^2(x^2 - 4)$
23.  $x^2 + x - 2 = (x + 2)(x - 1)$   
 $x^2 - 4x + 3 = (x - 3)(x - 1)$   
 $x^2 - x - 6 = (x - 3)(x + 2)$   
*mcm*  $(x + 2)(x - 1)(x - 3)$
24.  $4 + 12a + 9a^2 = (2 + 3a)^2$   
 $3a^2 + 14a + 8 = (3a)^2 + 14(3a) + 24$   
 $= [(3a + 12)(3a + 2)] \div 3 = (a + 4)(3a + 2)$   
 $6a^2 + 13a + 6 = (6a)^2 + 13(6a) + 36$   
 $= [(6a + 9)(6a + 4)] \div 3 \cdot 2 = (2a + 3)(3a + 2)$   
*mcm*  $(a + 4)(2a + 3)(3a + 2)^2$
25.  $10x^2 + 10 = 5 \cdot 2(x^2 + 1)$   
 $15x + 15 = 5 \cdot 3(x + 1)$   
 $5x^2 - 5 = 5(x^2 - 1) = 5(x + 1)(x - 1)$   
*mcm*  $5 \cdot 2 \cdot 3(x^2 + 1)(x + 1)(x - 1) \Rightarrow 30(x^2 + 1)(x^2 - 1)$
26.  $ax - 2bx + ay - 2by = x(a - 2b) + y(a - 2b)$   
 $= (x + y)(a - 2b)$   
 $x^2 + xy = x(x + y)$   
 $x^2 - xy = x(x - y)$   
*mcm*  $x(x + y)(x - y)(a - 2b) \Rightarrow x(x^2 - y^2)(a - 2b)$
27.  $4a^2b + 4ab^2 = 2^2 ab(a + b)$   
 $6a - 6b = 2 \cdot 3(a - b)$   
 $15a^2 - 15b^2 = 5 \cdot 3(a^2 - b^2) = 5 \cdot 3(a + b)(a - b)$   
*mcm*  $2^2 \cdot 3 \cdot 5ab(a + b)(a - b) \Rightarrow 60ab(a^2 - b^2)$
28.  $x^2 - 25 = (x + 5)(x - 5)$   
 $x^3 - 125 = (x - 5)(x^2 + 5x + 25)$   
 $2x + 10 = 2(x + 5)$   
*mcm*  $2(x + 5)(x - 5)(x^2 + 5x + 25)$
29.  $a^3b - 6a^2b^2 + 9ab^3 = ab(a^2 - 6ab + 9b^2)$   
 $= ab(a - 3b)^2$   
 $a^2 - 2ab - 3b^2 = (a - 3b)(a + b)$   
 $ab^2 + b^3 = b^2(a + b)$   
*mcm*  $ab^2(a - 3b)^2(a + b)$
30.  $2m^2 + 2mn = 2m(m + n)$   
 $4mn - 4n^2 = 2^2 n(m - n)$   
 $6m^3n - 6mn^3 = 2 \cdot 3mn(m^2 - n^2) = 2 \cdot 3mn(m + n)(m - n)$   
*mcm*  $2^2 \cdot 3mn(m + n)(m - n) \Rightarrow 12mn(m^2 - n^2)$
31.  $20(x^2 - y^2) = 2^2 \cdot 5(x + y)(x - y)$   
 $15(x - y)^2 = 5 \cdot 3(x - y)^2$   
 $12(x + y)^2 = 2^2 \cdot 3(x + y)^2$   
*mcm*  $2^2 \cdot 5 \cdot 3(x + y)^2(x - y)^2 \Rightarrow 60(x + y)^2(x - y)^2$
32.  $ax^2 + 5ax - 14a = a(x^2 + 5x - 14) = a(x + 7)(x - 2)$   
 $x^3 + 14x^2 + 49x = x(x^2 + 14x + 49) = x(x + 7)^2$   
 $x^4 + 7x^3 - 18x^2 = x^2(x^2 + 7x - 18) = x^2(x + 9)(x - 2)$   
*mcm*  $ax^2(x + 7)^2(x - 2)(x + 9)$

33.  $2x^3 - 12x^2 + 18x = 2x(x^2 - 6x + 9) = 2x(x-3)^2$   
 $3x^4 - 27x^2 = 3x^2(x^2 - 9) = 3x^2(x+3)(x-3)$   
 $5x^3 + 30x^2 + 45x = 5x(x^2 + 6x + 9) = 5x(x+3)^2$   
*mcm*  $2 \cdot 3 \cdot 5x^2(x+3)^2(x-3)^2 \Rightarrow 30x^2(x+3)^2(x-3)^2$
34.  $3 - 3a^2 = 3(1 - a^2) = 3(1+a)(1-a)$   
 $6 + 6a = 2 \cdot 3(1+a)$   
 $12 + 12a^2 = 2^2 \cdot 3(1+a^2)$   
 $9 - 9a = 3^2(1-a)$   
*mcm*  $2^2 \cdot 3^2(1+a^2)(1+a)(1-a)$   
 $\Rightarrow 36(1+a^2)(1-a^2) = 36(1-a^4)$
35.  $2(3n-2)^2 = 2(3n-2)^2$   
 $135n^3 - 40 = 5(27n^3 - 8) = 5(3n-2)(9n^2 + 6n + 4)$   
 $12n - 8 = 2^2(3n-2)$   
*mcm*  $5 \cdot 2^2(3n-2)^2(9n^2 + 6n + 4)$   
 $\Rightarrow 20(3n-2)^2(9n^2 + 6n + 4)$
36.  $12mn + 8m - 3n - 2 = 4m(3n+2) - (3n+2)$   
 $= (4m-1)(3n+2)$   
 $48m^2n - 3n + 32m^2 - 2 = 16m^2(3n+2) - (3n+2)$   
 $= (16m^2-1)(3n+2)$   
 $= (4m+1)(4m-1)(3n+2)$   
 $6n^2 - 5n - 6 = (6n)^2 - 5(6n) - 36$   
 $= [(6n-9)(6n+4)] \div 3 \cdot 2$   
 $= (2n-3)(3n+2)$   
*mcm*  $(4m+1)(4m-1)(3n+2)(2n-3)$   
 $\Rightarrow (16m^2-1)(3n+2)(2n-3)$
37.  $15a^2x^5 + 16a^2x^4 - 15a^2x^3 = a^2x^3(15x^2 + 16x - 15)$   
 $= a^2x^3[(15x)^2 + 16(15x) - 225]$   
 $= a^2x^3[(15x+25)(15x-9)] \div 5 \cdot 3$   
 $= a^2x^3(3x+5)(5x-3)$   
 $18x^3 + 60x^2 + 50x = 2x(9x^2 + 30x + 25)$   
 $= 2x[(9x)^2 + 30(9x) + 225]$   
 $= 2x[(9x+15)(9x+15)] \div 3 \cdot 3$   
 $= 2x(3x+5)^2$   
 $12ax^3 + 20ax^2 = 2^2ax^2(3x+5)$   
*mcm*  $= 2^2a^2x^3(3x+5)^2(5x-3)$   
 $= 4a^2x^3(3x+5)^2(5x-3)$
38.  $16 + 8x^2 + x^4 = (4+x^2)^2$   
 $16 - 8x^2 + x^4 = (4-x^2)^2 = (2-x)^2(2+x)^2$   
 $16 - x^4 = (4+x^2)(4-x^2) = (4+x^2)(2+x)(2-x)$   
*mcm*  $(4+x^2)^2(2+x)^2(2-x)^2$
39.  $1 + a^2 = 1 + a^2$   
 $(1+a)^2 = (1+a)^2$   
 $1 + a^3 = (1+a)(1-a+a^2)$   
*mcm*  $(1+a)^2(1-a+a^2)(1+a^2)$
40.  $8n^2 - 10n - 3 = (8n)^2 - 10(8n) - 24$   
 $= [(8n-12)(8n+2)] \div 4 \cdot 2 = (2n-3)(4n+1)$   
 $20n^2 + 13n + 2 = (20n)^2 + 13(20n) + 40$   
 $= [(20n+8)(20n+5)] \div 4 \cdot 5 = (5n+2)(4n+1)$   
 $10n^2 - 11n - 6 = (10n)^2 - 11(10n) - 60$   
 $= [(10n-15)(10n+4)] \div 5 \cdot 2 = (2n-3)(5n+2)$   
*mcm*  $(2n-3)(5n+2)(4n+1)$
41.  $6a^2 + ab - 2b^2 = 36a^2 + 6ab - 12b^2$   
 $= [(6a+4b)(6a-3b)] \div 2 \cdot 3$   
 $= (3a+2b)(2a-b)$   
 $15a^2 + 22ab + 8b^2 = (15a)^2 + 22b(15a) + 120b^2$   
 $= [(15a+12b)(15a+10b)] \div 3 \cdot 5$   
 $= (5a+4b)(3a+2b)$   
 $10a^2 + 3ab - 4b^2 = (10a)^2 + 3b(10a) - 40b^2$   
 $= [(10a+8b)(10a-5b)] \div 2 \cdot 5$   
 $= (5a+4b)(2a-b)$   
*mcm*  $(3a+2b)(2a-b)(5a+4b)$
42.  $12x^2 + 5xy - 2y^2 = (12x)^2 + 5y(12x) - 24y^2$   
 $= [(12x+8y)(12x-3y)] \div 4 \cdot 3$   
 $= (3x+2y)(4x-y)$   
 $15x^2 + 13xy + 2y^2 = (15x)^2 + 13y(15x) + 30y^2$   
 $= [(15x+10y)(15x+3y)] \div 5 \cdot 3$   
 $= (3x+2y)(5x+y)$   
 $20x^2 - xy - y^2 = (20x)^2 - y(20x) - 20y^2$   
 $= [(20x-5y)(20x+4y)] \div 5 \cdot 4$   
 $= (4x-y)(5x+y)$   
*mcm*  $(4x-y)(5x+y)(3x+2y)$

$$\begin{aligned}
 43. \quad & 6b^2x^2 + 6b^2x^3 = 2 \cdot 3b^2x^2(1+x) \\
 & 3a^2x - 3a^2x^2 = 3a^2x(1-x) \\
 1-x^4 &= (1+x^2)(1-x^2) = (1+x^2)(1+x)(1-x) \\
 \text{mcm } & 2 \cdot 3a^2b^2x^2(1+x^2)(1+x)(1-x) \\
 & \Rightarrow 6a^2b^2x^2(1+x^2)(1-x^2)
 \end{aligned}$$

$$\begin{aligned}
 44. \quad & x^4 + 8x - 4x^3 - 32 = x^3(x-4) + 8(x-4) \\
 & = (x^3+8)(x-4) \\
 & = (x+2)(x^2-2x+4)(x-4) \\
 a^2x^4 - 2a^2x^3 - 8a^2x^2 &= a^2x^2(x^2-2x-8) \\
 & = a^2x^2(x-4)(x+2) \\
 2x^4 - 4x^3 + 8x^2 &= 2x^2(x^2-2x+4) \\
 \text{mcm } & 2a^2x^2(x+2)(x^2-2x+4)(x-4)
 \end{aligned}$$

$$\begin{aligned}
 45. \quad & x^4 - 10x^2 + 9 = (x^4 - 10x^2 + 9 + 4x^2 - 4x^2) \\
 & = (x^4 - 6x^2 + 9) - 4x^2 \\
 & = (x^2 - 3)^2 - 4x^2 \\
 & = (x^2 - 2x - 3)(x^2 + 2x - 3) \\
 & = (x-3)(x+1)(x+3)(x-1) \\
 x^2 + 4x + 3 &= (x^2 + 4x + 3 + 1 - 1) \\
 & = (x^2 + 4x + 4) - 1 \\
 & = (x+2)^2 - 1 \\
 & = (x+2+1)(x+2-1) = (x+3)(x+1) \\
 x^2 - 4x + 3 &= (x^2 - 4x + 3 + 1 - 1) \\
 & = (x^2 - 4x + 4) - 1 \\
 & = (x-2)^2 - 1 \\
 & = (x-2+1)(x-2-1) = (x-1)(x-3) \\
 x^3 - 9x + x^2 - 9 &= x^2(x+1) - 9(x+1) \\
 & = (x^2-9)(x+1) \\
 & = (x+3)(x-3)(x+1) \\
 \text{mcm } & (x+3)(x-3)(x+1)(x-1) \Rightarrow (x^2-9)(x^2-1) \\
 46. \quad & 1-a^3 = (1-a)(1+a+a^2) \\
 1-a &= (1-a) \\
 1-a^2 &= (1+a)(1-a) \\
 1-2a+a^2 &= (1-a)^2 \\
 \text{mcm } & (1-a)^2(1+a+a^2)(1+a)
 \end{aligned}$$

$$\begin{aligned}
 47. \quad & a(ab-b^2)^2 = a[b(a-b)]^2 = ab^2(a-b)^2 \\
 & b(a^2+ab)^2 = b[a(a+b)]^2 = a^2b(a+b)^2 \\
 a^4b^2 - a^2b^4 &= a^2b^2(a^2-b^2) = a^2b^2(a+b)(a-b) \\
 & a^2b - ab^2 = ab(a-b) \\
 \text{mcm } & a^2b^2(a+b)^2(a-b)^2
 \end{aligned}$$

$$\begin{aligned}
 48. \quad & m^3 - 27n^3 = (m-3n)(m^2+3mn+9n^2) \\
 & m^2 - 9n^2 = (m-3n)(m+3n) \\
 m^2 - 6mn + 9n^2 &= (m-3n)^2 \\
 m^2 + 3mn + 9n^2 &= (m^2+3mn+9n^2) \\
 \text{mcm } & (m-3n)^2(m^2+3mn+9n^2)(m+3n)
 \end{aligned}$$

### EJERCICIO 118

$$\begin{aligned}
 1. \quad & \frac{a^2}{ab} = \frac{a}{b} & 10. \quad & \frac{21mn^3x^6}{28m^4n^2x^2} = \frac{3nx^4}{4m^3} \\
 2. \quad & \frac{2a}{8a^2b} = \frac{1}{4ab} & 11. \quad & \frac{42a^2c^3n}{26a^4c^5m} = \frac{21n}{13a^2c^2m} \\
 3. \quad & \frac{x^2y^2}{x^3y^3} = \frac{1}{xy} & 12. \quad & \frac{7x^3y^4z^6}{34x^7y^8z^{10}} = \frac{1}{2x^4y^4z^4} \\
 4. \quad & \frac{ax^3}{4x^5y} = \frac{a}{4x^2y} & 13. \quad & \frac{30x^6y^2}{45a^3x^4z^3} = \frac{2x^2y^2}{3a^3z^3} \\
 5. \quad & \frac{6m^2n^3}{3m} = 2mn^3 & 14. \quad & \frac{a^5b^7}{3a^8b^9c} = \frac{1}{3a^3b^2c} \\
 6. \quad & \frac{9x^2y^3}{24a^2x^3y^4} = \frac{3}{8a^2xy} & 15. \quad & \frac{21a^8b^{10}c^{12}}{63a^4bc^2} = \frac{a^4b^9c^{10}}{3} \\
 7. \quad & \frac{8m^4n^3x^2}{24mn^2x^2} = \frac{m^3n}{3} & 16. \quad & \frac{54x^9y^{11}z^{13}}{63x^{10}y^{12}z^{15}} = \frac{6}{7xyz^2} \\
 8. \quad & \frac{12x^3y^4z^5}{32xy^2z} = \frac{3x^2y^2z^4}{8} & 17. \quad & \frac{15a^{12}b^{15}c^{20}}{75a^{11}b^{16}c^{22}} = \frac{a}{5bc^2} \\
 9. \quad & \frac{12a^2b^3}{60a^3b^5x^6} = \frac{1}{5ab^2x^6} & 18. \quad & \frac{75a^7m^5}{100a^3m^{12}n^3} = \frac{3a^4}{4m^7n^3}
 \end{aligned}$$

## EJERCICIO 119

$$1. \frac{3ab}{2a^2x+2a^3} = \frac{3ab}{2a^2(x+a)} = \frac{3b}{2a(x+a)}$$

$$2. \frac{xy}{3x^2y-3xy^2} = \frac{xy}{3xy(x-y)} = \frac{1}{3(x-y)}$$

$$3. \frac{2ax+4bx}{3ay+6by} = \frac{2x(a+2b)}{3y(a+2b)} = \frac{2x}{3y}$$

$$4. \frac{x^2-2x-3}{x-3} = \frac{(x-3)(x+1)}{x-3} = x+1$$

$$5. \frac{10a^2b^3c}{80(a^3-a^2b)} = \frac{a^2b^3c}{8a^2(a-b)} = \frac{b^3c}{8(a-b)}$$

$$6. \frac{x^2-4}{5ax+10a} = \frac{(x+2)(x-2)}{5a(x+2)} = \frac{x-2}{5a}$$

$$7. \frac{3x^2-4x-15}{x^2-5x+6} = \frac{(3x)^2-4(3x)-45}{(x-3)(x-2)} = \frac{[(3x-9)(3x+5)] \div 3}{(x-3)(x-2)} = \frac{(x-3)(3x+5)}{(x-3)(x-2)} = \frac{3x+5}{x-2}$$

$$8. \frac{15a^2bn-45a^2bm}{10a^2b^2n-30a^2b^2m} = \frac{15a^2b(n-3m)}{10a^2b^2(n-3m)} = \frac{3}{2b}$$

$$9. \frac{x^2-y^2}{x^2+2xy+y^2} = \frac{(x+y)(x-y)}{(x+y)^2} = \frac{x-y}{x+y}$$

$$10. \frac{3x^2y+15xy}{x^2-25} = \frac{3xy(x+5)}{(x+5)(x-5)} = \frac{3xy}{x-5}$$

$$11. \frac{a^2-4ab+4b^2}{a^3-8b^3} = \frac{(a-2b)^2}{(a-2b)(a^2+2ab+4b^2)} = \frac{a-2b}{a^2+2ab+4b^2}$$

$$12. \frac{x^3+4x^2-21x}{x^3-9x} = \frac{x(x^2+4x-21)}{x(x^2-9)} = \frac{(x+7)(x-3)}{(x+3)(x-3)} = \frac{x+7}{x+3}$$

$$13. \frac{6x^2+5x-6}{15x^2-7x-2} = \frac{(6x)^2+5(6x)-36}{(15x)^2-7(15x)-30} = \frac{[(6x+9)(6x-4)] \div 3 \cdot 2}{[(15x-10)(15x+3)] \div 5 \cdot 3} = \frac{(2x+3)(3x-2)}{(3x-2)(5x+1)} = \frac{2x+3}{5x+1}$$

$$14. \frac{a^3+1}{a^4-a^3+a-1} = \frac{a^3+1}{a^3(a-1)+(a-1)} = \frac{a^3+1}{(a^3+1)(a-1)} = \frac{1}{a-1}$$

$$15. \frac{2ax+ay-4bx-2by}{ax-4a-2bx+8b} = \frac{2x(a-2b)+y(a-2b)}{x(a-2b)-4(a-2b)} = \frac{(2x+y)(a-2b)}{(x-4)(a-2b)} = \frac{2x+y}{x-4}$$

$$16. \frac{a^2-ab-6b^2}{a^3x-6a^2bx+9ab^2x} = \frac{(a-3b)(a+2b)}{ax(a^2-6b+9b^2)} = \frac{(a-3b)(a+2b)}{ax(a-3b)^2} = \frac{a+2b}{ax(a-3b)}$$

$$17. \frac{m^2+n^2}{m^4-n^4} = \frac{m^2+n^2}{(m^2+n^2)(m^2-n^2)} = \frac{1}{m^2-n^2}$$

$$18. \frac{x^3+y^3}{(x+y)^3} = \frac{(x+y)(x^2-xy+y^2)}{(x+y)^3} = \frac{x^2-xy+y^2}{(x+y)^2}$$

$$19. \frac{(m-n)^2}{m^2-n^2} = \frac{(m-n)^2}{(m+n)(m-n)} = \frac{m-n}{m+n}$$

$$20. \frac{(a-x)^3}{a^3-x^3} = \frac{(a-x)^3}{(a-x)(a^2+ax+x^2)} = \frac{(a-x)^2}{a^2+ax+x^2}$$

$$21. \frac{a^2-a-20}{a^2-7a+10} = \frac{(a-5)(a+4)}{(a-5)(a-2)} = \frac{a+4}{a-2}$$

$$22. \frac{(1-a^2)^2}{a^2+2a+1} = \frac{[(a+1)(1-a)]^2}{(a+1)^2} = (1-a)^2$$

$$23. \frac{a^4b^2-a^2b^4}{a^4-b^4} = \frac{a^2b^2(a^2-b^2)}{(a^2+b^2)(a^2-b^2)} = \frac{a^2b^2}{a^2+b^2}$$

$$24. \frac{x^2-y^2}{x^3-y^3} = \frac{(x+y)(x-y)}{(x-y)(x^2+xy+y^2)} = \frac{x+y}{x^2+xy+y^2}$$

$$25. \frac{24a^3b+8a^2b^2}{36a^4+24a^3b+4a^2b^2}$$

$$= \frac{8a^2b(3a+b)}{4a^2(9a^2+6ab+b^2)} = \frac{2b(3a+b)}{(3a+b)^2} = \frac{2b}{3a+b}$$

$$26. \frac{n^3-n}{n^2-5n-6} = \frac{n(n^2-1)}{(n-6)(n+1)} = \frac{n(n+1)(n-1)}{(n-6)(n+1)} = \frac{n(n-1)}{n-6}$$

$$27. \frac{8n^3+1}{8n^3-4n^2+2n} = \frac{(2n+1)(4n^2-2n+1)}{2n(4n^2-2n+1)} = \frac{2n+1}{2n}$$

$$28. \frac{a^2 - (b-c)^2}{(a+b)^2 - c^2}$$

$$= \frac{(a+b-c)(a-b+c)}{(a+b-c)(a+b+c)} = \frac{a-b+c}{a+b+c}$$

$$29. \frac{(a+b)^2 - (c-d)^2}{(a+c)^2 - (b-d)^2}$$

$$= \frac{(a+b+c-d)(a+b-c+d)}{(a+b+c-d)(a-b+c+d)}$$

$$= \frac{a+b-c+d}{a-b+c+d}$$

$$30. \frac{3x^3 + 9x^2}{x^2 + 6x + 9} = \frac{3x^2(x+3)}{(x+3)^2} = \frac{3x^2}{x+3}$$

$$31. \frac{10a^2(a^3 + b^3)}{6a^4 - 6a^3b + 6a^2b^2}$$

$$= \frac{10a^2(a+b)(a^2 - ab + b^2)}{6a^2(a^2 - ab + b^2)} = \frac{5(a+b)}{3}$$

$$32. \frac{a(4a^2 - 8ab)}{x(3a^2 - 6ab)} = \frac{4a^2(a-2b)}{3ax(a-2b)} = \frac{4a}{3x}$$

$$33. \frac{x^3 - 6x^2}{x^2 - 12x + 36} = \frac{x^2(x-6)}{(x-6)^2} = \frac{x^2}{x-6}$$

$$34. \frac{(x-4y)^2}{x^5 - 64x^2y^3}$$

$$= \frac{(x-4y)^2}{x^2(x^3 - 64y^3)}$$

$$= \frac{(x-4y)^2}{x^2(x-4y)(x^2 + 4xy + 16y^2)}$$

$$= \frac{x-4y}{x^2(x^2 + 4xy + 16y^2)}$$

$$35. \frac{x^3 - 3xy^2}{x^4 - 6x^2y^2 + 9y^4} = \frac{x(x^2 - 3y^2)}{(x^2 - 3y^2)^2} = \frac{x}{x^2 - 3y^2}$$

$$36. \frac{m^3n + 3m^2n + 9mn}{m^3 - 27}$$

$$= \frac{mn(m^2 + 3m + 9)}{(m-3)(m^2 + 3m + 9)} = \frac{mn}{m-3}$$

$$37. \frac{x^4 - 8x^2 + 15}{x^4 - 9} = \frac{(x^2 - 5)(x^2 - 3)}{(x^2 + 3)(x^2 - 3)} = \frac{x^2 - 5}{x^2 + 3}$$

$$38. \frac{a^4 + 6a^2 - 7}{a^4 + 8a^2 - 9} = \frac{(a^2 + 7)(a^2 - 1)}{(a^2 + 9)(a^2 - 1)} = \frac{a^2 + 7}{a^2 + 9}$$

$$39. \frac{3x^2 + 19x + 20}{6x^2 + 17x + 12}$$

$$= \frac{(3x+5)(x+4)}{(6x+8)(6x+9)}$$

$$= \frac{[(3x+5)(3x+4)] \div 3}{[(6x+8)(6x+9)] \div 2 \cdot 3}$$

$$= \frac{(x+5)(3x+4)}{(3x+4)(2x+3)} = \frac{x+5}{2x+3}$$

$$40. \frac{4a^4 - 15a^2 - 4}{a^2 - 8a - 20}$$

$$= \frac{(4a^2)^2 - 15(4a^2) - 16}{(a-10)(a+2)}$$

$$= \frac{[(4a^2 - 16)(4a^2 + 1)] \div 4}{(a-10)(a+2)}$$

$$= \frac{(a^2 - 4)(4a^2 + 1)}{(a-10)(a+2)}$$

$$= \frac{(a+2)(a-2)(4a^2 + 1)}{(a-10)(a+2)}$$

$$= \frac{(a-2)(4a^2 + 1)}{a-10}$$

$$41. \frac{125a + a^4}{2a^3 + 20a^2 + 50a}$$

$$= \frac{a(125 + a^3)}{2a(a^2 + 10a + 25)}$$

$$= \frac{(5+a)(25 - 5a + a^2)}{2(a+5)^2}$$

$$= \frac{a^2 - 5a + 25}{2(a+5)}$$

$$42. \frac{a^2n^2 - 36a^2}{an^2 + an - 30a}$$

$$= \frac{a^2(n^2 - 36)}{a(n^2 + n - 30)}$$

$$= \frac{a(n+6)(n-6)}{(n+6)(n-5)}$$

$$= \frac{a(n-6)}{n-5}$$

$$43. \frac{3m^2 + 5mn - 8n^2}{m^3 - n^3}$$

$$= \frac{(3m+8n)(3m-4n)}{(m-n)(m^2 + mn + n^2)}$$

$$= \frac{[(3m+8n)(3m-4n)] \div 3}{(m-n)(m^2 + mn + n^2)}$$

$$= \frac{(3m+8n)(m-n)}{(m-n)(m^2 + mn + n^2)}$$

$$= \frac{3m+8n}{m^2 + mn + n^2}$$

$$44. \frac{15a^3b - 18a^2b^2}{20a^2b^2 - 24ab^2}$$

$$= \frac{3a^2b(5a-6)}{4ab^2(5a-6)} = \frac{3a}{4b}$$

$$45. \frac{9x^2 - 24x + 16}{9x^4 - 16x^2}$$

$$= \frac{(3x-4)^2}{x^2(9x^2 - 16)}$$

$$= \frac{(3x-4)^2}{x^2(3x+4)(3x-4)} = \frac{3x-4}{x^2(3x+4)}$$

$$46. \frac{16a^2x - 25x}{12a^3 - 7a^2 - 10a}$$

$$= \frac{x(16a^2 - 25)}{a(12a^2 - 7a - 10)}$$

$$= \frac{x(4a+5)(4a-5)}{a[(12a)^2 - 7(12a) - 120]}$$

$$= \frac{x(4a+5)(4a-5)}{a[(12a-15)(12a+8)] \div 3 \cdot 4}$$

$$= \frac{x(4a+5)(4a-5)}{a(4a-5)(3a+2)} = \frac{x(4a+5)}{a(3a+2)}$$

$$47. \frac{8x^4 - xy^3}{4x^4 - 4x^3y + x^2y^2}$$

$$= \frac{x(8x^3 - y^3)}{x^2(4x^2 - 4xy + y^2)}$$

$$= \frac{(2x-y)(4x^2 + 2xy + y^2)}{x(2x-y)^2}$$

$$= \frac{4x^2 + 2xy + y^2}{x(2x-y)}$$

$$\begin{aligned}
 48. \quad & \frac{3an - 4a - 6bn + 8b}{6n^2 - 5n - 4} \\
 &= \frac{3n(a - 2b) - 4(a - 2b)}{(6n)^2 - 5(6n) - 24} \\
 &= \frac{(3n - 4)(a - 2b)}{[(6n - 8)(6n + 3)] \div 2 \cdot 3} \\
 &= \frac{(3n - 4)(a - 2b)}{(3n - 4)(2n + 1)} = \frac{a - 2b}{2n + 1}
 \end{aligned}$$

$$\begin{aligned}
 49. \quad & \frac{x^4 - 49x^2}{x^3 + 2x^2 - 63x} \\
 &= \frac{(x^2 + 7x)(x^2 - 7x)}{x(x^2 + 2x - 63)} \\
 &= \frac{x^2(x + 7)(x - 7)}{x(x + 9)(x - 7)} = \frac{x(x + 7)}{x + 9}
 \end{aligned}$$

$$\begin{aligned}
 50. \quad & \frac{x^4 + x - x^3y - y}{x^3 - x - x^2y + y} \\
 &= \frac{x^3(x - y) + (x - y)}{x^2(x - y) - (x - y)} \\
 &= \frac{(x^3 + 1)(x - y)}{(x^2 - 1)(x - y)} \\
 &= \frac{(x + 1)(x^2 - x + 1)}{(x + 1)(x - 1)} \\
 &= \frac{x^2 - x + 1}{x - 1}
 \end{aligned}$$

$$\begin{aligned}
 51. \quad & \frac{2x^3 + 6x^2 - x - 3}{x^3 + 3x^2 + x + 3} \\
 &= \frac{2x^2(x + 3) - (x + 3)}{x^2(x + 3) + (x + 3)} \\
 &= \frac{(2x^2 - 1)(x + 3)}{(x^2 + 1)(x + 3)} = \frac{2x^2 - 1}{x^2 + 1}
 \end{aligned}$$

$$\begin{aligned}
 52. \quad & \frac{a^3m - 4am + a^3n - 4an}{a^4 - 4a^3 - 12a^2} \\
 &= \frac{am(a^2 - 4) + an(a^2 - 4)}{a^2(a^2 - 4a - 12)} \\
 &= \frac{a(m + n)(a^2 - 4)}{a^2(a - 6)(a + 2)} \\
 &= \frac{(m + n)(a + 2)(a - 2)}{a(a - 6)(a + 2)} \\
 &= \frac{(m + n)(a - 2)}{a(a - 6)}
 \end{aligned}$$

$$\begin{aligned}
 53. \quad & \frac{4a^2 - (x - 3)^2}{(2a + x)^2 - 9} \\
 &= \frac{(2a + x - 3)(2a - x + 3)}{(2a + x + 3)(2a + x - 3)} \\
 &= \frac{2a - x + 3}{2a + x + 3}
 \end{aligned}$$

$$\begin{aligned}
 54. \quad & \frac{m - am + n - an}{1 - 3a + 3a^2 - a^3} \\
 &= \frac{m(1 - a) + n(1 - a)}{(1 - a^3) - 3a(1 - a)} \\
 &= \frac{(m + n)(1 - a)}{(1 - a)(1 + a + a^2) - 3a(1 - a)} \\
 &= \frac{(m + n)(1 - a)}{(1 - a)(1 - 2a + a^2)} \\
 &= \frac{m + n}{a^2 - 2a + 1} = \frac{m + n}{(a - 1)^2}
 \end{aligned}$$

$$\begin{aligned}
 55. \quad & \frac{6x^2 + 3}{42x^5 - 9x^3 - 15x} \\
 &= \frac{3(2x^2 + 1)}{3x(14x^4 - 3x^2 - 5)} \\
 &= \frac{2x^2 + 1}{x[(14x^2)^2 - 3(14x^2) - 70]} \\
 &= \frac{2x^2 + 1}{x[(14x^2 - 10)(14x^2 + 7)] \div 2 \cdot 7} \\
 &= \frac{2x^2 + 1}{x(7x^2 - 5)(2x^2 + 1)} = \frac{1}{x(7x^2 - 5)}
 \end{aligned}$$

$$\begin{aligned}
 56. \quad & \frac{a^2 - a^3 - 1 + a}{a^2 + 1 - a^3 - a} \\
 &= \frac{a^2(1 - a) - (1 - a)}{a^2(1 - a) + (1 - a)} \\
 &= \frac{(a^2 - 1)(1 - a)}{(a^2 + 1)(1 - a)} = \frac{a^2 - 1}{a^2 + 1}
 \end{aligned}$$

$$\begin{aligned}
 57. \quad & \frac{8x^3 + 12x^2y + 6xy^2 + y^3}{6x^2 + xy - y^2} \\
 &= \frac{6xy(2x + y) + (8x^3 + y^3)}{(6x)^2 + y(6x) - 6y^2} \\
 &= \frac{6xy(2x + y) + (2x + y)(4x^2 - 2xy + y^2)}{[(6x + 3y)(6x - 2y)] \div 3 \cdot 2} \\
 &= \frac{(2x + y)(4x^2 + 4xy + y^2)}{(2x + y)(3x - y)} = \frac{(2x + y)^2}{3x - y}
 \end{aligned}$$

$$\begin{aligned}
 58. \quad & \frac{8n^3 - 125}{25 - 20n + 4n^2} \\
 &= \frac{(2n - 5)(4n^2 + 10n + 25)}{(2n - 5)^2} \\
 &= \frac{4n^2 + 10n + 25}{2n - 5}
 \end{aligned}$$

$$\begin{aligned}
 59. \quad & \frac{6 - x - x^2}{15 + 2x - x^2} \\
 &= \frac{-(x^2 + x - 6)}{-(x^2 - 2x - 15)} \\
 &= \frac{(x + 3)(x - 2)}{(x - 5)(x + 3)} = \frac{x - 2}{x - 5}
 \end{aligned}$$

$$\begin{aligned}
 60. \quad & \frac{3 + 2x - 8x^2}{4 + 5x - 6x^2} \\
 &= \frac{-(8x^2 - 2x - 3)}{-(6x^2 - 5x - 4)} \\
 &= \frac{(8x)^2 - 2(8x) - 24}{(6x)^2 - 5(6x) - 24} \\
 &= \frac{[(8x - 6)(8x + 4)] \div 2 \cdot 4}{[(6x - 8)(6x + 3)] \div 2 \cdot 3} \\
 &= \frac{(4x - 3)(2x + 1)}{(3x - 4)(2x + 1)} = \frac{4x - 3}{3x - 4}
 \end{aligned}$$

$$\begin{aligned}
 61. \quad & \frac{m^2n^2 + 3mn - 10}{4 - 4mn + m^2n^2} \\
 &= \frac{(mn + 5)(mn - 2)}{(mn - 2)^2} = \frac{mn + 5}{mn - 2}
 \end{aligned}$$

$$\begin{aligned}
 62. \quad & \frac{x^3 + x^2y - 4b^2x - 4b^2y}{4b^2 - 4bx + x^2} \\
 &= \frac{x^2(x + y) - 4b^2(x + y)}{(2b - x)^2} \\
 &= \frac{(x^2 - 4b^2)(x + y)}{(x - 2b)^2} \\
 &= \frac{(x + 2b)(x - 2b)(x + y)}{(x - 2b)^2} \\
 &= \frac{(x + 2b)(x + y)}{x - 2b}
 \end{aligned}$$

$$\begin{aligned}
 63. \quad & \frac{x^6 + x^3 - 2}{x^4 - x^3y - x + y} \\
 &= \frac{(x^3 + 2)(x^3 - 1)}{x^3(x - y) - (x - y)} \\
 &= \frac{(x^3 + 2)(x^3 - 1)}{(x^3 - 1)(x - y)} = \frac{x^3 + 2}{x - y}
 \end{aligned}$$

$$\begin{aligned}
 64. \quad & \frac{(x^2 - x - 2)(x^2 - 9)}{(x^2 - 2x - 3)(x^2 + x - 6)} \\
 &= \frac{(x - 2)(x + 1)(x + 3)(x - 3)}{(x - 3)(x + 1)(x + 3)(x - 2)} = 1
 \end{aligned}$$

$$\begin{aligned}
 65. \quad & \frac{(a^2 - 4a + 4)(4a^2 - 4a + 1)}{(a^2 + a - 6)(2a^2 - 5a + 2)} \\
 &= \frac{(a - 2)^2(2a - 1)^2}{(a + 3)(a - 2)[(2a)^2 - 5(2a) + 4]} \\
 &= \frac{(a - 2)(2a - 1)^2}{(a + 3)[(2a - 4)(2a - 1)] \div 2} \\
 &= \frac{(a - 2)(2a - 1)^2}{(a + 3)(a - 2)(2a - 1)} = \frac{2a - 1}{a + 3}
 \end{aligned}$$

$$\begin{aligned}
 66. \quad & \frac{(x^3 - 3x)(x^3 - 1)}{(x^4 + x^3 + x^2)(x^2 - 1)} \\
 &= \frac{x(x^2 - 3)(x - 1)(x^2 + x + 1)}{x^2(x^2 + x + 1)(x + 1)(x - 1)} \\
 &= \frac{x^2 - 3}{x(x + 1)}
 \end{aligned}$$

$$\begin{aligned}
 67. \quad & \frac{(4n^2 + 4n - 3)(n^2 + 7n - 30)}{(2n^2 - 7n + 3)(4n^2 + 12n + 9)} \\
 &= \frac{[(4n)^2 + 4(4n) - 12](n + 10)(n - 3)}{[(2n)^2 - 7(2n) + 6](2n + 3)^2} \\
 &= \frac{(n + 10)(n - 3)[(4n + 6)(4n - 2)] \div 2 \cdot 2}{(2n + 3)^2 [(2n - 6)(2n - 1)] \div 2} \\
 &= \frac{(n + 10)(n - 3)(2n + 3)(2n - 1)}{(2n + 3)^2 (n - 3)(2n - 1)} = \frac{n + 10}{2n + 3}
 \end{aligned}$$

$$\begin{aligned}
 68. \quad & \frac{(x^6 - y^6)(x + y)}{(x^3 - y^3)(x^3 + x^2y + xy^2 + y^3)} \\
 &= \frac{(x^3 + y^3)(x^3 - y^3)(x + y)}{(x^3 - y^3)[x^2(x + y) + y^2(x + y)]} \\
 &= \frac{(x^3 + y^3)(x + y)}{(x^2 + y^2)(x + y)} = \frac{x^3 + y^3}{x^2 + y^2}
 \end{aligned}$$

$$\begin{aligned}
 69. \quad & \frac{x^3 + 3x^2 - 4}{x^3 + x^2 - 8x - 12} \\
 & \begin{array}{r|l}
 1 & 3 & 0 & -4 & -2 \\
 -2 & -2 & 4 & & \\
 \hline
 1 & 1 & -2 & 0 & \\
 \hline
 & & & & (x + 2)(x^2 + x - 2) \\
 & & & & = (x + 2)(x + 2)(x - 1) \\
 & & & & = (x + 2)^2(x - 1) \\
 & & & & x^3 + x^2 - 8x - 12 \\
 1 & 1 & -8 & -12 & -2 \\
 -2 & 2 & 12 & & \\
 \hline
 1 & -1 & -6 & 0 & \\
 \hline
 & & & & = (x + 2)(x^2 - x - 6) \\
 & & & & = (x + 2)(x - 3)(x + 2) \\
 & & & & = (x + 2)^2(x - 3) \\
 & & & & \Rightarrow \frac{(x + 2)^2(x - 1)}{(x + 2)^2(x - 3)} = \frac{x - 1}{x - 3}
 \end{array}
 \end{aligned}$$

$$\begin{aligned}
 70. \quad & \frac{x^3 - x^2 - 8x + 12}{x^3 - x^2 - 8x + 12} \\
 & \begin{array}{r|l}
 1 & -1 & -8 & 12 & 2 \\
 2 & 2 & -12 & & \\
 \hline
 1 & 1 & -6 & 0 & \\
 \hline
 & & & & = (x - 2)(x^2 + x - 6) \\
 & & & & = (x - 2)(x + 3)(x - 2) \\
 & & & & = (x - 2)^2(x + 3) \\
 & & & & x^3 - 2x^3 - 7x^2 + 20x - 12 \\
 1 & -2 & -7 & 20 & -12 & 2 \\
 2 & 0 & -14 & 12 & & \\
 \hline
 1 & 0 & -7 & 6 & 0 & \\
 \hline
 & & & & (x - 2)(x^3 - 7x + 6) \\
 1 & 0 & -7 & 6 & 2 \\
 2 & 4 & -6 & & \\
 \hline
 1 & 2 & -3 & 0 & \\
 \hline
 & & & & = (x - 2)(x - 2)(x^2 + 2x - 3) \\
 & & & & = (x - 2)^2(x + 3)(x - 1) \\
 & & & & \Rightarrow \frac{(x - 2)^2(x + 3)}{(x - 2)^2(x + 3)(x - 1)} \\
 & & & & = \frac{1}{x - 1}
 \end{array}
 \end{aligned}$$

$$\begin{aligned}
 71. \quad & \frac{x^4 - 7x^2 - 2x + 8}{x^4 - 7x^2 - 2x + 8} \\
 & \begin{array}{r|l}
 1 & 0 & -7 & -2 & 8 & -2 \\
 -2 & 4 & 6 & -8 & & \\
 \hline
 1 & -2 & -3 & 4 & 0 & \\
 \hline
 & & & & (x + 2)(x^3 - 2x^2 - 3x + 4) \\
 1 & -2 & -3 & 4 & 1 \\
 1 & -1 & -4 & & \\
 \hline
 1 & -1 & -4 & 0 & \\
 \hline
 & & & & (x + 2)(x - 1)(x^2 - x - 4) \\
 & & & & x^4 - 2x^3 - 9x^2 + 10x + 24 \\
 1 & -2 & -9 & 10 & 24 & -2 \\
 -2 & 8 & 2 & -24 & & \\
 \hline
 1 & -4 & -1 & 12 & 0 & \\
 \hline
 & & & & (x + 2)(x^3 - 4x^2 - x + 12) \\
 1 & -4 & -1 & 12 & 3 \\
 -3 & 3 & 12 & & \\
 \hline
 1 & -1 & -4 & 0 & \\
 \hline
 & & & & (x + 2)(x - 3)(x^2 - x - 4) \\
 & & & & \Rightarrow \frac{(x + 2)(x - 1)(x^2 - x - 4)}{(x + 2)(x - 3)(x^2 - x - 4)} = \frac{x - 1}{x - 3}
 \end{array}
 \end{aligned}$$

$$\begin{aligned}
 72. \quad & \frac{a^5 - a^3 - a^2 + 1}{a^5 - a^3 - a^2 + 1} \\
 &= a^2(a^3 - 1) - (a^3 - 1) \\
 &= (a^2 - 1)(a^3 - 1) \\
 &= (a - 1)^2(a + 1)(a^2 + a + 1) \\
 & \begin{array}{r|l}
 a^5 - 2a^4 - 6a^3 + 8a^2 + 5a - 6 \\
 1 & -2 & -6 & 8 & 5 & -6 & 1 \\
 1 & -1 & -7 & 1 & 6 & & \\
 \hline
 (a - 1)(a^4 - a^3 - 7a^2 + a + 6) \\
 1 & -1 & -7 & 1 & 6 & 1 \\
 1 & 0 & -7 & -6 & & \\
 \hline
 (a - 1)^2(a^3 - 7a - 6) \\
 1 & 0 & -7 & -6 & -1 \\
 -1 & 1 & 6 & & \\
 \hline
 1 & -1 & -6 & 0 & \\
 \hline
 & & & & (a - 1)^2(a + 1)(a^2 - a - 6) \\
 & & & & = (a - 1)^2(a + 1)(a - 3)(a + 2) \\
 & & & & \Rightarrow \frac{(a - 1)^2(a + 1)(a^2 + a + 1)}{(a - 1)^2(a + 1)(a - 3)(a + 2)} \\
 & & & & = \frac{a^2 + a + 1}{(a - 3)(a + 2)}
 \end{array}
 \end{aligned}$$

## EJERCICIO 120

$$1. \frac{4-4x}{6x-6} = \frac{4(1-x)}{6(x-1)} = -\frac{4(x-1)}{6(x-1)} = -\frac{2}{3}$$

$$2. \frac{a^2-b^2}{b^2-a^2} = -\frac{(a^2-b^2)}{(a^2-b^2)} = -1$$

$$3. \frac{m^2-n^2}{(n-m)^2} = \frac{(m+n)(m-n)}{(n-m)(n-m)} = \frac{(m+n)(m-n)}{(m-n)(m-n)} = \frac{m+n}{m-n}$$

$$4. \frac{x^2-x-12}{16-x^2} = \frac{(x-4)(x+3)}{(4-x)(4+x)} = -\frac{(x-4)(x+3)}{(x-4)(4+x)} = -\frac{x+3}{4+x}$$

$$5. \frac{3y-6x}{2mx-my-2nx+ny} = \frac{3(y-2x)}{2x(m-n)-y(m-n)} = \frac{3(y-2x)}{(2x-y)(m-n)} = -\frac{3(2x-y)}{(2x-y)(m-n)} = -\frac{3}{m-n}$$

$$6. \frac{2x^2-9x-5}{10+3x-x^2} = -\frac{[(2x)^2-9(2x)-10]}{x^2-3x-10} = -\frac{(2x-10)(2x+1)}{(x-5)(x+2)} = -\frac{(x-5)(2x+1)}{(x-5)(x+2)} = -\frac{2x+1}{x+2}$$

$$7. \frac{8-a^3}{a^2+2a-8} = \frac{(2-a)(4+2a+a^2)}{(a+4)(a-2)} = -\frac{(a-2)(4+2a+a^2)}{(a+4)(a-2)} = -\frac{a^2+2a+4}{a+4}$$

$$8. \frac{a^2+a-2}{n-an-m+am} = \frac{(a+2)(a-1)}{n(1-a)-m(1-a)} = \frac{(a+2)(a-1)}{(n-m)(1-a)} = \frac{(a+2)(a-1)}{(m-n)(a-1)} = \frac{a+2}{m-n}$$

$$9. \frac{4x^2-4xy+y^2}{5y-10x} = \frac{(2x-y)^2}{5(y-2x)} = -\frac{(2x-y)^2}{5(2x-y)} = -\frac{2x-y}{5}$$

$$10. \frac{3mx-nx-3my+ny}{ny^2-nx^2-3my^2+3mx^2} = \frac{3m(x-y)-n(x-y)}{-3m(y^2-x^2)+n(y^2-x^2)} = \frac{(3m-n)(x-y)}{(3m-n)(y^2-x^2)} = \frac{(3m-n)(x-y)}{(3m-n)(x^2-y^2)} = \frac{x-y}{(x+y)(x-y)} = \frac{1}{x+y}$$

$$11. \frac{9-6x+x^2}{x^2-7x+12} = \frac{(x-3)^2}{(x-4)(x-3)} = \frac{x-3}{x-4}$$

$$12. \frac{a^2-b^2}{b^3-a^3} = \frac{(a+b)(a-b)}{(b-a)(b^2+ab+a^2)} = -\frac{(a+b)(a-b)}{(a-b)(b^2+ab+a^2)} = -\frac{a+b}{b^2+ab+a^2}$$

$$13. \frac{3ax-3bx-6a+6b}{2b-2a-bx+ax} = \frac{3x(a-b)-6(a-b)}{2(b-a)-x(b-a)} = \frac{3(x-2)(a-b)}{(2-x)(b-a)} = \frac{3(x-2)(a-b)}{(x-2)(a-b)} = 3$$

$$14. \frac{a^2-x^2}{x^2-ax-3x+3a} = \frac{(a+x)(a-x)}{x(x-a)-3(x-a)} = \frac{(a+x)(a-x)}{(x-3)(x-a)} = \frac{(a+x)(a-x)}{(3-x)(a-x)} = \frac{a+x}{3-x}$$

$$15. \frac{3bx-6x}{8-b^3} = \frac{3x(b-2)}{(2-b)(4+2b+b^2)} = -\frac{3x(b-2)}{(b-2)(4+2b+b^2)} = -\frac{3x}{4+2b+b^2}$$

$$16. \frac{(1-a)^3}{a-1} = -\frac{(1-a)^3}{(1-a)} = -(1-a)^2$$

$$17. \frac{2x^3-2x^2y-2xy^2}{3y^3+3xy^2-3x^2y} = \frac{2x(x^2-xy-y^2)}{3y(y^2+xy-x^2)} = -\frac{2x(x^2-xy-y^2)}{3y(x^2-xy-y^2)} = -\frac{2x}{3y}$$

$$18. \frac{(a-b)^3}{(b-a)^2} = \frac{(a-b)^3}{(a-b)^2} = a-b$$



$$\begin{aligned}
 19. \quad & \frac{2x^2 - 22x + 60}{75 - 3x^2} \\
 &= \frac{[(2x)^2 - 22(2x) + 120]}{3(25 - x^2)} \\
 &= \frac{(2x - 12)(2x - 10)}{3(5 - x)(5 + x)} \\
 &= \frac{(2x - 12)(x - 5)}{3(5 - x)(5 + x)} = \frac{2(6 - x)(5 - x)}{3(5 - x)(5 + x)} = \frac{2(6 - x)}{3(5 + x)}
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & \frac{6a^2 - 3b^2}{b^4 - 4ab^2 + 4a^2} \\
 &= \frac{3a^2(2a - b^2)}{(b^2 - 2a)^2} = \frac{3a^2(2a - b^2)}{(2a - b^2)(2a - b^2)} = \frac{3a^2}{2a - b^2}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & \frac{(x - y)^2 - z^2}{(y + z) - x^2} \\
 &= \frac{(x - y - z)(x - y + z)}{(y + z - x)(y + z + x)} \\
 &= \frac{(z + y - x)(y - x - z)}{(z + y - x)(y + z + x)} = \frac{y - x - z}{x + y + z}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & \frac{3a^2 - 3ab}{bd - ad - bc + ac} \\
 &= \frac{3a(a - b)}{d(b - a) - c(b - a)} \\
 &= \frac{3a(a - b)}{(d - c)(b - a)} = \frac{3a(a - b)}{(c - d)(a - b)} = \frac{3a}{c - d}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & \frac{(x - 5)^3}{125 - x^3} \\
 &= \frac{(x - 5)^3}{(5 - x)(25 + 5x + x^2)} \\
 &= -\frac{(x - 5)^3}{(x - 5)(x^2 + 5x + 25)} = -\frac{(x - 5)^2}{x^2 + 5x + 25}
 \end{aligned}$$

$$24. \quad \frac{13x - 6 - 6x^2}{6x^2 - 13x + 6} = -\frac{(6x^2 - 13x + 6)}{6x^2 - 13x + 6} = -1$$

$$\begin{aligned}
 25. \quad & \frac{2x^3 - 2xy^2 + x^2 - y^2}{2xy^2 + y^2 - 2x^3 - x^2} \\
 &= \frac{2x(x^2 - y^2) + (x^2 - y^2)}{y^2(2x + 1) - x^2(2x + 1)} \\
 &= \frac{(2x + 1)(x^2 - y^2)}{(2x + 1)(y^2 - x^2)} = -\frac{(x^2 - y^2)}{(x^2 - y^2)} = -1
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & \frac{30x^2y - 45xy^2 - 20x^3}{8x^3 + 27y^3} \\
 &= \frac{5x(6xy - 9y^2 - 4x^2)}{(2x + 3y)(4x^2 - 6xy + 9y^2)} \\
 &= -\frac{5x(4x^2 - 6xy + 9y^2)}{(2x + 3y)(4x^2 - 6xy + 9y^2)} = -\frac{5x}{2x + 3y}
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & \frac{n + 1 - n^3 - n^2}{n^3 - n - 2n^2 + 2} \\
 &= \frac{(n + 1) - n^2(n + 1)}{n(n^2 - 1) - 2(n^2 - 1)} \\
 &= \frac{(1 - n^2)(n + 1)}{(n - 2)(n^2 - 1)} = \frac{(1 - n^2)(n + 1)}{(2 - n)(1 - n^2)} = \frac{n + 1}{2 - n}
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & \frac{(x - 2)^2(x^2 + x - 12)}{(2 - x)(3 - x)^2} \\
 &= \frac{(2 - x)^2(x + 4)(x - 3)}{(2 - x)(3 - x)^2} \\
 &= \frac{(x - 2)(x + 4)(3 - x)}{(3 - x)^2} = \frac{(x - 2)(x + 4)}{3 - x}
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & \frac{5x^3 - 15x^2y}{90x^3y^2 - 10x^5} \\
 &= \frac{5x^2(x - 3y)}{10x^3(9y^2 - x^2)} \\
 &= \frac{(x - 3y)}{2x(3y - x)(3y + x)} \\
 &= -\frac{x - 3y}{2x(x - 3y)(3y + x)} = \frac{-1}{2x(3y + x)}
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & \frac{(x^2 - 1)(x^2 - 8x + 16)}{(x^2 - 4x)(1 - x^2)} \\
 &= \frac{(x + 1)(x - 1)(x - 4)(x - 4)}{x(x - 4)(1 + x)(1 - x)} = \frac{(1 - x)(4 - x)}{x(1 - x)} = \frac{4 - x}{x}
 \end{aligned}$$

## EJERCICIO 121

1.  $\frac{a^4 - a^3x + a^2x^2 - ax^3}{a^4 - a^3x - 2a^2x^2 + 2ax^3}$  Factor común a

$$\begin{array}{r|l} a^3 - a^2x + ax^2 - x^3 & a^3 - a^2x - 2ax^2 + 2x^3 \\ -a^3 + a^2x + 2ax^2 - 2x^3 & 1 \end{array}$$

$$3ax^2 - 3x^3 \div 3x^2$$

$$\begin{array}{r|l} a^3 - a^2x - 2ax^2 + 2x^3 & a - x \\ -a^3 + a^2x & a^2 - 2x^2 \end{array}$$

$$-2ax^2 + 2x^3 \quad mcd = a(a - x)$$

$$+ 2ax^2 - 2x^3 \quad = a^2 - ax$$

$$\begin{array}{r|l} a^4 - a^3x + a^2x^2 - ax^3 & a^2 - ax \\ -a^4 + a^3x & a^2 + x^2 \end{array}$$

$$a^2x^2 - ax^3$$

$$-a^2x^2 + ax^3$$

$$\begin{array}{r|l} a^4 - a^3x - 2a^2x^2 + 2ax^3 & a^2 - ax \\ -a^4 + a^3x & a^2 - 2x^2 \end{array}$$

$$-2a^2x^2 + 2ax^3$$

$$+ 2a^2x^2 - 2ax^3$$

$$= \frac{a^2 + x^2}{a^2 - 2x^2} \text{ Rta.}$$

2.  $\frac{x^4 + 3x^3 + 4x^2 - 3x - 5}{x^4 + 3x^3 + 6x^2 + 3x + 5}$

$$\begin{array}{r|l} x^4 + 3x^3 + 4x^2 - 3x - 5 & x^4 + 3x^3 + 6x^2 + 3x + 5 \\ -x^4 - 3x^3 - 6x^2 - 3x - 5 & 1 \end{array}$$

$$-2x^2 - 6x - 10 \quad \div -2$$

$$\begin{array}{r|l} x^4 + 3x^3 + 6x^2 + 3x + 5 & x^2 + 3x + 5 \\ -x^4 - 3x^3 - 5x^2 & x^2 \end{array}$$

$$x^2 + 3x + 5$$

$$\begin{array}{r|l} x^2 + 3x + 5 & x^2 + 3x + 5 \\ -x^2 - 3x - 5 & 1 \end{array} \quad mcd \quad x^2 + 3x + 5$$

$$\Rightarrow \begin{array}{r|l} x^4 + 3x^3 + 4x^2 - 3x - 5 & x^2 + 3x + 5 \\ -x^4 - 3x^3 - 5x^2 & x^2 - 1 \end{array}$$

$$-x^2 - 3x - 5$$

$$x^2 + 3x + 5$$

$$\begin{array}{r|l} x^4 + 3x^3 + 6x^2 + 3x + 5 & x^2 + 3x + 5 \\ -x^4 - 3x^3 - 5x^2 & x^2 + 1 \end{array}$$

$$x^2 + 3x + 5$$

$$-x^2 - 3x - 5$$

$$= \frac{x^2 - 1}{x^2 + 1} \text{ Rta.}$$

3.  $\frac{2ax^4 - ax^3 - ax^2 - 2ax + 2a(3)}{3ax^4 - 4ax^3 + ax^2 + 3ax - 3a(2)}$  Factor común a

$$\begin{array}{r|l} 6x^4 - 3x^3 - 3x^2 - 6x + 6 & 6x^4 - 8x^3 + 2x^2 + 6x - 6 \quad (5) \\ -6x^4 + 8x^3 - 2x^2 - 6x + 6 & 1 \end{array}$$

$$5x^3 - 5x^2 - 12x + 12 \quad (6)$$

$$\begin{array}{r|l} 30x^4 - 40x^3 + 10x^2 + 30x - 30 & 30x^3 - 30x^2 - 72x + 72 \quad (\div 6) \\ -30x^4 + 30x^3 + 72x^2 - 72x & x \end{array}$$

$$-10x^3 + 82x^2 - 42x - 30 \quad (\div -2)$$

$$\begin{array}{r|l} 5x^3 - 5x^2 - 12x + 12 & 5x^3 - 41x^2 + 21x + 15 \quad (12) \\ -5x^3 + 41x^2 - 21x - 15 & 1 \end{array}$$

$$36x^2 - 33x - 3 \quad (\div 3)$$

$$\begin{array}{r|l} 60x^3 - 492x^2 + 252x + 180 & 12x^2 - 11x - 1 \quad (437) \\ -60x^3 + 55x^2 + 5x & 5x \end{array}$$

$$-437x^2 + 257x + 180 \quad (-12)$$

$$\begin{array}{r|l} 5.244x^2 - 4.807x - 437 & 5.244x^2 - 3.084x - 2.160 \quad (\div 12) \\ -5.244x^2 + 3.084x + 2.160 & 1 \end{array}$$

$$-1723x + 1723 \quad (\div -1.723)$$

$$\begin{array}{r|l} 437x^2 - 257x - 180 & x - 1 \\ -437x^2 + 437x & 437x \end{array}$$

$$180x - 180 \quad (\div 180)$$

$$\begin{array}{r|l} x - 1 & x - 1 \\ -x + 1 & 1 \end{array} \quad mcd = a(x - 1) = ax - a$$

$$\Rightarrow \begin{array}{r|l} 2ax^4 - ax^3 - ax^2 - 2ax + 2a & ax - a \\ -2ax^4 + 2ax^3 & 2x^3 + x^2 - 2 \end{array}$$

$$ax^3 - ax^2$$

$$-ax^3 + ax^2$$

$$-2ax + 2a$$

$$+ 2ax - 2a$$

$$\begin{array}{r|l} 3ax^4 - 4ax^3 + ax^2 + 3ax - 3a & ax - a \\ -3ax^4 + 3ax^3 & 3x^3 - x^2 + 3 \end{array}$$

$$-ax^3 + ax^2$$

$$+ ax^3 - ax^2$$

$$3ax - 3a$$

$$-3ax + 3a$$

$$= \frac{2x^3 + x^2 - 2}{3x^3 - x^2 + 3} \text{ Rta.}$$

$$\begin{array}{r}
 4. \quad \frac{6x^3 - 13x^2 + 18x - 8}{10x^3 - 9x^2 + 11x + 12} \quad (10) \\
 \frac{60x^3 - 130x^2 + 180x - 80}{-60x^3 + 54x^2 - 66x - 72} \quad \left| \frac{60x^3 - 54x^2 + 66x + 72}{1} \right. \quad (\div 6) \\
 \hline
 -76x^2 + 114x - 152 \quad (\div -38) \\
 \frac{10x^3 - 9x^2 + 11x + 12}{-10x^3 + 15x^2 - 20x} \quad \left| \frac{2x^2 - 3x + 4}{5x} \right. \\
 \hline
 6x^2 - 9x + 12 \quad (\div 3) \\
 \frac{2x^2 - 3x + 4}{-2x^2 + 3x - 4} \quad \left| \frac{2x^2 - 3x + 4}{1} \right. \\
 \hline
 \text{mcd} = 2x^2 - 3x + 4 \\
 \\
 \frac{6x^3 - 13x^2 + 18x - 8}{-6x^3 + 9x^2 - 12x} \quad \left| \frac{2x^2 - 3x + 4}{3x - 2} \right. \\
 \hline
 -4x^2 + 6x - 8 \\
 +4x^2 - 6x + 8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \frac{10x^3 - 9x^2 + 11x + 12}{-10x^3 + 15x^2 - 20x} \quad \left| \frac{2x^2 - 3x + 4}{5x + 3} \right. \\
 \hline
 6x^2 - 9x + 12 \\
 -6x^2 + 9x - 12 \\
 \hline
 = \frac{3x - 2}{5x + 3} \quad \text{Rta.}
 \end{array}$$

$$\begin{array}{r}
 5. \quad \frac{x^4 - 2x^3y + 2x^2y^2 - xy^3}{2x^4 - 5x^3y + 4x^2y^2 - xy^3} \quad (2) \quad \text{Factor común } x \\
 \frac{2x^3 - 4x^2y + 4xy^2 - 2y^3}{-2x^3 + 5x^2y - 4xy^2 + y^3} \quad \left| \frac{2x^3 - 5x^2y + 4xy^2 - y^3}{1} \right. \\
 \hline
 x^2y - y^3 \quad (\div y) \\
 \frac{2x^3 - 5x^2y + 4xy^2 - y^3}{-2x^3 + 2xy^2} \quad \left| \frac{x^2 - y^2}{2x} \right. \quad (5) \\
 \hline
 -5x^2y + 6xy^2 - y^3 \quad (\div -y) \\
 \frac{5x^2 - 5y^2}{-5x^2 + 6xy - y^2} \quad \left| \frac{5x^2 - 6xy + y^2}{1} \right. \\
 \hline
 6xy - 6y^2 \quad (\div 6y) \\
 \frac{5x^2 - 6xy + y^2}{-5x^2 + 5xy} \quad \left| \frac{x - y}{5x} \right. \\
 \hline
 -xy + y^2 \quad (\div -y) \\
 \frac{x - y}{-x + y} \quad \left| \frac{x - y}{1} \right. \\
 \hline
 \text{mcd } x(x - y) = x^2 - xy
 \end{array}$$

Continúa

### Continuación

$$\begin{array}{r}
 5. \quad \frac{x^4 - 2x^3y + 2x^2y^2 - xy^3}{-x^4 + x^3y} \quad \left| \frac{x^2 - xy}{x^2 - xy + y^2} \right. \\
 \hline
 -x^3y + 2x^2y^2 - xy^3 \\
 +x^3y - x^2y^2 \\
 \hline
 x^2y^2 - xy^3 \\
 -x^2y^2 + xy^3 \\
 \hline
 \\
 \frac{2x^4 - 5x^3y + 4x^2y^2 - xy^3}{-2x^4 + 2x^3y} \quad \left| \frac{x^2 - xy}{2x^2 - 3xy + y^2} \right. \\
 \hline
 -3x^3y + 4x^2y^2 \\
 +3x^3y - 3x^2y^2 \\
 \hline
 x^2y^2 - xy^3 \\
 -x^2y^2 + xy^3 \\
 \hline
 = \frac{x^2 - xy + y^2}{2x^2 - 3xy + y^2} \quad \text{Rta.}
 \end{array}$$

$$\begin{array}{r}
 6. \quad \frac{2a^5 - a^4 + 2a^3 + 2a^2 + 3}{3a^5 - a^4 + 3a^3 + 4a^2 + 5} \quad (3) \\
 \frac{6a^5 - 3a^4 + 6a^3 + 6a^2 + 9}{-6a^5 + 2a^4 - 6a^3 - 8a^2 - 10} \quad \left| \frac{6a^5 - 2a^4 + 6a^3 + 8a^2 + 10}{1} \right. \quad (\div 2) \\
 \hline
 -a^4 - 2a^2 - 1 \quad (\div -1) \\
 \frac{3a^5 - a^4 + 3a^3 + 4a^2 + 5}{-3a^5 - 6a^3 - 3a} \quad \left| \frac{a^4 + 2a^2 + 1}{3a} \right. \\
 \hline
 -a^4 - 3a^3 + 4a^2 - 3a + 5 \quad (-1) \\
 \frac{a^4 + 2a^2 + 1}{-a^4 - 3a^3 + 4a^2 - 3a + 5} \quad \left| \frac{a^4 + 3a^3 - 4a^2 + 3a - 5}{1} \right. \\
 \hline
 -3a^3 + 6a^2 - 3a + 6 \quad (\div -3) \\
 \frac{a^4 + 3a^3 - 4a^2 + 3a - 5}{-a^4 + 2a^3 - a^2 + 2a} \quad \left| \frac{a^3 - 2a^2 + a - 2}{a} \right. \\
 \hline
 5a^3 - 5a^2 + 5a - 5 \quad (\div 5) \\
 \frac{a^3 - 2a^2 + a - 2}{-a^3 + a^2 - a + 1} \quad \left| \frac{a^3 - a^2 + a - 1}{1} \right. \\
 \hline
 -a^2 - 1 \quad (\div -1) \\
 \frac{a^3 - a^2 + a - 1}{-a^3 - a} \quad \left| \frac{a^2 + 1}{a} \right. \\
 \hline
 -a^2 - 1 \quad (\div -1) \\
 \frac{a^2 + 1}{-a^2 - 1} \quad \left| \frac{a^2 + 1}{1} \right. \\
 \hline
 \text{mcd} = a^2 + 1
 \end{array}$$

Continúa

**Continuación**

$$\begin{array}{r|l}
 6. \Rightarrow 2a^5 - a^4 + 2a^3 + 2a^2 + 3 & a^2 + 1 \\
 -2a^5 & -2a^3 \\
 \hline
 -a^4 & +2a^2 + 3 \\
 +a^4 & +a^2 \\
 \hline
 & 3a^2 + 3 \\
 & -3a^2 - 3 \\
 \hline
 \end{array}$$

$$\begin{array}{r|l}
 3a^5 - a^4 + 3a^3 + 4a^2 + 5 & a^2 + 1 \\
 -3a^5 & -3a^3 \\
 \hline
 -a^4 & +4a^2 + 5 \\
 +a^4 & +a^2 \\
 \hline
 & 5a^2 + 5 \\
 & -5a^2 - 5 \\
 \hline
 \end{array}$$

$$= \frac{2a^3 - a^2 + 3}{3a^3 - a^2 + 5} \text{ Rta.}$$

$$\begin{array}{r|l}
 7. \quad 1 - x & -x^3 + x^4 \\
 -1 + 2x + x^2 + 2x^3 - x^4 & 1 \\
 \hline
 x + x^2 + x^3 & (\div x) \\
 1 - 2x - x^2 - 2x^3 + x^4 & \frac{1 + x + x^2}{3} \quad (3) \\
 -1 - x - x^2 & 1 \\
 \hline
 -3x - 2x^2 - 2x^3 + x^4 & (\div -x) \\
 3 + 3x + 3x^2 & \frac{3 + 2x + 2x^2 - x^3}{1} \\
 -3 - 2x - 2x^2 + x^3 & 1 \\
 \hline
 x + x^2 + x^3 & (\div x) \\
 3 + 2x + 2x^2 - x^3 & \frac{1 + x + x^2}{3} \\
 -3 - 3x - 3x^2 & 3 \\
 \hline
 -x - x^2 - x^3 & (\div -x) \\
 1 + x + x^2 & \frac{1 + x + x^2}{1} \\
 -1 - x - x^2 & 1 \quad \text{mcd} = 1 + x + x^2 \\
 \hline
 \Rightarrow 1 - x & -x^3 + x^4 \\
 -1 - x - x^2 & 1 - 2x + x^2 \\
 \hline
 -2x - x^2 - x^3 + x^4 & \\
 +2x + 2x^2 + 2x^3 & \\
 \hline
 x^2 + x^3 + x^4 & \\
 -x^2 - x^3 - x^4 & \\
 \hline
 \end{array}$$

**Continúa**

**Continuación**

$$\begin{array}{r|l}
 7. \quad 1 - 2x - x^2 - 2x^3 + x^4 & 1 + x + x^2 \\
 -1 - x - x^2 & 1 - 3x + x^2 \\
 \hline
 -3x - 2x^2 - 2x^3 + x^4 & \\
 +3x + 3x^2 + 3x^3 & \\
 \hline
 x^2 + x^3 + x^4 & \\
 -x^2 - x^3 - x^4 & \\
 \hline
 \end{array}$$

$$= \frac{1 - 2x + x^2}{1 - 3x + x^2} \text{ Rta.}$$

$$\begin{array}{l}
 8. \quad 2m^3 + 2m^2n - mn^2 - n^3 \\
 = m(2m^2 - n^2) + n(2m^2 - n^2) = (m+n)(2m^2 - n^2) \\
 3m^3 + 3m^2n + mn^2 + n^3 \\
 = m(3m^2 + n) + n(3m^2 + n) = (m+n)(3m^2 + n) \\
 \text{mcd} = m + n
 \end{array}$$

$$\begin{array}{r|l}
 2m^3 + 2m^2n - mn^2 - n^3 & m + n \\
 -2m^3 - 2m^2n & 2m^2 - n^2 \\
 \hline
 -mn^2 - n^3 & \\
 +mn^2 + n^3 & \\
 \hline
 \end{array}$$

$$\begin{array}{r|l}
 3m^3 + 3m^2n + mn^2 + n^3 & m + n \\
 -3m^3 - 3m^2n & 3m^2 + n \\
 \hline
 mn^2 + n^3 & \\
 -mn^2 - n^3 & \\
 \hline
 \end{array}$$

$$= \frac{2m^2 - n^2}{3m^2 + n} \text{ Rta.}$$

$$\begin{array}{r|l}
 9. \quad \frac{6a^5 + 3a^4 - 4a^3 - 2a^2 + 10a + 5}{3a^6 + 7a^4 - a^2 + 15} \quad (2) \\
 6a^6 & +14a^4 & -2a^2 & +30 & \frac{6a^5 + 3a^4 - 4a^3 - 2a^2 + 10a + 5}{a} \\
 -6a^6 - 3a^5 + 4a^4 + 2a^3 - 10a^2 - 5a & & & & a \\
 \hline
 -3a^5 + 18a^4 + 2a^3 - 12a^2 - 5a + 30 & & & & (\div -1) \\
 6a^5 + 3a^4 - 4a^3 - 2a^2 + 10a + 5 & & & & \frac{3a^5 - 18a^4 - 2a^3 + 12a^2 + 5a - 30}{2} \\
 -6a^5 + 36a^4 + 4a^3 - 24a^2 - 10a + 60 & & & & \\
 \hline
 39a^4 & -26a^2 & +65 & & (\div 13) \\
 3a^5 - 18a^4 - 2a^3 + 12a^2 + 5a - 30 & & & & \frac{3a^4 - 2a^2 + 5}{a} \\
 -3a^5 & +2a^3 & -5a & & \\
 \hline
 -18a^4 & +12a^2 & -30 & & (\div -6) \\
 3a^4 - 2a^2 + 5 & & & & \frac{3a^4 - 2a^2 + 5}{1} \\
 -3a^4 + 2a^2 - 5 & & & & \\
 \hline
 \end{array}$$

$$\text{mcd} = 3a^4 - 2a^2 + 5$$

**Continúa**

**Continuación**

$$\begin{array}{r|l}
 9. \quad \begin{array}{r} 6a^5+3a^4-4a^3-2a^2+10a+5 \\ -6a^5 \quad +4a^3 \quad -10a \\ \hline 3a^4 \quad -2a^2 \quad +5 \\ -3a^4 \quad +2a^2 \quad -5 \\ \hline \end{array} & \begin{array}{l} \frac{3a^4-2a^2+5}{2a+1} \\ \frac{3a^6+7a^4-a^2+15}{-3a^6+2a^4-5a^2} \\ \frac{3a^4-2a^2+5}{a^2+3} \\ \hline 9a^4-6a^2+15 \\ \hline -9a^4+6a^2-15 \end{array} \\
 \end{array} = \frac{2a+1}{a^2+3} \quad Rta.$$

$$\begin{array}{r|l}
 10. \quad \begin{array}{r} 5x^6-10x^4+21x^3-2x+4 \quad (3) \\ 3x^6-6x^4+11x^3+2x-4 \quad (5) \\ \hline 15x^6-30x^4+63x^3-6x+12 \\ -15x^6+30x^4-55x^3-10x+20 \\ \hline 8x^3-16x+32 \quad (\div 8) \\ \hline 3x^6-6x^4+11x^3+2x-4 \quad | \quad x^3-2x+4 \\ -3x^6+6x^4-12x^3 \quad | \quad 3x^3 \\ \hline -x^3+2x-4 \quad (\div -1) \\ \hline x^3-2x+4 \quad | \quad x^3-2x+4 \\ -x^3+2x-4 \quad | \quad 1 \quad \quad \quad mcd = x^3-2x+4 \end{array} & \\
 \end{array}$$

$$\begin{array}{r|l}
 \begin{array}{r} 5x^6-10x^4+21x^3-2x+4 \quad | \quad x^3-2x+4 \\ -5x^6+10x^4-20x^3 \quad | \quad 5x^3+1 \\ \hline x^3-2x+4 \end{array} & \begin{array}{r} 3x^6-6x^4+11x^3+2x-4 \quad | \quad x^3-2x+4 \\ -3x^6+6x^4-12x^3 \quad | \quad 3x^3-1 \\ \hline -x^3+2x-4 \\ +x^3-2x+4 \\ \hline \end{array} \\
 \end{array} = \frac{5x^3+1}{3x^3-1} \quad Rta.$$

$$\begin{array}{r|l}
 11. \quad \begin{array}{r} n^6-3n^5-n^4+3n^3+7n^2-21n \\ = n^5(n-3)-n^3(n-3)+7n(n-3) = (n-3)(n^5-n^3+7n) \\ n^6+2n^5-n^4-2n^3+7n^2+14n \\ = n^5(n+2)-n^3(n+2)+7n(n+2) = (n+2)(n^5-n^3+7n) \\ \hline \begin{array}{r} n^6-3n^5-n^4+3n^3+7n^2-21n \quad | \quad n^5-n^3+7n \\ -n^6 \quad +n^4 \quad -7n^2 \\ \hline -3n^5 \quad +3n^3 \quad -21n \\ +3n^5 \quad -3n^3 \quad +21n \end{array} & \begin{array}{r} n^5-n^3+7n \\ \hline n-3 \\ \hline \begin{array}{r} n^6+2n^5-n^4-2n^3+7n^2+14n \\ -n^6 \quad +n^4 \quad -7n^2 \\ \hline 2n^5 \quad -2n^3 \quad +14n \\ -2n^5 \quad +2n^3 \quad -14n \end{array} \\ \hline n+2 \end{array} \\
 \end{array} & \\
 \end{array} = \frac{n-3}{n+2} \quad Rta.$$

$$\begin{array}{r|l}
 12. \quad \begin{array}{r} a^7+2a^6-5a^5+8a^4+a^3+2a^2-5a+8 \\ -a^7-2a^6+5a^5-10a^4-4a^3+10a^2-16a \\ \hline -2a^4-3a^3+12a^2-21a+8 \quad (\div -1) \\ \hline 2a^6+4a^5-10a^4+20a^3+8a^2-20a+32 \quad | \quad 2a^4+3a^3-12a^2+21a-8 \quad (a) \\ -2a^6-3a^5+12a^4-21a^3+8a^2 \quad | \quad a^2 \\ \hline a^5+2a^4-a^3+16a^2-20a+32 \\ \hline 2a^5+3a^4-12a^3+21a^2-8a \quad | \quad a^5+2a^4-a^3+16a^2-20a+32 \\ -2a^5-4a^4+2a^3-32a^2+40a-64 \quad | \quad 2 \\ \hline -a^4-10a^3-11a^2+32a-64 \quad (-1) \end{array} & \\
 \end{array}$$

**Continúa**

**Continuación**

$$\begin{array}{r|l}
 12. \quad a^5 + 2a^4 - a^3 + 16a^2 - 20a + 32 & a^4 + 10a^3 + 11a^2 - 32a + 64 \quad (2) \\
 -a^5 - 10a^4 - 11a^3 + 32a^2 - 64a & a \\
 \hline
 -8a^4 - 12a^3 + 48a^2 - 84a + 32 & (\div -4) \\
 2a^4 + 20a^3 + 22a^2 - 64a + 128 & 2a^4 + 3a^3 - 12a^2 + 21a - 8 \\
 -2a^4 - 3a^3 + 12a^2 - 21a + 8 & 1 \\
 \hline
 17a^3 + 34a^2 - 85a + 136 & (\div 17) \\
 2a^4 + 3a^3 - 12a^2 + 21a - 8 & a^3 + 2a^2 - 5a + 8 \\
 -2a^4 - 4a^3 + 10a^2 - 16a & 2a \\
 \hline
 -a^3 - 2a^2 + 5a - 8 & (-1) \\
 a^3 + 2a^2 - 5a + 8 & a^3 + 2a^2 - 5a + 8 \\
 -a^3 - 2a^2 + 5a - 8 & 1
 \end{array}$$

$$mcd = a^3 + 2a^2 - 5a + 8$$

$$\begin{array}{r|l}
 a^7 + 2a^6 - 5a^5 + 8a^4 + a^3 + 2a^2 - 5a + 8 & a^3 + 2a^2 - 5a + 8 \\
 -a^7 - 2a^6 + 5a^5 - 8a^4 & a^4 + 1 \\
 \hline
 a^3 + 2a^2 - 5a + 8 & \\
 -a^3 - 2a^2 + 5a - 8 & \\
 \hline
 & = \frac{a^4 + 1}{a^3 + 2} \quad Rta
 \end{array}$$

**EJERCICIO 122**

$$1. \frac{3}{2a} \cdot \frac{2a}{2a} = \frac{6a}{4a^2}$$

$$2. \frac{5}{9x^2} \cdot \frac{4a}{4a} = \frac{20a}{36ax^2}$$

$$3. \frac{m}{ab^2} \cdot \frac{2a}{2a} = \frac{2am}{2a^2b^2}$$

$$4. \frac{3x}{8y} \cdot \frac{3xy^2}{3xy^2} = \frac{9x^2y^2}{24xy^3}$$

$$5. \frac{4m}{5n^2} \cdot \frac{n}{n} = \frac{4mn}{5n^3}$$

$$6. \frac{2x+7}{5} \cdot \frac{3}{3} = \frac{6x+21}{15}$$

$$7. \frac{2x}{x-1} \cdot \frac{x}{x} = \frac{2x^2}{x^2-x}$$

$$8. \frac{a^2}{a+2} \cdot \frac{2a}{2a} = \frac{2a^3}{2a^2+4a}$$

$$9. \frac{3a}{a+b} \cdot \frac{a+b}{a+b} = \frac{3a^2+3ab}{a^2+2ab+b^2}$$

$$10. \frac{x-4}{x+3} \cdot \frac{x+2}{x+2} = \frac{x^2-2x-8}{x^2+5x+6}$$

$$11. \frac{2a}{x+a} \cdot \frac{a^2}{a^2} = \frac{2a^3}{a^2x+a^3}$$

$$12. \frac{x-y}{6} \cdot \frac{2}{2} = \frac{2x-2y}{12}$$

$$13. \frac{5x}{a-b} \cdot \frac{a+b}{a+b} = \frac{5ax+5bx}{a^2-b^2}$$

$$14. \frac{x-5}{a} \cdot \frac{3x}{3x} = \frac{3x^2-15x}{3ax}$$

$$15. \frac{5x}{2x+y} \cdot \frac{2x+y}{2x+y} = \frac{10x^2+5xy}{4x^2+4xy+y^2}$$

$$16. \frac{x+3}{x+1} \cdot \frac{x-3}{x-3} = \frac{x^2-9}{x^2-2x-3}$$

$$17. \frac{2}{a+1} \cdot \frac{a^2-a+1}{a^2-a+1} = \frac{2a^2-2a+2}{a^3+1}$$

$$18. \frac{x-2y}{3x} \cdot \frac{3xy}{3xy} = \frac{3x^2y-6xy^2}{9x^2y}$$

$$19. \frac{x-1}{x+1} \cdot \frac{x+1}{x+1} = \frac{x^2-1}{x^2+2x+1}$$

$$20. \frac{a+b}{7a^2} \cdot \frac{9ab}{9ab} = \frac{9a^2b+9ab^2}{63a^3b}$$

$$21. \frac{x+1}{x+5} \cdot \frac{x-2}{x-2} = \frac{x^2-x-2}{x^2+3x-10}$$

**EJERCICIO 123**

$$\begin{aligned}
 1. \quad & \frac{6a^3-10a^2}{2a} \\
 & = \frac{6a^3}{2a} - \frac{10a^2}{2a} \\
 & = 3a^2 - 5a
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \frac{9x^3y-6x^2y^2+3xy^3}{3xy} \\
 & = \frac{9x^3y}{3xy} - \frac{6x^2y^2}{3xy} + \frac{3xy^3}{3xy} \\
 & = 3x^2 - 2xy + y^2
 \end{aligned}$$

$$\begin{array}{r|l}
 3. \quad x^2+3 & x \\
 -x^2 & x \\
 \hline
 3 & \\
 & = x + \frac{3}{x}
 \end{array}$$

$$\begin{array}{r|l}
 4. \quad 10a^2+15a-2 & 5a \\
 -10a^2 & 2a+3 \\
 \hline
 15a-2 & \\
 -15a & \\
 \hline
 -2 & \\
 & = 2a+3 - \frac{2}{5a}
 \end{array}$$

$$\begin{array}{r}
 5. \quad \begin{array}{r} 9x^3 - 6x^2 + 3x - 5 \\ -9x^3 \end{array} \Bigg| \begin{array}{r} 3x \\ 3x^2 - 2x + 1 \end{array} \\
 \hline
 \begin{array}{r} -6x^2 \\ +6x^2 \end{array} \\
 \hline
 \begin{array}{r} 3x \\ -3x \end{array} \\
 \hline
 \begin{array}{r} -5 \\ -5 \end{array} \\
 \hline
 = 3x^2 - 2x + 1 - \frac{5}{3x}
 \end{array}$$

$$\begin{array}{r}
 6. \quad \begin{array}{r} x^2 - 5x - 16 \\ -x^2 - 2x \end{array} \Bigg| \begin{array}{r} x + 2 \\ x - 7 \end{array} \\
 \hline
 \begin{array}{r} -7x - 16 \\ +7x + 14 \end{array} \\
 \hline
 \begin{array}{r} -2 \\ -2 \end{array} \\
 \hline
 = x - 7 - \frac{2}{x + 2}
 \end{array}$$

$$\begin{array}{r}
 7. \quad \begin{array}{r} 12x^2 - 6x - 2 \\ -12x^2 + 3x \end{array} \Bigg| \begin{array}{r} 4x - 1 \\ 3x \end{array} \\
 \hline
 \begin{array}{r} -3x - 2 \\ -3x - 2 \end{array} \\
 \hline
 = 3x + \frac{-3x - 2}{4x - 1} = 3x - \frac{3x + 2}{4x - 1}
 \end{array}$$

$$\begin{array}{r}
 8. \quad \begin{array}{r} a^3 \\ -a^3 - 2a^2b \end{array} \Bigg| \begin{array}{r} +3b^3 \\ a + 2b \\ a^2 - 2ab + 4b^2 \end{array} \\
 \hline
 \begin{array}{r} -2a^2b \\ 2a^2b + 4ab^2 \end{array} \\
 \hline
 \begin{array}{r} 4ab^2 + 3b^3 \\ -4ab^2 - 8b^3 \end{array} \\
 \hline
 \begin{array}{r} -5b^3 \\ -5b^3 \end{array} \\
 \hline
 = a^2 - 2ab + 4b^2 - \frac{5b^3}{a + 2b}
 \end{array}$$

$$\begin{array}{r}
 9. \quad \begin{array}{r} x^3 - x^2 - 6x + 1 \\ -x^3 + 3x \end{array} \Bigg| \begin{array}{r} x^2 - 3 \\ x - 1 \end{array} \\
 \hline
 \begin{array}{r} -x^2 - 3x + 1 \\ x^2 - 3 \end{array} \\
 \hline
 \begin{array}{r} -3x - 2 \\ -3x - 2 \end{array} \\
 \hline
 = x - 1 + \frac{-3x - 2}{x^2 - 3} = x - 1 - \frac{3x + 2}{x^2 - 3}
 \end{array}$$

$$\begin{array}{r}
 10. \quad \begin{array}{r} 3x^3 + 4x^2y + 2xy^2 - 6y^3 \\ -3x^3 + 2x^2y \end{array} \Bigg| \begin{array}{r} 3x - 2y \\ x^2 + 2xy + 2y^2 \end{array} \\
 \hline
 \begin{array}{r} 6x^2y + 2xy^2 \\ -6x^2y + 4xy^2 \end{array} \\
 \hline
 \begin{array}{r} 6xy^2 - 6y^3 \\ -6xy^2 + 4y^3 \end{array} \\
 \hline
 \begin{array}{r} -2y^3 \\ -2y^3 \end{array} \\
 \hline
 = x^2 + 2xy + 2y^2 - \frac{2y^3}{3x - 2y}
 \end{array}$$

$$\begin{array}{r}
 11. \quad \begin{array}{r} 2x^3 - 7x^2 + 6x - 8 \\ -2x^3 + x^2 - x \end{array} \Bigg| \begin{array}{r} 2x^2 - x + 1 \\ x - 3 \end{array} \\
 \hline
 \begin{array}{r} -6x^2 + 5x - 8 \\ 6x^2 - 3x + 3 \end{array} \\
 \hline
 \begin{array}{r} 2x - 5 \\ 2x - 5 \end{array} \\
 \hline
 = x - 3 + \frac{2x - 5}{2x^2 - x + 1}
 \end{array}$$

$$\begin{array}{r}
 12. \quad \begin{array}{r} 2a^4 - 3a^3 + a^2 \\ -2a^4 + 2a^3 - 2a^2 \end{array} \Bigg| \begin{array}{r} a^2 - a + 1 \\ 2a^2 - a - 2 \end{array} \\
 \hline
 \begin{array}{r} -a^3 - a^2 \\ a^3 - a^2 + a \end{array} \\
 \hline
 \begin{array}{r} -2a^2 + a \\ 2a^2 - 2a + 2 \end{array} \\
 \hline
 \begin{array}{r} -a + 2 \\ -a + 2 \end{array} \\
 \hline
 = 2a^2 - a - 2 - \frac{a - 2}{a^2 - a + 1}
 \end{array}$$

$$\begin{array}{r}
 13. \quad \begin{array}{r} x^4 - 4x^2 - 3x \\ -x^4 + 2x^2 \end{array} \Bigg| \begin{array}{r} x^2 - 2 \\ x^2 - 2 \end{array} \\
 \hline
 \begin{array}{r} -2x^2 - 3x \\ 2x^2 - 4 \end{array} \\
 \hline
 \begin{array}{r} -3x - 4 \\ -3x - 4 \end{array} \\
 \hline
 = x^2 - 2 - \frac{3x + 4}{x^2 - 2}
 \end{array}$$

$$\begin{array}{r}
 14. \quad \begin{array}{r} 10n^3 - 18n^2 - 5n + 3 \\ -10n^3 + 15n^2 - 5n \end{array} \Bigg| \begin{array}{r} 2n^2 - 3n + 1 \\ 5n \end{array} \\
 \hline
 \begin{array}{r} -3n^2 - 10n + 3 \\ -3n^2 - 10n + 3 \end{array} \\
 \hline
 = 5n - \frac{3n^2 + 10n - 3}{2n^2 - 3n + 1}
 \end{array}$$

$$\begin{array}{r}
 15. \quad \begin{array}{r} 8x^4 \\ -8x^4 - 10x^3 - 12x^2 \end{array} \Bigg| \begin{array}{r} 4x^2 + 5x + 6 \\ 2x^2 \end{array} \\
 \hline
 \begin{array}{r} -10x^3 - 12x^2 \\ -10x^3 - 12x^2 \end{array} \\
 \hline
 = 2x^2 - \frac{10x^3 + 12x^2}{4x^2 + 5x + 6}
 \end{array}$$

$$\begin{array}{r}
 16. \quad \begin{array}{r} 6m^5 + 3m^4n \\ -6m^5 + 2m^3n^2 - 2m^2n^3 \end{array} \Bigg| \begin{array}{r} 3m^3 - mn^2 + n^3 \\ 2m^2 + mn \end{array} \\
 \hline
 \begin{array}{r} 3m^4n + 2m^3n^2 - 2m^2n^3 \\ -3m^4n + m^2n^3 - mn^4 \end{array} \\
 \hline
 \begin{array}{r} 2m^3n^2 - m^2n^3 - mn^4 \\ 2m^3n^2 - m^2n^3 - mn^4 \end{array} \\
 \hline
 = 2m^2 + mn + \frac{2m^3n^2 - m^2n^3 - mn^4}{3m^3 - mn^2 + n^3}
 \end{array}$$

## EJERCICIO 124

$$1. a + \frac{4a}{a+2} = \frac{a(a+2)+4a}{a+2} = \frac{a^2+2a+4a}{a+2} = \frac{a^2+6a}{a+2} = \frac{a(a+6)}{a+2}$$

$$2. m-n - \frac{n^2}{m} = \frac{(m-n)m-n^2}{m} = \frac{m^2-mn-n^2}{m}$$

$$3. x+5 - \frac{3}{x-2} = \frac{(x+5)(x-2)-3}{x-2} = \frac{x^2+3x-10-3}{x-2} = \frac{x^2+3x-13}{x-2}$$

$$4. a + \frac{ab}{a+b} = \frac{a(a+b)+ab}{a+b} = \frac{a^2+ab+ab}{a+b} = \frac{a^2+2ab}{a+b}$$

$$5. \frac{1-a^2}{a} + a - 3 = \frac{a(a-3)+1-a^2}{a} = \frac{a^2-3a+1-a^2}{a} = -\frac{3a-1}{a}$$

$$6. 1 - \frac{a+x}{a-x} = \frac{(a-x)-(a+x)}{a-x} = \frac{a-x-a-x}{a-x} = -\frac{2x}{a-x}$$

$$7. \frac{2a+x}{a+x} - 1 = \frac{2a+x-(a+x)}{a+x} = \frac{2a+x-a-x}{a+x} = \frac{a}{a+x}$$

$$8. x+2 - \frac{3}{x-1} = \frac{(x+2)(x-1)-3}{x-1} = \frac{x^2+x-2-3}{x-1} = \frac{x^2+x-5}{x-1}$$

$$9. x^2-3x - \frac{x^2-6x}{x+2} = \frac{(x^2-3x)(x+2)-(x^2-6x)}{x+2} = \frac{x^3-x^2-6x-x^2+6x}{x+2} = \frac{x^3-2x^2}{x+2} = \frac{x^2(x-2)}{x+2}$$

$$10. x+y + \frac{x^2-y^2}{x-y} = \frac{(x+y)(x-y)+x^2-y^2}{x-y} = \frac{x^2-y^2+x^2-y^2}{x-y} = \frac{2x^2-2y^2}{x-y} = \frac{2(x^2-y^2)}{x-y} = \frac{2(x+y)(x-y)}{x-y} = 2x+2y = 2(x+y)$$

$$11. \frac{3mn}{m-n} + m - 2n = \frac{(m-n)(m-2n)+3mn}{m-n} = \frac{m^2-3mn+2n^2+3mn}{m-n} = \frac{m^2+2n^2}{m-n}$$

$$12. 2a-3x - \frac{5ax-6x^2}{a+2x} = \frac{(2a-3x)(a+2x)-(5ax-6x^2)}{a+2x} = \frac{2a^2+ax-6x^2-5ax+6x^2}{a+2x} = \frac{2a^2-4ax}{a+2x}$$

$$13. m^2-2m+4 - \frac{m^3}{m+2} = \frac{(m^2-2m+4)(m+2)-m^3}{m+2} = \frac{m^3+8-m^3}{m+2} = \frac{8}{m+2}$$

$$14. x^2-5x - \frac{3x(x+2)}{x-2} = \frac{(x^2-5x)(x-2)-3x(x+2)}{x-2} = \frac{x^3-7x^2+10x-3x^2-6x}{x-2} = \frac{x^3-10x^2+4x}{x-2}$$

$$15. a^2+3ab-b^2 + \frac{7ab^2-b^3}{2a-b} = \frac{(a^2+3ab-b^2)(2a-b)+7ab^2-b^3}{2a-b} = \frac{2a^3+5a^2b-5ab^2+b^3+7ab^2-b^3}{2a-b} = \frac{2a^3+5a^2b+2ab^2}{2a-b}$$

$$16. \frac{x^3+2}{x^2-x+1} - (x+1) = \frac{(x^3+2)-(x^2-x+1)(x+1)}{x^2-x+1} = \frac{x^3+2-x^3-1}{x^2-x+1} = \frac{1}{x^2-x+1}$$

$$17. x+3 - \frac{x^3-2x^2+1}{x^2-4x+3} = \frac{(x+3)(x^2-4x+3)-(x^3-2x^2+1)}{x^2-4x+3} = \frac{x^3-x^2-9x+9-x^3+2x^2-1}{x^2-4x+3} = \frac{x^2-9x+8}{x^2-4x+3} = \frac{(x-8)(x-1)}{(x-3)(x-1)} = \frac{x-8}{x-3}$$



$$\begin{aligned}
 18. \quad & 3a + \frac{3a^2b + 3ab^2}{a^2 - b^2} \\
 &= \frac{3a(a^2 - b^2) + 3a^2b + 3ab^2}{a^2 - b^2} \\
 &= \frac{3a^3 - 3ab^2 + 3a^2b + 3ab^2}{a^2 - b^2} \\
 &= \frac{3a^3 + 3a^2b}{a^2 - b^2} = \frac{3a^2(a+b)}{(a+b)(a-b)} \\
 &= \frac{3a^2}{a-b}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & x - 3 - \frac{x^3 - 27}{x^2 - 6x + 9} \\
 &= \frac{(x-3)(x^2 - 6x + 9) - (x^3 - 27)}{x^2 - 6x + 9} \\
 &= \frac{x^3 - 9x^2 + 27x - 27 - x^3 + 27}{x^2 - 6x + 9} \\
 &= \frac{-9x^2 + 27x}{(x-3)^2} = \frac{-9x(x-3)}{(x-3)^2} \\
 &= \frac{-9x}{x-3} = \frac{9x}{3-x}
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & a^2 - 3a + 5 + \frac{2a^3 - 11a + 9}{a^2 + a - 2} \\
 &= \frac{(a^2 - 3a + 5)(a^2 + a - 2) + 2a^3 - 11a + 9}{a^2 + a - 2} \\
 &= \frac{a^4 - 2a^3 + 11a - 10 + 2a^3 - 11a + 9}{a^2 + a - 2} \\
 &= \frac{a^4 - 1}{(a+2)(a-1)} = \frac{(a^2-1)(a^2+1)}{(a+2)(a-1)} \\
 &= \frac{(a^2+1)(a+1)(a-1)}{(a+2)(a-1)} \\
 &= \frac{a^3 + a^2 + a + 1}{a+2}
 \end{aligned}$$

## EJERCICIO 125

$$\begin{aligned}
 1. \quad & \frac{a}{b}; \frac{1}{ab} \quad mcm = ab \quad ab \div b = a \\
 & \quad \quad \quad ab \div ab = 1 \\
 & \frac{a}{b} = \frac{a \cdot a}{ab} = \frac{a^2}{ab} \\
 & \frac{1}{ab} = \frac{1 \cdot 1}{ab} = \frac{1}{ab} \Rightarrow \frac{a^2}{ab}, \frac{1}{ab} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \frac{x}{2a}, \frac{4}{3a^2x} \quad mcm = 6a^2x \\
 & 6a^2x \div 2a = 3ax \\
 & 6a^2x \div 3a^2x = 2 \\
 & \frac{x}{2a} = \frac{x(3ax)}{6a^2x} = \frac{3ax^2}{6a^2x} \\
 & \frac{4}{3a^2x} = \frac{4 \cdot 2}{6a^2x} = \frac{8}{6a^2x} \\
 & \Rightarrow \frac{3ax^2}{6a^2x}, \frac{8}{6a^2x} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{1}{2x^2}, \frac{3}{4x}, \frac{5}{8x^3} \quad mcm = 8x^3 \\
 & 8x^3 \div 2x^2 = 4x \\
 & 8x^3 \div 4x = 2x^2 \\
 & 8x^3 \div 8x^3 = 1 \\
 & \frac{1}{2x^2} = \frac{1 \cdot 4x}{8x^3} = \frac{4x}{8x^3} \\
 & \frac{3}{4x} = \frac{3x \cdot 2x^2}{8x^3} = \frac{6x^2}{8x^3} \\
 & \frac{5}{8x^3} = \frac{5 \cdot 1}{8x^3} = \frac{5}{8x^3} \\
 & \Rightarrow \frac{4x}{8x^3}, \frac{6x^2}{8x^3}, \frac{5}{8x^3} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{3x}{ab^2}, \frac{x}{a^2b}, \frac{3}{a^3} \quad mcm = a^3b^2 \\
 & a^3b^2 \div ab^2 = a^2 \quad a^3b^2 \div a^2b = ab \quad a^3b^2 \div a^3 = b^2 \\
 & \frac{3x}{ab^2} = \frac{3x(a^2)}{a^3b^2} = \frac{3a^2x}{a^3b^2}; \frac{x}{a^2b} = \frac{x(ab)}{a^3b^2} = \frac{abx}{a^3b^2}; \frac{3}{a^3} = \frac{3(b^2)}{a^3b^2} = \frac{3b^2}{a^3b^2} \\
 & \Rightarrow \frac{3a^2x}{a^3b^2}, \frac{abx}{a^3b^2}, \frac{3b^2}{a^3b^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{7y}{6x^2}, \frac{1}{9xy}, \frac{5x}{12y^3} \quad mcm = 36x^2y^3 \\
 & 36x^2y^3 \div 6x^2 = 6y^3 \quad 36x^2y^3 \div 9xy = 4xy^2 \quad 36x^2y^3 \div 12y^3 = 3x^2 \\
 & \frac{7y}{6x^2} = \frac{7y(6y^3)}{36x^2y^3} = \frac{42y^4}{36x^2y^3}; \frac{1}{9xy} = \frac{1(4xy^2)}{36x^2y^3} = \frac{4xy^2}{36x^2y^3}; \\
 & \frac{5x}{12y^2} = \frac{5x(3x^2)}{36x^2y^3} = \frac{15x^3}{36x^2y^3} \Rightarrow \frac{42y^4}{36x^2y^3}, \frac{4xy^2}{36x^2y^3}, \frac{15x^3}{36x^2y^3} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{a-1}{3a}, \frac{5}{6a}, \frac{a+2}{a^2} \quad mcm = 6a^2 \\
 & 6a^2 \div 3a = 2a \quad 6a^2 \div 6a = a \quad 6a^2 \div a^2 = 6 \\
 & \frac{a-1}{3a} = \frac{(a-1)(2a)}{6a^2} = \frac{2a^2 - 2a}{6a^2}; \frac{5}{6a} = \frac{5 \cdot 1}{6a^2} = \frac{5}{6a^2}; \\
 & \frac{a+2}{a^2} = \frac{(a+2)6}{6a^2} = \frac{6a+12}{6a^2} \Rightarrow \frac{2a^2 - 2a}{6a^2}, \frac{5}{6a^2}, \frac{6a+12}{6a^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{x-y}{x^2y}, \frac{x+y}{3xy^2}, 5 \quad mcm = 3x^2y^2 \\
 & 3x^2y^2 \div x^2y = 3y \\
 & 3x^2y^2 \div 3xy^2 = x \\
 & \frac{x-y}{x^2y} = \frac{(x-y)(3y)}{3x^2y^2} = \frac{3xy - 3y^2}{3x^2y^2}; \frac{x+y}{3xy^2} = \frac{(x+y)x}{3x^2y^2} = \frac{x^2 + xy}{3x^2y^2}; \\
 & 5 = \frac{5(3x^2y^2)}{3x^2y^2} = \frac{15x^2y^2}{3x^2y^2} \Rightarrow \frac{3xy - 3y^2}{3x^2y^2}, \frac{x^2 + xy}{3x^2y^2}, \frac{15x^2y^2}{3x^2y^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \frac{m+n}{2m}, \frac{m-n}{5m^3n}, \frac{1}{10n^2} \quad mcm = 10m^3n^2 \\
 & 10m^3n^2 \div 2m = 5m^2n^2 \\
 & 10m^3n^2 \div 5m^3n = 2n \\
 & 10m^3n^2 \div 10n^2 = m^3 \\
 & \frac{m+n}{2m} = \frac{(m+n)(5m^2n^2)}{10m^3n^2} = \frac{5m^3n^2 + 5m^2n^3}{10m^3n^2} \\
 & \frac{m-n}{5m^3n} = \frac{(m-n)(2n)}{10m^3n^2} = \frac{2mn - 2n^2}{10m^3n^2} \\
 & \frac{1}{10n^2} = \frac{1(m^3)}{10m^3n^2} = \frac{m^3}{10m^3n^2} \\
 & \Rightarrow \frac{5m^3n^2 + 5m^2n^3}{10m^3n^2}, \frac{2mn - 2n^2}{10m^3n^2}, \frac{m^3}{10m^3n^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \frac{a+b}{6}, \frac{a-b}{2a}, \frac{a^2+b^2}{3b^2} \quad mcm = 6ab^2 \\
 & 6ab^2 \div 6 = ab^2 \\
 & 6ab^2 \div 2a = 3b^2 \\
 & 6ab^2 \div 3b^2 = 2a \\
 & \frac{a+b}{6} = \frac{(a+b)(ab^2)}{6ab^2} = \frac{a^2b^2 + ab^3}{6ab^2}; \\
 & \frac{a-b}{2a} = \frac{(a-b)(3b^2)}{6ab^2} = \frac{3ab^2 - 3b^3}{6ab^2}; \\
 & \frac{a^2+b^2}{3b^2} = \frac{(a^2+b^2)(2a)}{6ab^2} = \frac{2a^3 + 2ab^2}{6ab^2} \\
 & \Rightarrow \frac{a^2b^2 + ab^3}{6ab^2}, \frac{3ab^2 - 3b^3}{6ab^2}, \frac{2a^3 + 2ab^2}{6ab^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \frac{2a-b}{3a^2}, \frac{3b-a}{4b^2}, \frac{a-3b}{2} \quad mcm = 12a^2b^2 \\
 & 12a^2b^2 \div 3a^2 = 4b^2 \\
 & 12a^2b^2 \div 4b^2 = 3a^2 \\
 & 12a^2b^2 \div 2 = 6a^2b^2 \\
 & \frac{2a-b}{3a^2} = \frac{(2a-b)4b^2}{12a^2b^2} = \frac{8ab^2 - 4b^3}{12a^2b^2}; \\
 & \frac{3b-a}{4b^2} = \frac{(3b-a)3a^2}{12a^2b^2} = \frac{9a^2b - 3a^3}{12a^2b^2}; \\
 & \frac{a-3b}{2} = \frac{(a-3b)6a^2b^2}{12a^2b^2} = \frac{6a^3b^2 - 18a^2b^3}{12a^2b^2} \\
 & \Rightarrow \frac{8ab^2 - 4b^3}{12a^2b^2}, \frac{9a^2b - 3a^3}{12a^2b^2}, \frac{6a^3b^2 - 18a^2b^3}{12a^2b^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \frac{2}{5}, \frac{3}{x+1} \quad mcm = 5x+5 \\
 & (5x+5) \div 5 = x+1 \quad (5x+5) \div (x+1) = 5 \\
 & \frac{2}{5} = \frac{2(x+1)}{5x+5} = \frac{2x+2}{5x+5}; \quad \frac{3}{x+1} = \frac{3 \cdot 5}{5x+5} = \frac{15}{5x+5} \\
 & \Rightarrow \frac{2x+2}{5x+5}, \frac{15}{5x+5} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{a}{a+b}, \frac{b}{a^2-b^2} \quad mcm = a^2-b^2 \\
 & (a^2-b^2) \div (a+b) = a-b \quad (a^2-b^2) \div (a^2-b^2) = 1 \\
 & \frac{a}{a+b} = \frac{a(a-b)}{a^2-b^2} = \frac{a^2-ab}{a^2-b^2}; \\
 & \frac{b}{a^2-b^2} = \frac{1b}{a^2-b^2} = \frac{b}{a^2-b^2} \\
 & \Rightarrow \frac{a^2-ab}{a^2-b^2}, \frac{b}{a^2-b^2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{x}{x^2-1}, \frac{1}{x^2-x-2} \quad x^2-1 = (x+1)(x-1) \\
 & x^2-x-2 = (x-2)(x+1) \\
 & mcm = (x-1)(x-2)(x+1) \\
 & = (x^2-1)(x-2) \\
 & = x^3-2x^2-x+2 \\
 & \begin{array}{r|l} x^3-2x^2-x+2 & x^2-1 \\ -x^3 & +x \\ \hline -2x^2 & +2 \\ 2x^2 & -2 \end{array} \quad \begin{array}{r|l} x^3-2x^2-x+2 & x^2-x-2 \\ -x^3+x^2+2x & \\ \hline -x^2+x+2 & \\ x^2-x-2 & \end{array} \\
 & \frac{x}{x^2-1} = \frac{x(x-2)}{x^3-2x^2-x+2} = \frac{x^2-2x}{x^3-2x^2-x+2}; \\
 & \frac{1}{x^2-x-2} = \frac{1(x-1)}{x^3-2x^2-x+2} = \frac{x-1}{x^3-2x^2-x+2} \\
 & \Rightarrow \frac{x^2-2x}{x^3-2x^2-x+2}; \frac{x-1}{x^3-2x^2-x+2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{a-3}{4(a+5)}, \frac{3a}{8} \quad mcm = 8(a+5) \\
 & [8(a+5)] \div [4(a+5)] = 2 \quad 8(a+5) \div 8 = a+5 \\
 & \frac{a-3}{4(a+5)} = \frac{2(a-3)}{8(a+5)} = \frac{2a-6}{8(a+5)}; \\
 & \frac{3a}{8} = \frac{3a(a+5)}{8(a+5)} = \frac{3a^2+15a}{8(a+5)} \\
 & \Rightarrow \frac{2a-6}{8(a+5)}, \frac{3a^2+15a}{8(a+5)} \quad Rta.
 \end{aligned}$$

$$15. \frac{x^2}{3(a-x)}, \frac{x}{6} \quad mcm = 6(a-x)$$

$$[6(a-x)] \div [3(a-x)] = 2 \quad [6(a-x)] \div 6 = a-x$$

$$\frac{x^2}{3(a-x)} = \frac{2x^2}{6(a-x)}; \quad \frac{x}{6} = \frac{x(a-x)}{6(a-x)} = \frac{ax-x^2}{6(a-x)}$$

$$\Rightarrow \frac{2x^2}{6(a-x)}, \frac{ax-x^2}{6(a-x)} \quad Rta.$$

$$16. \frac{3}{x^2}, \frac{2}{x}, \frac{x+3}{x^2-x} \quad mcm = x^2(x-1)$$

$$[x^2(x-1)] \div x^2 = x-1 \quad [x^2(x-1)] \div x = x(x-1)$$

$$[x^2(x-1)] \div (x^2-x) = x$$

$$\frac{3}{x^2} = \frac{3(x-1)}{x^2(x-1)} = \frac{3x-3}{x^2(x-1)};$$

$$\frac{2}{x} = \frac{2(x^2-x)}{x^2(x-1)} = \frac{2x^2-2x}{x^2(x-1)};$$

$$\frac{x+3}{x^2-x} = \frac{x(x+3)}{x^2(x-1)} = \frac{x^2+3x}{x^2(x-1)}$$

$$\Rightarrow \frac{3x-3}{x^2(x-1)}, \frac{2x^2-2x}{x^2(x-1)}, \frac{x^2+3x}{x^2(x-1)} \quad Rta.$$

$$17. \frac{1}{2a+2b}, \frac{a}{4a-4b}, \frac{b}{8} \quad mcm = 8(a^2-b^2)$$

$$[8(a^2-b^2)] \div (2a+2b) = 4(a-b) \quad [8(a^2-b^2)] \div 8 = a^2-b^2$$

$$[8(a^2-b^2)] \div (4a-4b) = 2(a+b)$$

$$\frac{1}{2a+2b} = \frac{4(a-b)}{8(a^2-b^2)};$$

$$\frac{a}{4a-4b} = \frac{2a(a+b)}{8(a^2-b^2)} = \frac{2a^2+2ab}{8(a^2-b^2)};$$

$$\frac{b}{8} = \frac{b(a^2-b^2)}{8(a^2-b^2)} = \frac{a^2b-b^3}{8(a^2-b^2)}$$

$$\Rightarrow \frac{4(a-b)}{8(a^2-b^2)}, \frac{2a^2+2ab}{8(a^2-b^2)}, \frac{a^2b-b^3}{8(a^2-b^2)} \quad Rta.$$

$$18. \frac{x}{xy}, \frac{y}{x^2+xy}, \frac{3}{xy+y^2} \quad mcm = xy(x+y)$$

$$[xy(x+y)] \div xy = x+y \quad [xy(x+y)] \div (x^2+xy) = y$$

$$[xy(x+y)] \div (xy+y^2) = x$$

$$\frac{x}{xy} = \frac{x(x+y)}{xy(x+y)} = \frac{x^2+xy}{xy(x+y)}$$

$$\frac{y}{x^2+xy} = \frac{y^2}{xy(x+y)}; \quad \frac{3}{xy+y^2} = \frac{3x}{xy(x+y)}$$

$$\Rightarrow \frac{x^2+xy}{xy(x+y)}, \frac{y^2}{xy(x+y)}, \frac{3x}{xy(x+y)} \quad Rta.$$

$$19. \frac{2}{a^2-b^2}, \frac{1}{a^2+ab}, \frac{a}{a^2-ab} \quad mcm = a(a^2-b^2)$$

$$[a(a^2-b^2)] \div (a^2-b^2) = a$$

$$[a(a^2-b^2)] \div (a^2+ab) = a-b$$

$$[a(a^2-b^2)] \div (a^2-ab) = a+b$$

$$\frac{2}{a^2-b^2} = \frac{2a}{a(a^2-b^2)}; \quad \frac{1}{a^2+ab} = \frac{a-b}{a(a^2-b^2)}$$

$$\frac{a}{a^2-ab} = \frac{a(a+b)}{a(a^2-b^2)} = \frac{a^2+ab}{a(a^2-b^2)}$$

$$\Rightarrow \frac{2a}{a(a^2-b^2)}, \frac{a-b}{a(a^2-b^2)}, \frac{a^2+ab}{a(a^2-b^2)} \quad Rta.$$

$$20. \frac{3x}{x+1}, \frac{x^2}{x-1}, \frac{x^3}{x^2-1} \quad mcm = x^2-1$$

$$(x^2-1) \div (x+1) = x-1$$

$$(x^2-1) \div (x-1) = x+1 \quad (x^2-1) \div (x^2-1) = 1$$

$$\frac{3x}{x+1} = \frac{3x(x-1)}{x^2-1} = \frac{3x^2-3x}{x^2-1}$$

$$\frac{x^2}{x-1} = \frac{x^2(x+1)}{x^2-1} = \frac{x^3+x^2}{x^2-1}; \quad \frac{x^3}{x^2-1} = \frac{x^3}{x^2-1}$$

$$\Rightarrow \frac{3x^2-3x}{x^2-1}, \frac{x^3+x^2}{x^2-1}, \frac{x^3}{x^2-1} \quad Rta.$$

$$21. \frac{1}{m^2-n^2}, \frac{m}{m^2+mn}, \frac{n}{m^2-mn} \quad mcm = m(m^2-n^2)$$

$$[m(m^2-n^2)] \div (m^2-n^2) = m \quad [m(m^2-n^2)] \div (m^2+mn) = m-n$$

$$[m(m^2-n^2)] \div (m^2-mn) = m+n$$

$$\frac{1}{m^2-n^2} = \frac{m}{m(m^2-n^2)};$$

$$\frac{m}{m^2+mn} = \frac{m(m-n)}{m(m^2-n^2)} = \frac{m^2-mn}{m(m^2-n^2)};$$

$$\frac{n}{m^2-mn} = \frac{n(m+n)}{m(m^2-n^2)} = \frac{mn+n^2}{m(m^2-n^2)}$$

$$\Rightarrow \frac{m}{m(m^2-n^2)}, \frac{m^2-mn}{m(m^2-n^2)}, \frac{n(m+n)}{m(m^2-n^2)} \quad Rta.$$

$$22. \frac{n+1}{n-1}, \frac{n-1}{n+1}, \frac{n^2+1}{n^2-1} \quad mcm = n^2-1$$

$$(n^2-1) \div (n-1) = n+1$$

$$(n^2-1) \div (n+1) = n-1 \quad (n^2-1) \div (n^2-1) = 1$$

$$\frac{n+1}{n-1} = \frac{(n+1)(n+1)}{n^2-1} = \frac{(n+1)^2}{n^2-1}; \quad \frac{n-1}{n+1} = \frac{(n-1)^2}{n^2-1};$$

$$\frac{n^2+1}{n^2-1} = \frac{n^2+1}{n^2-1} \Rightarrow \frac{(n+1)^2}{n^2-1}, \frac{(n-1)^2}{n^2-1}, \frac{n^2+1}{n^2-1} \quad Rta.$$

$$\begin{aligned}
 23. \quad & \frac{a^2-b^2}{a^2+b^2}, \frac{a^2+b^2}{a^2-b^2}, \frac{a^4+b^4}{a^4-b^4} \quad mcm = a^4 - b^4 \\
 & (a^4 - b^4) \div (a^2 + b^2) = a^2 - b^2 \\
 & (a^4 - b^4) \div (a^2 - b^2) = a^2 + b^2 \quad (a^4 - b^4) \div (a^4 - b^4) = 1 \\
 & \frac{a^2 - b^2}{a^2 + b^2} = \frac{(a^2 - b^2)^2}{a^4 - b^4}; \quad \frac{a^2 + b^2}{a^2 - b^2} = \frac{(a^2 + b^2)^2}{a^4 - b^4}; \\
 & \frac{a^4 + b^4}{a^4 - b^4} = \frac{a^4 + b^4}{a^4 - b^4} \\
 & \Rightarrow \frac{(a^2 - b^2)^2}{a^4 - b^4}, \frac{(a^2 + b^2)^2}{a^4 - b^4}, \frac{a^4 + b^4}{a^4 - b^4} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & \frac{3x}{x-1}, \frac{x-1}{x+2}, \frac{1}{x^2+x-2} \quad mcm = x^2 + x - 2 \\
 & (x^2 + x - 2) \div (x - 1) = x + 2 \\
 & (x^2 + x - 2) \div (x + 2) = x - 1 \\
 & (x^2 + x - 2) \div (x^2 + x - 2) = 1 \\
 & \frac{3x}{x-1} = \frac{3x(x+2)}{x^2+x-2} = \frac{3x^2+6x}{x^2+x-2}; \\
 & \frac{x-1}{x+2} = \frac{(x-1)^2}{x^2+x-2}; \quad \frac{1}{x^2+x-2} = \frac{1}{x^2+x-2} \\
 & \Rightarrow \frac{3x^2+6x}{x^2+x-2}, \frac{(x-1)^2}{x^2+x-2}, \frac{1}{x^2+x-2} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & \frac{x}{2}, \frac{x}{5x+15}, \frac{x-1}{10x+30} \quad mcm = 10(x+3) \\
 & [10(x+3)] \div 2 = 5(x+3) \\
 & [10(x+3)] \div [5(x+3)] = 2 \\
 & [10(x+3)] \div [10(x+3)] = 1 \\
 & \frac{x}{2} = \frac{5x(x+3)}{10(x+3)} = \frac{5x^2+15}{10(x+3)} \\
 & \frac{x}{5x+15} = \frac{2x}{10(x+3)}; \quad \frac{x-1}{10x+30} = \frac{x-1}{10(x+3)} \\
 & \Rightarrow \frac{5x^2+15}{10(x+3)}, \frac{2x}{10(x+3)}, \frac{x-1}{10(x+3)} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & \frac{2x-1}{x+4}, \frac{3x+1}{3x+12}, \frac{4x+3}{6x+24} \quad mcm = 6(x+4) \\
 & [6(x+4)] \div (x+4) = 6 \quad [6(x+4)] \div [3(x+4)] = 2 \\
 & [6(x+4)] \div [6(x+4)] = 1 \\
 & \frac{2x-1}{x+4} = \frac{6(2x-1)}{6(x+4)} = \frac{12x-6}{6(x+4)}; \\
 & \frac{3x+1}{3x+12} = \frac{2(3x+1)}{6(x+4)} = \frac{6x+2}{6(x+4)}; \\
 & \frac{4x+3}{6x+24} = \frac{4x+3}{6(x+4)} \\
 & \Rightarrow \frac{12x-6}{6(x+4)}, \frac{6x+2}{6(x+4)}, \frac{4x+3}{6(x+4)} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & \frac{a}{a+4}, \frac{2}{9a^2-25}, \frac{5}{3a-5} \quad mcm = (a+4)(3a+5)(3a-5) \\
 & [(a+4)(3a+5)(3a-5)] \div (a+4) = (3a+5)(3a-5) \\
 & [(a+4)(3a+5)(3a-5)] \div (9a^2-25) = a+4 \\
 & [(a+4)(3a+5)(3a-5)] \div (3a-5) = (a+4)(3a+5) \\
 & \frac{3}{a+4} = \frac{3(3a+5)(3a-5)}{(a+4)(3a+5)(3a-5)} = \frac{27a^2-75}{(a+4)(9a^2-25)}; \\
 & \frac{2}{9a^2-25} = \frac{2(a+4)}{(a+4)(3a+5)(3a-5)} = \frac{2a+8}{(a+4)(9a^2-25)}; \\
 & \frac{5}{3a-5} = \frac{5(a+4)(3a+5)}{(a+4)(3a+5)(3a-5)} = \frac{15a^2+85a+100}{(a+4)(9a^2-25)} \\
 & \Rightarrow \frac{27a^2-75}{(a+4)(9a^2-25)}, \frac{2a+8}{(a+4)(9a^2-25)}, \frac{15a^2+85a+100}{(a+4)(9a^2-25)} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & \frac{x+1}{x^2-4}, \frac{x+2}{x^2+x-6}, \frac{3x}{x^2+5x+6} \quad mcm = (x+2)(x^2+x-6) \\
 & [(x+2)(x^2+x-6)] \div (x^2-4) = x+3 \\
 & [(x+2)(x^2+x-6)] \div (x^2+x-6) = x+2 \\
 & [(x+2)(x^2+x-6)] \div (x^2+5x+6) = x-2 \\
 & \frac{x+1}{x^2-4} = \frac{(x+1)(x+3)}{(x+2)(x^2+x-6)} = \frac{x^2+4x+3}{(x+2)(x^2+x-6)}; \\
 & \frac{x+2}{x^2+x-6} = \frac{(x+2)(x+2)}{(x+2)(x^2+x-6)} = \frac{(x+2)^2}{(x+2)(x^2+x-6)}; \\
 & \frac{3x}{x^2+5x+6} = \frac{3x(x-2)}{(x+2)(x^2+x-6)} = \frac{3x^2-6x}{(x+2)(x^2+x-6)} \\
 & \Rightarrow \frac{x^2+4x+3}{(x+2)(x^2+x-6)}, \frac{(x+2)^2}{(x+2)(x^2+x-6)}, \frac{3x^2-6x}{(x+2)(x^2+x-6)} \quad Rta.
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & \frac{a+3}{a^2+a-20}, \frac{5a}{a^2-7a+12}, \frac{a+1}{a^2+2a-15} \\
 & mcm = (a+5)(a^2-7a+12) \\
 & [(a+5)(a^2-7a+12)] \div (a^2+a-20) = a-3 \\
 & [(a+5)(a^2-7a+12)] \div (a^2-7a+12) = a+5 \\
 & [(a+5)(a^2-7a+12)] \div (a^2+2a-15) = a-4 \\
 & \frac{a+3}{a^2+a-20} = \frac{(a+3)(a-3)}{(a+5)(a^2-7a+12)} = \frac{a^2-9}{(a+5)(a-4)(a-3)}; \\
 & \frac{5a}{a^2-7a+12} = \frac{5a(a+5)}{(a+5)(a^2-7a+12)} = \frac{5a^2+25}{(a+5)(a-4)(a-3)}; \\
 & \frac{a+1}{a^2+2a-15} = \frac{(a+1)(a-4)}{(a+5)(a^2-7a+12)} = \frac{a^2-3a-4}{(a+5)(a-4)(a-3)} \\
 & \Rightarrow \frac{a^2-9}{(a+5)(a-4)(a-3)}, \frac{5a^2+25}{(a+5)(a-4)(a-3)}, \frac{a^2-3a-4}{(a+5)(a-4)(a-3)} \quad Rta.
 \end{aligned}$$

$$30. \frac{a+1}{a^3-1}, \frac{2a}{a^2+a+1}, \frac{1}{x-1} \quad mcm=a^3-1$$

$$(a^3-1) \div (a^3-1)=1 \quad (a^3-1) \div (a^2+a+1)=a-1$$

$$(a^3-1) \div (a-1)=a^2+a+1$$

$$\frac{a+1}{a^3-1} = \frac{a+1}{a^3-1}; \frac{2a}{a^2+a+1} = \frac{2a}{a^3-1} = \frac{2a^2-2}{a^3-1};$$

$$\frac{1}{a-1} = \frac{a^2+a+1}{a^3-1} \Rightarrow \frac{a+1}{a^3-1}, \frac{2a^2-2}{a^3-1}, \frac{a^2+a+1}{a^3-1} \text{ Rta.}$$

$$31. \frac{1}{x-1}, \frac{1}{x^3-1}, \frac{2}{3} \quad mcm=3(x^3-1)$$

$$[3(x^3-1)] \div (x-1)=3(x^2+x+1)$$

$$[3(x^3-1)] \div (x^3-1)=3 \quad [3(x^3-1)] \div 3=x^3-1$$

$$\frac{1}{x-1} = \frac{3(x^2+x+1)}{3(x^3-1)} = \frac{3x^2+3x+3}{3(x^3-1)};$$

$$\frac{1}{x^3-1} = \frac{3}{3(x^3-1)}; \frac{2}{3} = \frac{2(x^3-1)}{3(x^3-1)} = \frac{2x^3-2}{3(x^3-1)}$$

$$\Rightarrow \frac{3x^2+3x+3}{3(x^3-1)}, \frac{3}{3(x^3-1)}, \frac{2x^3-2}{3(x^3-1)} \text{ Rta.}$$

$$32. \frac{3}{2a^2+2ab}, \frac{b}{a^2x+abx}, \frac{1}{4ax^2-4bx^2}$$

$$mcm=4ax^2(a^2-b^2)$$

$$[4ax^2(a^2-b^2)] \div (2a^2+2ab)=2x^2(a-b)$$

$$[4ax^2(a^2-b^2)] \div (a^2x+abx)=4x(a-b)$$

$$[4ax^2(a^2-b^2)] \div (4ax^2-4bx^2)=a(a+b)$$

$$\frac{3}{2a^2+2ab} = \frac{3[2x^2(a-b)]}{4ax^2(a^2-b^2)} = \frac{6ax^2-6bx^2}{4ax^2(a^2-b^2)};$$

$$\frac{b}{a^2x+abx} = \frac{b[4x(a-b)]}{4ax^2(a^2-b^2)} = \frac{4abx-4b^2x}{4ax^2(a^2-b^2)};$$

$$\frac{1}{4ax^2-4bx^2} = \frac{a(a+b)}{4ax^2(a^2-b^2)} = \frac{a^2+ab}{4ax^2(a^2-b^2)}$$

$$\Rightarrow \frac{6ax^2-6bx^2}{4ax^2(a^2-b^2)}, \frac{4abx-4b^2x}{4ax^2(a^2-b^2)}, \frac{a^2+ab}{4ax^2(a^2-b^2)} \text{ Rta.}$$

$$33. \frac{1}{a-1}, \frac{a+1}{(a-1)^2}, \frac{3(a+1)}{(a-1)^3} \quad mcm=(a-1)^3$$

$$(a-1)^3 \div (a-1)=(a-1)^2$$

$$(a-1)^3 \div (a-1)^2=a-1 \quad (a-1)^3 \div (a-1)^3=1$$

$$\frac{1}{a-1} = \frac{(a-1)^2}{(a-1)^3}; \frac{a+1}{(a-1)^2} = \frac{(a+1)(a-1)}{(a-1)^3} = \frac{a^2-1}{(a-1)^3};$$

$$\frac{3(a+1)}{(a-1)^3} = \frac{3a+3}{(a-1)^3} \Rightarrow \frac{(a-1)^2}{(a-1)^3}, \frac{a^2-1}{(a-1)^3}, \frac{3a+3}{(a-1)^3} \text{ Rta.}$$

$$34. \frac{2x-3}{6x^2+7x+2}, \frac{3}{2x+1}, \frac{2x-1}{6x+4} \quad mcm=2(3x+2)(2x+1)$$

$$[2(3x+2)(2x+1)] \div (6x^2+7x+2)=2$$

$$[2(3x+2)(2x+1)] \div (2x+1)=2(3x+2)$$

$$[2(3x+2)(2x+1)] \div (6x+4)=2x+1$$

$$\frac{2x-3}{6x^2+7x+2} = \frac{2(2x-3)}{2(3x+2)(2x+1)} = \frac{4x-6}{2(3x+2)(2x+1)};$$

$$\frac{3}{2x+1} = \frac{6(3x+2)}{2(3x+2)(2x+1)} = \frac{18x+12}{2(3x+2)(2x+1)};$$

$$\frac{2x-1}{6x+4} = \frac{(2x-1)(2x+1)}{2(3x+2)(2x+1)} = \frac{4x^2-1}{2(3x+2)(2x+1)}$$

$$\Rightarrow \frac{4x-6}{2(3x+2)(2x+1)}, \frac{18x+12}{2(3x+2)(2x+1)}, \frac{4x^2-1}{2(3x+2)(2x+1)} \text{ Rta.}$$

## EJERCICIO 126

$$1. \frac{x-2}{4} + \frac{3x+2}{6} = \frac{3x-2}{12} + \frac{2x+2}{6} = \frac{3x-2+4x+4}{12} = \frac{7x+2}{12}$$

$$2. \frac{2}{5a^2} + \frac{1}{3ab} = \frac{3b+2a}{15a^2b} = \frac{5a+6b}{15a^2b}$$

$$3. \frac{a-2b}{15a} + \frac{b-a}{20b} = \frac{4b(a-2b)+3a(b-a)}{60ab}$$

$$= \frac{4ab-8b^2+3ab-3a^2}{60ab} = \frac{-3a^2+7ab-8b^2}{60ab}$$

$$4. \frac{a+3b}{3ab} + \frac{a^2b-4ab^2}{5a^2b^2} = \frac{5ab(a+3b)+3(a^2b-4ab^2)}{15a^2b^2}$$

$$= \frac{5a^2b+15ab^2+3a^2b-12ab^2}{15a^2b^2}$$

$$= \frac{8a^2b+3ab^2}{15a^2b^2} = \frac{ab(8a+3b)}{15a^2b^2} = \frac{8a+3b}{15ab}$$

$$5. \frac{a-1}{3} + \frac{2a}{6} + \frac{3a+4}{12}$$

$$= \frac{4(a-1)+2 \cdot 2a+3a+4}{12} = \frac{4a-4+4a+3a+4}{12} = \frac{11a}{12}$$

$$6. \frac{n}{m^2} + \frac{3}{mn} + \frac{2}{m} = \frac{n \cdot n+3m+2mn}{m^2n} = \frac{3m+2mn+n^2}{m^2n}$$

$$7. \frac{1-x}{2x} + \frac{x+2}{x^2} + \frac{1}{3ax^2}$$

$$= \frac{3ax(1-x)+6a(x+2)+2}{6ax^2}$$

$$= \frac{3ax-3ax^2+6ax-12a+2}{6ax^2} = \frac{9ax+12a-3ax^2+2}{6ax^2}$$

$$8. \frac{2a-3}{3a} + \frac{3x+2}{10x} + \frac{x-a}{5ax} = \frac{10x(2a-3)+3a(3x+2)+6(x-a)}{30ax}$$

$$= \frac{20ax-30x+9ax+6a+6x-6a}{30ax}$$

$$= \frac{29ax-24x}{30ax} = \frac{x(29a-24)}{30ax} = \frac{29a-24}{30a}$$

$$\begin{aligned}
 9. \quad & \frac{3}{5} + \frac{x+2}{2x} + \frac{x^2+2}{6x^2} \\
 &= \frac{6x^2 \cdot 3 + 15x(x+2) + 5(x^2+2)}{30x^2} \\
 &= \frac{18x^2 + 15x^2 + 30x + 5x^2 + 10}{30x^2} \\
 &= \frac{38x^2 + 30x + 10}{30x^2} = \frac{2(19x^2 + 15x + 5)}{30x^2} = \frac{19x^2 + 15x + 5}{15x^2}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \frac{x-y}{12} + \frac{2x+y}{15} + \frac{y-4x}{30} \\
 &= \frac{5(x-y) + 4(2x+y) + 2(y-4x)}{60} \\
 &= \frac{5x - 5y + 8x + 4y + 2y - 8x}{60} = \frac{5x + y}{60}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \frac{m-n}{mn} + \frac{n-a}{na} + \frac{2a-m}{am} \\
 &= \frac{a(m-n) + m(n-a) + n(2a-m)}{amn} \\
 &= \frac{am - an + mn - ma + 2an - mn}{amn} = \frac{an}{amn} = \frac{1}{m}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{x+2}{3x} + \frac{x^2-2}{5x^2} + \frac{2-x^3}{9x^3} \\
 &= \frac{15x^2(x+2) + 9x(x^2-2) + 5(2-x^3)}{45x^3} \\
 &= \frac{15x^3 + 30x^2 + 9x^3 - 18x + 10 - 5x^3}{45x^3} \\
 &= \frac{19x^3 + 30x^2 - 18x + 10}{45x^3}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{1}{ab} + \frac{b^2-a^2}{ab^3} + \frac{ab+b^2}{a^2b^2} \\
 &= \frac{ab^2 + a(b^2-a^2) + b(ab+b^2)}{a^2b^3} \\
 &= \frac{ab^2 + ab^2 - a^3 + ab^2 + b^3}{a^2b^3} = \frac{-a^3 + 3ab^2 + b^3}{a^2b^3}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{a+3b}{ab} + \frac{2a-3m}{am} + \frac{3}{a} \\
 &= \frac{m(a+3b) + b(2a-3m) + 3bm}{abm} \\
 &= \frac{am + 3bm + 2ab - 3bm + 3bm}{abm} = \frac{am + 2ab + 3bm}{abm}
 \end{aligned}$$

## EJERCICIO 127

$$1. \quad \frac{1}{a+1} + \frac{1}{a-1} = \frac{a-1+a+1}{a^2-1} = \frac{2a}{a^2-1}$$

$$\begin{aligned}
 2. \quad & \frac{2}{x+4} + \frac{1}{x-3} \\
 &= \frac{2(x-3) + x+4}{x^2+x-12} = \frac{2x-6+x+4}{x^2+x-12} = \frac{3x-2}{x^2+x-12}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{3}{1-x} + \frac{6}{2x+5} \\
 &= \frac{3(2x+5) + 6(1-x)}{(1-x)(2x+5)} = \frac{6x+15+6-6x}{(1-x)(2x+5)} = \frac{21}{(1-x)(2x+5)}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{x}{x-y} + \frac{x}{x+y} \\
 &= \frac{x(x+y) + x(x-y)}{x^2-y^2} = \frac{x^2+xy+x^2-xy}{x^2-y^2} = \frac{2x^2}{x^2-y^2}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{m+3}{m-3} + \frac{m+2}{m-2} \\
 &= \frac{(m-2)(m+3) + (m-3)(m+2)}{(m-3)(m-2)} \\
 &= \frac{m^2 + m - 6 + m^2 - m - 6}{(m-3)(m-2)} = \frac{2m^2 - 12}{(m-3)(m-2)} = \frac{2(m^2 - 6)}{(m-3)(m-2)}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{x+y}{x-y} + \frac{x-y}{x+y} = \frac{(x+y)(x+y) + (x-y)(x-y)}{x^2-y^2} \\
 &= \frac{(x+y)^2 + (x-y)^2}{x^2-y^2} \\
 &= \frac{x^2 + 2xy + y^2 + x^2 - 2xy + y^2}{x^2-y^2} = \frac{2x^2 + 2y^2}{x^2-y^2}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{x}{x^2-1} + \frac{x+1}{(x-1)^2} = \frac{x(x-1) + (x+1)^2}{(x-1)^2(x+1)} \\
 &= \frac{x^2 - x + x^2 + 2x + 1}{(x-1)^2(x+1)} = \frac{2x^2 + x + 1}{(x-1)^2(x+1)}
 \end{aligned}$$

$$8. \quad \frac{2}{x-5} + \frac{3x}{x^2-25} = \frac{2(x+5) + 3x}{x^2-25} = \frac{2x+10+3x}{x^2-25} = \frac{5x+10}{x^2-25}$$

$$9. \quad \frac{1}{3x-2y} + \frac{x-y}{9x^2-4y^2} = \frac{3x+2y+x-y}{9x^2-4y^2} = \frac{4x+y}{9x^2-4y^2}$$

$$\begin{aligned}
 10. \quad & \frac{x+a}{x+3a} + \frac{3a^2-x^2}{x^2-9a^2} = \frac{(x-3a)(x+a) + 3a^2 - x^2}{x^2-9a^2} \\
 &= \frac{x^2 + ax - 3ax - 3a^2 + 3a^2 - x^2}{x^2-9a^2} \\
 &= \frac{-2ax}{x^2-9a^2} = \frac{2ax}{9a^2-x^2}
 \end{aligned}$$

$$11. \frac{a}{1-a^2} + \frac{a}{1+a^2} = \frac{a(1+a^2) + a(1-a^2)}{(1-a^2)(1+a^2)} = \frac{a+a^3+a-a^3}{(1-a^2)(1+a^2)} = \frac{2a}{1-a^4}$$

$$12. \frac{2}{a^2-ab} + \frac{2}{ab+b^2} = \frac{2b(a+b) + 2a(a-b)}{ab(a^2-b^2)} = \frac{2ab+2b^2+2a^2-2ab}{ab(a^2-b^2)} = \frac{2a^2+2b^2}{ab(a^2-b^2)}$$

$$13. \frac{ab}{9a^2-b^2} + \frac{a}{3a+b} = \frac{ab+a(3a-b)}{9a^2-b^2} = \frac{ab+3a^2-ab}{9a^2-b^2} = \frac{3a^2}{9a^2-b^2}$$

$$14. \frac{1}{a^2-b^2} + \frac{1}{(a-b)^2} = \frac{a-b+a+b}{(a+b)(a-b)^2} = \frac{2a}{(a+b)(a-b)^2}$$

$$15. \frac{3}{x^2+y^2} + \frac{2}{(x+y)^2} = \frac{3(x+y)^2 + 2(x^2+y^2)}{(x^2+y^2)(x+y)^2} = \frac{3x^2+6xy+3y^2+2x^2+2y^2}{(x^2+y^2)(x+y)^2} = \frac{5x^2+6xy+5y^2}{(x^2+y^2)(x+y)^2}$$

$$16. \frac{x}{a^2-ax} + \frac{a+x}{ax} + \frac{a}{ax-x^2} \\ a^2-ax = a(a-x) \\ ax = ax \quad mcm = ax(a-x) \\ ax-x^2 = x(a-x) \\ = \frac{x^2+(a+x)(a-x)+a^2}{ax(a-x)} \\ = \frac{x^2+a^2-x^2+a^2}{ax(a-x)} = \frac{2a^2}{ax(a-x)} = \frac{2a}{x(a-x)}$$

$$17. \frac{3}{2x+4} + \frac{x-1}{2x-4} + \frac{x+8}{x^2-4} \\ 2x+4 = 2(x+2) \\ 2x-4 = 2(x-2) \quad mcm = 2(x^2-4) \\ x^2-4 = (x-2)(x+2) \\ = \frac{3(x-2) + (x-1)(x+2) + 2(x+8)}{2(x^2-4)} \\ = \frac{3x-6+x^2+x-2+2x+16}{2(x^2-4)} \\ = \frac{x^2+6x+8}{2(x^2-4)} = \frac{(x+2)(x+4)}{2(x+2)(x-2)} = \frac{x+4}{2(x-2)}$$

$$18. \frac{1}{x+x^2} + \frac{1}{x-x^2} + \frac{x+3}{1-x^2} \\ x+x^2 = x(1+x) \\ x-x^2 = x(1-x) \quad mcm = x(1-x^2) \\ 1-x^2 = (1+x)(1-x) \\ = \frac{1-x+1+x+x(x+3)}{x(1-x^2)} \\ = \frac{2+x^2+3x}{x(1-x^2)} = \frac{(x+1)(x+2)}{x(1-x)(1+x)} = \frac{x+2}{x(1-x)}$$

$$19. \frac{x-y}{x+y} + \frac{x+y}{x-y} + \frac{4xy}{x^2-y^2} \quad mcm = x^2-y^2 \\ = \frac{(x-y)(x-y) + (x+y)(x+y) + 4xy}{x^2-y^2} \\ = \frac{x^2-2xy+y^2+x^2+2xy+y^2+4xy}{x^2-y^2} \\ = \frac{2x^2+2y^2+4xy}{x^2-y^2} = \frac{2(x^2+2xy+y^2)}{x^2-y^2} \\ = \frac{2(x+y)^2}{(x+y)(x-y)} = \frac{2(x+y)}{x-y}$$

$$20. \frac{1}{a-5} + \frac{a}{a^2-4a-5} + \frac{a+5}{a^2+2a+1} \\ a-5 = a-5 \\ a^2-4a-5 = (a-5)(a+1) \\ a^2+2a+1 = (a+1)^2 \quad mcm = (a-5)(a+1)^2 \\ = \frac{(a+1)^2 + a(a+1) + (a+5)(a-5)}{(a-5)(a+1)^2} \\ = \frac{a^2+2a+1+a^2+a+a^2-25}{(a-5)(a+1)^2} \\ = \frac{3a^2+3a-24}{(a-5)(a+1)^2} = \frac{3(a^2+a-8)}{(a-5)(a+1)^2}$$

$$21. \frac{3}{a} + \frac{2}{5a-3} + \frac{1-85a}{25a^2-9} \quad mcm = a(25a^2-9) \\ = \frac{3(25a^2-9) + 2a(5a+3) + a(1-85a)}{a(25a^2-9)} \\ = \frac{75a^2-27+10a^2+6a+a-85a^2}{a(25a^2-9)} = \frac{7a-27}{a(25a^2-9)}$$

$$22. \frac{x+1}{10} + \frac{x-3}{5x-10} + \frac{x-2}{2} \quad mcm = 10(x-2) \\ = \frac{(x+1)(x-2) + 2(x-3) + 5(x-2)(x-2)}{10(x-2)} \\ = \frac{x^2-x-2+2x-6+5x^2-20x+20}{10(x-2)} = \frac{6x^2-19x+12}{10(x-2)}$$

$$\begin{aligned}
 23. \quad & \frac{x+5}{x^2+x-12} + \frac{x+4}{x^2+2x-15} + \frac{x-3}{x^2+9x+20} \\
 & x^2+x-12=(x+4)(x-3) \\
 & x^2+2x-15=(x+5)(x-3) \\
 & x^2+9x+20=(x+5)(x+4) \\
 & mcm=(x+5)(x+4)(x-3) \\
 & = \frac{(x+5)(x+5)+(x+4)(x+4)+(x-3)(x-3)}{(x+5)(x+4)(x-3)} \\
 & = \frac{x^2+10x+25+x^2+8x+16+x^2-6x+9}{(x+5)(x+4)(x-3)} \\
 & = \frac{3x^2+12x+50}{(x+5)(x+4)(x-3)}
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & \frac{1}{x-2} + \frac{1-2x^2}{x^3-8} + \frac{x}{x^2+2x+4} \\
 & x^3-8=(x-2)(x^2+2x+4) \quad mcm=x^3-8 \\
 & = \frac{x^2+2x+4+1-2x^2+x(x-2)}{x^3-8} \\
 & = \frac{-x^2+2x+5+x^2-2x}{x^3-8} = \frac{5}{x^3-8}
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & \frac{2}{a+1} + \frac{a}{(a+1)^2} + \frac{a+1}{(a+1)^3} \quad mcm=(a+1)^3 \\
 & = \frac{2(a+1)^2+a(a+1)+a+1}{(a+1)^3} \\
 & = \frac{2a^2+4a+2+a^2+a+a+1}{(a+1)^3} \\
 & = \frac{3a^2+6a+3}{(a+1)^3} = \frac{3(a^2+2a+1)}{(a+1)^3} = \frac{3(a+1)^2}{(a+1)^3} = \frac{3}{a+1}
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & \frac{2x}{3x^2+11x+6} + \frac{x+1}{x^2-9} + \frac{1}{3x+2} \\
 & 3x^2+11x+6=(x+3)(3x+2) \\
 & x^2-9=(x+3)(x-3) \\
 & 3x+2=3x+2 \quad mcm=(x^2-9)(3x+2) \\
 & = \frac{2x(x-3)+(x+1)(3x+2)+x^2-9}{(x^2-9)(3x+2)} \\
 & = \frac{2x^2-6x+3x^2+5x+2+x^2-9}{(x^2-9)(3x+2)} \\
 & = \frac{6x^2-x-7}{(x^2-9)(3x+2)}
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & \frac{x^2-4}{x^3+1} + \frac{1}{x+1} + \frac{3}{x^2-x+1} \\
 & x^3+1=(x+1)(x^2-x+1) \quad mcm=x^3+1 \\
 & = \frac{x^2-4+x^2-x+1+3x+3}{x^3+1} \\
 & = \frac{2x^2+2x}{x^3+1} = \frac{2x(x+1)}{(x+1)(x^2-x+1)} = \frac{2x}{x^2-x+1}
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & \frac{1}{x-1} + \frac{1}{(x-1)(x+2)} + \frac{x+1}{(x-1)(x+2)(x+3)} \\
 & mcm=(x-1)(x+2)(x+3) \\
 & = \frac{(x+2)(x+3)+x+3+x+1}{(x-1)(x+2)(x+3)} \\
 & = \frac{x^2+5x+6+2x+4}{(x-1)(x+2)(x+3)} = \frac{x^2+7x+10}{(x-1)(x+2)(x+3)} \\
 & = \frac{(x+5)(x+2)}{(x-1)(x+2)(x+3)} = \frac{x+5}{(x-1)(x+3)}
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & \frac{x-2}{2x^2-5x-3} + \frac{x-3}{2x^2-3x-2} + \frac{2x-1}{x^2-5x+6} \\
 & 2x^2-5x-3=(x-3)(2x+1) \\
 & 2x^2-3x-2=(x-2)(2x+1) \\
 & x^2-5x+6=(x-3)(x-2) \\
 & mcm=(x-3)(x-2)(2x+1) \\
 & = \frac{(x-2)(x-2)+(x-3)(x-3)+(2x-1)(2x+1)}{(x-3)(x-2)(2x+1)} \\
 & = \frac{x^2-4x+4+x^2-6x+9+4x^2-1}{(x-3)(x-2)(2x+1)} \\
 & = \frac{6x^2-10x+12}{(x-3)(x-2)(2x+1)}
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & \frac{a-2}{a-1} + \frac{a+3}{a+2} + \frac{a+1}{a-3} \quad mcm=(a-1)(a+2)(a-3) \\
 & = \frac{(a+2)(a-2)(a-3)+(a-1)(a+3)(a-3)+(a-1)(a+1)(a+2)}{(a-1)(a+2)(a-3)} \\
 & = \frac{a^3-3a^2-4a+12+a^3-a^2-9a+9+a^3+2a^2-a-2}{(a-1)(a+2)(a-3)} \\
 & = \frac{3a^3-2a^2-14a+19}{(a-1)(a+2)(a-3)}
 \end{aligned}$$



## EJERCICIO 128

- $$\frac{x-3}{4} - \frac{x+2}{8} = \frac{2(x-3)-(x+2)}{8} = \frac{2x-6-x-2}{8} = \frac{x-8}{8}$$
- $$\frac{a+5b}{a^2} - \frac{b-3}{ab} = \frac{b(a+5b)-a(b-3)}{a^2b} = \frac{ab+5b^2-ab+3a}{a^2b} = \frac{3a+5b^2}{a^2b}$$
- $$\frac{2}{3mn^2} - \frac{1}{2m^2n} = \frac{2(2m)-(3n)}{6m^2n^2} = \frac{4m-3n}{6m^2n^2}$$
- $$\frac{a-3}{5ab} - \frac{4-3ab^2}{3a^2b^3} = \frac{3ab^2(a-3)-5(4-3ab^2)}{15a^2b^3} = \frac{3a^2b^2-9ab^2-20+15ab^2}{15a^2b^3} = \frac{3a^2b^2+6ab^2-20}{15a^2b^3}$$
- $$\frac{2a+3}{4a} - \frac{a-2}{8a} = \frac{2(2a+3)-(a-2)}{8a} = \frac{4a+6-a+2}{8a} = \frac{3a+8}{8a}$$
- $$\frac{y-2x}{20x} - \frac{x-3y}{24y} = \frac{6y(y-2x)-5x(x-3y)}{120xy} = \frac{6y^2-12xy-5x^2+15xy}{120xy} = \frac{6y^2+3xy-5x^2}{120xy}$$
- $$\frac{x-1}{3} - \frac{x-2}{4} - \frac{x+3}{6} = \frac{4(x-1)-3(x-2)-2(x+3)}{12} = \frac{4x-4-3x+6-2x-6}{12} = \frac{-x-4}{12} = -\frac{x+4}{12}$$
- $$\frac{3}{5} - \frac{2a+1}{10a} - \frac{4a^2+1}{20a^2} = \frac{4a^2(3)-2a(2a+1)-(4a^2+1)}{20a^2} = \frac{12a^2-4a^2-2a-4a^2-1}{20a^2} = \frac{4a^2-2a-1}{20a^2}$$
- $$\frac{3}{5x} - \frac{x-1}{3x^2} - \frac{x^2+2x+3}{15x^3} = \frac{3x^2(3)-5x(x-1)-(x^2+2x+3)}{15x^3} = \frac{9x^2-5x^2+5x-x^2-2x-3}{15x^3} = \frac{3x^2+3x-3}{15x^3} = \frac{3(x^2+x-1)}{15x^3} = \frac{x^2+x-1}{5x^3}$$
- $$\frac{1}{2a} - \frac{2+b}{3ab} - \frac{5}{6a^2b^3} = \frac{3ab^3-2ab(2+b)-5}{6a^2b^3} = \frac{3ab^3-4ab^2-2ab^3-5}{6a^2b^3} = \frac{ab^3-4ab^2-5}{6a^2b^3}$$

## EJERCICIO 129

- $$\frac{1}{x-4} - \frac{1}{x-3} \quad mcm=(x-4)(x-3)$$

$$= \frac{x-3-(x-4)}{(x-4)(x-3)} = \frac{x-3-x+4}{(x-4)(x-3)} = \frac{1}{(x-4)(x-3)}$$
- $$\frac{m-n}{m+n} - \frac{m+n}{m-n} \quad mcm=m^2-n^2$$

$$= \frac{(m-n)(m-n)-(m+n)(m+n)}{m^2-n^2} = \frac{m^2-2mn+n^2-m^2-2mn-n^2}{m^2-n^2} = \frac{-4mn}{m^2-n^2} = \frac{4mn}{n^2-m^2}$$
- $$\frac{1-x}{1+x} - \frac{1+x}{1-x} = \frac{(1-x)(1-x)-(1+x)(1+x)}{1-x^2} = \frac{1-2x+x^2-1-2x-x^2}{1-x^2} = \frac{-4x}{1-x^2} = \frac{4x}{x^2-1}$$
- $$\frac{a+b}{a^2+ab} - \frac{b-a}{ab+b^2}$$

$$a^2+ab=a(a+b) \quad ; \quad ab+b^2=b(a+b)$$

$$mcm=ab(a+b)$$

$$= \frac{b(a+b)-a(b-a)}{ab(a+b)} = \frac{ab+b^2-ab+a^2}{ab(a+b)} = \frac{a^2+b^2}{ab(a+b)}$$
- $$\frac{m+n}{m-n} - \frac{m^2+n^2}{m^2-n^2} = \frac{(m+n)(m+n)-(m^2+n^2)}{m^2-n^2} = \frac{m^2+2mn+n^2-m^2-n^2}{m^2-n^2} = \frac{2mn}{m^2-n^2}$$
- $$\frac{1}{x+x^2} - \frac{1}{x-x^2} \quad x+x^2=x(x+1) \quad ; \quad x-x^2=x(1-x)$$

$$mcm=x(1-x^2)$$

$$= \frac{1-x-(1+x)}{x(1-x^2)} = \frac{1-x-1-x}{x(1-x^2)} = \frac{-2x}{x(1-x^2)} = \frac{-2}{1-x^2} = \frac{2}{x^2-1}$$

$$\begin{aligned}
 7. \quad & \frac{a+x}{(a-x)^2} - \frac{x}{a^2-x^2} \\
 &= \frac{(a+x)(a+x) - x(a-x)}{(a-x)^2(a+x)} \\
 &= \frac{a^2+2ax+x^2-ax+x^2}{(a-x)^2(a+x)} = \frac{a^2+ax+2x^2}{(a-x)^2(a+x)}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \frac{a+1}{6a+3} - \frac{1}{12a+6} \\
 & 6a+3=3(2a+1) \quad ; \quad 12a+6=6(2a+1) \\
 & \quad \quad \quad mcm=6(2a+1) \\
 &= \frac{2(a+1)-1}{6(2a+1)} = \frac{2a+2-1}{6(2a+1)} = \frac{2a+1}{6(2a+1)} = \frac{1}{6}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \frac{a-4}{a^2-6a+9} - \frac{a+3}{a^2+a-12} \\
 & a^2-6a+9=(a-3)^2 \quad ; \quad a^2+a-12=(a+4)(a-3) \\
 & \quad \quad \quad mcm=(a-3)^2(a+4) \\
 &= \frac{(a+4)(a-4) - (a-3)(a+3)}{(a+4)(a-3)^2} \\
 &= \frac{a^2-16-a^2+9}{(a+4)(a-3)^2} = \frac{-7}{(a+4)(a-3)^2}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \frac{a^2+4ab-3b^2}{a^2-9b^2} - \frac{b}{a+3b} \quad mcm=a^2-9b^2 \\
 &= \frac{a^2+4ab-3b^2-b(a-3b)}{a^2-9b^2} \\
 &= \frac{a^2+4ab-3b^2-ab+3b^2}{a^2-9b^2} \\
 &= \frac{a^2+3ab}{a^2-9b^2} = \frac{a(a+3b)}{(a+3b)(a-3b)} = \frac{a}{a-3b}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \frac{x}{x^2-1} - \frac{x+1}{(x-1)^2} \quad mcm=(x-1)^2(x+1) \\
 &= \frac{x(x-1) - (x+1)(x+1)}{(x+1)(x-1)^2} \\
 &= \frac{x^2-x-x^2-2x-1}{(x+1)(x-1)^2} = \frac{-3x-1}{(x+1)(x-1)^2} = -\frac{3x+1}{(x+1)(x-1)^2}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{1}{a^3-b^3} - \frac{1}{(a-b)^3} \quad mcm=(a-b)^3(a^2+ab+b^2) \\
 &= \frac{(a-b)^2 - (a^2+ab+b^2)}{(a-b)^3(a^2+ab+b^2)} \\
 &= \frac{a^2-2ab+b^2-a^2-ab-b^2}{(a-b)^3(a^2+ab+b^2)} = \frac{-3ab}{(a-b)^3(a^2+ab+b^2)}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{x+3}{6x^2+x-2} - \frac{1}{4x^2-4x+1} \\
 & 6x^2+x-2=(3x+2)(2x-1) \\
 & 4x^2-4x+1=(2x-1)^2 \quad mcm=(2x-1)^2(3x+2) \\
 &= \frac{(2x-1)(x+3) - (3x+2)}{(3x+2)(2x-1)^2} \\
 &= \frac{2x^2+5x-3-3x-2}{(3x+2)(2x-1)^2} = \frac{2x^2+2x-5}{(3x+2)(2x-1)^2}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{x-1}{4x+4} - \frac{x+2}{8x-8} \quad mcm=8(x^2-1) \\
 &= \frac{2(x-1)(x-1) - (x+2)(x+1)}{8(x^2-1)} \\
 &= \frac{2x^2-4x+2-x^2-3x-2}{8(x^2-1)} = \frac{x^2-7x}{8(x^2-1)}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{x}{xy-y^2} - \frac{1}{y} \quad mcm=y(x-y) \\
 &= \frac{x-(x-y)}{y(x-y)} = \frac{x-x+y}{y(x-y)} = \frac{y}{y(x-y)} = \frac{1}{x-y}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{b}{a^2-b^2} - \frac{b}{a^2+ab} \quad mcm=a(a^2-b^2) \\
 &= \frac{ab-b(a-b)}{a(a^2-b^2)} = \frac{ab-ab+b^2}{a(a^2-b^2)} = \frac{b^2}{a(a^2-b^2)}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{2a-3}{6a+9} - \frac{a-1}{4a^2+12a+9} \\
 & 6a+9=3(2a+3) \quad ; \quad 4a^2+12a+9=(2a+3)^2 \\
 & \quad \quad \quad mcm=3(2a+3)^2 \\
 &= \frac{(2a+3)(2a-3) - 3(a-1)}{3(2a+3)^2} \\
 &= \frac{4a^2-9-3a+3}{3(2a+3)^2} = \frac{4a^2-3a-6}{3(2a+3)^2}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \frac{x+1}{x^2+x+1} - \frac{x-1}{x^2-x+1} \quad mcm=(x^2+x+1)(x^2-x+1) \\
 &= \frac{x+1-(x-1)}{(x^2+x+1)(x^2-x+1)} \\
 &= \frac{x+1-x+1}{(x^2+x+1)(x^2-x+1)} = \frac{2}{(x^2+x+1)(x^2-x+1)}
 \end{aligned}$$

$$19. \frac{a-1}{a^2+a} - \frac{1}{2a-2} - \frac{1}{2a+2} \quad mcm = 2a(a^2-1)$$

$$= \frac{2(a-1)(a-1) - a(a+1) - a(a-1)}{2a(a^2-1)}$$

$$= \frac{2(a^2-2a+1) - a^2 - a - a^2 + a}{2a(a^2-1)}$$

$$= \frac{2a^2 - 4a + 2 - 2a^2}{2a(a^2-1)}$$

$$= -\frac{4a-2}{2a(a^2-1)}$$

$$= -\frac{2(2a-1)}{2a(a^2-1)} = -\frac{2a-1}{a(a^2-1)} = \frac{1-2a}{a(a^2-1)}$$

$$20. \frac{1}{4a+4} - \frac{1}{8a-8} - \frac{1}{12a^2+12}$$

$$mcm = 24(a^2+1)(a^2-1)$$

$$= \frac{6(a^2+1)(a-1) - 3(a^2+1)(a+1) - 2(a^2-1)}{24(a^2+1)(a^2-1)}$$

$$= \frac{6(a^3 - a^2 + a - 1) - 3(a^3 + a^2 + a + 1) - 2a^2 + 2}{24(a^2+1)(a^2-1)}$$

$$= \frac{6a^3 - 6a^2 + 6a - 6 - 3a^3 - 3a^2 - 3a - 3 - 2a^2 + 2}{24(a^2+1)(a^2-1)}$$

$$= \frac{3a^3 - 11a^2 + 3a - 7}{24(a^4-1)}$$

$$21. \frac{y}{x^2-xy} - \frac{1}{x} - \frac{1}{x-y} \quad mcm = x(x-y)$$

$$= \frac{y - (x-y) - x}{x(x-y)}$$

$$= \frac{y-x+y-x}{x(x-y)}$$

$$= \frac{2y-2x}{x(x-y)} = \frac{2(y-x)}{x(x-y)} = -\frac{2(x-y)}{x(x-y)} = -\frac{2}{x}$$

$$22. \frac{a}{a^2+ab} - \frac{1}{a} - \frac{1}{a+b} \quad mcm = a(a+b)$$

$$= \frac{a - (a+b) - a}{a(a+b)} = \frac{-a-b}{a(a+b)} = -\frac{a+b}{a(a+b)} = -\frac{1}{a}$$

$$23. \frac{1}{x^2-xy} - \frac{1}{x^2+xy} - \frac{2y}{x^3-xy^2} \quad mcm = x(x^2-y^2)$$

$$= \frac{x+y-(x-y)-2y}{x(x^2-y^2)} = \frac{x-y-x+y}{x(x^2-y^2)} = \frac{0}{x(x^2-y^2)} = 0$$

$$24. \frac{x}{x^2+x-2} - \frac{3}{x^2+2x-3} - \frac{x}{x^2+5x+6}$$

$$x^2+x-2 = (x+2)(x-1)$$

$$x^2+2x-3 = (x+3)(x-1)$$

$$x^2+5x+6 = (x+3)(x+2)$$

$$mcm = (x+2)(x-1)(x+3)$$

$$= \frac{x(x+3) - 3(x+2) - x(x-1)}{(x+2)(x-1)(x+3)}$$

$$= \frac{x^2+3x-3x-6-x^2+x}{(x+2)(x-1)(x+3)} = \frac{x-6}{(x+2)(x-1)(x+3)}$$

$$25. \frac{3}{x^2+x+1} - \frac{x+2}{(x-1)^2} - \frac{1-9x}{(x^3-1)(x-1)} \quad mcm = (x^3-1)(x-1)$$

$$= \frac{3(x-1)^2 - (x+2)(x^2+x+1) - (1-9x)}{(x^3-1)(x-1)}$$

$$= \frac{3x^2-6x+3-x^3-x^2-x-2x^2-2x-2-1+9x}{(x^3-1)(x-1)}$$

$$= -\frac{x^3}{(x^3-1)(x-1)}$$

$$26. \frac{a^2+b^2}{a^3-b^3} - \frac{a+b}{2a^2+2ab+2b^2} - \frac{1}{2a-2b}$$

$$a^3-b^3 = (a-b)(a^2+ab+b^2)$$

$$2a^2+2ab+2b^2 = 2(a^2+ab+b^2)$$

$$2a-2b = 2(a-b)$$

$$mcm = 2(a-b)(a^2+ab+b^2)$$

$$= \frac{2(a^2+b^2) - (a+b)(a-b) - (a^2+ab+b^2)}{2(a-b)(a^2+ab+b^2)}$$

$$= \frac{2a^2+2b^2-a^2+b^2-a^2-ab-b^2}{2(a-b)(a^2+ab+b^2)}$$

$$= \frac{2b^2-ab}{2(a-b)(a^2+ab+b^2)} = \frac{2b^2-ab}{2(a^3-b^3)}$$

$$27. \frac{3a}{2a^2-2a-4} - \frac{a-1}{4a^2+8a-32} - \frac{10a-1}{8a^2+40a+32}$$

$$2a^2-2a-4 = 2(a^2-a-2) = 2(a-2)(a+1)$$

$$4a^2+8a-32 = 4(a^2+2a-8) = 4(a+4)(a-2)$$

$$8a^2+40a+32 = 8(a^2+5a+4) = 8(a+4)(a+1)$$

$$mcm = 8(a+4)(a-2)(a+1)$$

$$= \frac{12a(a+4) - 2(a-1)(a+1) - (10a-1)(a-2)}{8(a+4)(a-2)(a+1)}$$

$$= \frac{12a^2+48a-2a^2+2-10a^2+20a+a-2}{8(a+4)(a-2)(a+1)}$$

$$= \frac{69a}{8(a+4)(a-2)(a+1)}$$

$$\begin{aligned}
 28. \quad & \frac{1}{4a-12x} - \frac{a^2+9x^2}{a^3-27x^3} - \frac{a}{2(a^2+3ax+9a^2)} \\
 & 4a-12x=4(a-3x) \\
 & a^3-27x^3=(a-3x)(a^2+3ax+9a^2) \\
 & 2(a^2+3ax+9a^2)=2(a^2+3ax+9a^2) \\
 & mcm=4(a^3-27x^3) \\
 & = \frac{a^2+3ax+9x^2-4(a^2+9x^2)-2a(a-3x)}{4(a^3-27x^3)} \\
 & = \frac{a^2+3ax+9x^2-4a^2-36x^2-2a^2+6ax}{4(a^3-27x^3)} \\
 & = \frac{-5a^2+9ax-27x^2}{4(a^3-27x^3)} = -\frac{5a^2-9ax+27x^2}{4(a^3-27x^3)}
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & \frac{2a^2-3}{10a+10} - \frac{a+1}{50} - \frac{9a^2-14}{50a+50} \\
 & 10a+10=10(a+1) \\
 & 50=50 \\
 & 50a+50=50(a+1) \\
 & mcm=50(a+1) \\
 & = \frac{5(2a^2-3)-(a+1)(a+1)-(9a^2-14)}{50(a+1)} \\
 & = \frac{10a^2-15-a^2-2a-1-9a^2+14}{50(a+1)} \\
 & = \frac{-2a-2}{50(a+1)} = -\frac{2(a+1)}{50(a+1)} = -\frac{1}{25}
 \end{aligned}$$

### EJERCICIO 130

$$\begin{aligned}
 1. \quad & \frac{2}{x-3} + \frac{3}{x+2} - \frac{4x-7}{x^2-x-6} \quad mcm=(x-3)(x+2) \\
 & = \frac{2(x+2)+3(x-3)-(4x-7)}{(x-3)(x+2)} \\
 & = \frac{2x+4+3x-9-4x+7}{(x-3)(x+2)} = \frac{x+2}{(x-3)(x+2)} = \frac{1}{x-3}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \frac{a}{3a+6} - \frac{1}{6a+12} + \frac{a+12}{12a+24} \quad mcm=12(a+2) \\
 & = \frac{4a-2+a+12}{12(a+2)} = \frac{5a+10}{12(a+2)} = \frac{5(a+2)}{12(a+2)} = \frac{5}{12}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{x}{x^2+1} + \frac{1}{3x} - \frac{1}{x^2} \quad mcm=3x^2(x^2+1) \\
 & = \frac{3x^3+x(x^2+1)-3(x^2+1)}{3x^2(x^2+1)} \\
 & = \frac{3x^3+x^3+x-3x^2-3}{3x^2(x^2+1)} = \frac{4x^3+x-3x^2-3}{3x^2(x^2+1)}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{a+3}{a^2-1} + \frac{a-1}{2a+2} + \frac{a-4}{4a-4} \quad mcm=4(a^2-1) \\
 & = \frac{4(a+3)+2(a-1)(a-1)+(a-4)(a+1)}{4(a^2-1)} \\
 & = \frac{4a+12+2a^2-4a+2+a^2-3a-4}{4(a^2-1)} = \frac{3a^2-3a+10}{4(a^2-1)}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{a-b}{a^2+ab} + \frac{a+b}{ab} - \frac{a}{ab+b^2} \quad mcm=ab(a+b) \\
 & = \frac{b(a-b)+(a+b)(a+b)-a^2}{ab(a+b)} \\
 & = \frac{ab-b^2+a^2+2ab+b^2-a^2}{ab(a+b)} = \frac{3ab}{ab(a+b)} = \frac{3}{a+b}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{x-y}{x+y} - \frac{x+y}{x-y} + \frac{4x^2}{x^2-y^2} \quad mcm=x^2-y^2 \\
 & = \frac{(x-y)(x-y)-(x+y)(x+y)+4x^2}{x^2-y^2} \\
 & = \frac{x^2-2xy+y^2-x^2-2xy-y^2+4x^2}{x^2-y^2} \\
 & = \frac{4x^2-4xy}{x^2-y^2} = \frac{4x(x-y)}{(x+y)(x-y)} = \frac{4x}{x+y}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{x}{a^2-ax} + \frac{1}{a} + \frac{1}{x} \quad mcm=ax(a-x) \\
 & = \frac{x^2+x(a-x)+a(a-x)}{ax(a-x)} \\
 & = \frac{x^2+ax-x^2+a^2-ax}{ax(a-x)} = \frac{a^2}{ax(a-x)} = \frac{a}{x(a-x)}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \frac{x+1}{x^2-x-20} - \frac{x+4}{x^2-4x-5} + \frac{x+5}{x^2+5x+4} \\
 & x^2-x-20=(x-5)(x+4) \\
 & x^2-4x-5=(x-5)(x+1) \\
 & x^2+5x+4=(x+4)(x+1) \\
 & mcm=(x-5)(x+4)(x+1) \\
 & = \frac{(x+1)(x+1)-(x+4)(x+4)+(x-5)(x+5)}{(x-5)(x+4)(x+1)} \\
 & = \frac{x^2+2x+1-x^2-8x-16+x^2-25}{(x-5)(x+4)(x+1)} \\
 & = \frac{x^2-6x-40}{(x-5)(x+4)(x+1)} \\
 & = \frac{(x-10)(x+4)}{(x-5)(x+4)(x+1)} = \frac{x-10}{(x-5)(x+1)}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \frac{2x+1}{12x+8} - \frac{x^2}{6x^2+x-2} + \frac{2x}{16x-8} \\
 & 12x+8=4(3x+2) \\
 & 6x^2+x-2=(3x+2)(2x-1) \\
 & 16x-8=8(2x-1) \\
 & mcm=8(3x+2)(2x-1) \\
 & = \frac{2(2x+1)(2x-1)-8x^2+2x(3x+2)}{8(3x+2)(2x-1)} \\
 & = \frac{8x^2-2-8x^2+6x^2+4x}{8(3x+2)(2x-1)} \\
 & = \frac{6x^2+4x-2}{8(3x+2)(2x-1)} \\
 & = \frac{2(3x^2+2x-1)}{8(3x+2)(2x-1)} = \frac{3x^2+2x-1}{4(3x+2)(2x-1)}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \frac{1}{ax} - \frac{1}{a^2+ax} + \frac{1}{a+x} \quad mcm=ax(a+x) \\
 & = \frac{a+x-x+ax}{ax(a+x)} = \frac{ax+a}{ax(a+x)} = \frac{a(x+1)}{ax(a+x)} = \frac{x+1}{x(a+x)}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \frac{1}{x+y} - \frac{1}{x-y} + \frac{2y}{x^2+y^2} \quad mcm=(x^2-y^2)(x^2+y^2) \\
 & = \frac{(x-y)(x^2+y^2)-(x+y)(x^2+y^2)+2y(x^2-y^2)}{(x^2-y^2)(x^2+y^2)} \\
 & = \frac{x^3+xy^2-x^2y-y^3-x^3-xy^2-x^2y-y^3+2x^2y-2y^3}{(x^2-y^2)(x^2+y^2)} \\
 & = \frac{-4y^3}{x^4-y^4} = \frac{4y^3}{y^4-x^4}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{a-1}{3a+3} - \frac{a-2}{6a-6} + \frac{a^2+2a-6}{9a^2-9} \quad mcm=18(a^2-1) \\
 & = \frac{6(a-1)(a-1)-3(a-2)(a+1)+2(a^2+2a-6)}{18(a^2-1)} \\
 & = \frac{6a^2-12a+6-3a^2+3a+6+2a^2+4a-12}{18(a^2-1)} \\
 & = \frac{5a^2-5a}{18(a^2-1)} = \frac{5a(a-1)}{18(a+1)(a-1)} = \frac{5a}{18(a+1)}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{1}{a^2+2a-24} + \frac{2}{a^2-2a-8} - \frac{3}{a^2+8a+12} \\
 & a^2+2a-24=(a+6)(a-4) \\
 & a^2-2a-8=(a-4)(a+2) \\
 & a^2+8a+12=(a+6)(a+2) \\
 & mcm=(a+6)(a+2)(a-4) \\
 & = \frac{a+2+2(a+6)-3(a-4)}{(a+6)(a+2)(a-4)} \\
 & = \frac{a+2+2a+12-3a+12}{(a+6)(a+2)(a-4)} = \frac{26}{(a+6)(a+2)(a-4)}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{x+y}{xy} - \frac{x+2y}{xy+y^2} - \frac{y}{x^2+xy} \quad mcm=xy(x+y) \\
 & = \frac{(x+y)(x+y)-x(x+2y)-y^2}{xy(x+y)} \\
 & = \frac{x^2+2xy+y^2-x^2-2xy-y^2}{xy(x+y)} = \frac{0}{xy(x+y)} = 0
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{a^3}{a^3+1} + \frac{a+3}{a^2-a+1} - \frac{a-1}{a+1} \quad mcm=a^3+1 \\
 & = \frac{a^3+(a+1)(a+3)-(a-1)(a^2-a+1)}{a^3+1} \\
 & = \frac{a^3+a^2+4a+3-a^3+a^2-a+a^2-a+1}{a^3+1} = \frac{3a^2+2a+4}{a^3+1}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{1}{x-1} + \frac{2x}{x^2-1} - \frac{3x^2}{x^3-1} \quad mcm=(x^2-1)(x^2+x+1) \\
 & = \frac{(x+1)(x^2+x+1)+2x(x^2+x+1)-3x^2(x+1)}{(x^2-1)(x^2+x+1)} \\
 & = \frac{x^3+x^2+x+x^2+x+1+2x^3+2x^2+2x-3x^3-3x^2}{(x^2-1)(x^2+x+1)} \\
 & = \frac{x^2+4x+1}{(x^2-1)(x^2+x+1)}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{a+b}{a^2-ab+b^2} - \frac{1}{a+b} + \frac{3a^2}{a^3+b^3} \quad mcm = a^3+b^3 \\
 & = \frac{(a+b)(a+b) - (a^2-ab+b^2) + 3a^2}{a^3+b^3} \\
 & = \frac{a^2+2ab+b^2 - a^2+ab-b^2+3a^2}{a^3+b^3} \\
 & = \frac{3a^2+3ab}{a^3+b^3} = \frac{3a(a+b)}{(a+b)(a^2-ab+b^2)} = \frac{3a}{a^2-ab+b^2}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \frac{2}{x-2} + \frac{2x+3}{x^2+2x+4} - \frac{6x+12}{x^3-8} \quad mcm = x^3-8 \\
 & = \frac{2(x^2+2x+4) + (2x+3)(x-2) - (6x+12)}{x^3-8} \\
 & = \frac{2x^2+4x+8+2x^2-4x+3x-6-6x-12}{x^3-8} \\
 & = \frac{4x^2-3x-10}{x^3-8} = \frac{(x-2)(4x+5)}{x^3-8} = \frac{4x+5}{x^2+2x+4}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & \frac{3x+2}{x^2+3x-10} - \frac{5x+1}{x^2+4x-5} + \frac{4x-1}{x^2-3x+2} \\
 & x^2+3x-10 = (x+5)(x-2); \quad x^2+4x-5 = (x+5)(x-1) \\
 & x^2-3x+2 = (x-2)(x-1); \quad mcm = (x+5)(x-2)(x-1) \\
 & = \frac{(3x+2)(x-1) - (5x+1)(x-2) + (4x-1)(x+5)}{(x+5)(x-2)(x-1)} \\
 & = \frac{3x^2-3x+2x-2-5x^2+10x-x+2+4x^2+20x-x-5}{(x+5)(x-2)(x-1)} \\
 & = \frac{2x^2+27x-5}{(x+5)(x-2)(x-1)}
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & \frac{1}{(n+1)^2} + \frac{1}{n-1} - \frac{1}{(n-1)^3} - \frac{1}{n} \quad mcm = n(n-1)^3 \\
 & = \frac{n(n-1) + n(n-1)^2 - n - (n-1)^3}{n(n-1)^3} \\
 & = \frac{n^2 - n + n^3 - 2n^2 + n - n - n^3 + 3n^2 - 3n + 1}{n(n-1)^3} = \frac{2n^2 - 4n + 1}{n(n-1)^3}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & \frac{1}{a^2+5} - \frac{a^2-5}{(a^2+5)^2} + \frac{a^2+5}{a^4-25} \quad mcm = (a^4-25)(a^2+5) \\
 & = \frac{a^4-25 - (a^2-5)(a^2-5) + (a^2+5)(a^2+5)}{(a^4-25)(a^2+5)} \\
 & = \frac{a^4-25 - a^4+10a^2-25+a^4+10a^2+25}{(a^4-25)(a^2+5)} = \frac{a^4+20a^2-25}{(a^4-25)(a^2+5)}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & \frac{1-x^2}{9-x^2} - \frac{x^2}{9+6x+x^2} - \frac{6x}{9-6x+x^2} \\
 & 9-x^2 = (3+x)(3-x); \quad 9+6x+x^2 = (3+x)^2 \\
 & 9-6x+x^2 = (3-x)^2; \quad mcm = (3+x)^2(3-x)^2 \\
 & = \frac{(1-x^2)(9-x^2) - x^2(3-x)^2 - 6x(3+x)^2}{(3+x)^2(3-x)^2} \\
 & = \frac{9-x^2-9x^2+x^4-9x^2+6x^3-x^4-54x-36x^2-6x^3}{(3+x)^2(3-x)^2}
 \end{aligned}$$

$$= \frac{9-54x-55x^2}{(3+x)^2(3-x)^2}$$

$$\begin{aligned}
 23. \quad & \frac{x}{2x+2} - \frac{x+1}{3x-3} + \frac{x-1}{6x+6} - \frac{5}{18x-18} \quad mcm = 18(x^2-1) \\
 & = \frac{9x(x-1) - 6(x+1)(x+1) + 3(x-1)(x-1) - 5(x+1)}{18(x^2-1)} \\
 & = \frac{9x^2-9x-6x^2-12x-6+3x^2-6x+3-5x-5}{18(x^2-1)}
 \end{aligned}$$

$$= \frac{6x^2-32x-8}{18(x^2-1)} = \frac{2(3x^2-16x-4)}{18(x^2-1)} = \frac{3x^2-16x-4}{9(x^2-1)}$$

$$\begin{aligned}
 24. \quad & \frac{a+2}{2a+2} - \frac{7a}{8a^2-8} - \frac{a-3}{4a-4} \quad mcm = 8(a^2-1) \\
 & = \frac{4(a+2)(a-1) - 7a - 2(a-3)(a+1)}{8(a^2-1)} \\
 & = \frac{4a^2+4a-8-7a-2a^2+4a+6}{8(a^2-1)} = \frac{2a^2+a-2}{8(a^2-1)}
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & \frac{a-3}{20a+10} + \frac{2a+5}{40a+20} - \frac{4a-1}{60a+30} \quad mcm = 120(2a+1) \\
 & = \frac{12(a-3) + 6(2a+5) - 4(4a-1)}{120(2a+1)} \\
 & = \frac{12a-36+12a+30-16a+4}{120(2a+1)} \\
 & = \frac{8a-2}{120(2a+1)} = \frac{2(4a-1)}{120(2a+1)} = \frac{4a-1}{60(2a+1)}
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & \frac{2}{2x^2+5x+3} - \frac{1}{2x^2-x-6} + \frac{3}{x^2-x-2} \\
 & 2x^2+5x+3 = (2x+3)(x+1) \\
 & 2x^2-x-6 = (2x+3)(x-2) \\
 & x^2-x-2 = (x-2)(x+1) \\
 & mcm = (2x+3)(x+1)(x-2) \\
 & = \frac{2(x-2) - (x+1) + 3(2x+3)}{(2x+3)(x+1)(x-2)} \\
 & = \frac{2x-4-x-1+6x+9}{(2x+3)(x+1)(x-2)} = \frac{7x+4}{(2x+3)(x+1)(x-2)}
 \end{aligned}$$

$$\begin{aligned}
 27. \frac{a-1}{a-2} - \frac{a-2}{a+3} + \frac{1}{a-1} \quad mcm &= (a-2)(a+3)(a-1) \\
 &= \frac{(a-1)^2(a+3) - (a-2)^2(a-1) + (a-2)(a+3)}{(a-2)(a+3)(a-1)} \\
 &= \frac{(a^2-2a+1)(a+3) - (a^2-4a+4)(a-1) + a^2+a-6}{(a-2)(a+3)(a-1)} \\
 &= \frac{a^3+3a^2-2a^2-6a+a+3-a^3+a^2+4a^2-4a-4a+4+a^2+a-6}{(a-2)(a+3)(a-1)} \\
 &= \frac{7a^2-12a+1}{(a-2)(a+3)(a-1)}
 \end{aligned}$$

$$\begin{aligned}
 28. \frac{2+3a}{2-3a} - \frac{2-3a}{2+3a} - \frac{a}{(2-3a)^2} \quad mcm &= (4-9a^2)(2-3a) \\
 &= \frac{(2+3a)(4-9a^2) - (2-3a)^3 - a(2+3a)}{(4-9a^2)(2-3a)} \\
 &= \frac{8-18a^2+12a-27a^3-8+36a-54a^2+27a^3-2a-3a^2}{(4-9a^2)(2-3a)} \\
 &= \frac{46a-75a^2}{(4-9a^2)(2-3a)}
 \end{aligned}$$

$$\begin{aligned}
 29. \frac{1}{5+5a} + \frac{1}{5-5a} - \frac{1}{10+10a^2} \quad mcm &= 10(1+a^2)(1-a^2) \\
 &= \frac{2(1+a^2)(1-a) + 2(1+a^2)(1+a) - (1-a^2)}{10(1+a^2)(1-a^2)} \\
 &= \frac{2-2a+2a^2-2a^3+2+2a+2a^2+2a^3-1+a^2}{10(1+a^2)(1-a^2)} \\
 &= \frac{5a^2+3}{10(1-a^4)}
 \end{aligned}$$

$$\begin{aligned}
 30. \frac{1}{3-3x} - \frac{1}{3+3x} + \frac{x}{6+6x^2} - \frac{x}{2-2x^2} \\
 3-3x &= 3(1-x) \quad ; \quad 3+3x = 3(1+x) \\
 6+6x^2 &= 6(1+x^2) \quad ; \quad 2-2x^2 = 2(1-x^2) \\
 mcm &= 6(1+x^2)(1-x^2) = 6(1-x^4) \\
 &= \frac{2(1+x^2)(1+x) - 2(1+x^2)(1-x) + x(1-x^2) - 3x(1+x^2)}{6(1-x^4)} \\
 &= \frac{2+2x+2x^2+2x^3-2+2x-2x^2+2x^3+x-x^3-3x-3x^3}{6(1-x^4)} \\
 &= \frac{2x}{6(1-x^4)} = \frac{x}{3(1-x^4)}
 \end{aligned}$$

## EJERCICIO 131

$$\begin{aligned}
 1. \frac{1}{m-n} + \frac{m}{n^2-m^2} &= \frac{1}{m-n} - \frac{m}{m^2-n^2} \quad mcm = m^2-n^2 \\
 &= \frac{m+n-m}{m^2-n^2} = \frac{n}{m^2-n^2}
 \end{aligned}$$

$$\begin{aligned}
 2. \frac{x^2}{x^2-xy} - \frac{2x}{y-x} &= \frac{x^2}{x(x-y)} + \frac{2x}{x-y} = \frac{x}{x-y} + \frac{2x}{x-y} \\
 mcm &= x-y \\
 &= \frac{x+2x}{x-y} = \frac{3x}{x-y}
 \end{aligned}$$

$$\begin{aligned}
 3. \frac{1}{2x-x^2} + \frac{x}{x^2-4} &= \frac{1}{x(2-x)} - \frac{x}{4-x^2} \\
 mcm &= x(4-x^2) \\
 &= \frac{2+x-x^2}{x(4-x^2)} = \frac{(2-x)(1+x)}{x(2-x)(x+2)} = \frac{1+x}{x(2+x)}
 \end{aligned}$$

$$\begin{aligned}
 4. \frac{a+b}{a^2-ab} + \frac{a}{b^2-a^2} &= \frac{a+b}{a(a-b)} - \frac{a}{a^2-b^2} \\
 mcm &= a(a^2-b^2)
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{(a+b)(a+b) - a^2}{a(a^2-b^2)} = \frac{a^2+2ab+b^2-a^2}{a(a^2-b^2)} = \frac{2ab+b^2}{a(a^2-b^2)}
 \end{aligned}$$

$$\begin{aligned}
 5. \frac{x-4}{x^2-2x-3} - \frac{x}{6-2x} &= \frac{x-4}{(x-3)(x+1)} + \frac{x}{2(x-3)} \\
 mcm &= 2(x-3)(x+1) \\
 &= \frac{2(x-4) + x(x+1)}{2(x-3)(x+1)} = \frac{2x-8+x^2+x}{2(x-3)(x+1)} = \frac{x^2+3x-8}{2(x-3)(x+1)}
 \end{aligned}$$

$$\begin{aligned}
 6. \frac{1}{x^2+2x-8} + \frac{1}{(2-x)(x+3)} &= \frac{1}{(x+4)(x-2)} - \frac{1}{(x-2)(x+3)} \\
 mcm &= (x-2)(x+3)(x+4) \\
 &= \frac{x+3-(x+4)}{(x-2)(x+3)(x+4)} \\
 &= \frac{x+3-x-4}{(x-2)(x+3)(x+4)} \\
 &= \frac{-1}{(x-2)(x+3)(x+4)} = \frac{1}{(2-x)(x+3)(x+4)}
 \end{aligned}$$

$$\begin{aligned}
 7. \frac{1}{2x+2} + \frac{2}{1-x} + \frac{7}{4x-4} &= \frac{1}{2(x+1)} - \frac{2}{x-1} + \frac{7}{4(x-1)} \\
 mcm &= 4(x^2-1) \\
 &= \frac{2(x-1) - 8(x+1) + 7(x+1)}{4(x^2-1)} \\
 &= \frac{2x-2-8x-8+7x+7}{4(x^2-1)} = \frac{x-3}{4(x^2-1)}
 \end{aligned}$$

$$8. \frac{2a}{a+3} + \frac{3a}{a-3} + \frac{2a}{9-a^2} = \frac{2a}{a+3} + \frac{3a}{a-3} - \frac{2a}{a^2-9}$$

$$mcm = a^2 - 9$$

$$= \frac{2a(a-3) + 3a(a+3) - 2a}{a^2-9}$$

$$= \frac{2a^2 - 6a + 3a^2 + 9a - 2a}{a^2-9} = \frac{5a^2 + a}{a^2-9}$$

$$9. \frac{x+3y}{y+x} + \frac{3y^2}{x^2-y^2} - \frac{x}{y-x} = \frac{x+3y}{y+x} + \frac{3y^2}{x^2-y^2} - \frac{x}{x-y}$$

$$mcm = x^2 - y^2$$

$$= \frac{(x+3y)(x-y) + 3y^2 + x(x+y)}{x^2-y^2}$$

$$= \frac{x^2 - xy + 3xy - 3y^2 + 3y^2 + x^2 + xy}{x^2-y^2} = \frac{2x^2 + 3xy}{x^2-y^2}$$

$$10. \frac{x}{x^2+2x-3} + \frac{x-3}{(1-x)(x+2)} + \frac{1}{x+2}$$

$$= \frac{x}{(x+3)(x-1)} - \frac{x-3}{(x-1)(x+2)} + \frac{1}{x+2}$$

$$mcm = (x+3)(x+2)(x-1)$$

$$= \frac{x(x+2) - (x-3)(x+3) + (x+3)(x-1)}{(x+3)(x+2)(x-1)}$$

$$= \frac{x^2 + 2x - x^2 + 9 + x^2 + 2x - 3}{(x+3)(x+2)(x-1)} = \frac{x^2 + 4x + 6}{(x+3)(x+2)(x-1)}$$

$$11. \frac{3}{2a+2} - \frac{1}{4a-4} - \frac{4}{8-8a^2} = \frac{3}{2(a+1)} - \frac{1}{4(a-1)} + \frac{4}{8(a^2-1)}$$

$$mcm = 8(a^2-1)$$

$$= \frac{12(a-1) - 2(a+1) + 4}{8(a^2-1)}$$

$$= \frac{12a - 12 - 2a - 2 + 4}{8(a^2-1)} = \frac{10a - 10}{8(a^2-1)} = \frac{10(a-1)}{8(a-1)(a+1)} = \frac{5}{4(a+1)}$$

$$12. \frac{1}{a-3} + \frac{a+1}{(3-a)(a-2)} + \frac{2}{(2-a)(1-a)}$$

$$= \frac{1}{a-3} - \frac{a+1}{(a-3)(a-2)} + \frac{2}{(a-2)(a-1)}$$

$$mcm = (a-3)(a-2)(a-1)$$

$$= \frac{(a-2)(a-1) - (a+1)(a-1) + 2(a-3)}{(a-3)(a-2)(a-1)}$$

$$= \frac{a^2 - 3a + 2 - a^2 + 1 + 2a - 6}{(a-3)(a-2)(a-1)}$$

$$= \frac{-a-3}{(a-3)(a-2)(a-1)} = \frac{a+3}{(3-a)(a-2)(a-1)}$$

$$13. \frac{2x}{x-1} + \frac{2x^3+2x^2}{1-x^3} + \frac{1}{x^2+x+1}$$

$$= \frac{2x}{x-1} - \frac{2x^2(x+1)}{x^3-1} + \frac{1}{x^2+x+1}$$

$$mcm = x^3 - 1$$

$$= \frac{2x(x^2+x+1) - 2x^2(x+1) + (x-1)}{x^3-1}$$

$$= \frac{2x^3 + 2x^2 + 2x - 2x^3 - 2x^2 + x - 1}{x^3-1} = \frac{3x-1}{x^3-1}$$

$$14. \frac{x+2}{3x-1} + \frac{x+1}{3-2x} + \frac{4x^2+6x+3}{6x^2-11x+3}$$

$$= \frac{x+2}{3x-1} - \frac{x+1}{2x-3} + \frac{4x^2+6x+3}{(2x-3)(3x-1)}$$

$$mcm = (2x-3)(3x-1)$$

$$= \frac{(x+2)(2x-3) - (x+1)(3x-1) + 4x^2+6x+3}{(2x-3)(3x-1)}$$

$$= \frac{2x^2 - 3x + 4x - 6 - 3x^2 + x - 3x + 1 + 4x^2 + 6x + 3}{(2x-3)(3x-1)}$$

$$= \frac{3x^2 + 5x - 2}{(2x-3)(3x-1)} = \frac{(x+2)(3x-1)}{(2x-3)(3x-1)} = \frac{x+2}{2x-3}$$

## EJERCICIO 132

$$1. \frac{2a^2}{3b} \cdot \frac{6b^2}{4a} = \frac{12a^2b^2}{12ab} = ab$$

$$2. \frac{x^2y}{5} \cdot \frac{10a^3}{3m^2} \cdot \frac{9m}{x^3} = \frac{90x^2ya^3m}{15x^3m^2} = \frac{6a^3y}{xm}$$

$$3. \frac{5x^2}{7y^3} \cdot \frac{4y^2}{7m^3} \cdot \frac{14m}{5x^4} = \frac{14 \cdot 5 \cdot 4x^2my^2}{49 \cdot 5x^4m^3y^3} = \frac{8}{7x^2m^2y}$$

$$4. \frac{5}{a} \cdot \frac{2a}{b^2} \cdot \frac{3b}{10} = \frac{10 \cdot 3ab}{10ab^2} = \frac{3}{b}$$

$$5. \frac{2x^3}{15a^3} \cdot \frac{3a^2}{y} \cdot \frac{5x^2}{7xy^2} = \frac{15 \cdot 2a^2x^5}{15 \cdot 7a^3xy^3} = \frac{2x^4}{7ay^3}$$

$$6. \frac{7a}{6m^2} \cdot \frac{3m}{10n^2} \cdot \frac{5n^4}{14ax} = \frac{7 \cdot 3 \cdot 5amn^4}{14 \cdot 6 \cdot 10am^2n^2x} = \frac{n^2}{8mx}$$

$$7. \frac{2x^2+x}{6} + \frac{8}{4x+2} = \frac{x(2x+1)}{3} \cdot \frac{4}{2(2x+1)} = \frac{2x}{3}$$

$$8. \frac{5x+25}{14} \cdot \frac{7x+7}{10x+50} = \frac{5(x+5)}{14} \cdot \frac{7(x+1)}{10(x+5)} = \frac{x+1}{4}$$



$$9. \frac{m+n}{mn-n^2} \cdot \frac{n^2}{m^2-n^2}$$

$$= \frac{m+n}{n(m-n)} \cdot \frac{n^2}{(m+n)(m-n)} = \frac{n}{(m-n)^2} = \frac{n}{m^2-2mn+n^2}$$

$$10. \frac{xy-2y^2}{x^2+xy} \cdot \frac{x^2+2xy+y^2}{x^2-2xy}$$

$$= \frac{y(x-2y)}{x(x+y)} \cdot \frac{(x+y)^2}{x(x-2y)} = \frac{y(x+y)}{x^2} = \frac{xy+y^2}{x^2}$$

$$11. \frac{x^2-4xy+4y^2}{x^2+2xy} \cdot \frac{x^2}{x^2-4y^2}$$

$$= \frac{(x-2y)^2}{x(x+2y)} \cdot \frac{x^2}{(x+2y)(x-2y)} = \frac{x(x-2y)}{(x+2y)^2} = \frac{x^2-2xy}{x^2+4xy+y^2}$$

$$12. \frac{2x^2+2x}{2x^2} \cdot \frac{x^2-3x}{x^2-2x-3} = \frac{2x(x+1)}{2x^2} \cdot \frac{x(x-3)}{(x-3)(x+1)} = 1$$

$$13. \frac{a^2-ab+a-b}{a^2+2a+1} \cdot \frac{3}{6a^2-6ab}$$

$$= \frac{(a+1)(a-b)}{(a+1)(a+1)} \cdot \frac{3}{6a(a-b)} = \frac{1}{2a(a+1)} = \frac{1}{2a^2+2a}$$

$$14. \frac{(x-y)^3}{x^3-1} \cdot \frac{x^2+x+1}{(x-y)^2} = \frac{(x-y)}{(x-1)(x^2+x+1)} \cdot x^2+x+1 = \frac{x-y}{x-1}$$

$$15. \frac{2a-2}{2a^2-50} \cdot \frac{a^2-4a-5}{3a+3} = \frac{2(a-1)}{2(a^2-25)} \cdot \frac{(a-5)(a+1)}{3(a+1)}$$

$$= \frac{(a-1)(a-5)}{3(a+5)(a-5)} = \frac{a-1}{3(a+5)} = \frac{a-1}{3a+15}$$

$$16. \frac{2x^2-3x-2}{6x+3} \cdot \frac{3x+6}{x^2-4} = \frac{(x-2)(2x+1)}{3(2x+1)} \cdot \frac{3(x+2)}{(x-2)(x+2)} = 1$$

$$17. \frac{y^2+9y+18}{y-5} \cdot \frac{5y-25}{5y+15} = \frac{(y+6)(y+3)}{y-5} \cdot \frac{5(y-5)}{5(y+3)} = y+6$$

$$18. \frac{x^3+2x^2-3x}{4x^2+8x+3} \cdot \frac{2x^2+3x}{x^2-x}$$

$$= \frac{x(x^2+2x-3)}{(2x+3)(2x+1)} \cdot \frac{x(2x+3)}{x(x-1)}$$

$$= \frac{x(x+3)(x-1)}{(2x+1)(x-1)} = \frac{x(x+3)}{2x+1} = \frac{x^2+3x}{2x+1}$$

$$19. \frac{x^3-27}{a^3-1} \cdot \frac{a^2+a+1}{x^2+3x+9}$$

$$= \frac{(x-3)(x^2+3x+9)}{(a-1)(a^2+a+1)} \cdot \frac{a^2+a+1}{x^2+3x+9} = \frac{x-3}{a-1}$$

$$20. \frac{a^2+4ab+4b^2}{3} \cdot \frac{2a+4b}{(a+2b)^3} = \frac{(a+2b)^2}{3} \cdot \frac{2(a+2b)}{(a+2b)^3} = \frac{2}{3}$$

$$21. \frac{1-x}{a+1} \cdot \frac{a^2+a}{x-x^2} \cdot \frac{x^2}{a} = \frac{1-x}{a+1} \cdot \frac{a(a+1)}{x(1-x)} \cdot \frac{x^2}{a} = x$$

$$22. \frac{x^2+2x}{x^2-16} \cdot \frac{x^2-2x-8}{x^3+x^2} \cdot \frac{x^2+4x}{x^2+4x+4}$$

$$= \frac{x(x+2)}{(x-4)(x+4)} \cdot \frac{(x-4)(x+2)}{x^2(x+1)} \cdot \frac{x(x+4)}{(x+2)(x+2)}$$

$$= \frac{x^2(x+2)^2(x-4)(x+4)}{x^2(x+2)^2(x-4)(x+4)(x+1)} = \frac{1}{x+1}$$

$$23. \frac{(m+n)^2-x^2}{(m+x)^2-n^2} \cdot \frac{(m-n)^2-x^2}{m^2+mn-mx}$$

$$= \frac{(m+n+x)(m+n-x)}{(m+n+x)(m-n+x)} \cdot \frac{(m-n+x)(m-n-x)}{m(m+n-x)}$$

$$= \frac{m-n-x}{m}$$

$$24. \frac{2a^3+2ab^2}{2ax^2-2ax} \cdot \frac{x^3-x}{a^2x+b^2x} \cdot \frac{x}{x+1}$$

$$= \frac{2a(a^2+b^2)}{2ax(x-1)} \cdot \frac{x(x^2-1)}{x(a^2+b^2)} \cdot \frac{x}{x+1} = 1$$

$$25. \frac{a^2-5a+6}{3a-15} \cdot \frac{6a}{a^2-a-30} \cdot \frac{a^2-25}{2a-4}$$

$$= \frac{(a-3)(a-2)}{3(a-5)} \cdot \frac{6a}{(a-6)(a+5)} \cdot \frac{(a+5)(a-5)}{2(a-2)}$$

$$= \frac{a(a-3)}{a-6} = \frac{a^2-3a}{a-6}$$

$$26. \frac{x^2-3xy-10y^2}{x^2-2xy-8y^2} \cdot \frac{x^2-16y^2}{x^2+4xy} \cdot \frac{x^2-6xy}{x+2y}$$

$$= \frac{(x-5y)(x+2y)}{(x-4y)(x+2y)} \cdot \frac{(x+4y)(x-4y)}{x(x+4y)} \cdot \frac{x(x-6y)}{x+2y}$$

$$= \frac{(x-5y)(x-6y)}{x+2y} = \frac{x^2-11xy+30y^2}{x+2y}$$

$$27. \frac{x^2+4ax+4a^2}{3ax-6a^2} \cdot \frac{2ax-4a^2}{ax+a} \cdot \frac{6a+6x}{x^2+3ax+2a^2}$$

$$= \frac{(x+2a)^2}{3a(x-2a)} \cdot \frac{2a(x-2a)}{a(x+1)} \cdot \frac{6(a+x)}{(x+2a)(x+a)}$$

$$= \frac{4(x+2a)}{a(x+1)} = \frac{4x+8a}{ax+a}$$

$$28. \frac{a^2-81}{2a^2+10a} \cdot \frac{a+11}{a^2-36} \cdot \frac{2a-12}{2a+18} \cdot \frac{a^3+5a^2}{2a+22}$$

$$= \frac{(a+9)(a-9)}{2a(a+5)} \cdot \frac{a+11}{(a+6)(a-6)} \cdot \frac{2(a-6)}{2(a+9)} \cdot \frac{a^2(a+5)}{2(a+11)}$$

$$= \frac{a(a-9)}{4(a+6)} = \frac{a^2-9a}{4a+24}$$

$$\begin{aligned}
 29. \quad & \frac{a^2+7a+10}{a^2-6a-7} \cdot \frac{a^2-3a-4}{a^2+2a-15} \cdot \frac{a^3-2a^2-3a}{a^2-2a-8} \\
 &= \frac{(a+5)(a+2)}{(a-7)(a+1)} \cdot \frac{(a-4)(a+1)}{(a+5)(a-3)} \cdot \frac{a(a^2-2a-3)}{(a-4)(a+2)} \\
 &= \frac{a(a-3)(a+1)}{(a-3)(a-7)} = \frac{a(a+1)}{a-7} = \frac{a^2+a}{a-7}
 \end{aligned}$$

### EJERCICIO 133

$$\begin{aligned}
 1. \quad & \left(a + \frac{a}{b}\right) \left(a - \frac{a}{b+1}\right) \\
 &\Rightarrow a + \frac{a}{b} = \frac{ab+a}{b} = \frac{a(b+1)}{b} \\
 &\Rightarrow a - \frac{a}{b+1} = \frac{a(b+1)-a}{b+1} = \frac{ab+a-a}{b+1} = \frac{ab}{b+1} \\
 &\Rightarrow \frac{a(b+1)}{b} \cdot \frac{ab}{b+1} = a^2
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \left(x - \frac{2}{x+1}\right) \left(x + \frac{1}{x+2}\right) \\
 &\Rightarrow x - \frac{2}{x+1} = \frac{x(x+1)-2}{x+1} = \frac{x^2+x-2}{x+1} = \frac{(x+2)(x-1)}{x+1} \\
 &\Rightarrow x + \frac{1}{x+2} = \frac{x(x+2)+1}{x+2} = \frac{x^2+2x+1}{x+2} = \frac{(x+1)(x+1)}{x+2} \\
 &\Rightarrow \frac{(x+2)(x-1)}{x+1} \cdot \frac{(x+1)^2}{x+2} = (x-1)(x+1) = x^2-1
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \left(1 - \frac{x}{a+x}\right) \left(1 + \frac{x}{a}\right) \\
 &\Rightarrow 1 - \frac{x}{a+x} = \frac{a+x-x}{a+x} = \frac{a}{a+x} \\
 &\Rightarrow 1 + \frac{x}{a} = \frac{a+x}{a} \\
 &\Rightarrow \frac{a}{a+x} \cdot \frac{a+x}{a} = 1
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \left(a + \frac{ab}{a-b}\right) \left(1 - \frac{b^2}{a^2}\right) \\
 &\Rightarrow a + \frac{ab}{a-b} = \frac{a(a-b)+ab}{a-b} = \frac{a^2-ab+ab}{a-b} = \frac{a^2}{a-b} \\
 &\Rightarrow 1 - \frac{b^2}{a^2} = \frac{a^2-b^2}{a^2} \\
 &\Rightarrow \frac{a^2}{a-b} \cdot \frac{a^2-b^2}{a^2} = \frac{(a+b)(a-b)}{(a-b)} = a+b
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & \frac{x^4+27x}{x^3-x^2+x} \cdot \frac{x^4+x}{x^4-3x^3+9x^2} \cdot \frac{1}{x(x+3)^2} \cdot \frac{x^2}{x-3} \\
 &= \frac{x(x^3+27)}{x(x^2-x+1)} \cdot \frac{x(x^3+1)}{x^2(x^2-3x+9)} \cdot \frac{x}{(x+3)^2(x-3)} \\
 &= \frac{(x+3)(x^2-3x+9)}{x^2-x+1} \cdot \frac{(x+1)(x^2-x+1)}{x^2-3x+9} \cdot \frac{1}{(x^2-9)(x+3)} \\
 &= \frac{x+1}{x^2-9}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \left(x+2 - \frac{12}{x+1}\right) \left(x-2 + \frac{10-3x}{x+5}\right) \\
 &\Rightarrow x+2 - \frac{12}{x+1} = \frac{(x+2)(x+1)-12}{x+1} \\
 &= \frac{x^2+3x+2-12}{x+1} = \frac{x^2+3x-10}{x+1} = \frac{(x+5)(x-2)}{x+1} \\
 &\Rightarrow x-2 + \frac{10-3x}{x+5} = \frac{(x-2)(x+5)+10-3x}{x+5} = \frac{x^2+3x-10+10-3x}{x+5} = \frac{x^2}{x+5} \\
 &\Rightarrow \frac{(x+5)(x-2)}{x+1} \cdot \frac{x^2}{x+5} = \frac{x^2(x-2)}{x+1} = \frac{x^3-2x^2}{x+1}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \left(1 + \frac{x}{y}\right) \left(x - \frac{x^2}{x+y}\right) \\
 &\Rightarrow 1 + \frac{x}{y} = \frac{y+x}{y} \\
 &\Rightarrow x - \frac{x^2}{x+y} = \frac{x(x+y)-x^2}{x+y} = \frac{x^2+xy-x^2}{x+y} = \frac{xy}{x+y} \\
 &\Rightarrow \frac{y+x}{y} \cdot \frac{xy}{x+y} = x
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \left(a+x - \frac{ax+x^2}{a+2x}\right) \left(1 + \frac{x}{a+x}\right) \\
 &\Rightarrow a+x - \frac{ax+x^2}{a+2x} = \frac{(a+x)(a+2x)-(ax+x^2)}{a+2x} \\
 &= \frac{a^2+3ax+2x^2-ax-x^2}{a+2x} = \frac{a^2+2ax+x^2}{a+2x} = \frac{(a+x)^2}{a+2x} \\
 &\Rightarrow 1 + \frac{x}{a+x} = \frac{a+x+x}{a+x} = \frac{a+2x}{a+x} \\
 &\Rightarrow \frac{(a+x)^2}{a+2x} \cdot \frac{a+2x}{a+x} = a+x
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \left(x - \frac{x^3 - 6x}{x^2 - 25}\right) \left(x + 1 - \frac{8}{x+3}\right) \\
 & \Rightarrow x - \frac{x^3 - 6x}{x^2 - 25} = \frac{x(x^2 - 25) - (x^3 - 6x)}{x^2 - 25} \\
 & = \frac{x^3 - 25x - x^3 + 6x}{x^2 - 25} = \frac{-19x}{x^2 - 25} = \frac{19x}{25 - x^2} \\
 & \Rightarrow x + 1 - \frac{8}{x+3} = \frac{(x+1)(x+3) - 8}{x+3} \\
 & = \frac{x^2 + 4x + 3 - 8}{x+3} = \frac{x^2 + 4x - 5}{x+3} = \frac{(x+5)(x-1)}{x+3} \\
 & \Rightarrow \frac{19x}{25 - x^2} \cdot \frac{(x+5)(x-1)}{x+3} \\
 & = \frac{19x(x-1)}{(5-x)(x+3)} = \frac{19x^2 - 19x}{5x + 15 - x^2 - 3x} = \frac{19x^2 - 19x}{15 + 2x - x^2}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \left(a + 2x - \frac{14x^2}{2a+x}\right) \left(a - x + \frac{a^2 + 5x^2}{a+4x}\right) \\
 & \Rightarrow a + 2x - \frac{14x^2}{2a+x} \\
 & = \frac{(a+2x)(2a+x) - 14x^2}{2a+x} \\
 & = \frac{2a^2 + 5ax + 2x^2 - 14x^2}{2a+x} = \frac{2a^2 + 5ax - 12x^2}{2a+x} = \frac{(a+4x)(2a-3x)}{2a+x} \\
 & \Rightarrow a - x + \frac{a^2 + 5x^2}{a+4x} \\
 & = \frac{(a-x)(a+4x) + a^2 + 5x^2}{a+4x} \\
 & = \frac{a^2 + 3ax - 4x^2 + a^2 + 5x^2}{a+4x} = \frac{2a^2 + 3ax + x^2}{a+4x} = \frac{(a+x)(2a+x)}{a+4x} \\
 & \Rightarrow \frac{(a+4x)(2a-3x)}{2a+x} \cdot \frac{(a+x)(2a+x)}{a+4x} \\
 & = (2a-3x)(a+x) = 2a^2 - ax - 3x^2
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \left(m - \frac{mn}{m+n}\right) \left(1 + \frac{n^3}{m^3}\right) \\
 & \Rightarrow m - \frac{mn}{m+n} = \frac{m(m+n) - mn}{m+n} = \frac{m^2 + mn - mn}{m+n} = \frac{m^2}{m+n} \\
 & \Rightarrow 1 + \frac{n^3}{m^3} = \frac{m^3 + n^3}{m^3} = \frac{(m+n)(m^2 - mn + n^2)}{m^3} \\
 & \Rightarrow \frac{m^2}{m+n} \cdot \frac{(m+n)(m^2 - mn + n^2)}{m^3} = \frac{m^2 - mn + n^2}{m}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \left(1 + \frac{a}{b}\right) \left(1 - \frac{b}{a}\right) \left(1 + \frac{b^2}{a^2 - b^2}\right) \\
 & \Rightarrow 1 + \frac{a}{b} = \frac{b+a}{b} \\
 & \Rightarrow 1 - \frac{b}{a} = \frac{a-b}{a} \\
 & \Rightarrow 1 + \frac{b^2}{a^2 - b^2} = \frac{a^2}{a^2 - b^2} \\
 & \Rightarrow \frac{b+a}{b} \cdot \frac{a-b}{a} \cdot \frac{a^2}{(a+b)(a-b)} = \frac{a^2}{ab} = \frac{a}{b}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \left(2 + \frac{2}{x+1}\right) \left(3 - \frac{6}{x+2}\right) \left(1 + \frac{1}{x}\right) \\
 & \Rightarrow 2 + \frac{2}{x+1} = \frac{2(x+1) + 2}{x+1} = \frac{2x+4}{x+1} = \frac{2(x+2)}{x+1} \\
 & \Rightarrow 3 - \frac{6}{x+2} = \frac{3(x+2) - 6}{x+2} = \frac{3x+6-6}{x+2} = \frac{3x}{x+2} \\
 & \Rightarrow 1 + \frac{1}{x} = \frac{x+1}{x} \\
 & \Rightarrow \frac{2(x+2)}{x+1} \cdot \frac{3x}{x+2} \cdot \frac{x+1}{x} = 6
 \end{aligned}$$

### EJERCICIO 134

$$\begin{aligned}
 1. \quad & \frac{x^2}{3y^2} \div \frac{2x}{y^3} = \frac{x^2}{3y^2} \cdot \frac{y^3}{2x} = \frac{xy}{6} \\
 2. \quad & \frac{3a^2b}{5x^2} \div a^2b^3 = \frac{3a^2b}{5x^2} \cdot \frac{1}{a^2b^3} = \frac{3}{5b^2x^2} \\
 3. \quad & \frac{5m^2}{7n^3} \div \frac{10m^4}{14an^4} = \frac{5m^2}{7n^3} \cdot \frac{14an^4}{10m^4} = \frac{an}{m^2} \\
 4. \quad & 6a^2x^3 \div \frac{a^2x}{5} = 6a^2x^3 \cdot \frac{5}{a^2x} = 30x^2 \\
 5. \quad & \frac{15m^2}{19ax^3} \div \frac{20y^2}{38a^3x^4} = \frac{15m^2}{19ax^3} \cdot \frac{38a^3x^4}{20y^2} = \frac{3m^2a^2x}{2y^2} \\
 6. \quad & \frac{11x^2y^3}{7m^2} \div 22y^4 = \frac{11x^2y^3}{7m^2} \cdot \frac{1}{22y^4} = \frac{x^2}{14m^2y} \\
 7. \quad & \frac{x-1}{3} \div \frac{2x-2}{6} = \frac{x-1}{3} \cdot \frac{6}{2(x-1)} = 1 \\
 8. \quad & \frac{3a^2}{a^2 + 6ab + 9b^2} \div \frac{5a^3}{a^2b + 3ab^2} = \frac{3a^2}{(a+3b)^2} \cdot \frac{ab(a+3b)}{5a^3} = \frac{3b}{5(a+3b)} \\
 9. \quad & \frac{x^3 - x}{2x^2 + 6x} \div \frac{5x^2 - 5x}{2x + 6} = \frac{x(x^2 - 1)}{2x(x+3)} \cdot \frac{2(x+3)}{5x(x-1)} = \frac{x+1}{5x} \\
 10. \quad & \frac{1}{a^2 - a - 30} \div \frac{2}{a^2 + a - 42} \\
 & = \frac{1}{(a-6)(a+5)} \cdot \frac{(a+7)(a-6)}{2} = \frac{a+7}{2(a+5)} \\
 11. \quad & \frac{20x^2 - 30x}{15x^3 + 15x^2} \div \frac{4x-6}{x+1} = \frac{5x(4x-6)}{15x^2(x+1)} \cdot \frac{x+1}{4x-6} = \frac{1}{3x}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{a^2 - 6a + 5}{a^2 - 15a + 56} \div \frac{a^2 + 2a - 35}{a^2 - 5a - 24} \\
 &= \frac{(a-5)(a-1)}{(a-8)(a-7)} \cdot \frac{(a-8)(a+3)}{(a+7)(a-5)} \\
 &= \frac{(a-1)(a+3)}{(a-7)(a+7)} = \frac{a^2 + 2a - 3}{a^2 - 49}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{8x^2 + 26x + 15}{16x^2 - 9} \div \frac{6x^2 + 13x - 5}{9x^2 - 1} \\
 &= \frac{(2x+5)(4x+3)}{(4x+3)(4x-3)} \cdot \frac{(3x+1)(3x-1)}{(2x+5)(3x-1)} = \frac{3x+1}{4x-3}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{x^3 - 121x}{x^2 - 49} \div \frac{x^2 - 11x}{x+7} \\
 &= \frac{x(x^2 - 121)}{(x+7)(x-7)} \cdot \frac{(x+7)}{x(x-11)} = \frac{x+11}{x-7}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{ax^2 + 5}{4a^2 - 1} \div \frac{a^3x^2 + 5a^2}{2a - 1} \\
 &= \frac{ax^2 + 5}{(2a+1)(2a-1)} \cdot \frac{2a-1}{a^2(ax^2 + 5)} = \frac{1}{a^2(2a+1)}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{a^4 - 1}{a^3 + a^2} \div \frac{a^4 + 4a^2 + 3}{3a^3 + 9a} \\
 &= \frac{(a^2+1)(a^2-1)}{a^2(a+1)} \cdot \frac{3a(a^2+3)}{(a^2+3)(a^2+1)} = \frac{3(a-1)}{a}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{x^3 + 125}{x^2 - 64} \div \frac{x^3 - 5x^2 + 25x}{x^2 + x - 56} \\
 &= \frac{(x+5)(x^2 - 5x + 25)}{(x+8)(x-8)} \cdot \frac{(x+8)(x-7)}{x(x^2 - 5x + 25)} \\
 &= \frac{(x+5)(x-7)}{x(x-8)} = \frac{x^2 - 2x - 35}{x^2 - 8x}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \frac{16x^2 - 24xy + 9y^2}{16x - 12y} \div \frac{64x^3 - 27y^3}{32x^2 + 24xy + 18y^2} \\
 &= \frac{(4x-3y)^2}{4(4x-3y)} \cdot \frac{2(16x^2 + 12xy + 9y^2)}{(4x-3y)(16x^2 + 12xy + 9y^2)} = \frac{1}{2}
 \end{aligned}$$

$$19. \quad \frac{a^2 - 6a}{a^3 + 3a^2} \div \frac{a^2 + 3a - 54}{a^2 + 9a} = \frac{a(a-6)}{a^2(a+3)} \cdot \frac{a(a+9)}{(a+9)(a-6)} = \frac{1}{a+3}$$

$$\begin{aligned}
 20. \quad & \frac{15x^2 + 7x - 2}{25x^3 - x} \div \frac{6x^2 + 13x + 6}{25x^2 + 10x + 1} \\
 &= \frac{(3x+2)(5x-1)}{x(5x-1)(5x+1)} \cdot \frac{(5x+1)^2}{(2x+3)(3x+2)} = \frac{5x+1}{x(2x+3)} = \frac{5x+1}{2x^2 + 3x}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & \frac{x^3 - 1}{2x^2 - 2x + 2} \div \frac{7x^2 + 7x + 7}{7x^3 + 7} \\
 &= \frac{(x-1)(x^2 + x + 1)}{2(x^2 - x + 1)} \cdot \frac{7(x^3 + 1)}{7(x^2 + x + 1)} \\
 &= \frac{(x-1)}{2(x^2 - x + 1)} \cdot (x+1)(x^2 - x + 1) = \frac{(x-1)(x+1)}{2} = \frac{x^2 - 1}{2}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & \frac{2mx - 2my + nx - ny}{3x - 3y} \div \frac{8m + 4n}{3(x-y)} \\
 &= \frac{(2m+n)(x-y)}{3(x-y)} \cdot \frac{1}{4(2m+n)} = \frac{1}{12}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & \frac{x^2 - 6x + 9}{4x^2 - 1} \div \frac{x^2 + 5x - 24}{2x^2 + 17x + 8} \\
 &= \frac{(x-3)^2}{(2x+1)(2x-1)} \cdot \frac{(2x+1)(x+8)}{(x+8)(x-3)} = \frac{x-3}{2x-1}
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & \frac{2a^2 + 7ab - 15b^2}{a^3 + 4a^2b} \div \frac{a^2 - 3ab - 40b^2}{a^2 - 4ab - 32b^2} \\
 &= \frac{(a+5b)(2a-3b)}{a^2(a+4b)} \cdot \frac{(a-8b)(a+4b)}{(a-8b)(a+5b)} = \frac{2a-3b}{a^2}
 \end{aligned}$$

### EJERCICIO 135

$$\begin{aligned}
 1. \quad & \left(1 + \frac{a}{a+b}\right) \div \left(1 + \frac{2a}{b}\right) \\
 &\Rightarrow 1 + \frac{a}{a+b} = \frac{a+b+a}{a+b} = \frac{2a+b}{a+b} \\
 &\Rightarrow 1 + \frac{2a}{b} = \frac{b+2a}{b} \\
 &\Rightarrow \frac{2a+b}{a+b} \div \frac{b+2a}{b} = \frac{2a+b}{a+b} \cdot \frac{b}{b+2a} = \frac{b}{a+b}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \left(x - \frac{2}{x+1}\right) \div \left(x - \frac{x}{x+1}\right) \\
 &\Rightarrow x - \frac{2}{x+1} = \frac{x(x+1) - 2}{x+1} = \frac{x^2 + x - 2}{x+1} \\
 &\Rightarrow x - \frac{x}{x+1} = \frac{x(x+1) - x}{x+1} = \frac{x^2}{x+1} \\
 &\Rightarrow \frac{x^2 + x - 2}{x+1} \div \frac{x^2}{x+1} = \frac{x^2 + x - 2}{x+1} \cdot \frac{x+1}{x^2} = \frac{x^2 + x - 2}{x^2}
 \end{aligned}$$

$$\begin{aligned}
 3. \left(1-a+\frac{a^2}{1+a}\right) \div \left(1+\frac{2}{a^2-1}\right) \\
 \Rightarrow 1-a+\frac{a^2}{1+a} = \frac{(1-a)(1+a)+a^2}{1+a} = \frac{1-a^2+a^2}{1+a} = \frac{1}{1+a} \\
 \Rightarrow 1+\frac{2}{a^2-1} = \frac{a^2-1+2}{a^2-1} = \frac{a^2+1}{a^2-1} \\
 \Rightarrow \frac{1}{1+a} \div \frac{a^2+1}{a^2-1} = \frac{1}{1+a} \cdot \frac{a^2-1}{a^2+1} = \frac{a-1}{a^2+1}
 \end{aligned}$$

$$\begin{aligned}
 4. \left(x+\frac{2}{x+3}\right) \div \left(x+\frac{3}{x+4}\right) \\
 \Rightarrow x+\frac{2}{x+3} = \frac{x(x+3)+2}{x+3} = \frac{x^2+3x+2}{x+3} = \frac{(x+1)(x+2)}{x+3} \\
 \Rightarrow x+\frac{3}{x+4} = \frac{x(x+4)+3}{x+4} = \frac{x^2+4x+3}{x+4} = \frac{(x+3)(x+1)}{x+4} \\
 \Rightarrow \frac{(x+1)(x+2)}{x+3} \div \frac{(x+3)(x+1)}{x+4} \\
 = \frac{(x+1)(x+2)}{x+3} \cdot \frac{x+4}{(x+3)(x+1)} = \frac{(x+2)(x+4)}{(x+3)^2} = \frac{x^2+6x+8}{x^2+6x+9}
 \end{aligned}$$

$$\begin{aligned}
 5. \left(a+b+\frac{b^2}{a-b}\right) \div \left(1-\frac{b}{a+b}\right) \\
 \Rightarrow a+b+\frac{b^2}{a-b} = \frac{(a+b)(a-b)+b^2}{a-b} = \frac{a^2-b^2+b^2}{a-b} = \frac{a^2}{a-b} \\
 \Rightarrow 1-\frac{b}{a+b} = \frac{a+b-b}{a+b} = \frac{a}{a+b} \\
 \Rightarrow \frac{a^2}{a-b} \div \frac{a}{a+b} = \frac{a^2}{a-b} \cdot \frac{a+b}{a} = \frac{a(a+b)}{a-b} = \frac{a^2+ab}{a-b}
 \end{aligned}$$

$$\begin{aligned}
 6. \left(1-\frac{1}{x^3+2}\right) \div \left(x+\frac{1}{x-1}\right) \\
 \Rightarrow 1-\frac{1}{x^3+2} = \frac{x^3+2-1}{x^3+2} = \frac{x^3+1}{x^3+2} = \frac{(x+1)(x^2-x+1)}{x^3+2} \\
 \Rightarrow x+\frac{1}{x-1} = \frac{x(x-1)+1}{x-1} = \frac{x^2-x+1}{x-1} \\
 \Rightarrow \frac{(x+1)(x^2-x+1)}{x^3+2} \div \frac{x^2-x+1}{x-1} \\
 = \frac{(x+1)(x^2-x+1)}{x^3+2} \cdot \frac{x-1}{x^2-x+1} = \frac{(x+1)(x-1)}{x^3-2} = \frac{x^2-1}{x^3+2}
 \end{aligned}$$

$$\begin{aligned}
 7. \left(x+\frac{1}{x+2}\right) \div \left(1+\frac{3}{x^2-4}\right) \\
 \Rightarrow x+\frac{1}{x+2} = \frac{x(x+2)+1}{x+2} = \frac{x^2+2x+1}{x+2} = \frac{(x+1)^2}{x+2} \\
 \Rightarrow 1+\frac{3}{x^2-4} = \frac{x^2-4+3}{x^2-4} = \frac{x^2-1}{x^2-4} = \frac{(x+1)(x-1)}{(x+2)(x-2)} \\
 \Rightarrow \frac{(x+1)^2}{x+2} \div \frac{(x+1)(x-1)}{(x+2)(x-2)} \\
 = \frac{(x+1)^2}{x+2} \cdot \frac{(x+2)(x-2)}{(x+1)(x-1)} = \frac{(x+1)(x-2)}{x-1} = \frac{x^2-x-2}{x-1}
 \end{aligned}$$

$$\begin{aligned}
 8. \left(n-\frac{2n-1}{n^2+2}\right) \div \left(n^2+1-\frac{n-1}{n}\right) \\
 \Rightarrow n-\frac{2n-1}{n^2+2} = \frac{n(n^2+2)-(2n-1)}{n^2+2} = \frac{n^3+2n-2n+1}{n^2+2} = \frac{n^3+1}{n^2+2} \\
 \Rightarrow n^2+1-\frac{n-1}{n} = \frac{n(n^2+1)-(n-1)}{n} = \frac{n^3+n-n+1}{n} = \frac{n^3+1}{n} \\
 \Rightarrow \frac{n^3+1}{n^2+2} \div \frac{n^3+1}{n} = \frac{n^3+1}{n^2+2} \cdot \frac{n}{n^3+1} = \frac{n}{n^2+2}
 \end{aligned}$$

### EJERCICIO 136

$$1. \frac{3x}{4y} \cdot \frac{8y}{9x} \div \frac{z^2}{3x^2} = \frac{2}{3} \cdot \frac{3x^2}{z^2} = \frac{2x^2}{z^2}$$

$$2. \frac{5a}{b} \div \left(\frac{2a}{b^2} \cdot \frac{5x}{4a^2}\right) = \frac{5a}{b} \cdot \frac{2ab^2}{5x} = \frac{2a^2b}{x}$$

$$\begin{aligned}
 3. \frac{a+1}{a-1} \cdot \frac{3a-3}{2a+2} \div \frac{a^2+a}{a^2+a-2} \\
 = \frac{a+1}{a-1} \cdot \frac{3(a-1)}{2(a+1)} \cdot \frac{(a+2)(a-1)}{a(a+1)} \\
 = \frac{3(a+2)(a-1)}{2a(a+1)} = \frac{3a^2+3a-6}{2a^2+2a}
 \end{aligned}$$

$$\begin{aligned}
 4. \frac{64a^2-81b^2}{x^2-81} \cdot \frac{(x-9)^2}{8a-9b} \div \frac{8a^2+9ab}{(x+9)^2} \\
 = \frac{(8a+9b)(8a-9b)}{(x+9)(x-9)} \cdot \frac{(x-9)^2}{8a-9b} \cdot \frac{(x+9)^2}{a(8a+9b)} \\
 = \frac{(x-9)(x+9)}{a} = \frac{x^2-81}{a}
 \end{aligned}$$

$$\begin{aligned}
 5. \frac{x^2-x-12}{x^2-49} \cdot \frac{x^2-x-56}{x^2+x-20} \div \frac{x^2-5x-24}{x+5} \\
 = \frac{(x-4)(x+3)}{(x+7)(x-7)} \cdot \frac{(x-8)(x+7)}{(x+5)(x-4)} \cdot \frac{x+5}{(x-8)(x+3)} = \frac{1}{x-7}
 \end{aligned}$$

$$\begin{aligned}
 6. \frac{a^2-8a+7}{a^2-11a+30} \cdot \frac{a^2-36}{a^2-1} \div \frac{a^2-a-42}{a^2-4a-5} \\
 = \frac{(a-7)(a-1)}{(a-6)(a-5)} \cdot \frac{(a+6)(a-6)}{(a+1)(a-1)} \cdot \frac{(a-5)(a+1)}{(a-7)(a+6)} = 1
 \end{aligned}$$

7.  $\frac{x^4 - 27x}{x^2 + 7x - 30} \cdot \frac{x^2 + 20x + 100}{x^3 + 3x^2 + 9x} \div \frac{x^2 - 100}{x - 3} = \frac{x(x-3)(x^2 + 3x + 9)}{(x+10)(x-3)} \cdot \frac{(x+10)^2}{x(x^2 + 3x + 9)} \cdot \frac{x-3}{(x+10)(x-10)} = \frac{x-3}{x-10}$
8.  $\frac{(a^2+1)}{3a-6} \div \left( \frac{a^3+a}{6a-12} \cdot \frac{4x+8}{x-3} \right) = \frac{a^2+1}{3(a-2)} \div \frac{a(a^2+1) \cdot 4(x+2)}{6(a-2) \cdot x-3} = \frac{a^2+1}{3(a-2)} \cdot \frac{3(a-2)(x-3)}{2a(a^2+1)(x+2)} = \frac{x-3}{2a(x+2)} = \frac{x-3}{2ax+4a}$
9.  $\frac{8x^2-10x-3}{6x^2+13x+6} \cdot \frac{4x^2-9}{3x^2+2x} \div \frac{8x^2+14x+3}{9x^2+12x+4} = \frac{(2x-3)(4x+1)}{(2x+3)(3x+2)} \cdot \frac{(2x+3)(2x-3)}{x(3x+2)} \cdot \frac{(3x+2)^2}{(2x+3)(4x+1)} = \frac{(2x-3)^2}{x(2x+3)} = \frac{4x^2-12x+9}{2x^2+3x}$
10.  $\frac{(a+b)^2 - c^2}{(a-b)^2 - c^2} \cdot \frac{(a+c)^2 - b^2}{a^2+ab-ac} \div \frac{a+b+c}{a^2} = \frac{(a+b+c)(a+b-c)}{(a-b+c)(a-b-c)} \cdot \frac{(a+b+c)(a-b+c)}{a(a+b-c)} \cdot \frac{a^2}{a+b+c} = \frac{a(a+b+c)}{a-b-c} = \frac{a^2+ab+ac}{a-b-c}$
11.  $\frac{a^2-5a}{b+b^2} \div \left( \frac{a^2+6a-55}{b^2-1} \cdot \frac{ax+3a}{ab^2+11b^2} \right) = \frac{a(a-5)}{b(1+b)} \cdot \frac{b^2(b+1)(b-1)(a+11)}{a(a+11)(a-5)(x+3)} = \frac{b(b-1)}{x+3} = \frac{b^2-b}{x+3}$
12.  $\frac{m^3+6m^2n+9mn^2}{2m^2n+7mn^2+3n^3} \cdot \frac{4m^2-n^2}{8m^2-2mn-n^2} \div \frac{m^3+27n^3}{16m^2+8mn+n^2}$   
 $= \frac{m(m+3n)^2}{n(m+3n)(2m+n)} \cdot \frac{(2m+n)(2m-n)}{(2m-n)(4m+n)} \cdot \frac{(4m+n)^2}{(m+3n)(m^2-3mn-9n^2)} = \frac{m(4m+n)}{n(m^2-3mn+9n^2)} = \frac{4m^2+mn}{m^2n-3mn^2+9n^3}$
13.  $\frac{(a^2-ax)^2}{a^2+x^2} \cdot \frac{1}{a^3+a^2x} \div \left( \frac{a^3-a^2x}{a^2+2ax+x^2} \cdot \frac{a^2-x^2}{a^3+ax^2} \right)$   
 $= \frac{(a^2-ax)^2}{a^2+x^2} \cdot \frac{1}{a^2(a+x)} \cdot \frac{a(a+x)^2(a^2+x^2)}{a(a^2-ax)(a+x)(a-x)} = \frac{a^2-ax}{a^2(a-x)} = \frac{a(a-x)}{a^2(a-x)} = \frac{1}{a}$
14.  $\frac{(a^2-3a)^2}{9-a^2} \cdot \frac{27-a^3}{(a+3)^2-3a} \div \frac{a^4-9a^2}{(a^2+3a)^2}$   
 $= \frac{(a^2-3a)^2}{(3+a)(3-a)} \cdot \frac{(3-a)(9+3a+a^2)}{a^2+3a+9} \cdot \frac{(a^2+3a)^2}{(a^2-3a)(a^2+3a)} = \frac{(a^2-3a)(a^2+3a)}{3+a} = \frac{a(a^2-3a)(a+3)}{a+3} = a^3-3a^2$

### EJERCICIO 137

1.  $\frac{a-\frac{a}{b}}{b-\frac{1}{b}} = \frac{\frac{ab-a}{b}}{\frac{b^2-1}{b}} = \frac{a(b-1)}{(b+1)(b-1)} = \frac{a}{b+1}$
2.  $\frac{x^2-\frac{1}{x}}{1-\frac{1}{x}} = \frac{\frac{x^3-1}{x}}{\frac{x-1}{x}} = \frac{(x-1)(x^2+x+1)}{x-1} = x^2+x+1$
3.  $\frac{\frac{a}{b}-\frac{a}{a}}{1+\frac{b}{a}} = \frac{\frac{a^2-b^2}{ab}}{\frac{a+b}{a}} = \frac{(a+b)(a-b)}{b(a+b)} = \frac{a-b}{b}$
4.  $\frac{\frac{1}{m}+\frac{1}{n}}{\frac{1}{m}-\frac{1}{n}} = \frac{\frac{m+n}{mn}}{\frac{n-m}{mn}} = \frac{m+n}{n-m}$
5.  $\frac{x+\frac{x}{2}}{x-\frac{x}{4}} = \frac{\frac{2x+x}{2}}{\frac{4x-x}{4}} = \frac{2(3x)}{3x} = 2$
6.  $\frac{\frac{x}{y}-\frac{y}{x}}{1+\frac{y}{x}} = \frac{\frac{x^2-y^2}{xy}}{\frac{x+y}{x}} = \frac{(x+y)(x-y)}{y(x+y)} = \frac{x-y}{y}$
7.  $\frac{x+4+\frac{3}{x}}{x-4-\frac{5}{x}} = \frac{x^2+4x+3}{x^2-4x-5} = \frac{(x+1)(x+3)}{(x-5)(x+1)} = \frac{x+3}{x-5}$
8.  $\frac{a-4+\frac{4}{a}}{1-\frac{2}{a}} = \frac{\frac{a^2-4a+4}{a}}{\frac{a-2}{a}} = \frac{(a-2)(a-2)}{(a-2)} = a-2$

$$\begin{aligned}
 & \frac{2a^2 - b^2}{a} - b \\
 9. & \frac{4a^2 + b^2}{4ab} + 1 \\
 & \frac{2a^2 - b^2 - ab}{4a^2 + b^2 + 4ab} \\
 & = \frac{a}{4a^2 + b^2 + 4ab} \\
 & = \frac{4b(2a^2 - b^2 - ab)}{4a^2 + b^2 + 4ab} \\
 & = \frac{4b(a-b)(2a+b)}{(2a+b)^2} \\
 & = \frac{4b(a-b)}{2a+b} = \frac{4ab - 4b^2}{2a+b}
 \end{aligned}$$

$$10. \frac{2 + \frac{3a}{5b}}{a + \frac{10b}{3}} = \frac{\frac{10b + 3a}{5b}}{\frac{3a + 10b}{3}} = \frac{3}{5b}$$

$$\begin{aligned}
 & \frac{a-x + \frac{x^2}{a+x}}{a^2 - \frac{a^2}{a+x}} \\
 11. & \frac{a^2 - x^2 + x^2}{a^2 - \frac{a^2}{a+x}} \\
 & = \frac{a^2 - x^2 + x^2}{\frac{a^3 + a^2x - a^2}{a+x}} \\
 & = \frac{a^2}{a^2(a+x-1)} = \frac{1}{a+x-1}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{a+5 - \frac{a}{8}}{1 + \frac{a}{a^2}} \\
 12. & \frac{a^2 + 5a - 14}{a^2 + 8a + 7} \\
 & = \frac{a}{a^2} \\
 & = \frac{a(a+7)(a-2)}{(a+7)(a+1)} \\
 & = \frac{a(a-2)}{a+1} = \frac{a^2 - 2a}{a+1}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{1}{a} - \frac{9}{a^2} + \frac{20}{a^3} \\
 13. & \frac{16}{a} - a \\
 & = \frac{a^2 - 9a + 20}{16a^2} \\
 & = \frac{a}{16a^2} \\
 & = \frac{(a-5)(a-4)}{a^2(4+a)(4-a)} \\
 & = -\frac{a-5}{a^2(a+4)} = -\frac{a-5}{a^2+4a^2} = \frac{5-a}{a^3+4a^2}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{20x^2 + 7x - 6}{x} \\
 14. & \frac{4}{x^2 - 25} \\
 & \frac{(4x+3)(5x-2)}{4-25x^2} \\
 & = \frac{x}{4-25x^2} \\
 & = \frac{x(4x+3)(5x-2)}{(2+5x)(2-5x)} \\
 & = -\frac{4x^2+3x}{5x+2}
 \end{aligned}$$

$$\begin{aligned}
 & 1 + \frac{1}{x-1} \\
 15. & 1 + \frac{1}{x^2-1} \\
 & = \frac{x-1+1}{x-1} = \frac{x(x+1)}{x^2-1} = \frac{x+1}{x}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{a - \frac{ab}{a+b}}{a + \frac{ab}{a-b}} = \frac{\frac{a^2 + ab - ab}{a+b}}{\frac{a^2 - ab + ab}{a-b}} \\
 16. & = \frac{a^2(a-b)}{a^2(a+b)} = \frac{a-b}{a+b}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{x-1 - \frac{5}{x+3}}{x+5 - \frac{35}{x+3}} \\
 17. & \frac{x^2 + 2x - 8}{x^2 + 8x - 20} \\
 & = \frac{(x+4)(x-2)}{(x+10)(x-2)} = \frac{x+4}{x+10}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{a+2 - \frac{7a+9}{a+3}}{a-4 + \frac{5a-11}{a+1}} \\
 18. & \frac{a^2 + 5a + 6 - 7a - 9}{a^2 - 3a - 4 + 5a - 11} \\
 & = \frac{(a+1)(a^2 - 2a - 3)}{(a+3)(a^2 + 2a - 15)} \\
 & = \frac{(a+1)(a-3)(a+1)}{(a+3)(a+5)(a-3)} \\
 & = \frac{(a+1)^2}{(a+3)(a+5)} = \frac{a^2 + 2a + 1}{a^2 + 8a + 15}
 \end{aligned}$$

## EJERCICIO 138

$$\begin{aligned}
 & \frac{1 + \frac{x+1}{x-1}}{\frac{1}{x-1} - \frac{1}{x+1}} \\
 1. & \frac{x-1+x+1}{x-1} = \frac{2x(x+1)}{x^2-1} = x^2 + x
 \end{aligned}$$

$$\begin{aligned}
 & \frac{\frac{1}{x-1} + \frac{2}{x+1}}{\frac{x-2}{x} + \frac{2x+6}{x+1}} \\
 2. & \frac{x+1+2(x-1)}{x^2-1} \\
 & = \frac{(x^2-x-2)+x(2x+6)}{x(x+1)} \\
 & = \frac{x(3x-1)}{(x-1)(3x^2+5x-2)} \\
 & = \frac{x(3x-1)}{(x-1)(3x-1)(x+2)} = \frac{x}{x^2+x-2}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{\frac{a}{a-b} - \frac{b}{a+b}}{\frac{a+b}{a-b} + \frac{a}{b}} \\
 3. & \frac{a(a+b) - b(a-b)}{(a-b)(a+b)} \\
 & = \frac{b(a+b) + a(a-b)}{b(a-b)} \\
 & = \frac{a^2 + ab - ab + b^2}{a+b} = \frac{a^2 + b^2}{a+b} = \frac{b}{a+b}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{\frac{x+3}{x+4} - \frac{x+1}{x-1}}{\frac{x+2}{x-1} - \frac{x-3}{x+4}} \\
 4. & \frac{(x+3)(x+2) - (x+1)(x+4)}{(x+4)(x+2)} \\
 & = \frac{(x-1)(x+4) - (x-3)(x+2)}{(x+2)(x+4)} \\
 & = \frac{x^2 + 5x + 6 - x^2 - 5x - 4}{x^2 + 3x - 4 - x^2 + x + 6} \\
 & = \frac{2}{4x+2} = \frac{2}{2(2x+1)} = \frac{1}{2x+1}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{\frac{m^2}{n} + \frac{m^2 - n^2}{m+n}}{\frac{m-n}{n} + \frac{n}{m}} \\
 &= \frac{\frac{m^2(m+n) - n(m^2 - n^2)}{n(m+n)}}{\frac{m(m-n) + n^2}{nm}} \\
 &= \frac{\frac{m^3 + m^2n - m^2n + n^3}{m+n}}{\frac{m^2 - mn + n^2}{m}} \\
 &= \frac{\frac{m^3 + n^3}{m+n}}{\frac{m^2 - mn + n^2}{m}} \\
 &= \frac{(m+n)(m^2 - mn + n^2)}{m^2 - mn + n^2} \cdot \frac{m}{m^2 - mn + n^2} = m
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{\frac{a^2}{b^3} + \frac{1}{a}}{\frac{a}{b} - \frac{b-a}{a-b}} \\
 &= \frac{\frac{a^3 + b^3}{ab^3}}{\frac{a(a-b) - b(b-a)}{b(a-b)}} \\
 &= \frac{\frac{(a+b)(a^2 - ab + b^2)}{ab^3}}{\frac{a^2 - ab - b^2 + ab}{b(a-b)}} \\
 &= \frac{(a+b)(a^2 - ab + b^2)}{\frac{ab^2}{a-b}} \\
 &= \frac{(a+b)(a^2 - ab + b^2)}{ab^2} \cdot \frac{a-b}{(a+b)(a-b)} \\
 &= \frac{a^2 - ab + b^2}{ab^2}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{1 + \frac{2x}{1+x^2}}{2x + \frac{2x^5+2}{1-x^4}} \\
 &= \frac{\frac{1+x^2+2x}{1+x^2}}{\frac{2x(1-x^4) + 2x^5+2}{(1+x^2)(1-x^2)}} \\
 &= \frac{x^2+2x+1}{\frac{2x-2x^5+2x^5+2}{1-x^2}} \\
 &= \frac{(x+1)^2}{\frac{2(x+1)}{(x+1)(1-x)}} \\
 &= \frac{(x+1)^2 \cdot (x+1)(1-x)}{2(x+1)} \\
 &= \frac{(x+1)^2(1-x)}{2} \\
 &= \frac{(x^2+2x+1)(1-x)}{2} \\
 &= \frac{x^2 - x^3 + 2x - 2x^2 + 1 - x}{2} \\
 &= \frac{1+x-x^2-x^3}{2}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & \frac{\frac{x+y}{x} - \frac{x-y}{x+y}}{\frac{x-y}{x+y} - \frac{x+2y}{x+y}} \\
 &= \frac{\frac{(x+y)^2 - (x-y)^2}{(x-y)(x+y)}}{\frac{(x+y)^2 - x(x+2y)}{x(x+y)}} \\
 &= \frac{\frac{x^2+2xy+y^2-x^2+2xy-y^2}{x-y}}{\frac{x^2+2xy+y^2-x^2-2xy}{x}} \\
 &= \frac{4xy}{\frac{x-y}{\frac{y^2}{x}}} \\
 &= \frac{4xy}{x-y} \cdot \frac{x}{y^2} = \frac{4x^2}{y(x-y)} = \frac{4x^2}{xy-y^2}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & \frac{\frac{a+x}{a-x} - \frac{b+x}{b-x}}{\frac{2}{a-x} - \frac{2}{b-x}} \\
 &= \frac{(a+x)(b-x) - (b+x)(a-x)}{(a-x)(b-x)} \\
 &= \frac{2(b-x) - 2(a-x)}{(a-x)(b-x)} \\
 &= \frac{ab - ax + bx - x^2 - ab + bx - ax + x^2}{2b - 2x - 2a + 2x} \\
 &= \frac{2bx - 2ax}{2(b-a)} = \frac{2x(b-a)}{2(b-a)} = x
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \frac{\frac{a}{a+x} - \frac{a}{2a+2x}}{\frac{a}{a-x} + \frac{a}{a+x}} = \frac{\frac{2a-a}{2(a+x)}}{\frac{a(a+x) + a(a-x)}{(a-x)(a+x)}} \\
 &= \frac{\frac{a}{2}}{\frac{a^2+ax+a^2-ax}{a-x}} \\
 &= \frac{\frac{a}{2}}{\frac{a}{a-x}} = \frac{a}{2} \cdot \frac{a-x}{2a^2} = \frac{a-x}{4a}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \frac{\frac{a+2b}{a-b} + \frac{b}{a}}{\frac{a+b}{a} + \frac{3b}{a-b}} = \frac{\frac{a(a+2b) + b(a-b)}{a(a-b)}}{\frac{(a+b)(a-b) + 3ab}{a(a-b)}} \\
 &= \frac{a^2+2ab+ab-b^2}{a^2-b^2+3ab} \\
 &= \frac{a^2+3ab-b^2}{a^2+3ab-b^2} = 1
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{1 - \frac{7}{x} + \frac{12}{x^2}}{x - \frac{16}{x}} \\
 &= \frac{\frac{x^2 - 7x + 12}{x^2}}{\frac{x^2 - 16}{x}} \\
 &= \frac{(x-4)(x-3)}{x} \cdot \frac{1}{(x-4)(x+4)} \\
 &= \frac{x-3}{x(x+4)} = \frac{x-3}{x^2+4x}
 \end{aligned}$$



$$\begin{aligned}
 13. \quad & \frac{\frac{a^2}{b} - \frac{b^2}{a}}{\frac{1}{b} + \frac{1}{a} + \frac{b}{a^2}} \\
 &= \frac{\frac{a^3 - b^3}{ab}}{\frac{a^3 - b^3}{a^2b}} \\
 &= \frac{a^3 - b^3}{a^2 + ab + b^2} \cdot \frac{a^2b}{a^2b} \\
 &= \frac{a^3 - b^3}{a^2 + ab + b^2} \cdot \frac{a}{a} \\
 &= (a-b)(a^2 + ab + b^2) \cdot \frac{a}{a^2 + ab + b^2} \\
 &= a(a-b) = a^2 - ab
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{x-2y - \frac{4y^2}{x+y}}{x-3y - \frac{5y^2}{x+y}} \\
 &= \frac{(x-2y)(x+y) - 4y^2}{(x-3y)(x+y) - 5y^2} \\
 &= \frac{x^2 - xy - 6y^2}{x^2 - 2xy - 8y^2} \\
 &= \frac{(x-3y)(x+2y)}{(x-4y)(x+2y)} = \frac{x-3y}{x-4y}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{\frac{2}{1-a} + \frac{2}{1+a}}{\frac{2}{1+a} - \frac{2}{1-a}} \\
 &= \frac{\frac{2(1+a) + 2(1-a)}{(1-a)(1+a)}}{\frac{2(1+a) - 2(1-a)}{(1+a)(1-a)}} \\
 &= \frac{2+2a+2-2a}{2-2a-2+2a} = \frac{4}{-4a} = -\frac{1}{a}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{\frac{1}{x+y+z} - \frac{1}{x-y+z}}{\frac{1}{x-y+z} - \frac{1}{x+y+z}} \\
 &= \frac{\frac{x-y+z-x-y-z}{(x+y+z)(x-y+z)}}{\frac{x-y+z-x-y-z}{(x-y+z)(x+y+z)}} = \frac{-2y}{2y} = -1
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{1 + \frac{2b+c}{a-b-c}}{1 - \frac{c-2b}{a-b+c}} \\
 &= \frac{\frac{a-b-c+2b+c}{a-b-c}}{\frac{a-b+c-c+2b}{a-b+c}} \\
 &= \frac{a+b}{a-b-c} \cdot \frac{a-b+c}{a-b+c} = \frac{a-b+c}{a-b-c}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \frac{\frac{a}{1-a} + \frac{1-a}{a}}{\frac{1-a}{a} - \frac{a}{1-a}} \\
 &= \frac{\frac{a^2 + (1-a)^2}{a(1-a)}}{\frac{(1-a)^2 - a^2}{a(1-a)}} \\
 &= \frac{a^2 + 1 - 2a + a^2}{1 - 2a + a^2 - a^2} = \frac{2a^2 - 2a + 1}{1 - 2a}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & \frac{x+1 - \frac{6x+12}{x+2}}{x-4 + \frac{11x-22}{x-2}} \\
 &= \frac{\frac{x+1 - \frac{6(x+2)}{x+2}}{x+7}}{\frac{x-4 + \frac{11(x-2)}{x-2}}{x+7}} = \frac{x-5}{x+7} = 1
 \end{aligned}$$

$$20. \quad 1 + \frac{1}{x} = \frac{1}{x+1} = 1 \cdot \frac{x}{x+1} = \frac{x}{x+1}$$

$$\begin{aligned}
 21. \quad & \frac{1}{1 + \frac{1}{1 - \frac{1}{x}}} = \frac{1}{1 + \frac{1}{\frac{x-1}{x}}} \\
 &= \frac{1}{1 + \frac{x}{x-1}} = \frac{1}{\frac{x-1+x}{x-1}} \\
 &= \frac{1}{2x-1} = 1 \cdot \frac{x-1}{2x-1} = \frac{x-1}{2x-1}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & 1 - \frac{1}{2 + \frac{1}{\frac{x}{3} - 1}} \\
 &= 1 - \frac{1}{2 + \frac{1}{\frac{x-3}{3}}} \\
 &= 1 - \frac{1}{2 + \frac{3}{x-3}} \\
 &= 1 - \frac{1}{\frac{2x-3}{x-3}} \\
 &= 1 - \frac{x-3}{2x-3} = \frac{2x-3-x+3}{2x-3} = \frac{x}{2x-3}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & \frac{2}{1 + \frac{2}{1 + \frac{2}{x}}} \\
 &= \frac{2}{1 + \frac{2}{\frac{x+2}{x}}} \\
 &= \frac{2}{1 + \frac{2x}{x+2}} \\
 &= \frac{2}{\frac{x+2+2x}{x+2}} = \frac{2}{3x+2} = 2 \cdot \frac{x+2}{3x+2} = \frac{2x+4}{3x+2}
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & \frac{1}{x - \frac{x}{x - \frac{x^2}{x+1}}} \\
 &= \frac{1}{x - \frac{x}{\frac{x^2+x-x^2}{x+1}}} \\
 &= \frac{1}{x - \frac{x}{x}} = \frac{1}{x-x} = \frac{1}{-x} = -\frac{1}{x}
 \end{aligned}$$

$$25. \frac{1}{a+2-\frac{a+1}{a-\frac{1}{a}}} = \frac{1}{a+2-\frac{a+1}{\frac{a^2-1}{a}}} = \frac{1}{a+2-\frac{a(a+1)}{(a+1)(a-1)}} = \frac{1}{a+2-\frac{a}{a-1}} = \frac{1}{\frac{(a+2)(a-1)-a}{a-1}} = \frac{1}{\frac{a^2+a-2-a}{a-1}} = 1 \cdot \frac{a-1}{a^2-2} = \frac{a-1}{a^2-2}$$

$$26. \frac{x-1}{x+2-\frac{x-2}{x-\frac{x-2}{x+1}}} = \frac{x-1}{x+2-\frac{x^2+2}{\frac{x^2+x-x+2}{x+1}}} = \frac{x-1}{x+2-\frac{x^2+2}{x+1}} = \frac{x-1}{x+2-\frac{(x^2+2)(x+1)}{x^2+2}} = \frac{x-1}{x+2-x-1} = x-1$$

### EJERCICIO 139

$$1. \frac{x-2}{x+3} \text{ Para } x \rightarrow 2 \quad \frac{2-2}{2+3} = \frac{0}{5} = 0$$

$$2. \frac{x-2}{x-3} \text{ Para } x \rightarrow 3 \quad \frac{3-2}{3-3} = \frac{1}{0} = \infty$$

$$3. \frac{x^2-a^2}{x^2+a^2} \text{ Para } x \rightarrow a \quad \frac{a^2-a^2}{a^2+a^2} = \frac{0}{2a^2} = 0$$

$$4. \frac{x^2+y^2}{x^2-y^2} \text{ Para } x \rightarrow y \quad \frac{y^2+y^2}{y^2-y^2} = \frac{2y^2}{0} = \infty$$

$$5. \frac{x-1}{x-2} \text{ Para } x \rightarrow 2 \quad \frac{2-1}{2-2} = \frac{1}{0} = \infty = 0$$

$$6. \frac{x^2-9}{x^2+x-12} \text{ Para } x \rightarrow 3 \quad \frac{(x+3)(x-3)}{(x+4)(x-3)} = \frac{x+3}{x+4} = \frac{3+3}{3+4} = \frac{6}{7}$$

$$7. \frac{a^2-a-6}{a^2+2a-15} \text{ Para } a \rightarrow 3 \quad \frac{(a-3)(a+2)}{(a+5)(a-3)} = \frac{a+2}{a+5} = \frac{3+2}{3+5} = \frac{5}{8}$$

$$8. \frac{x^2-7x+10}{x^3-2x^2-x+2} \text{ Para } x \rightarrow 2 \quad \frac{(x-5)(x-2)}{x^2(x-2)-(x-2)} = \frac{(x-5)(x-2)}{(x^2-1)(x-2)} = \frac{x-5}{x^2-1} = \frac{2-5}{4-1} = \frac{-3}{3} = -1$$

$$9. \frac{x^2-2x+1}{x^3-2x^2-x+2} \text{ Para } x \rightarrow 1$$

$$\frac{(x-1)^2}{x^2(x-2)-(x-2)}$$

$$= \frac{(x-1)^2}{(x^2-1)(x-2)}$$

$$= \frac{(x-1)^2}{(x-1)(x+1)(x-2)} = \frac{x-1}{x^2-x-2} = \frac{1-1}{1^2-1-2} = \frac{0}{-2} = 0$$

$$10. \frac{a^3-8}{a^2+11a-26} \text{ Para } a \rightarrow 2$$

$$\frac{(a-2)(a^2+2a+4)}{(a+13)(a-2)} = \frac{a^2+2a+4}{a+13} = \frac{2^2+2 \cdot 2+4}{2+13} = \frac{12}{15} = \frac{4}{5}$$

$$11. \frac{x^2-7x+6}{x^2-2x+1} \text{ Para } x \rightarrow 1 \quad \frac{(x-6)(x-1)}{(x-1)^2} = \frac{x-6}{x-1} = \frac{1-6}{1-1} = \frac{-5}{0} = \infty$$

$$12. \frac{x^3-3x-2}{x^3-7x+6} \text{ Para } x \rightarrow 2$$

$$x^3-3x-2 = \begin{array}{ccc|c} 1 & 0 & -3 & -2 \\ & 2 & 4 & 2 \\ \hline 1 & 2 & 1 & 0 \end{array}$$

$$\Rightarrow (x-2)(x^2+2x+1)$$

$$x^3-7x+6 = \begin{array}{ccc|c} 1 & 0 & -7 & 6 \\ & 2 & 4 & -6 \\ \hline 1 & 2 & -3 & 0 \end{array}$$

$$\Rightarrow (x-2)(x^2+2x-3)$$

$$\frac{(x-2)(x+1)^2}{(x-2)(x^2+2x-3)} = \frac{(x+1)^2}{x^2+2x-3} = \frac{(2+1)^2}{2^2+2 \cdot 2-3} = \frac{9}{5}$$

$$13. \frac{x^2-16}{x^3-4x^2-x+4} \quad \text{Para } x \rightarrow 4$$

$$\frac{(x-4)(x+4)}{x^2(x-4)-(x-4)} = \frac{(x-4)(x+4)}{(x^2-1)(x-4)} = \frac{x+4}{x^2-1} = \frac{4+4}{4^2-1} = \frac{8}{15}$$

$$14. \frac{4x^2-4x+1}{4x^2+8x-5} \quad \text{Para } x \rightarrow \frac{1}{2}$$

$$\frac{(2x-1)^2}{(2x+5)(2x-1)} = \frac{2x-1}{2x+5} = \frac{2 \cdot \frac{1}{2} - 1}{2 \cdot \frac{1}{2} + 5} = \frac{1-1}{1+5} = \frac{0}{6} = 0$$

$$15. \frac{8x^2-6x+1}{4x^3+12x^2-15x+4} \quad \text{Para } x \rightarrow \frac{1}{2}$$

$$\Rightarrow 8x^2-6x+1 = (8x)^2 - 6(8x)+8$$

$$= (8x-4)(8x-2) = (2x-1)(4x-1)$$

$$\Rightarrow 4x^3+12x^2-15x+4 = \begin{array}{cccc|c} 4 & 12 & -15 & 4 & -4 \\ & -16 & 16 & -4 & \\ \hline & 4 & -4 & 1 & 0 \end{array}$$

$$= (x+4)(4x^2-4x+1) = (x+4)(2x-1)^2$$

$$\Rightarrow \frac{(2x-1)(4x-1)}{(2x-1)^2(x+4)} = \frac{4x-1}{(2x-1)(x+4)} = \frac{4 \cdot \frac{1}{2} - 1}{\left(2 \cdot \frac{1}{2} - 1\right)\left(\frac{1}{2} + 4\right)} = \frac{1}{0} = \infty$$

$$16. \frac{x^3-9x+10}{x^4-x^3-11x^2+9x+18} \quad \text{Para } x \rightarrow 2$$

$$\Rightarrow x^3-9x+10$$

$$\begin{array}{cccc|c} 1 & 0 & -9 & 10 & 2 \\ & 2 & 4 & -10 & \\ \hline 1 & 2 & -5 & 0 & \end{array} = (x-2)(x^2+2x-5)$$

$$\Rightarrow x^4-x^3-11x^2+9x+18$$

$$\begin{array}{cccc|c} 1 & -1 & -11 & 9 & 18 \\ & 2 & 2 & -18 & -18 \\ \hline 1 & 1 & -9 & -9 & 0 \end{array} = (x-2)(x^3+x^2-9x-9)$$

$$\Rightarrow \frac{(x-2)(x^2+2x-5)}{(x-2)(x^3+x^2-9x-9)}$$

$$= \frac{x^2+2x-5}{x^3+x^2-9x-9} = \frac{2^2+2 \cdot 2-5}{2^3+2^2-9 \cdot 2-9} = \frac{3}{-15} = -\frac{1}{5}$$

$$17. \frac{x^3-a^3}{x-a} \quad \text{Para } x \rightarrow a$$

$$\frac{(x-a)(x^2+ax+a^2)}{x-a} = x^2+ax+a^2 = a^2+a^2+a^2 = 3a^2$$

$$18. \frac{a^2-2ab+b^2}{a^2-ab} \quad \text{Para } b \rightarrow a \quad \frac{(a-b)^2}{a(a-b)} = \frac{a-b}{a} = \frac{a-a}{a} = 0$$

$$19. \frac{x^2-y^2}{xy-y^2} \quad \text{Para } y \rightarrow x$$

$$\frac{(x+y)(x-y)}{y(x-y)} = \frac{x+y}{y} = \frac{x+x}{x} = \frac{2x}{x} = 2$$

$$20. \frac{x^3-a^3}{a^2x-a^3} \quad \text{Para } x \rightarrow a$$

$$\frac{(x-a)(x^2+ax+a^2)}{a^2(x-a)} = \frac{x^2+ax+a^2}{a^2} = \frac{a^2+a^2+a^2}{a^2} = \frac{3a^2}{a^2} = 3$$

$$21. \frac{x^3-3x+2}{2x^3-6x^2+6x-2} \quad \text{Para } x \rightarrow 1$$

$$\Rightarrow x^3-3x+2$$

$$\begin{array}{cccc|c} 1 & 0 & -3 & 2 & 1 \\ & 1 & 1 & -2 & \\ \hline 1 & 1 & -2 & 0 & \end{array} = (x-1)(x^2+x-2)$$

$$= (x-1)(x+2)(x-1)$$

$$= (x-1)^2(x+2)$$

$$\Rightarrow \frac{x^3-3x+2}{2x^3-6x^2+6x-2}$$

$$\begin{array}{cccc|c} 2 & -6 & 6 & -2 & 1 \\ & 2 & -4 & 2 & \\ \hline 2 & -4 & 2 & 0 & \end{array} = (x-1)(2x^2-4x+2)$$

$$= (x-1)(x-1)(2x-2)$$

$$= (x-1)^2(2x-2)$$

$$\Rightarrow \frac{(x-1)^2(x+2)}{(x-1)^2(2x-2)} = \frac{x+2}{2x-2} = \frac{1+2}{2 \cdot 1 - 2} = \frac{3}{0} = \infty$$

$$22. \frac{x^4-x^3-7x^2+x+6}{x^4-3x^3-3x^2+11x-6} \quad \text{Para } x \rightarrow 3$$

$$\Rightarrow x^4-x^3-7x^2+x+6$$

$$\begin{array}{cccc|c} 1 & -1 & -7 & 1 & 6 \\ & -2 & 6 & 2 & -6 \\ \hline 1 & -3 & -1 & 3 & 0 \end{array} = (x+2)(x^3-3x^2-x+3)$$

$$\begin{array}{cccc|c} 1 & -3 & -1 & 3 & 1 \\ & 1 & -2 & -3 & \\ \hline 1 & -2 & -3 & 0 & \end{array}$$

$$= (x+2)(x-1)(x^2-2x-3)$$

$$= (x+2)(x-1)(x-3)(x+1)$$

Continúa

### Continuación

$$\begin{aligned}
 22. \Rightarrow x^4 - 3x^3 - 3x^2 + 11x - 6 \\
 & \begin{array}{r|l}
 1 & -3 & -3 & 11 & -6 & \\
 & -2 & 10 & -14 & 6 & \\ \hline
 1 & -5 & 7 & -3 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 & = (x+2)(x^3 - 5x^2 + 7x - 3) \\
 & \begin{array}{r|l}
 1 & -5 & 7 & -3 & \\
 & 1 & -4 & 3 & \\ \hline
 1 & -4 & 3 & 0 & \\
 \end{array} \Bigg| \frac{1}{-} \\
 & = (x+2)(x-1)(x^2 - 4x + 3) \\
 & = (x+2)(x-1)(x-3)(x-1) \\
 & \Rightarrow \frac{(x+2)(x-1)(x-3)(x+1)}{(x+2)(x-1)(x-3)(x-1)} \\
 & = \frac{x+1}{x-1} = \frac{3+1}{3-1} = \frac{4}{2} = 2
 \end{aligned}$$

$$\begin{aligned}
 23. \frac{3x^3 - 5x^2 - 4x + 4}{x^4 + 2x^3 - 3x^2 - 8x - 4} \text{ Para } x \rightarrow 2 \\
 \Rightarrow 3x^3 - 5x^2 - 4x + 4 \\
 \begin{array}{r|l}
 3 & -5 & -4 & 4 & \\
 & 6 & 2 & -4 & \\ \hline
 3 & 1 & -2 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 = (x-2)(3x^2 + x - 2) \\
 \Rightarrow x^4 + 2x^3 - 3x^2 - 8x - 4 \\
 \begin{array}{r|l}
 1 & 2 & -3 & -8 & -4 & \\
 & 2 & 8 & 10 & 4 & \\ \hline
 1 & 4 & 5 & 2 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 (x-2)(x^3 + 4x^2 + 5x + 2) \\
 \begin{array}{r|l}
 1 & 4 & 5 & 2 & \\
 & -2 & -4 & -2 & \\ \hline
 1 & 2 & 1 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 = (x-2)(x+2)(x^2 + 2x + 1) \\
 \Rightarrow \frac{(x-2)(3x^2 + x - 2)}{(x-2)(x+2)(x+1)^2} \\
 = \frac{3x^2 + x - 2}{(x+2)(x+1)^2} \\
 = \frac{3 \cdot 2^2 + 2 - 2}{(2+2)(2+1)^2} = \frac{12}{36} = \frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 24. \frac{x^2 - 5x + 4}{x^4 - 2x^3 - 9x^2 + 2x + 8} \text{ Para } x \rightarrow 1 \\
 \Rightarrow x^2 - 5x + 4 = (x-1)(x-4) \\
 \Rightarrow x^4 - 2x^3 - 9x^2 + 2x + 8 \\
 \begin{array}{r|l}
 1 & -2 & -9 & 2 & 8 & \\
 & 1 & -1 & -10 & -8 & \\ \hline
 1 & -1 & -10 & -8 & 0 & \\
 \end{array} \Bigg| \frac{1}{-}
 \end{aligned}$$

Continúa

### Continuación

$$\begin{aligned}
 24. (x-1)(x^3 - x^2 - 10x - 8) \\
 \begin{array}{r|l}
 1 & -1 & -10 & -8 & \\
 & 4 & 12 & 8 & \\ \hline
 1 & 3 & 2 & 0 & \\
 \end{array} \Bigg| \frac{4}{-} \\
 = (x-1)(x-4)(x^2 + 3x + 2) \\
 = \frac{(x-1)(x-4)}{(x-1)(x-4)(x^2 + 3x + 2)} \\
 \Rightarrow \frac{1}{x^2 + 3x + 2} = \frac{1}{1^2 + 3 \cdot 1 + 2} = \frac{1}{6}
 \end{aligned}$$

$$\begin{aligned}
 25. \frac{x^5 - 4x^3 + 8x^2 - 32}{x^5 - 3x^3 + 10x^2 - 4x - 40} \text{ Para } x \rightarrow 2 \\
 \Rightarrow x^5 - 4x^3 + 8x^2 - 32 \\
 \begin{array}{r|l}
 1 & 0 & -4 & 8 & 0 & -32 & \\
 & 2 & 4 & 0 & 16 & 32 & \\ \hline
 1 & 2 & 0 & 8 & 16 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 (x-2)(x^4 + 2x^3 + 8x + 16) \\
 \begin{array}{r|l}
 1 & 2 & 0 & 8 & 16 & \\
 & -2 & 0 & 0 & -16 & \\ \hline
 1 & 0 & 0 & 8 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 = (x-2)(x+2)(x^3 + 8) \\
 \Rightarrow x^5 - 3x^3 + 10x^2 - 4x - 40 \\
 \begin{array}{r|l}
 1 & 0 & -3 & 10 & -4 & -40 & \\
 & 2 & 4 & 2 & 24 & 40 & \\ \hline
 1 & 2 & 1 & 12 & 20 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 (x-2)(x^4 + 2x^3 + x^2 + 12x + 20) \\
 \begin{array}{r|l}
 1 & 2 & 1 & 12 & 20 & \\
 & -2 & 0 & -2 & -20 & \\ \hline
 1 & 0 & 1 & 10 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 (x-2)(x+2)(x^3 + x + 10) \\
 \begin{array}{r|l}
 1 & 0 & 1 & 10 & \\
 & -2 & 4 & -10 & \\ \hline
 1 & -2 & 5 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 = (x-2)(x+2)^2(x^2 - 2x + 5) \\
 \Rightarrow \frac{(x-2)(x+2)(x^3 + 8)}{(x-2)(x+2)^2(x^2 - 2x + 5)} \\
 = \frac{x^3 + 8}{(x+2)(x^2 - 2x + 5)} \\
 = \frac{2^3 + 8}{(2+2)(2^2 - 2 \cdot 2 + 5)} = \frac{16}{20} = \frac{4}{5}
 \end{aligned}$$

$$\begin{aligned}
 26. \frac{8x^2 + 6x - 9}{12x^2 - 13x + 3} \text{ Para } x \rightarrow \frac{3}{4} \\
 \Rightarrow \frac{(8x)^2 + 6(8x) - 72}{(12x)^2 - 13(12x) + 36} \\
 = \frac{(8x+12)(8x-6)}{(12x-9)(12x-4)} \\
 = \frac{(2x+3)(4x-3)}{(4x-3)(3x-1)} \\
 = \frac{2x+3}{3x-1} = \frac{2 \cdot \frac{3}{4} + 3}{3 \cdot \frac{3}{4} - 1} = \frac{\frac{9}{2} + 3}{\frac{9}{4} - 1} = \frac{\frac{15}{2}}{\frac{5}{4}} = \frac{36}{10} = \frac{18}{5}
 \end{aligned}$$

$$\begin{aligned}
 27. \frac{x^3 + 6x^2 + 12x + 8}{x^4 - 8x^2 + 16} \text{ Para } x \rightarrow -2 \\
 \Rightarrow x^3 + 6x^2 + 12x + 8 \\
 \begin{array}{r|l}
 1 & 6 & 12 & 8 & \\
 & -2 & -8 & -8 & \\ \hline
 1 & 4 & 4 & 0 & \\
 \end{array} \Bigg| \frac{2}{-} \\
 = (x+2)(x^2 + 4x + 4) = (x+2)^3 \\
 \Rightarrow x^4 - 8x^2 + 16 \\
 \begin{array}{r|l}
 1 & 0 & -8 & 0 & 16 & \\
 & -2 & 4 & 8 & -16 & \\ \hline
 1 & -2 & -4 & 8 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 (x+2)(x^3 - 2x^2 - 4x + 8) \\
 \begin{array}{r|l}
 1 & -2 & -4 & 8 & \\
 & -2 & 8 & -8 & \\ \hline
 1 & -4 & 4 & 0 & \\
 \end{array} \Bigg| \frac{-2}{-} \\
 = (x+2)^2(x-4x+4) \\
 = (x+2)^2(x-2)^2 \\
 \Rightarrow \frac{(x+2)^3}{(x+2)^2(x-2)^2} \\
 = \frac{x+2}{(x-2)^2} = \frac{-2+2}{(-2-2)^2} = \frac{0}{16} = 0
 \end{aligned}$$

$$\begin{aligned}
 28. \frac{9x^3 + 3x^2 + 3x + 1}{27x^3 + 1} \text{ Para } x \rightarrow -\frac{1}{3} \\
 = \frac{3x^2(3x+1) + (3x+1)}{27x^3 + 1} \\
 = \frac{(3x^2+1)(3x+1)}{(3x+1)(9x^2 - 3x + 1)} \\
 = \frac{3x^2 + 1}{9x^2 - 3x + 1} \\
 = \frac{3\left(-\frac{1}{3}\right)^2 + 1}{9\left(-\frac{1}{3}\right)^2 - 3\left(-\frac{1}{3}\right) + 1} = \frac{\frac{4}{3} + 1}{\frac{4}{3} - 1 + 1} = \frac{\frac{7}{3}}{\frac{4}{3}} = \frac{7}{4}
 \end{aligned}$$

$$29. \frac{1}{x-1} - \frac{3}{x^3-1} \text{ Para } x \rightarrow 1 \quad \frac{x^2+x+1-3}{x^3-1} = \frac{x^2+x-2}{x^3-1} = \frac{(x-1)(x+2)}{(x-1)(x^2+x+1)} = \frac{x+2}{x^2+x+1} = \frac{1+2}{1^2+1+1} = \frac{3}{3} = 1$$

$$30. (x^2+3x-10) \left( 1 + \frac{1}{x-2} \right) \text{ Para } x \rightarrow 2 \quad (x+5)(x-2) \left( \frac{x-1}{x-2} \right) = (x+5)(x-1) \Rightarrow (2+5)(2-1) = 7$$

### EJERCICIO 140

$$1. \frac{12x^2+31x+20}{18x^2+21x-4} = \frac{(12x)^2+31(12x)+240}{(18x)^2+21(18x)-72} = \frac{(12x+16)(12x+15)}{(18x+24)(18x-3)} = \frac{(3x+4)(4x+5)}{(3x+4)(6x-1)} = \frac{4x+5}{6x-1}$$

$$2. \left( \frac{1}{a} + \frac{2}{a^2} + \frac{1}{a^3} \right) \div \left( a + 2 - \frac{2a+1}{a} \right) = \left( \frac{a^2+2a+1}{a^3} \right) \div \left( \frac{a^2+2a-2a-1}{a} \right) = \frac{(a+1)^2}{a^3} \cdot \frac{a}{(a+1)(a-1)} = \frac{a+1}{a^2(a-1)} = \frac{a+1}{a^3-a^2}$$

$$3. \frac{x^3+3x^2+9x}{x^5-27x^2} = \frac{x(x^2+3x+9)}{x^2(x^3-27)} = \frac{x^2+3x+9}{x(x-3)(x^2+3x+9)} = \frac{1}{x(x-3)}$$

$$4. \frac{(x+y)^2}{y} - \frac{x(x-y)^2}{xy} = \frac{x(x+y)^2 - x(x-y)^2}{xy} = \frac{x^3+2x^2y+xy^2 - x^3+2x^2y-xy^2}{xy} = \frac{4x^2y}{xy} = 4x$$

$$5. \frac{a^4-2b^3+a^2b(b-2)}{a^4-a^2b-2b^2} = \frac{a^4-2b^3+a^2b^2-2a^2b}{(a^2-2b)(a^2+b)} = \frac{a^2(a^2+b^2)-2b(b^2+a^2)}{(a^2-2b)(a^2+b)} = \frac{(a^2-2b)(a^2+b^2)}{(a^2-2b)(a^2+b)} = \frac{a^2+b^2}{a^2+b}$$

$$6. a + \frac{1+5a}{a^2-5} = \frac{a^3-5a+1+5a}{a^2-5} = \frac{a^3+1}{a^2-5} = \frac{(a+1)(a^2-a+1)}{a^2-5}$$

$$a - \frac{a+5}{a+1} = \frac{a^2+a-a-5}{a+1} = \frac{a^2-5}{a+1}$$

$$\Rightarrow \frac{(a+1)(a^2-a+1)}{a^2-5} \cdot \frac{a^2-5}{a+1} = a^2-a+1$$

$$7. x^2+5x-4 - \frac{x^3-29}{x-5} = \frac{(x-5)(x^2+5x-4) - x^3+29}{x-5} = \frac{x^3-29x+20-x^3+29}{x-5} = \frac{49-29x}{x-5}$$

$$x+34 + \frac{170-x^2}{x-5} = \frac{x^2+29x-170+170-x^2}{x-5} = \frac{29x}{x-5}$$

$$\Rightarrow \frac{49-29x}{x-5} \div \frac{29x}{x-5} = \frac{49-29x}{x-5} \cdot \frac{x-5}{29x} = \frac{49-29x}{29x}$$

$$8. \frac{4x^2-5xy+y^2}{3x} = \frac{4x^2}{3x} - \frac{5xy}{3x} + \frac{y^2}{3x} = \frac{4x}{3} - \frac{5y}{3} + \frac{y^2}{3x}$$

$$9. \frac{m-n-x}{mnx} = \frac{m}{mnx} - \frac{n}{mnx} - \frac{x}{mnx} = \frac{1}{nx} - \frac{1}{mx} - \frac{1}{mn}$$

$$10. \frac{x^3-xy^2}{x-y} = x^2+xy$$

$$\Rightarrow \frac{x(x^2-y^2)}{x-y} = x(x+y)$$

$$\Rightarrow \frac{x(x+y)(x-y)}{x-y} = x(x+y) \Rightarrow x(x+y) = x(x+y)$$

$$11. x^2-2x+1 - \frac{9x-3x^2}{x-3} = \frac{x^3-1}{x-1}$$

$$\Rightarrow \frac{(x-1)^2(x-3)-3x(3-x)}{x-3} = \frac{(x-1)(x^2+x+1)}{x-1}$$

$$\Rightarrow \frac{x^3-5x^2+7x-3-9x+3x^2}{x-3} = x^2+x+1$$

$$\Rightarrow \frac{x^3-2x^2-2x-3}{x-3} = x^2+x+1$$

$$\Rightarrow \frac{(x-3)(x^2+x+1)}{x-3} = x^2+x+1 \Rightarrow x^2+x+1 = x^2+x+1$$

$$12. \frac{a^4-5a^2+4}{a^3+a^2-4a-4} = a-3 + \frac{2+4a}{2a+1}$$

$$\Rightarrow \frac{(a-2)(a-1)(a+2)(a+1)}{(a-2)(a+1)(a+2)} = \frac{2a^2-5a-3+2+4a}{2a+1}$$

$$\Rightarrow a-1 = \frac{2a^2-a-1}{2a+1} \Rightarrow a-1 = \frac{(2a+1)(a-1)}{2a+1} \Rightarrow a-1 = a-1$$

$$\begin{aligned}
 13. \quad & \frac{1}{a-b} + \frac{1}{a+b} + \frac{2a}{a^2-ab+b^2} \\
 &= \frac{a^3+b^3+(a-b)(a^2-ab+b^2)+2a(a^2-b^2)}{(a^3+b^3)(a-b)} \\
 &= \frac{a^3+b^3+a^3-2a^2b+2ab^2-b^3+2a^3-2ab^2}{(a^3+b^3)(a-b)} \\
 &= \frac{4a^3-2a^2b}{(a^3+b^3)(a-b)}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \left( \frac{a^2}{1-a^2} - \frac{a^4}{1-a^4} \right) \cdot \left( 1-a + \frac{1+a^3}{a^2} \right) \\
 &= \left( \frac{a^2(1+a^2)-a^4}{1-a^4} \right) \cdot \left( \frac{a^2(1-a)+1+a^3}{a^2} \right) \\
 &= \left( \frac{a^2+a^4-a^4}{1-a^4} \right) \cdot \left( \frac{a^2-a^3+1+a^3}{a^2} \right) \\
 &= \frac{a^2}{1-a^4} \cdot \frac{a^2+1}{a^2} = \frac{1}{1-a^2}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \left( \frac{x^2-9}{x^2-x-12} \div \frac{x-3}{x^2+3x} \right) \cdot \frac{a^2x^2-16a^2}{2x^2+7x+3} \cdot \left( \frac{2}{a^2x} + \frac{1}{a^2x^2} \right) \\
 &= \left( \frac{(x+3)(x-3)}{(x-4)(x+3)} \cdot \frac{x(x+3)}{x-3} \right) \cdot \frac{a^2(x-4)(x+4)}{(x+3)(2x+1)} \cdot \left( \frac{2x+1}{a^2x^2} \right) = \frac{x+4}{x}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{3x^3-x^2-12x+4}{6x^4+x^3-25x^2-4x+4} \\
 & \Rightarrow 3x^3-x^2-12x+4 \\
 & \begin{array}{r|l}
 3 & -1 & -12 & 4 & -2 \\
 & -6 & 14 & -4 & \\
 \hline
 3 & -7 & 2 & 0 & \\
 \end{array} \\
 &= (x+2)(3x^2-7x+2) = (x+2)(x-2)(3x-1) \\
 & \begin{array}{r|l}
 6x^4+x^3-25x^2-4x+4 & \\
 6 & 1 & -25 & -4 & 4 & -2 \\
 & -12 & 22 & 6 & -4 & \\
 \hline
 6 & -11 & -3 & 2 & 0 & \\
 \end{array} \\
 &= (x+2)(6x^3-11x^2-3x+2) \\
 & \begin{array}{r|l}
 6 & -11 & -3 & 2 & \\
 & 12 & 2 & -2 & \\
 \hline
 6 & 1 & -1 & 0 & \\
 \end{array} \\
 &= (x-2)(x+2)(6x^2+x-1) \\
 &= (x-2)(x+2)(2x+1)(3x-1) \\
 & \Rightarrow \frac{(x+2)(x-2)(3x-1)}{(x-2)(x+2)(2x+1)(3x-1)} = \frac{1}{2x+1}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{16-81x^2}{72x^2-5x-12} \\
 &= \frac{(4-9x)(4+9x)}{(72x^2-5(72x)-864)} \\
 &= \frac{(4-9x)(4+9x)}{(72x-32)(72x+27)} \\
 &= \frac{(4-9x)(4+9x)}{(9x-4)(8x+3)} = -\frac{(4-9x)(4+9x)}{(4-9x)(8x+3)} = -\frac{9x+4}{8x+3}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \left( \frac{1}{x} - \frac{2}{x+2} + \frac{3}{x+3} \right) \div \left( \frac{x}{x+2} + \frac{x}{x+3} + \frac{6}{x^2+5x+6} \right) \\
 &= \frac{x^2+5x+6-2x(x+3)+3x(x+2)}{x(x^2+5x+6)} \div \frac{x(x+3)+x(x+2)+6}{x^2+5x+6} \\
 &= \frac{x^2+5x+6-2x^2-6x+3x^2+6x}{x(x^2+5x+6)} \cdot \frac{x^2+5x+6}{x^2+3x+x^2+2x+6} \\
 &= \frac{2x^2+5x+6}{x} \cdot \frac{1}{2x^2+5x+6} = \frac{1}{x}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & \frac{\frac{b}{a} + 1 + \frac{b}{a-b}}{1 - \frac{b^2}{a^2} - 2 \frac{a-3b}{a-b}} \\
 &= \frac{\frac{b}{a^2-b^2} + \frac{a-b+b}{2a-2b-a+3b}}{\frac{b}{a^2} + \frac{a-b+b}{a-b}} \\
 &= \frac{a^2b}{a(a^2-b^2)} + \frac{a-b}{a-b} \\
 &= \frac{a^2b}{a(a^2-b^2)} + \frac{a}{a+b} \\
 &= \frac{a^2b+a^2(a-b)}{a(a^2-b^2)} = \frac{a^2b+a^3-a^2b}{a(a^2-b^2)} \\
 &= \frac{a^3}{a(a^2-b^2)} = \frac{a^2}{a^2-b^2}
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & \frac{1}{3} \left( \frac{x^2-36}{x} \div \frac{x}{x^2-4} \right) \cdot \frac{1}{x-\frac{36}{x}} \cdot \frac{1}{x-\frac{4}{x}} \\
 &= \frac{1}{3} \left( \frac{(x+6)(x-6)}{x} \cdot \frac{(x+2)(x-2)}{x} \right) \cdot \frac{1}{\frac{x^2-36}{x}} \cdot \frac{1}{\frac{x^2-4}{x}} \\
 &= \frac{(x+6)(x-6)}{3x} \cdot \frac{(x+2)(x-2)}{x} \cdot \frac{x}{x^2-36} \cdot \frac{x}{x^2-4} \\
 &= \frac{x^2(x+6)(x-6)(x+2)(x-2)}{3x^2(x+6)(x-6)(x+2)(x-2)} = \frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & \frac{\frac{3a}{(a-2b)^2} + \frac{5}{a-5b} + \frac{1}{a-2b}}{\frac{3a^2-14ab+10b^2}{a^2-4ab+4b^2}} \\
 &= \frac{3a(a-5b) + 5(a-2b)^2 + (a-2b)(a-5b)}{(a-2b)^2(a-5b)} \\
 &= \frac{3a^2-15ab+5a^2-20ab+20b^2+a^2-7ab+10b^2}{(a-5b)(3a^2-14ab+10b^2)} \\
 &= \frac{9a^2-42ab+30b^2}{(a-5b)(3a^2-14ab+10b^2)} = \frac{3(3a^2-14ab+10b^2)}{(a-5b)(3a^2-14ab+10b^2)} = \frac{3}{a-5b}
 \end{aligned}$$

$$\begin{aligned}
 22. \quad & \frac{\frac{x+1}{x-1} - \frac{x-1}{x+1}}{\frac{x-1}{x+1} + \frac{x+1}{x-1}} \cdot \frac{x^2+1}{2a^2-2b} \div \frac{2x}{a^2-b} \\
 &= \frac{(x+1)^2 - (x-1)^2}{x^2-1} \cdot \frac{x^2+1}{2(a^2-b)} \cdot \frac{a^2-b}{2x} \\
 &= \frac{x^2+2x+1-x^2+2x-1}{x^2-1} \cdot \frac{x^2+1}{2(a^2-b)} \cdot \frac{a^2-b}{2x} = \frac{4x}{2(x^2+1)} \cdot \frac{x^2+1}{4x} = \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & \frac{1}{3x-9} - \frac{1}{6x+12} - \frac{1}{2(x-3)^2} + \frac{1}{x-6} + \frac{9}{x} \\
 &= \frac{1}{3(x-3)} - \frac{1}{6(x+2)} - \frac{1}{2(x-3)^2} + \frac{x}{x^2-6x+9} \\
 &= \frac{2(x-3)(x+2) - (x-3)^2 - 3(x+2) + 6(x+2)}{6(x-3)^2(x+2)} \\
 &= \frac{2x^2-2x-12-x^2+6x-9-3x-6+6x^2+12x}{6(x-3)^2(x+2)} \\
 &= \frac{7x^2+13x-27}{6(x-3)^2(x+2)}
 \end{aligned}$$

$$\begin{aligned}
 24. \quad & \frac{a-b + \frac{a^2+b^2}{a+b}}{a+b - \frac{a^2-2b^2}{a-b}} \cdot \frac{b + \frac{b^2}{a}}{a-b} \cdot \frac{1}{1 + \frac{2a-b}{b}} \\
 &= \frac{\frac{a^2-b^2+a^2+b^2}{a+b}}{\frac{a^2-b^2-a^2+2b^2}{a-b}} \cdot \frac{\frac{ab+b^2}{a-b}}{\frac{b+2a-b}{b}} \\
 &= \frac{2a^2}{a-b} \cdot \frac{b(a+b)}{a-b} \cdot \frac{1}{\frac{2a}{b}} = \frac{2a^2(a-b)}{b^2(a+b)} \cdot \frac{b(a+b)}{a(a-b)} \cdot \frac{b}{2a} = 1
 \end{aligned}$$

## EJERCICIO 141

$$\begin{aligned}
 1. \quad & \frac{x}{6} + 5 = \frac{1}{3} - x \\
 \Rightarrow & \frac{x+30}{6} = \frac{1-3x}{3} \\
 & x+30 = 2(1-3x) \\
 & x+30 = 2-6x \\
 & x+6x = 2-30 \\
 & 7x = -28 \\
 & x = \frac{-28}{7} \\
 & x = -4
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & \frac{3x}{5} - \frac{2x}{3} + \frac{1}{5} = 0 \quad mcm=15 \\
 & 9x-10x+3=0 \\
 & -x = -3 \\
 & x = 3
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{1}{2x} + \frac{1}{4} - \frac{1}{10x} = \frac{1}{5} \quad mcm=20x \\
 & 10+5x-2=4x \\
 & 5x-4x = -10+2 \\
 & x = -8
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{x}{2} + 2 - \frac{x}{12} = \frac{x}{6} - \frac{5}{4} \quad mcm=12 \\
 & 6x+24-x=2x-15 \\
 & 6x-x-2x = -15-24 \\
 & 3x = -39 \\
 & x = \frac{-39}{3} \\
 & x = -13
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{3x}{4} - \frac{1}{5} + 2x = \frac{5}{4} - \frac{3x}{20} \quad mcm=20 \\
 & 15x-4+40x=25-3x \\
 & 55x+3x=25+4 \\
 & 58x=29 \\
 & x = \frac{29}{58} \\
 & x = \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{2}{3x} - \frac{5}{x} = \frac{7}{10} - \frac{3}{2x} + 1 \quad mcm=30x \\
 & 20-150=21x-45+30x \\
 & -130+45=51x \\
 & \frac{-85}{51} = x \\
 & \frac{-5}{3} = x
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{x-4}{3} - 5 = 0 \quad mcm=3 \\
 & x-4-15=0 \\
 & x-19=0 \\
 & x=19
 \end{aligned}$$

$$\begin{aligned}
 8. \quad & x - \frac{x+2}{12} = \frac{5x}{2} \quad mcm=12 \\
 & 12x-x-2=30x \\
 & 11x-30x=2 \\
 & -19x=2 \\
 & x = -\frac{2}{19}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad & x - \frac{5x-1}{3} = 4x - \frac{3}{5} \quad mcm=15 \\
 & 15x-25x+5=60x-9 \\
 & -10x-60x = -9-5 \\
 & -70x = -14 \\
 & x = \frac{-14}{-70} \\
 & x = \frac{1}{5}
 \end{aligned}$$

$$10. 10x - \frac{8x-3}{4} = 2(x-3) \quad mcm=4$$

$$40x - 8x + 3 = 8(x-3)$$

$$40x - 8x = 8x - 24 - 3$$

$$40x - 16x = -27$$

$$x = \frac{-27}{24}$$

$$x = -\frac{9}{8}$$

$$11. \frac{x-2}{3} - \frac{x-3}{4} = \frac{x-4}{5} \quad mcm=60$$

$$20(x-2) - 15(x-3) = 12(x-4)$$

$$20x - 40 - 15x + 45 = 12x - 48$$

$$5x - 12x = -48 - 5$$

$$-7x = -53$$

$$x = \frac{53}{7}$$

$$12. \frac{x-1}{2} - \frac{x-2}{3} - \frac{x-3}{4} = -\frac{x-5}{5}$$

$$mcm=60$$

$$30(x-1) - 20(x-2) - 15(x-3) = -12(x-5)$$

$$30x - 30 - 20x + 40 - 15x + 45 = -12x + 60$$

$$-5x + 55 = -12x + 60$$

$$-5x + 12x = 60 - 55$$

$$7x = 5$$

$$x = \frac{5}{7}$$

$$13. x - (5x-1) - \frac{7-5x}{10} = 1 \quad mcm=10$$

$$10x - 10(5x-1) - (7-5x) = 10$$

$$10x - 50x + 10 - 7 + 5x = 10$$

$$-35x + 3 = 10$$

$$-35x = 7$$

$$x = \frac{-7}{35}$$

$$x = -\frac{1}{5}$$

$$14. 2x - \frac{5x-6}{4} + \frac{1}{3}(x-5) = -5x$$

$$mcm=12$$

$$24x - 3(5x-6) + 4(x-5) = -60x$$

$$24x - 15x + 18 + 4x - 20 = -60x$$

$$13x - 2 = -60x$$

$$13x + 60x = 2$$

$$x = \frac{2}{73}$$

$$15. 4 - \frac{10x+1}{6} = 4x - \frac{16x+3}{4} \quad mcm=12$$

$$48 - 2(10x+1) = 48x - 3(16x+3)$$

$$48 - 20x - 2 = 48x - 48x - 9$$

$$-20x + 46 = -9$$

$$-20x = -55$$

$$x = \frac{-55}{-20}$$

$$x = \frac{11}{4}$$

$$16. \frac{1}{2}(x-1) - (x-3) = \frac{1}{3}(x+3) + \frac{1}{6} \quad mcm=6$$

$$3(x-1) - 6(x-3) = 2(x+3) + 1$$

$$3x - 3 - 6x + 18 = 2x + 6 + 1$$

$$-3x + 15 = 2x + 7$$

$$-5x = -8$$

$$x = \frac{8}{5}$$

$$17. \frac{6x+1}{3} - \frac{11x-2}{9} - \frac{1}{4}(5x-2) = \frac{5}{6}(6x+1) \quad mcm=36$$

$$12(6x+1) - 4(11x-2) - 9(5x-2) = 30(6x+1)$$

$$72x + 12 - 44x + 8 - 45x + 18 = 180x + 30$$

$$-17x + 38 = 180x + 30$$

$$-197x = -8$$

$$x = \frac{8}{197}$$

$$18. \frac{4x+1}{3} = \frac{1}{3}(4x-1) - \frac{13+2x}{6} - \frac{1}{2}(x-3) \quad mcm=6$$

$$2(4x+1) = 2(4x-1) - (13+2x) - 3(x-3)$$

$$8x + 2 = 8x - 2 - 13 - 2x - 3x + 9$$

$$2 = -6 - 5x$$

$$8 = -5x$$

$$-\frac{8}{5} = x$$

$$19. \frac{2}{5}(5x-1) + \frac{3}{10}(10x-3) = -\frac{1}{2}(x-2) - \frac{6}{5} \quad mcm=10$$

$$4(5x-1) + 3(10x-3) = -5(x-2) - 12$$

$$20x - 4 + 30x - 9 = -5x + 10 - 12$$

$$50x - 13 = -5x + 10 - 12$$

$$50x - 13 = -5x - 2$$

$$55x = 11$$

$$x = \frac{1}{5}$$



$$20. \frac{3x-1}{2} - \frac{5x+4}{3} - \frac{x+2}{8} = \frac{2x-3}{5} - \frac{1}{10}$$

$$mcm=120$$

$$60(3x-1) - 40(5x+4) - 15(x+2) = 24(2x-3) - 12$$

$$180x - 60 - 200x - 160 - 15x - 30 = 48x - 72 - 12$$

$$-35x - 250 = 48x - 84$$

$$-83x = 166$$

$$x = -2$$

$$21. \frac{7x-1}{3} - \frac{5-2x}{2x} = \frac{4x-3}{4} + \frac{1+4x^2}{3x}$$

$$mcm=12x$$

$$4x(7x-1) - 6(5-2x) = 3x(4x-3) + 4(1+4x^2)$$

$$28x^2 - 4x - 30 + 12x = 12x^2 - 9x + 4 + 16x^2$$

$$8x - 30 = -9x + 4$$

$$17x = 34$$

$$x = 2$$

$$22. \frac{2x+7}{3} - \frac{2(x^2-4)}{5x} - \frac{4x^2-6}{15x} = \frac{7x^2+6}{3x^2}$$

$$mcm=15x^2$$

$$5x^2(2x+7) - 6x(x^2-4) - x(4x^2-6) = 5(7x^2+6)$$

$$10x^3 + 35x^2 - 6x^3 + 24x - 4x^3 + 6x = 35x^2 + 30$$

$$30x = 30$$

$$x = \frac{30}{30}$$

$$x = 1$$

$$23. \frac{2}{3} \left( \frac{x+1}{5} \right) = \frac{3}{4} \left( \frac{x-6}{3} \right) \quad mcm=60$$

$$8(x+1) = 15(x-6)$$

$$8x + 8 = 15x - 90$$

$$8x - 15x = -90 - 8$$

$$-7x = -98$$

$$x = \frac{-98}{-7}$$

$$x = 14$$

$$24. \frac{3}{5} \left( \frac{2x-1}{6} \right) - \frac{4}{3} \left( \frac{3x+2}{4} \right) - \frac{1}{5} \left( \frac{x-2}{3} \right) + \frac{1}{5} = 0$$

$$mcm=60$$

$$6(2x-1) - 20(3x+2) - 4(x-2) + 12 = 0$$

$$12x - 6 - 60x - 40 - 4x + 8 + 12 = 0$$

$$-52x - 26 = 0$$

$$x = -\frac{26}{52} = -\frac{1}{2}$$

$$25. 10 - \frac{3x+5}{6} = 3\frac{11}{12} - \frac{x}{4}$$

$$\Rightarrow \frac{60-3x-5}{6} = \frac{47}{12} - \frac{x}{8} \quad mcm=24$$

$$4(55-3x) = 94 - 3x$$

$$220 - 12x = 94 - 3x$$

$$-12x + 3x = 94 - 220$$

$$-9x = -126$$

$$x = \frac{-126}{-9}$$

$$x = 14$$

$$26. 9x - 2 - 7x \left( \frac{1}{x} - \frac{1}{2} \right) = \frac{1 + \frac{x}{2}}{2} + 2\frac{3}{4}$$

$$\Rightarrow 9x - 2 - 7x \left( \frac{2-x}{2} \right) = \frac{x+2}{4} + \frac{11}{4}$$

$$\Rightarrow 9x - 2 - 7 \left( \frac{2-x}{2} \right) = \frac{x+13}{4} \quad mcm=4$$

$$36x - 8 - 14(2-x) = x + 13$$

$$36x - 8 - 28 + 14x = x + 13$$

$$50x - 36 = x + 13$$

$$49x = 49$$

$$x = 1$$

$$27. \frac{3x}{8} - \frac{7}{10} - \frac{12x-5}{16} - \frac{2x-3}{20} + \frac{4x+9}{4} + \frac{7}{80} = 0 \quad mcm=160$$

$$60x - 112 - 10(12x-5) - 8(2x-3) + 40(4x+9) + 14 = 0$$

$$60x - 112 - 120x + 50 - 16x + 24 + 160x + 360 + 14 = 0$$

$$84x + 336 = 0$$

$$84x = -336$$

$$x = \frac{-336}{84}$$

$$x = -4$$

$$28. \frac{5x}{4} - \frac{3}{17}(x-20) - (2x-1) = \frac{x+24}{34} \quad mcm=68$$

$$85x - 12(x-20) - 68(2x-1) = 2(x+24)$$

$$85x - 12x + 240 - 136x + 68 = 2x + 48$$

$$-63x + 308 = 2x + 48$$

$$-65x = -260$$

$$x = \frac{-260}{-65}$$

$$x = 4$$

$$29. 5 + \frac{x}{4} = \frac{1}{3} \left( 2 - \frac{x}{2} \right) - \frac{2}{3} + \frac{1}{4} \left( 10 - \frac{5x}{3} \right)$$

$$\Rightarrow \frac{20+x}{4} = \frac{1}{3} \left( \frac{4-x}{2} \right) - \frac{2}{3} + \frac{1}{4} \left( \frac{30-5x}{3} \right)$$

$$\Rightarrow \frac{20+x}{4} = \frac{4-x}{6} - \frac{2}{3} + \frac{30-5x}{12}$$

$$mcm=12$$

$$3(20+x) = 2(4-x) - 8 + 30 - 5x$$

$$60 + 3x = 8 - 2x - 8 + 30 - 5x$$

$$60 + 3x = -7x + 30$$

$$10x = -30$$

$$x = -3$$

$$30. \frac{5(x+2)}{12} + \frac{4}{9} - \frac{22-x}{36} = 3x - 20 - \frac{8-x}{12} - \frac{20-3x}{18} \quad mcm=36$$

$$15(x+2) + 16 - 22 + x = 108x - 720 - 3(8-x) - 2(20-3x)$$

$$15x + 30 - 6 + x = 108x - 720 - 24 + 3x - 40 + 6x$$

$$16x + 24 = 117x - 784$$

$$-101x = -808$$

$$x = 8$$

$$31. \left( 3 - \frac{x}{2} \right) - \left( 1 - \frac{x}{3} \right) = 7 - \left( x - \frac{x}{2} \right)$$

$$\Rightarrow \frac{6-x}{2} - \frac{3-x}{3} = 7 - \frac{x}{2} \quad mcm=6$$

$$3(6-x) - 2(3-x) = 42 - 3x$$

$$18 - 3x - 6 + 2x = 42 - 3x$$

$$12 - x = 42 - 3x$$

$$2x = 30$$

$$x = 15$$

$$32. (x+3)(x-3) - x^2 - \frac{5}{4} = \left( x - \frac{x}{5} \right) - \left( 3x - \frac{3}{4} \right)$$

$$\Rightarrow x^2 - 9 - x^2 - \frac{5}{4} = \frac{4x}{5} - \frac{12x-3}{4}$$

$$\Rightarrow -\frac{41}{4} = \frac{16x-60x+15}{20}$$

$$\Rightarrow -\frac{41}{4} = \frac{-44x+15}{20} \quad mcm=20$$

$$-205 = -44x + 15$$

$$-220 = -44x$$

$$5 = x$$

$$33. 2x - \left( 2x - \frac{3x-1}{8} \right) = \frac{2}{3} \left( \frac{x+2}{6} \right) - \frac{1}{4}$$

$$\Rightarrow 2x - \frac{16x-3x+1}{8} = \frac{2x+4}{18} - \frac{1}{4} \quad mcm=72$$

$$144x - 9(13x+1) = 4(2x+4) - 18$$

$$144x - 117x - 9 = 8x + 16 - 18$$

$$27x - 9 = 8x - 2$$

$$19x = 7$$

$$x = \frac{7}{19}$$

## EJERCICIO 142

$$1. \frac{3}{5} + \frac{3}{2x-1} = 0 \quad mcm=5(2x-1)$$

$$3(2x-1) + 15 = 0$$

$$6x - 3 + 15 = 0$$

$$6x = -12$$

$$x = -2$$

$$2. \frac{2}{4x-1} = \frac{3}{4x+1} \quad mcm=16x^2-1$$

$$2(4x+1) = 3(4x-1)$$

$$8x + 2 = 12x - 3$$

$$-4x = -5$$

$$x = \frac{5}{4}$$

$$3. \frac{5}{x^2-1} = \frac{1}{x-1} \quad mcm=x^2-1$$

$$5 = x + 1$$

$$4 = x$$

$$4. \frac{3}{x+1} - \frac{1}{x^2-1} = 0 \quad mcm=x^2-1$$

$$3(x-1) - 1 = 0$$

$$3x - 3 - 1 = 0$$

$$3x = 4$$

$$x = \frac{4}{3}$$

$$5. \frac{5x+8}{3x+4} = \frac{5x+2}{3x-4} \quad mcm=(3x+4)(3x-4)$$

$$(3x-4)(5x+8) = (5x+2)(3x+4)$$

$$15x^2 + 4x - 32 = 15x^2 + 26x + 8$$

$$-26x + 4x = 8 + 32$$

$$-22x = 40$$

$$x = -\frac{40}{22}$$

$$x = -\frac{20}{11}$$

$$6. \frac{10x^2-5x+8}{5x^2+9x-19} = 2 \quad mcm=5x^2+9x-19$$

$$10x^2 - 5x + 8 = 2(5x^2 + 9x - 19)$$

$$10x^2 - 5x + 8 = 10x^2 + 18x - 38$$

$$-5x - 18x = -38 - 8$$

$$-23x = -46$$

$$x = \frac{-46}{-23}$$

$$x = 2$$

$$7. \frac{1}{3x-3} + \frac{1}{4x+4} = \frac{1}{12x-12} \quad mcm=12(x^2-1)$$

$$4(x+1) + 3(x-1) = x+1$$

$$4x+4+3x-3 = x+1$$

$$7x-x=0$$

$$6x=0$$

$$x=0$$

$$8. \frac{x}{4} - \frac{x^2-8x}{4x-5} = \frac{7}{4} \quad mcm=4(4x-5)$$

$$x(4x-5) - 4(x^2-8x) = 7(4x-5)$$

$$4x^2 - 5x - 4x^2 + 32x = 28x - 35$$

$$27x = 28x - 35$$

$$-x = -35$$

$$x = 35$$

$$9. \frac{2x-9}{10} + \frac{2x-3}{2x-1} = \frac{x}{5} \quad mcm=10(2x-1)$$

$$(2x-9)(2x-1) + 10(2x-3) = 2x(2x-1)$$

$$4x^2 - 20x + 9 + 20x - 30 = 4x^2 - 2x$$

$$-21 = -2x$$

$$\frac{-21}{-2} = x$$

$$10\frac{1}{2} = x$$

$$10. \frac{(3x-1)^2}{x-1} = \frac{18x-1}{2} \quad mcm=2(x-1)$$

$$2(9x^2 - 6x + 1) = (x-1)(18x-1)$$

$$18x^2 - 12x + 2 = 18x^2 - 19x + 1$$

$$-12x + 19x = 1 - 2$$

$$7x = -1$$

$$x = -\frac{1}{7}$$

$$11. \frac{2x+7}{5x+2} - \frac{2x-1}{5x-4} = 0 \quad mcm=(5x+2)(5x-4)$$

$$(2x+7)(5x-4) - (2x-1)(5x+2) = 0$$

$$10x^2 + 27x - 28 - 10x^2 + x + 2 = 0$$

$$28x = 26$$

$$x = \frac{13}{14}$$

$$12. \frac{(5x-2)(7x+3)}{7x(5x-1)} - 1 = 0 \quad mcm=7x(5x-1)$$

$$(5x-2)(7x+3) - 7x(5x-1) = 0$$

$$35x^2 + x - 6 - 35x^2 + 7x = 0$$

$$8x = 6$$

$$x = \frac{3}{4}$$

$$13. \frac{3}{x-4} = \frac{2}{x-3} + \frac{8}{x^2-7x+12} \quad mcm=x^2-7x+12$$

$$3(x-3) = 2(x-4) + 8$$

$$3x-9 = 2x-8+8$$

$$3x-2x=9$$

$$x=9$$

$$14. \frac{6x-1}{18} - \frac{3(x+2)}{5x-6} = \frac{1+3x}{9} \quad mcm=18(5x-6)$$

$$(6x-1)(5x-6) - 54(x+2) = 2(1+3x)(5x-6)$$

$$30x^2 - 41x + 6 - 54x - 108 = -26x - 12 + 30x^2$$

$$-95x - 102 = -26x - 12$$

$$-69x = 90$$

$$x = -\frac{90}{69}$$

$$x = -1\frac{7}{23}$$

$$15. \frac{5}{1+x} - \frac{3}{1-x} - \frac{6}{1-x^2} = 0 \quad mcm=1-x^2$$

$$5(1-x) - 3(1+x) - 6 = 0$$

$$5 - 5x - 3 - 3x - 6 = 0$$

$$-8x - 4 = 0$$

$$-8x = 4$$

$$x = -\frac{1}{2}$$

$$16. \frac{1+2x}{1+3x} - \frac{1-2x}{1-3x} = -\frac{3x-14}{1-9x^2} \quad mcm=1-9x^2$$

$$(1+2x)(1-3x) - (1-2x)(1+3x) = -3x+14$$

$$1-x-6x^2-1-x+6x^2 = -3x+14$$

$$-2x = -3x+14$$

$$x = 14$$

$$17. \frac{3x-1}{x^2+7x+12} = \frac{1}{2x+6} + \frac{7}{6x+24}$$

$$\Rightarrow x^2+7x+12 = (x+3)(x+4)$$

$$\Rightarrow 2x+6 = 2(x+3)$$

$$\Rightarrow 6x+24 = 6(x+4) \quad mcm=6(x+3)(x+4)$$

$$6(3x-1) = 3(x+4) + 7(x+3)$$

$$18x-6 = 3x+12+7x+21$$

$$18x-6 = 10x+33$$

$$8x = 39$$

$$x = \frac{39}{8}$$

$$x = 4\frac{7}{8}$$

$$18. \frac{1}{(x-1)^2} - \frac{3}{2x-2} = -\frac{3}{2x+2} \quad mcm=2(x-1)^2(x+1)$$

$$2(x+1) - 3(x-1)(x+1) = -3(x-1)^2$$

$$2x+2 - 3x^2+3 = -3x^2+6x-3$$

$$2x+5 = 6x-3$$

$$-4x = -8$$

$$x = 2$$

$$19. \frac{5x+13}{15} - \frac{4x+5}{5x-15} = \frac{x}{3} \quad mcm=15(x-3)$$

$$(5x+13)(x-3) - 3(4x+5) = 5x(x-3)$$

$$5x^2 - 2x - 39 - 12x - 15 = 5x^2 - 15x$$

$$-14x - 54 = -15x$$

$$x = 54$$

$$20. \frac{2x-1}{2x+1} - \frac{x-4}{3x-2} = \frac{2}{3} \quad mcm=3(2x+1)(3x-2)$$

$$3(2x-1)(3x-2) - 3(x-4)(2x+1) = 2(2x+1)(3x-2)$$

$$18x^2 - 21x + 6 - 6x^2 + 21x + 12 = 12x^2 - 2x - 4$$

$$18 = -2x - 4$$

$$22 = -2x$$

$$-11 = x$$

$$21. \frac{4x+3}{2x-5} - \frac{3x+8}{3x-7} = 1 \quad mcm=(2x-5)(3x-7)$$

$$(4x+3)(3x-7) - (3x+8)(2x-5) = (2x-5)(3x-7)$$

$$12x^2 - 19x - 21 - 6x^2 - x + 40 = 6x^2 - 29x + 35$$

$$-20x + 19 = -29x + 35$$

$$9x = 16$$

$$x = \frac{16}{9}$$

$$x = 1\frac{7}{9}$$

$$22. \frac{10x-7}{15x+3} = \frac{3x+8}{12} - \frac{5x^2-4}{20x+4} \quad mcm=12(5x+1)$$

$$4(10x-7) = (3x+8)(5x+1) - 3(5x^2-4)$$

$$40x - 28 = 15x^2 + 43x + 8 - 15x^2 + 12$$

$$40x - 28 = 43x + 20$$

$$-3x = 48$$

$$x = -16$$

$$23. \frac{4x-1}{5} + \frac{x-2}{2x-7} = \frac{8x-3}{10} - 1\frac{3}{10} \quad mcm=10(2x-7)$$

$$2(4x-1)(2x-7) + 10(x-2) = (8x-3)(2x-7) - 13(2x-7)$$

$$16x^2 - 60x + 14 + 10x - 20 = 16x^2 - 62x + 21 - 26x + 91$$

$$-50x - 6 = -88x + 112$$

$$38x = 118$$

$$x = \frac{118}{38}$$

$$x = 3\frac{2}{19}$$

$$24. \frac{1}{x-1} - \frac{2}{x-2} = \frac{3}{2x-2} - \frac{2\frac{1}{3}}{2x-4}$$

$$\frac{1}{x-1} - \frac{2}{x-2} = \frac{3}{2x-2} - \frac{\frac{7}{3}}{2x-4}$$

$$\frac{1}{x-1} - \frac{2}{x-2} = \frac{3}{2x-2} - \frac{7}{6x-12}$$

$$mcm=6(x-1)(x-2)$$

$$6(x-2) - 12(x-1) = 9(x-2) - 7(x-1)$$

$$6x - 12 - 12x + 12 = 9x - 18 - 7x + 7$$

$$-6x = 2x - 11$$

$$-8x = -11$$

$$x = \frac{-11}{-8} = 1\frac{3}{8}$$

$$25. \frac{1}{x+3} - \frac{2}{5x-20} = \frac{1\frac{1}{2}}{3x-12} - \frac{2}{x+3}$$

$$mcm=15(x-4)(x+3)$$

$$15(x-4) - 6(x+3) = \frac{15(x+3)}{2} - 30(x-4)$$

$$15x - 60 - 6x - 18 = \frac{15x+45}{2} - 30x - 120$$

$$2(9x - 78) = 15x + 45 - 2(30x - 120)$$

$$18x - 156 = 15x + 45 - 60x + 240$$

$$18x - 156 = -45x + 285$$

$$63x = 441$$

$$x = 7$$

$$26. \frac{1}{6-2x} - \frac{4}{5-5x} = \frac{10}{12-4x} - \frac{3}{10-10x}$$

$$mcm=20(1-x)(3-x)$$

$$10(1-x) - 16(3-x) = 50(1-x) - 6(3-x)$$

$$10 - 10x - 48 + 16x = 50 - 50x - 18 + 6x$$

$$6x - 38 = -44x + 32$$

$$50x = 70$$

$$x = \frac{7}{5}$$

$$x = 1\frac{2}{5}$$

$$27. \frac{2}{3} - \frac{6x^2}{9x^2-1} = \frac{2}{3x-1} \quad mcm=3(9x^2-1)$$

$$2(9x^2-1) - 18x^2 = 6(3x-1)$$

$$18x^2 - 2 - 18x^2 = 18x + 6$$

$$-2 = 18x + 6$$

$$-8 = 18x$$

$$-\frac{4}{9} = x$$

$$28. \frac{5x^2 - 27x}{5x + 3} - \frac{1}{x} = x - 6 \quad mcm = x(5x + 3)$$

$$x(5x^2 - 27x) - (5x + 3) = x(5x + 3)(x - 6)$$

$$5x^3 - 27x^2 - 5x - 3 = 5x^3 - 27x^2 - 18x$$

$$-5x - 3 = -18x$$

$$13x = 3$$

$$x = \frac{3}{13}$$

$$29. \frac{4x + 1}{4x - 1} - \frac{6}{16x^2 - 1} = \frac{4x - 1}{4x + 1} \quad mcm = 16x^2 - 1$$

$$(4x + 1)^2 - 6 = (4x - 1)^2$$

$$16x^2 + 8x + 1 - 6 = 16x^2 - 8x + 1$$

$$16x - 5 = 1$$

$$16x = 6$$

$$x = \frac{3}{8}$$

$$30. 3\left(\frac{x-1}{x+1}\right) + 2\left(\frac{x+1}{x-4}\right) = \frac{5x(x-1)}{x^2 - 3x - 4}$$

$$mcm = x^2 - 3x - 4$$

$$3(x-1)(x-4) + 2(x+1)^2 = 5x(x-1)$$

$$3x^2 - 15x + 12 + 2x^2 + 4x + 2 = 5x^2 - 5x$$

$$-11x + 14 = -5x$$

$$-6x = -14$$

$$x = \frac{-7}{-3}$$

$$x = 2\frac{1}{3}$$

$$31. 2\left(\frac{x+2}{x-2}\right) - 3\left(\frac{x-2}{2x+3}\right) = \frac{x^2 + 78}{2x^2 - x - 6}$$

$$mcm = (x-2)(2x+3)$$

$$2(x+2)(2x+3) - 3(x-2)^2 = x^2 + 78$$

$$4x^2 + 14x + 12 - 3x^2 + 12x - 12 = x^2 + 78$$

$$26x = 78$$

$$x = 3$$

$$32. \frac{1}{x^2 + 3x - 28} - \frac{1}{x^2 + 12x + 35} = \frac{3}{x^2 + x - 20}$$

$$\Rightarrow x^2 + 3x - 28 = (x+7)(x-4)$$

$$\Rightarrow x^2 + 12x + 35 = (x+7)(x+5)$$

$$\Rightarrow x^2 + x - 20 = (x+5)(x-4)$$

$$mcm = (x+7)(x+5)(x-4)$$

$$x+5 - (x-4) = 3(x+7)$$

$$x+5 - x+4 = 3x+21$$

$$9 = 3x+21$$

$$-12 = 3x$$

$$-4 = x$$

$$33. \frac{x-2}{x^2 + 8x + 7} = \frac{2x-5}{x^2 - 49} - \frac{x-2}{x^2 - 6x - 7}$$

$$\Rightarrow x^2 + 8x + 7 = (x+7)(x+1)$$

$$\Rightarrow x^2 - 49 = (x+7)(x-7)$$

$$\Rightarrow x^2 - 6x - 7 = (x-7)(x+1)$$

$$mcm = (x+7)(x-7)(x+1) = (x^2 - 49)(x+1)$$

$$(x-2)(x-7) = (2x-5)(x+1) - (x-2)(x+7)$$

$$x^2 - 9x + 14 = 2x^2 - 3x - 5 - x^2 - 5x + 14$$

$$-9x + 14 = -8x + 9$$

$$-x = -5$$

$$x = 5$$

$$34. \frac{4x+5}{15x^2 + 7x - 2} - \frac{2x+3}{12x^2 - 7x - 10} - \frac{2x-5}{20x^2 - 29x + 5} = 0$$

$$\Rightarrow 15x^2 + 7x - 2 = (3x+2)(5x-1)$$

$$\Rightarrow 12x^2 - 7x - 10 = (4x-5)(3x+2)$$

$$\Rightarrow 20x^2 - 29x + 5 = (4x-5)(5x-1)$$

$$mcm = (3x+2)(5x-1)(4x-5)$$

$$(4x+5)(4x-5) - (2x+3)(5x-1) - (2x-5)(3x+2) = 0$$

$$16x^2 - 25 - 10x^2 - 13x + 3 - 6x^2 + 11x + 10 = 0$$

$$-2x - 12 = 0$$

$$-2x = 12$$

$$x = -6$$

$$35. \frac{7}{2x+1} - \frac{3}{x+4} = \frac{2}{x+1} - \frac{3(x+1)}{2x^2 + 9x + 4}$$

$$mcm = (2x+1)(x+4)(x+1)$$

$$7(x+4)(x+1) - 3(2x+1)(x+1) = 2(2x+1)(x+4) - 3(x+1)^2$$

$$7x^2 + 35x + 28 - 6x^2 - 9x - 3 = 4x^2 + 18x + 8 - 3x^2 - 6x - 3$$

$$26x + 25 = 12x + 5$$

$$14x = -20$$

$$x = -\frac{10}{7}$$

$$x = -1\frac{3}{7}$$

$$36. \frac{(x+3)^2}{(x-3)^2} = \frac{x-1}{x+1} + \frac{2(7x+1)}{x^2 - 2x - 3}$$

$$mcm = (x-3)^2(x+1)$$

$$(x+3)^2(x+1) = (x-3)^2(x-1) + 2(7x+1)(x-3)$$

$$x^3 + 7x^2 + 15x + 9 = x^3 - 7x^2 + 15x - 9 + 14x^2 - 40x - 6$$

$$9 = -15 - 40x$$

$$24 = -40x$$

$$-\frac{3}{5} = x$$

$$37. \frac{x-4}{x+5} - \frac{x+1}{x-2} = -\frac{12(x+3)}{(x+5)^2} \quad mcm = (x+5)^2(x-2)$$

$$(x+5)(x-2)(x-4) - (x+5)^2(x+1) = -12(x+3)(x-2)$$

$$x^3 - x^2 - 22x + 40 - x^3 - 11x^2 - 35x - 25 = -12x^2 - 12x + 72$$

$$-57x + 15 = -12x + 72$$

$$-45x = 57$$

$$x = -\frac{57}{45}$$

$$x = -1\frac{4}{15}$$

$$38. \frac{x-3}{x-4} - \frac{x-2}{x-3} = \frac{x+2}{x+1} - \frac{x+3}{x+2} \quad mcm = (x-4)(x-3)(x+1)(x+2)$$

$$(x-3)^2(x+1)(x+2) - (x^2-4)(x-4)(x+1) = (x+2)^2(x-4)(x-3) - (x^2-9)(x-4)(x+1)$$

$$x^4 - 3x^3 - 7x^2 + 15x + 18 - x^4 + 3x^3 + 8x^2 - 12x - 16 = x^4 - 3x^3 - 12x^2 + 20x + 48 - x^4 + 3x^3 + 13x^2 - 27x - 36$$

$$3x + 2 = -7x + 12$$

$$10x = 10$$

$$x = 1$$

$$39. \frac{x+6}{x+2} - \frac{x+1}{x-3} = \frac{x-5}{x-1} - \frac{x}{x+4} \quad mcm = (x+2)(x-3)(x-1)(x+4)$$

$$(x+6)(x-3)(x-1)(x+4) - (x^2-1)(x+2)(x+4) = (x-5)(x+2)(x-3)(x+4) - x(x+2)(x-3)(x-1)$$

$$x^4 + 6x^3 - 13x^2 - 66x + 72 - x^4 - 6x^3 - 7x^2 + 6x + 8 = x^4 - 2x^3 - 25x^2 + 26x + 120 - x^4 + 2x^3 + 5x^2 - 6x$$

$$-60x + 80 = 20x + 120$$

$$-80x = 40$$

$$x = -\frac{1}{2}$$

### EJERCICIO 143

$$1. a(x+1) = 1$$

$$x+1 = \frac{1}{a}$$

$$-1 + x + 1 = \frac{1}{a} - 1$$

$$x = \frac{1-a}{a}$$

$$2. ax - 4 = bx - 2$$

$$ax - bx = 4 - 2$$

$$x(a-b) = 2$$

$$x = \frac{2}{a-b}$$

$$3. ax + b^2 = a^2 - bx$$

$$ax + bx = a^2 - b^2$$

$$x(a+b) = (a+b)(a-b)$$

$$x = a - b$$

$$4. 3(2a-x) + ax = a^2 + 9$$

$$6a - 3x + ax = a^2 + 9$$

$$x(a-3) = a^2 + 9 - 6a$$

$$x(a-3) = (a-3)^2$$

$$x = a - 3$$

$$5. a(x+b) + x(b-a) = 2b(2a-x)$$

$$ax + ba + xb - ax = 4ab - 2bx$$

$$xb + 2bx = 4ab - ab$$

$$3bx = 3ab$$

$$x = \frac{3ab}{3b}$$

$$x = a$$

$$6. (x-a)^2 - (x+a)^2 = a(a-7x)$$

$$x^2 - 2ax + a^2 - x^2 - 2ax - a^2 = a^2 - 7ax$$

$$-4ax + 7ax = a^2$$

$$3ax = a^2$$

$$x = \frac{a^2}{3a}$$

$$x = \frac{a}{3}$$

$$7. ax - a(a+b) = -x - (1+ab)$$

$$ax - a^2 - ab = -x - 1 - ab$$

$$ax + x = a^2 - 1$$

$$x(a+1) = (a+1)(a-1)$$

$$x = a - 1$$

$$8. a^2(a-x) - b^2(x-b) = b^2(x-b)$$

$$a^3 - a^2x - b^2x + b^3 = b^2x - b^3$$

$$-a^2x - 2b^2x = -a^3 - 2b^3$$

$$a^2x + 2b^2x = a^3 + 2b^3$$

$$x(a^2 + 2b^2) = a^3 + 2b^3$$

$$x = \frac{a^3 + 2b^3}{a^2 + 2b^2}$$

$$9.$$

$$(x+a)(x-b) - (x+b)(x-2a) = b(a-2) + 3a$$

$$x^2 - bx + ax - ab - x^2 + 2ax - bx + 2ab = ab - 2b + 3a$$

$$-2bx + 3ax + ab = ab - 2b + 3a$$

$$x(3a - 2b) = 3a - 2b$$

$$x = 1$$

$$\begin{aligned}
 10. \quad x^2 + a^2 &= (a+x)^2 - a(a-1) \\
 x^2 + a^2 &= a^2 + 2ax + x^2 - a^2 + a \\
 a^2 &= 2ax + a \\
 \frac{a(a-1)}{2a} &= x \\
 \frac{a-1}{2} &= x
 \end{aligned}$$

$$\begin{aligned}
 11. \quad m(n-x) - m(n-1) &= m(mx-a) \\
 mn - mx - mn + m &= m^2x - am \\
 -mx - m^2x &= -am - m \\
 -xm(1+m) &= -m(a+1) \\
 x &= \frac{a+1}{m+1}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad x - a + 2 &= 2ax - 3(a+x) - 2(a-5) \\
 x - a + 2 &= 2ax - 3a - 3x - 2a + 10 \\
 x - a &= 2ax - 5a - 3x + 8 \\
 x + 4a - 8 &= 2ax - 3x \\
 4(a-2) &= 2ax - 4x \\
 4(a-2) &= 2x(a-2) \\
 2 &= x
 \end{aligned}$$

$$\begin{aligned}
 13. \quad a(x-a) - 2bx &= b(b-2a-x) \\
 ax - a^2 - 2bx &= b^2 - 2ab - bx \\
 ax - bx &= b^2 - 2ab + a^2 \\
 x(a-b) &= (b-a)(b-a) \\
 x &= -\frac{(a-b)(b-a)}{a-b} \\
 x &= -(b-a) \\
 x &= a-b
 \end{aligned}$$

$$\begin{aligned}
 14. \quad ax + bx &= (x+a-b)^2 - (x-2b)(x+2a) \\
 x(a+b) &= x^2 + 2ax - 2bx + a^2 - 2ab + b^2 - x^2 - 2ax + 2bx + 4ab \\
 x(a+b) &= a^2 + 2ab + b^2 \\
 x(a+b) &= (a+b)^2 \\
 x &= a+b
 \end{aligned}$$

$$\begin{aligned}
 15. \quad x(a+b) - 3 - a(a-2) &= 2(x-1) - x(a-b) \\
 ax + bx - 3 - a^2 + 2a &= 2x - 2 - ax + bx \\
 2ax - 2x &= a^2 - 2a + 1 \\
 2x(a-1) &= (a-1)^2 \\
 x &= \frac{a-1}{2}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad (m+4x)(3m+x) &= (2x-m)^2 + m(15x-m) \\
 3m^2 + 13mx + 4x^2 &= 4x^2 - 4mx + m^2 + 15mx - m^2 \\
 2mx &= -3m^2 \\
 x &= -\frac{3m^2}{2m} \\
 x &= -\frac{3m}{2}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad a^2(a-x) - a^2(a+1) - b^2(b-x) - b(1-b^2) + a(1+a) &= 0 \\
 a^3 - a^2x - a^3 - a^2 - b^3 + b^2x - b + b^3 + a + a^2 &= 0 \\
 -a^2x + b^2x - b + a &= 0 \\
 x(b^2 - a^2) - (b-a) &= 0 \\
 x(b-a)(a+b) &= b-a \\
 x(a+b) &= 1 \\
 x &= \frac{1}{a+b}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad (ax-b)^2 &= (bx-a)(a-x) - x^2(b-a^2) + a^2 + b(1-2b) \\
 a^2x^2 - 2abx + b^2 &= abx + bx^2 - a^2 - ax - bx^2 + a^2x^2 + a^2 + b - 2b^2 \\
 ax(1-3b) &= b(1-3b) \\
 x &= \frac{b}{a}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad (x+b)^2 - (x-a)^2 - (a+b)^2 &= 0 \\
 x^2 + 2bx + b^2 - x^2 + 2ax - a^2 - a^2 - 2ab - b^2 &= 0 \\
 2bx + 2ax - 2a^2 - 2ab &= 0 \\
 2x(b+a) - 2a(a+b) &= 0 \\
 2(x-a)(a+b) &= 0 \\
 2x &= 2a \\
 x &= a
 \end{aligned}$$

$$\begin{aligned}
 20. \quad (x+m)^3 - 12m^3 &= -(x-m)^3 + 2x^3 \\
 x^3 + 3x^2m + 3xm^2 + m^3 - 12m^3 &= -x^3 + 3x^2m - 3xm^2 + m^3 + 2x^3 \\
 2x^3 + 6xm^2 - 2x^3 &= 12m^3 \\
 6xm^2 &= 12m^3 \\
 x &= \frac{12m^3}{6m^2} \\
 x &= 2m
 \end{aligned}$$

## EJERCICIO 144

$$1. \frac{m}{x} - \frac{1}{m} = \frac{2}{m} \quad mcm = mx$$

$$m^2 - x = 2x$$

$$m^2 = 3x$$

$$\frac{m^2}{3} = x$$

$$2. \frac{a}{x} + \frac{b}{2} = \frac{4a}{x} \quad mcm = 2x$$

$$2a + bx = 8a$$

$$bx = 6a$$

$$x = \frac{6a}{b}$$

$$3. \frac{x}{2a} - \frac{1-x}{a^2} = \frac{1}{2a} \quad mcm = 2a^2$$

$$ax - 2(1-x) = a$$

$$ax - 2 + 2x = a$$

$$x(a+2) = a+2$$

$$x = \frac{a+2}{a+2}$$

$$x = 1$$

$$4. \frac{m}{x} + \frac{n}{m} = \frac{n}{x} + 1 \quad mcm = mx$$

$$m^2 + nx = mn + mx$$

$$m^2 - mn = mx - nx$$

$$m(m-n) = x(m-n)$$

$$m = x$$

$$5. \frac{a-1}{a} + \frac{1}{2} = \frac{3a-2}{x}$$

$$mcm = 2ax$$

$$2x(a-1) + ax = 2a(3a-2)$$

$$2ax - 2x + ax = 6a^2 - 4a$$

$$3ax - 2x = 2a(3a-2)$$

$$x(3a-2) = 2a(3a-2)$$

$$x = 2a$$

$$6. \frac{a-x}{a} - \frac{b-x}{b} = \frac{2(a-b)}{ab}$$

$$mcm = ab$$

$$b(a-x) - a(b-x) = 2(a-b)$$

$$ab - bx - ab + ax = 2(a-b)$$

$$x(a-b) = 2(a-b)$$

$$x = 2$$

$$7. \frac{x-3a}{a^2} - \frac{2a-x}{ab} = -\frac{1}{a} \quad mcm = a^2b$$

$$b(x-3a) - a(2a-x) = -ab$$

$$bx - 3ab - 2a^2 + ax = -ab$$

$$bx + ax = 2ab + 2a^2$$

$$x(a+b) = 2a(a+b)$$

$$x = 2a$$

$$8. \frac{x+m}{m} - \frac{x+n}{n} = \frac{m^2+n^2}{mn} - 2 \quad mcm = mn$$

$$n(x+m) - m(x+n) = m^2 + n^2 - 2mn$$

$$xn + mn - mx - mn = m^2 - 2mn + n^2$$

$$x(n-m) = (m-n)^2$$

$$x(n-m) = -(n-m)(m-n)$$

$$x = -(m-n)$$

$$x = n-m$$

$$9. \frac{x-b}{a} = 2 - \frac{x-a}{b} \quad mcm = ab$$

$$b(x-b) = 2ab - a(x-a)$$

$$bx - b^2 = 2ab - ax + a^2$$

$$bx + ax = a^2 + 2ab + b^2$$

$$x(a+b) = (a+b)^2$$

$$x = a+b$$

$$10. \frac{4x}{2a+b} - 3 = -\frac{3}{2} \quad mcm = 2(2a+b)$$

$$8x - 6(2a+b) = -3(2a+b)$$

$$8x - 12a - 6b = -6a - 3b$$

$$8x = 6a + 3b$$

$$x = \frac{3(2a+b)}{8}$$

$$11. \frac{2a+3x}{x+a} = \frac{2(6x-a)}{4x+a} \quad mcm = (x+a)(4x+a)$$

$$(2a+3x)(a+4x) = (2x+2a)(6x-a)$$

$$2a^2 + 11ax + 12x^2 = 12x^2 + 10ax - 2a^2$$

$$ax = -4a^2$$

$$x = -4a$$

$$12. \frac{2(x-c)}{4x-b} = \frac{2x+c}{4(x-b)} \quad mcm = 4(4x-b)(x-b)$$

$$8(x-c)(x-b) = (2x+c)(4x-b)$$

$$8x^2 - 8xb - 8xc + 8bc = 8x^2 - 2xb + 4xc - bc$$

$$-6xb - 12xc = -9bc$$

$$-6x(b+2c) = -9bc$$

$$x = \frac{3bc}{2(b+2c)}$$



$$13. \frac{1}{n} - \frac{m}{x} = \frac{1}{mn} - \frac{1}{x} \quad mcm = xmn$$

$$xm - m^2n = x - mn$$

$$xm - x = m^2n - mn$$

$$x(m-1) = mn(m-1)$$

$$x = mn$$

$$14. \frac{(x-2b)(2x+a)}{(x-a)(a-2b+x)} = 2 \quad mcm = (x-a)(a-2b+x)$$

$$(x-2b)(2x+a) = 2(x-a)(a-2b+x)$$

$$2x^2 + ax - 4bx - 2ab = -4bx + 2x^2 - 2a^2 + 4ab$$

$$ax = 6ab - 2a^2$$

$$ax = 2a(3b-a)$$

$$x = 2(3b-a)$$

$$15. \frac{x+m}{x-n} = \frac{n+x}{m+x} \quad mcm = (m+x)(x-n)$$

$$(x+m)^2 = (x+n)(x-n)$$

$$x^2 + 2mx + m^2 = x^2 - n^2$$

$$2mx = -m^2 - n^2$$

$$x = -\frac{m^2 + n^2}{2m}$$

$$16. \frac{x(2x+3b)(x+b)}{x+3b} = 2x^2 - bx + b^2 \quad mcm = x+3b$$

$$x(2x+3b)(x+b) = (x+3b)(2x^2 - bx + b^2)$$

$$2x^3 + 5x^2b + 3b^2x = 2x^3 + 5bx^2 - 2b^2x + 3b^3$$

$$3b^2x + 2b^2x = 3b^3$$

$$x = \frac{3b}{5}$$

$$17. \frac{3}{4} \left( \frac{x}{b} + \frac{x}{a} \right) = \frac{1}{3} \left( \frac{x}{b} - \frac{x}{a} \right) + \frac{5a+13b}{12a}$$

$$\Rightarrow \frac{3}{4} \left( \frac{ax+bx}{ab} \right) = \frac{1}{3} \left( \frac{ax-bx}{ab} \right) + \frac{5a+13b}{12a}$$

$$\Rightarrow \frac{3ax+3bx}{4ab} = \frac{ax-bx}{3ab} + \frac{5a+13b}{12a} \quad mcm = 12ab$$

$$3(3ax+3bx) = 4(ax-bx) + b(5a+13b)$$

$$9ax+9bx = 4ax-4bx+5ab+13b^2$$

$$5ax+13bx = 5ab+13b^2$$

$$x(5a+13b) = b(5a+13b)$$

$$x = b$$

$$18. \frac{x+a}{3} = \frac{(x-b)^2}{3x-a} + \frac{3ab-3b^2}{9x-3a} \quad mcm = 3(3x-a)$$

$$(x+a)(3x-a) = 3(x-b)^2 + 3ab - 3b^2$$

$$3x^2 + 2ax - a^2 = 3x^2 - 6bx + 3b^2 + 3ab - 3b^2$$

$$2ax + 6bx = a^2 + 3ab$$

$$2x(a+3b) = a(a+3b)$$

$$x = \frac{a}{2}$$

$$19. \frac{5x+a}{3x+b} = \frac{5x-b}{3x-a} \quad mcm = (3x+b)(3x-a)$$

$$(3x-a)(5x+a) = (5x-b)(3x+b)$$

$$15x^2 - 2ax - a^2 = 15x^2 + 2bx - b^2$$

$$-2ax - 2bx = a^2 - b^2$$

$$-2x(a+b) = (a+b)(a-b)$$

$$x = \frac{b-a}{2}$$

$$20. \frac{x+a}{x-a} - \frac{x-a}{x+a} = \frac{a(2x+ab)}{x^2-a^2} \quad mcm = (x-a)(x+a)$$

$$(x+a)^2 - (x-a)^2 = a(2x+ab)$$

$$x^2 + 2ax + a^2 - x^2 + 2ax - a^2 = 2ax + a^2b$$

$$4ax = 2ax + a^2b$$

$$2ax = a^2b$$

$$x = \frac{ab}{2}$$

$$21. \frac{2x-3a}{x+4a} - 2 = \frac{11a}{x^2-16a^2} \quad mcm = x^2 - 16a^2$$

$$(2x-3a)(x-4a) - 2(x^2-16a^2) = 11a$$

$$2x^2 - 11ax + 12a^2 - 2x^2 + 32a^2 = 11a$$

$$-11ax + 44a^2 = 11a$$

$$-11ax = 11a - 44a^2$$

$$-11ax = 11a(1-4a)$$

$$x = -(1-4a)$$

$$x = 4a-1$$

$$22. \frac{1}{x+a} + \frac{x^2}{a^2+ax} = \frac{x+a}{a} \quad mcm = a(x+a)$$

$$a+x^2 = (x+a)^2$$

$$a+x^2 = x^2 + 2ax + a^2$$

$$a-a^2 = 2ax$$

$$\frac{a(1-a)}{2a} = x$$

$$\frac{1-a}{2} = x$$

$$23. \frac{2(a+x)}{b} - \frac{3(b+x)}{a} = \frac{6(a^2-2b^2)}{ab} \quad mcm = ab$$

$$2a(a+x) - 3b(b+x) = 6(a^2-2b^2)$$

$$2a^2 + 2ax - 3b^2 - 3bx = 6a^2 - 12b^2$$

$$2ax - 3bx = 4a^2 - 9b^2$$

$$x(2a-3b) = (2a-3b)(2a+3b)$$

$$x = 2a+3b$$

$$24. m(n-x) - (m-n)(m+x) = n^2 - \frac{1}{n}(2mn^2 - 3m^2n) \quad mcm = n$$

$$\begin{aligned} nm(n-x) - n(m-n)(m+x) &= n^3 - (2mn^2 - 3m^2n) \\ mn^2 - mnx - m^2n + mn^2 - mnx + n^2x &= n^3 - 2mn^2 + 3m^2n \\ -2mnx + n^2x &= -4mn^2 + 4m^2n + n^3 \\ nx(n-2m) &= n(n^2 - 4mn + 4m^2) \\ x(n-2m) &= (n-2m)^2 \\ x &= n-2m \end{aligned}$$

## EJERCICIO 145

1.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} x - \frac{3x}{8} &= 2x - 11 \\ 8x - 3x &= 8(2x - 11) \\ 5x &= 16x - 88 \\ -11x &= -88 \\ x &= \frac{-88}{-11} \\ x &= 8 \end{aligned}$$

2.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} x + \frac{5x}{6} &= 3x - 14 \\ 6x + 5x &= 6(3x - 14) \\ 11x &= 18x - 84 \\ -7x &= -84 \\ x &= \frac{-84}{-7} \\ x &= 12 \end{aligned}$$

3.  $x \rightarrow N^\circ$  que se resta

$$\begin{aligned} 22 - x &= 11 + \frac{6x}{5} \\ 5(22 - x) &= 55 + 6x \\ 110 - 5x &= 55 + 6x \\ -11x &= -55 \\ x &= 5 \end{aligned}$$

4.  $x \rightarrow N^\circ$  que tiene diferencia

$$\begin{aligned} \frac{5}{4}x - \frac{7}{8}x &= 30 \quad mcm=8 \\ 10x - 7x &= 240 \\ 3x &= 240 \\ x &= 80 \end{aligned}$$

5.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} x - 17 &= \frac{3}{5}x - \frac{1}{6}x \quad mcm=30 \\ 30x - 510 &= 18x - 5x \\ -510 &= -17x \\ 30 &= x \end{aligned}$$

6.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} \frac{x}{5} + \frac{3}{8}x - 49 &= 2\left(\frac{1}{6}x - \frac{1}{12}x\right) \\ \Rightarrow \frac{x}{5} + \frac{3}{8}x - 49 &= \frac{x}{6} \quad mcm=120 \\ 24x + 45x - 5.880 &= 20x \\ 49x &= 5.880 \\ x &= 120 \end{aligned}$$

7.  $x \rightarrow$  Edad de A

$$\begin{aligned} \frac{3x}{5} &\rightarrow \text{Edad de B} \\ x + \frac{3x}{5} - 4 &= 2\left(\frac{3x}{5}\right) \quad mcm=5 \\ 5x + 3x - 20 &= 6x \\ 2x &= 20 \\ x &= 10 \text{ años} \rightarrow \text{Edad de A} \end{aligned}$$

$$\Rightarrow \frac{3 \cdot 10}{5} = \frac{30}{5} = 6 \text{ años} \rightarrow \text{Edad de B}$$

8.  $x \rightarrow$  Lo que tiene A

$$\begin{aligned} \frac{7x}{8} &\rightarrow \text{Lo que tiene B} \\ x + 90 &= 2\left(\frac{7x}{8}\right) \quad mcm=8 \end{aligned}$$

$$\begin{aligned} 8x + 720 &= 14x \\ -6x &= -720 \\ x &= \$120 \rightarrow \text{Tiene A} \\ \Rightarrow \frac{7 \cdot 120}{8} &= \$105 \rightarrow \text{Tiene B} \end{aligned}$$

9.  $x \rightarrow$  Long. pieza

$$\begin{aligned} x - \frac{3x}{5} &= 40 \quad mcm=5 \\ 5x - 3x &= 200 \\ 2x &= 200 \\ x &= 100m \end{aligned}$$

10.  $x \rightarrow$  Lo que tenía

$$\begin{aligned} x - \left(\frac{1}{3}x + \frac{1}{8}x\right) &= 39 \quad mcm=24 \\ 24x - 8x - 3x &= 936 \\ 13x &= 936 \\ x &= 72 \text{ bs.} \end{aligned}$$

11.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} 3x - 48 &= \frac{x}{3} \quad mcm=3 \\ 9x - 144 &= x \end{aligned}$$

$$\begin{aligned} 8x &= 144 \\ x &= 18 \end{aligned}$$

12.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} 4x - 19 &= \frac{x}{2} + 30 \quad mcm=2 \\ 8x - 38 &= x + 60 \\ 7x &= 98 \\ x &= 14 \end{aligned}$$

13.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} 80 - \frac{x}{2} &= x - 10 \quad mcm=2 \\ 160 - x &= 2x - 20 \\ -3x &= -180 \\ x &= 60 \end{aligned}$$

14.  $x \rightarrow N^\circ$  buscado

$$\begin{aligned} \frac{7x}{8} - 2 &= \frac{4x}{5} \quad mcm=40 \\ 35x - 80 &= 32x \\ 3x &= 80 \\ x &= \frac{80}{3} \\ x &= 26\frac{2}{3} \end{aligned}$$

15.  $x \rightarrow$  Ancho del buque

$$\begin{aligned} 800 - 744 &= \frac{8x}{9} \\ 56 &= \frac{8x}{9} \\ 504 &= 8x \\ \frac{504}{8} &= x \\ 63 \text{ Pies} &= x \end{aligned}$$

## EJERCICIO 146

- 1.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ mayor}$   
 $\frac{4(x+1)}{5} = x-4$   
 $\frac{4x+4}{5} = x-4$   
 $4x+4 = 5(x-4)$   
 $4x+4 = 5x-20$   
 $-x = -24$   
 $x = 24 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1$   
 $= 24+1 = 25 \rightarrow N^\circ \text{ mayor}$
- 2.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ mayor}$   
 $\frac{7x}{8} - 17 = \frac{3(x+1)}{5} \quad \text{mcm} = 40$   
 $35x - 680 = 24(x+1)$   
 $35x - 680 = 24x + 24$   
 $11x = 704$   
 $x = 64 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1$   
 $= 64+1 = 65 \rightarrow N^\circ \text{ mayor}$
- 3.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ mayor}$   
 $x-81 = \frac{3x}{4} - \frac{2(x+1)}{5} \quad \text{mcm} = 20$   
 $20x - 1.620 = 15x - 8(x+1)$   
 $20x - 1.620 = 15x - 8x - 8$   
 $13x = 1.612$   
 $x = 124 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1$   
 $= 124+1 = 125 \quad x \rightarrow N^\circ \text{ mayor}$
- 4.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ mayor}$   
 $\frac{1}{5}(x+1) + \frac{1}{33}x - 8 = \frac{3(x+1)}{20} \quad \text{mcm} = 660$   
 $132(x+1) + 20x - 5.280 = 99(x+1)$   
 $132x + 132 + 20x - 5.280 = 99x + 99$   
 $152x - 99x = 5.148 + 99$   
 $53x = 5.247$   
 $x = 99 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1 = 99+1 = 100 \rightarrow N^\circ \text{ mayor}$
- 5.**  $2x \rightarrow N^\circ \text{ menor}$   
 $2x+2 \rightarrow N^\circ \text{ mayor}$   
 $(2x+2)^2 - (2x)^2 = 324$   
 $4x^2 + 8x + 4 - 4x^2 = 324$   
 $8x = 320$   
 $x = 40$   
 $\Rightarrow 2x = 2 \cdot 40 = 80 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow 2x+2 = 80+2 = 82 \rightarrow N^\circ \text{ mayor}$
- 6.**  $x \rightarrow \text{Tiene B}$   
 $x+1 \rightarrow \text{Tiene A}$   
 $x-8 = \frac{4(x+1)}{5} - 4 \quad \text{mcm} = 5$   
 $5x - 40 = 4x + 4 - 20$   
 $5x - 4x = 40 - 16$   
 $x = \$24 \rightarrow \text{Tiene B}$   
 $\Rightarrow x+1 = 24+1 = \$25 \rightarrow \text{Tiene A}$
- 7.**  $x \rightarrow \text{Gane ayer}$   
 $x+1 \rightarrow \text{Gane hoy}$   
 $x + x + 1 - 25 = \frac{2x}{5}$   
 $5(2x - 24) = 2x$   
 $10x - 120 = 2x$   
 $8x = 120$   
 $x = \$15 \rightarrow \text{Gane ayer}$   
 $\Rightarrow x+1 = 15+1 = \$16 \rightarrow \text{Gane hoy}$
- 8.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ medio}$   
 $x+2 \rightarrow N^\circ \text{ mayor}$   
 $\frac{x}{20} + \frac{x+1}{27} + \frac{x+2}{41} = 9 \quad \text{mcm} = 22.140$   
 $1.107x + 820(x+1) + 540(x+2) = 199.260$   
 $1.107x + 820x + 820 + 540x + 1.080 = 199.260$   
 $2.467x = 197.360$   
 $x = 80 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1 = 80+1 = 81 \rightarrow N^\circ \text{ medio}$   
 $\Rightarrow x+2 = 80+2 = 82 \rightarrow N^\circ \text{ mayor}$
- 9.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ medio}$   
 $x+2 \rightarrow N^\circ \text{ mayor}$   
 $\frac{3x}{5} + \frac{5(x+2)}{6} - 31 = x+1 \quad \text{mcm} = 30$   
 $18x + 25(x+2) - 930 = 30x + 30$   
 $18x + 25x + 50 - 930 = 30x + 30$   
 $43x - 30x = 880 + 30$   
 $13x = 910$   
 $x = 70 \quad x \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1 = 70+1 = 71 \rightarrow N^\circ \text{ medio}$   
 $\Rightarrow x+2 = 70+2 = 72 \rightarrow N^\circ \text{ mayor}$
- 10.**  $x \rightarrow N^\circ \text{ menor}$   
 $x+1 \rightarrow N^\circ \text{ medio}$   
 $x+2 \rightarrow N^\circ \text{ mayor}$   
 $\frac{3(x+1)}{7} - \frac{3x}{10} - 1 = \frac{1}{11}(x+2) \quad \text{mcm} = 770$   
 $330(x+1) - 231x - 770 = 70(x+2)$   
 $330x + 330 - 231x - 770 = 70x + 140$   
 $29x = 580$   
 $x = 20 \rightarrow N^\circ \text{ menor}$   
 $\Rightarrow x+1 = 20+1 = 21 \rightarrow N^\circ \text{ medio}$   
 $\Rightarrow x+2 = 20+2 = 22 \rightarrow N^\circ \text{ mayor}$

11.  $x \rightarrow$  Edad B  
 $x+2 \rightarrow$  Edad A  
 $x-2 \rightarrow$  Edad C

$$x+x-2-12 = \frac{7(x+2)}{8}$$

$$8(2x-14) = 7(x+2)$$

$$16x-112 = 7x+14$$

$$9x = 126$$

$$x = 14 \rightarrow$$
 Edad B  
 $\Rightarrow x+2 = 14+2 = 16 \rightarrow$  Edad A  
 $\Rightarrow x-2 = 14-2 = 12 \rightarrow$  Edad C

12.  $x \rightarrow$  Edad B  
 $x-1 \rightarrow$  Edad A  
 $x+1 \rightarrow$  Edad C

$$(x+1)^2 - x^2 = \frac{17(x-1)}{5} - 4 \quad \text{mcm} = 5$$

$$5(x^2+2x+1) - 5x^2 = 17(x-1) - 20$$

$$5x^2+10x+5-5x^2 = 17x-17-20$$

$$-7x = -42$$

$$x = 6 \rightarrow$$
 Edad B  
 $\Rightarrow x-1 = 6-1 = 5 \rightarrow$  Edad A  
 $\Rightarrow x+1 = 6+1 = 7 \rightarrow$  Edad C

### EJERCICIO 147

1.  $x \rightarrow$  N° mayor  
 $59-x \rightarrow$  N° menor

$$\frac{x-5}{59-x} = 2$$

$$x-5 = 2(59-x)$$

$$x-5 = 118-2x$$

$$3x = 123$$

$$x = 41 \rightarrow$$
 N° mayor  
 $\Rightarrow 59-x = 59-41 = 18 \rightarrow$  N° menor

3.  $x \rightarrow$  N° mayor  
 $x-44 \rightarrow$  N° menor

$$\frac{x-2}{x-44} = 3$$

$$x-2 = 3(x-44)$$

$$x-2 = 3x-132$$

$$-2x = -130$$

$$x = 65 \rightarrow$$
 N° mayor  
 $\Rightarrow x-44 = 65-44 = 21 \rightarrow$  N° menor

5.  $x \rightarrow$  Parte mayor  
 $260-x \rightarrow$  Parte menor

$$\frac{2x-40}{3(260-x)} = 2$$

$$2x-40 = 6(260-x)$$

$$2x-40 = 1.560-6x$$

$$8x = 1.600$$

$$x = 200 \rightarrow$$
 Parte mayor  
 $\Rightarrow 260-x$   
 $= 260-200 = 60 \rightarrow$  Parte menor

2.  $x \rightarrow$  N° mayor  
 $436-x \rightarrow$  N° menor

$$\frac{x-73}{436-x} = 2$$

$$x-73 = 2(436-x)$$

$$x-73 = 872-2x$$

$$3x = 945$$

$$x = 315 \rightarrow$$
 N° mayor  
 $\Rightarrow 436-x = 436-315 = 121 \rightarrow$  N° menor

4.  $x \rightarrow$  N° mayor  
 $x-56 \rightarrow$  N° menor

$$\frac{x-8}{x-56} = 3$$

$$x-8 = 3(x-56)$$

$$x-8 = 3x-168$$

$$-2x = -160$$

$$x = 80 \rightarrow$$
 N° mayor  
 $\Rightarrow x-56 = 80-56 = 24 \rightarrow$  N° menor

6.  $x \rightarrow$  Parte de A  
 $196-x \rightarrow$  Parte de B

$$\frac{\frac{3x}{8}-16}{196-x} = 1$$

$$\frac{3x-128}{8} \cdot \frac{5}{196-x} = 1$$

$$5(3x-128) = 8(196-x)$$

$$15x-640 = 1.568-8x$$

$$23x = 2.208$$

$$x = 96 \text{ soles} \rightarrow$$
 Parte de A  
 $\Rightarrow 196-x$   
 $= 196-96 = 100 \text{ soles} \rightarrow$  Parte de B

### EJERCICIO 148

1.  $x \rightarrow$  Ganó el 1° día  
 $\frac{x}{2} \rightarrow$  Ganó el 2° día  
 $\frac{x}{4} \rightarrow$  Ganó el 3° día

$$x + \frac{x}{2} + \frac{x}{4} = 175 \quad \text{mcm} = 4$$

$$4x + 2x + x = 700$$

$$7x = 700$$

$$x = \$100 \rightarrow$$
 Ganó el 1° día  
 $\Rightarrow \frac{x}{2} = \frac{100}{2} = \$50 \rightarrow$  Ganó el 2° día  
 $\Rightarrow \frac{x}{4} = \frac{100}{4} = \$25 \rightarrow$  Ganó el 3° día

2.  $x \rightarrow$  Perdió miercoles  
 $\frac{3}{5}x \rightarrow$  Perdió jueves  
 $\frac{1}{2}x \rightarrow$  Perdió viernes

$$x + \frac{3}{5}x + \frac{1}{2}x = 252 \quad \text{mcm} = 10$$

$$10x + 6x + 5x = 2.520$$

$$21x = 2.520$$

$$x = \$120 \rightarrow$$
 Perdió miercoles  
 $\Rightarrow \frac{3}{5} \cdot 120 = \$72 \rightarrow$  Perdió jueves  
 $\Rightarrow \frac{1}{2} \cdot 120 = \$60 \rightarrow$  Perdió viernes

3.  $x \rightarrow$  Tiene A  
 $\frac{2}{3}x \rightarrow$  Tiene B  
 $\frac{2}{5}x \rightarrow$  Tiene C

$$x + \frac{2x}{3} + \frac{2x}{5} = 248 \quad \text{mcm} = 15$$

$$15x + 10x + 6x = 3.720$$

$$31x = 3.720$$

$$x = 120 \text{ suc.} \rightarrow$$
 Tiene A  
 $\Rightarrow \frac{2}{3} \cdot 120 = 80 \text{ sucres} \rightarrow$  Tiene B  
 $\Rightarrow \frac{2}{5} \cdot 120 = 48 \text{ sucres} \rightarrow$  Tiene C

4.  $x \rightarrow$  Edad A

$$\frac{3}{5}x \rightarrow \text{Edad B}$$

$$\frac{9}{40}x \rightarrow \text{Edad C}$$

$$x + \frac{3x}{5} + \frac{9x}{40} = 73 \quad \text{mcm}=40$$

$$40x + 24x + 9x = 2.920$$

$$73x = 2.920$$

$$x = 40$$

40 años  $\rightarrow$  edad de A

$$\Rightarrow \frac{3}{5} \cdot 40 = 24 \text{ años} \rightarrow \text{edad de B}$$

$$\Rightarrow \frac{9}{40} \cdot 40 = 9 \text{ años} \rightarrow \text{edad de C}$$

5.  $x \rightarrow$  1<sup>er</sup> día

$$\frac{1}{3}x \rightarrow 2^{\circ} \text{ día}$$

$$\frac{1}{9}x \rightarrow 3^{\circ} \text{ día}$$

$$\frac{1}{27}x \rightarrow 4^{\circ} \text{ día}$$

$$x + \frac{1}{3}x + \frac{1}{9}x + \frac{1}{27}x = 120 \quad \text{mcm}=27$$

$$27x + 9x + 3x + x = 3.240$$

$$40x = 3.240$$

$$x = 81 \text{ Km.}$$

81 Km.  $\rightarrow$  1<sup>er</sup> día

$$\Rightarrow \frac{1}{3} \cdot 81 = 27 \text{ Km.} \rightarrow 2^{\circ} \text{ día}$$

$$\Rightarrow \frac{1}{9} \cdot 81 = 9 \text{ Km.} \rightarrow 3^{\circ} \text{ día}$$

$$\Rightarrow \frac{1}{27} \cdot 81 = 3 \text{ Km.} \rightarrow 4^{\circ} \text{ día}$$

6.  $x \rightarrow$  1<sup>a</sup> semana

$$\frac{11}{10}x \rightarrow 2^{\text{a}} \text{ semana}$$

$$\frac{121}{100}x \rightarrow 3^{\text{a}} \text{ semana}$$

$$\frac{1.331}{1.000}x \rightarrow 4^{\text{a}} \text{ semana}$$

$$x + \frac{11}{10}x + \frac{121}{100}x + \frac{1.331}{1.000}x = 4.641 \quad \text{mcm}=1.000$$

$$1.000x + 1.100x + 1.210x + 1.331x = 4'641.000$$

$$4.641x = 4'641.000$$

$$x = 1.000 \text{ Km.}$$

## Continuación

6. 1.000 Km.  $\rightarrow$  1<sup>a</sup> semana

$$\Rightarrow \frac{11}{10} \cdot 1.000 = 1.100 \text{ Km.} \rightarrow 2^{\text{a}} \text{ semana}$$

$$\Rightarrow \frac{121}{100} \cdot 1.000 = 1.210 \text{ Km.} \rightarrow 3^{\text{a}} \text{ semana}$$

$$\Rightarrow \frac{1.331}{1.000} \cdot 1.000 = 1.331 \text{ Km.} \rightarrow 4^{\text{a}} \text{ semana}$$

7.  $x \rightarrow$  1<sup>a</sup> Persona ;  $\frac{x}{2} \rightarrow$  2<sup>a</sup> Persona

$$\frac{x}{8} \rightarrow 3^{\text{a}} \text{ Persona} ; \frac{x}{40} \rightarrow 4^{\text{a}} \text{ Persona}$$

$$\frac{x}{400} \rightarrow 5^{\text{a}} \text{ Persona}$$

$$x + \frac{x}{2} + \frac{x}{8} + \frac{x}{40} + \frac{x}{400} = 330.500 \quad \text{mcm}=400$$

$$400x + 200x + 50x + 10x + x = 132'200.000$$

$$661x = 132'200.000$$

$$x = 200.000 \text{ colones}$$

200.000 colones  $\rightarrow$  1<sup>a</sup> Persona

$$\Rightarrow \frac{x}{2} = \frac{200.000}{2} = 100.000 \text{ colones} \rightarrow 2^{\text{a}} \text{ Persona}$$

$$\Rightarrow \frac{x}{8} = \frac{200.000}{8} = 25.000 \text{ colones} \rightarrow 3^{\text{a}} \text{ Persona}$$

$$\Rightarrow \frac{x}{40} = \frac{200.000}{40} = 5.000 \text{ colones} \rightarrow 4^{\text{a}} \text{ Persona}$$

$$\Rightarrow \frac{x}{400} = \frac{200.000}{400} = 500 \text{ colones} \rightarrow 5^{\text{a}} \text{ Persona}$$

8.  $x \rightarrow$  Rec. en barco

$$\frac{4}{9}x \rightarrow \text{Rec. en tren}$$

$$\frac{5}{18}x \rightarrow \text{Rec. en avión}$$

$$x + \frac{4x}{9} + \frac{5x}{18} = 9.362 \quad \text{mcm}=18$$

$$18x + 8x + 5x = 168.516$$

$$31x = 168.516$$

$$x = 5.436 \text{ Km.}$$

5.436 Km.  $\rightarrow$  Rec. en barco

$$\Rightarrow \frac{4}{9}x = \frac{4}{9} \cdot 5.436 = 2.416 \text{ Km.} \rightarrow \text{Rec. en tren}$$

$$\Rightarrow \frac{5}{18}x = \frac{5}{18} \cdot 5.436 = 1.510 \text{ Km.} \rightarrow \text{Rec. en avión}$$

Continúa

## EJERCICIO 149

1.  $x \rightarrow$  Tenía al principio

$$x - 20 - \frac{2(x-20)}{3} = 10 \quad mcm=3$$

$$3x - 60 - 2(x-20) = 30$$

$$3x - 60 - 2x + 40 = 30$$

$$x - 20 = 30$$

$$x = 50$$

\$50  $\rightarrow$  Tenía al principio

2.  $x \rightarrow$  Tenía al principio

$$\frac{x}{2} - \frac{x}{4} = 21 \quad mcm=4$$

$$2x - x = 84$$

$$x = 84$$

84 Q.  $\rightarrow$  Tenía al principio

3.  $x \rightarrow$  Tengo ahora

$$x + 7 - \frac{4(x+7)}{5} = 20 \quad mcm=5$$

$$5x + 35 - 4(x+7) = 100$$

$$5x + 35 - 4x - 28 = 100$$

$$x + 7 = 100$$

$$x = 93$$

\$93  $\rightarrow$  Tengo ahora

4.  $x \rightarrow$  Tenía al principio

$$x - \frac{2x}{5} = \frac{3}{5}x \rightarrow \text{quedó}$$

$$\frac{5}{6} - \frac{3}{5}x = \frac{1}{2}x \rightarrow \text{prestó}$$

Luego

$$x - \frac{2}{5}x - \frac{1}{2}x = 500 \quad mcm=10$$

$$10x - 4x - 5x = 5.000$$

$$x = 5.000$$

5.000 bs.  $\rightarrow$  Tenía al principio

5.  $x \rightarrow$  Aves en la granja

$$\frac{4}{5}x \rightarrow \text{Palomas}$$

$$x - \frac{4}{5}x = \frac{x}{5} \quad \text{Re sto}$$

$$\frac{x}{5} \cdot \frac{3}{4} = \frac{3}{20}x \rightarrow \text{Gallinas}$$

$$x - \frac{4x}{5} - \frac{3x}{20} = 4 \quad mcm=20$$

$$20x - 16x - 3x = 80$$

$$x = 80$$

80  $\rightarrow$  Aves en la granja

$$\Rightarrow \frac{4}{5}x = \frac{4}{5} \cdot 80 = 64 \rightarrow \text{Palomas}$$

$$\Rightarrow \frac{3}{20}x = \frac{3}{20} \cdot 80 = 12 \rightarrow \text{Gallinas}$$

4  $\rightarrow$  Gallos

6.  $x \rightarrow$  Tenía al principio

$$x - \frac{4}{5}x = \frac{x}{5} \rightarrow \text{quedó}$$

$$\frac{2}{3} \cdot \frac{x}{5} = \frac{2}{15}x \rightarrow \text{Perdí}$$

$$x - \frac{4}{5}x - \frac{2}{15}x - 8 = 0 \quad mcm=15$$

$$15x - 12x - 2x - 120 = 0$$

$$x = 120$$

120 soles  $\rightarrow$  Tenía al principio

7.  $x \rightarrow$  Tenía al principio

$$x - \frac{5}{12}x + 42 = x + 2 \quad mcm=12$$

$$12x - 5x + 504 = 12x + 24$$

$$-5x = -480$$

$$x = 96$$

\$96  $\rightarrow$  Tenía al principio

8.  $x \rightarrow$  Tenía al principio

$$x - \frac{x}{2} - 15 = 30 \quad mcm=2$$

$$2x - x - 30 = 60$$

$$x = 90$$

\$90  $\rightarrow$  Tenía al principio

9.  $x \rightarrow$  Tenía al principio

$$x - \frac{3}{4}x + 1.300 = x + 100$$

$$mcm=4$$

$$4x - 3x + 5.200 = 4x + 400$$

$$-3x = -4.800$$

$$x = 1.600$$

1.600 suc.  $\rightarrow$  Tenía al principio

10.  $x \rightarrow$  Tenía al principio

$$x - \frac{3}{4}x = \frac{x}{4} \rightarrow \text{quedó}$$

$$\frac{2}{3} \cdot \frac{x}{4} = \frac{x}{6} \rightarrow \text{Libros}$$

$$x - \frac{3}{4}x - \frac{x}{6} = \frac{2}{5}x - 38$$

$$mcm=60$$

$$60x - 45x - 10x = 24x - 2.280$$

$$-19x = -2.280$$

$$x = 120$$

\$120  $\rightarrow$  Tenía al principio

## EJERCICIO 150

1.  $x \rightarrow$  Edad actual A

$3x \rightarrow$  Edad actual B

$$x - 15 = \frac{1}{6}(3x - 15) \quad mcm=6$$

$$6x - 90 = 3x - 15$$

$$3x = 75$$

$x = 25$  años  $\rightarrow$  Edad actual A

$\Rightarrow 3x = 25 \cdot 3 = 75$  años  $\rightarrow$  Edad actual B

2.  $x \rightarrow$  Edad actual B

$3x \rightarrow$  Edad actual A

$$3x + 20 = 2(x + 20)$$

$$3x + 20 = 2x + 40$$

$x = 20$  años  $\rightarrow$  Edad actual B

$\Rightarrow 3x = 3 \cdot 20 = 60$  años  $\rightarrow$  Edad actual A

3.  $x \rightarrow$  Edad actual A

$$x-5 = \frac{9}{11}(x+5) \quad \text{mcm}=11$$

$$11x-55=9x+45$$

$$2x=100$$

$$x=50$$

50 años  $\rightarrow$  Edad actual A

4.  $x \rightarrow$  Edad actual A

$$2(x-6)=x+24$$

$$2x-12=x+24$$

$$x=36$$

36 años  $\rightarrow$  Edad actual A

5.  $x \rightarrow$  Edad hijo

$$3x \rightarrow$$
 Edad padre

$$2(x+16)=3x+16$$

$$2x+32=3x+16$$

$$16=x$$

16 años  $\rightarrow$  Edad hijo

$\Rightarrow 3x=3 \cdot 16=48$  años  $\rightarrow$  Edad padre

6.  $x \rightarrow$  Edad padre

$$\frac{2}{5}x \rightarrow$$
 Edad hijo

$$\frac{2(x-8)}{7} = \frac{2x}{5} - 8 \quad \text{mcm}=35$$

$$10x-80=14x-280$$

$$200=4x$$

$$50=x$$

50 años  $\rightarrow$  Edad padre

$\Rightarrow \frac{2}{5}x = \frac{2}{5} \cdot 50 = 20$  años  $\rightarrow$  Edad hijo

7.  $x \rightarrow$  Edad actual de A

$$65-x \rightarrow$$
 Edad actual de B

$$65-x+10 = \frac{5(x+10)}{12} \quad \text{mcm}=12$$

$$900-12x=5x+50$$

$$850=17x$$

$$50=x$$

50 años  $\rightarrow$  Edad actual de A

$\Rightarrow 65-x=65-50=15$  años  $\rightarrow$  Edad actual de B

8.  $x \rightarrow$  Edad padre

$$x-25 \rightarrow$$
 Edad hijo

$$x-25-15 = \frac{3(x-15)}{8} \quad \text{mcm}=8$$

$$8x-320=3x-45$$

$$5x=275$$

$$x=55$$

55 años  $\rightarrow$  Edad padre

$\Rightarrow x-25=55-25=30$  años  $\rightarrow$  Edad hijo

9.  $2x \rightarrow$  Edad padre hace 10 años

$$x \rightarrow$$
 Edad hijo hace 10 años

$$2x+10 \rightarrow$$
 Edad actual padre

$$x+10 \rightarrow$$
 Edad actual hijo

$$2x+10+10 = \frac{3(x+10+10)}{2} \quad \text{mcm}=2$$

$$4x+40=3x+60$$

$$x=20$$

$\Rightarrow 2x+10=2 \cdot 20+10=50$  años  $\rightarrow$  Ed. act. padre

$\Rightarrow x+10=20+10=30$  años  $\rightarrow$  Ed. act. hijo

10.  $x+18 \rightarrow$  Edad de A

$$x \rightarrow$$
 Edad de B

$$x+18-18 = \frac{5(x-18)}{2} \quad \text{mcm}=2$$

$$2x=5x-90$$

$$90=3x$$

$$30=x$$

30 años  $\rightarrow$  Edad de B

$\Rightarrow x+18=30+18=48$  años  $\rightarrow$  Edad A

11.  $3x \rightarrow$  Edad A

$$x \rightarrow$$
 Edad B

$$3x-4+x-4=x+16$$

$$4x-8=x+16$$

$$3x=24$$

$$x=8$$

8 años  $\rightarrow$  Edad B

$\Rightarrow 3x=3 \cdot 8=24$  años  $\rightarrow$  Edad A

## EJERCICIO 151

1.  $x \rightarrow$  Tiene B  
 $2x \rightarrow$  Tiene A  
 $2x - 20 = \frac{4(x+20)}{5}$   $mcm=5$   
 $10x - 100 = 4x + 80$   
 $6x = 180$   
 $x = 30$   
30 soles  $\rightarrow$  Tiene B  
 $\Rightarrow 2x = 2 \cdot 30 = 60$  soles  $\rightarrow$  Tiene A
2.  $x \rightarrow$  Tiene B  
 $\frac{x}{2} \rightarrow$  Tiene A  
 $x - 24 = \frac{x}{2} + 24$   $mcm=2$   
 $2x - 48 = x + 48$   
 $x = 96$   
96 colones  $\rightarrow$  Tiene B  
 $\Rightarrow \frac{x}{2} = \frac{96}{2} = 48$  colones  $\rightarrow$  Tiene A
3.  $x \rightarrow$  Tiene A  
 $2x \rightarrow$  Tiene B  
 $\frac{3}{5}(2x - 6) = x + 6$   $mcm=5$   
 $6x - 18 = 5x + 30$   
 $x = 48$   
\$48  $\rightarrow$  Tiene A  
 $\Rightarrow 2x = 2 \cdot 48 = \$96 \rightarrow$  Tiene B
4.  $x \rightarrow$  Tiene A  
 $\frac{3}{5}x \rightarrow$  Tiene B  
 $\frac{3}{5}x + 30 = \frac{9}{5}(x - 30)$   $mcm=5$   
 $3x + 150 = 9x - 270$   
 $420 = 6x$   
 $70 = x$   
\$70  $\rightarrow$  Tiene A  
 $\Rightarrow \frac{3}{5}x = \frac{3}{5} \cdot 70 = \$42 \rightarrow$  Tiene B
5.  $x \rightarrow$  Tiene A y B  
 $x - 30 = \frac{x+30}{2}$   $mcm=2$   
 $2x - 60 = x + 30$   
 $x = 90$   
90 suc.  $\rightarrow$  Tiene A y B

6.  $x \rightarrow$  Tiene A  
 $\frac{2}{3}x \rightarrow$  Tiene B  
 $\frac{2}{3}x + 22 = \frac{7}{5}(x - 22)$   $mcm=15$   
 $10x + 330 = 21x - 462$   
 $792 = 11x$   
 $72 = x$  \$72  $\rightarrow$  Tiene A  
 $\Rightarrow \frac{2}{3}x = \frac{2}{3} \cdot 72 = \$48 \rightarrow$  Tiene B
7.  $x \rightarrow$  Tiene B  
 $\frac{4}{5}x \rightarrow$  Tiene A  
 $\frac{4}{5}x + 13 = x - 5$   $mcm=5$   
 $4x + 65 = 5x - 25$   
 $90 = x$  \$90  $\rightarrow$  Tiene B  
 $\Rightarrow \frac{4}{5}x = \frac{4}{5} \cdot 90 = \$72 \rightarrow$  Tiene A
8.  $x \rightarrow$  Tiene A  
 $\frac{x}{2} \rightarrow$  Tiene B  
 $\frac{x}{2} + \frac{1}{3}x = x + 5$   $mcm=6$   
 $3x + 2x = 6x + 30$   
 $5x = 6x + 30$   
 $30 = x$  \$30  $\rightarrow$  Tiene A  
 $\Rightarrow \frac{x}{2} = \frac{30}{2} = \$15 \rightarrow$  Tiene B
9.  $x \rightarrow$  Empezaron A y B  
 $x - \frac{3}{5}x = x - 24$   $mcm=5$   
 $5x - 3x = 5x - 120$   
 $-3x = -120$   
 $x = 40$   
40 balboas  $\rightarrow$  Empezaron A y B
10.  $x \rightarrow$  Empezaron A y B  
 $x - \frac{3}{4}x = \frac{x}{4} \rightarrow$  Le queda B  
 $\frac{x}{12} \rightarrow$  3ª parte de lo queda B  
 $\frac{x}{12} + 24 = \frac{x+288}{12} \rightarrow$  ha ganado A  
 $\frac{x}{4} = x - \left(\frac{x+288}{12}\right)$   $mcm=12$   
 $3x = 12x - x - 288$   
 $3x = 11x - 288$   
 $-8x = -288$   
 $x = 36$   
36 soles  $\rightarrow$  Empezaron A y B

## EJERCICIO 152

1.  $x \rightarrow$  N° años que pasan  
 $28 + x = \frac{3}{4}(x + 38)$   $mcm=4$   
 $112 + 4x = 3x + 114$   
 $x = 2$   
2  $\rightarrow$  años pasan
2.  $x \rightarrow$  N° años que pasan  
 $30 + x = \frac{7}{6}(x + 25)$   $mcm=6$   
 $180 + 6x = 7x + 175$   
 $5 = x$   
5  $\rightarrow$  años pasan
3.  $x \rightarrow$  N° años hace  
 $48 - x = \frac{9}{10}(52 - x)$   
 $mcm=10$   
 $480 - 10x = 468 - 9x$   
 $12 = x$   
12  $\rightarrow$  años hace
4.  $x \rightarrow$  N° años hace  
 $18 - x = \frac{1}{4}(27 - x)$   
 $mcm=4$   
 $72 - 4x = 27 - x$   
 $45 = 3x$   
 $15 = x$   
15  $\rightarrow$  años hace
5.  $x \rightarrow$  La suma de dinero  
 $\frac{3}{5}(50 + x) = x + 22$   $mcm=5$   
 $150 + 3x = 5x + 110$   
 $40 = 2x$   
 $20 = x$   
\$20  $\rightarrow$  La suma de dinero
6.  $x \rightarrow$  Gastó cada uno  
 $\frac{3}{11}(90 - x) = 50 - x$   $mcm=11$   
 $270 - 3x = 550 - 11x$   
 $8x = 280$   
 $x = 35$   
35Q.  $\rightarrow$  Gastó cada uno



7.  $x \rightarrow$  Edad actual hermano

$$\frac{3}{4}x \rightarrow \text{Edad actual persona}$$

$$(x+x) + \frac{3}{4}x + x = 75$$

$$3x + \frac{3}{4}x = 75 \quad mcm=4$$

$$12x + 3x = 300$$

$$x = 20$$

20 años  $\rightarrow$  Edad actual hermano

$$\Rightarrow \frac{3}{4}x = \frac{3}{4} \cdot 20 = 15 \text{ años} \rightarrow \text{Edad actual persona}$$

## EJERCICIO 153

1.  $x+3 \rightarrow$  Long. rect.

$x \rightarrow$  Ancho rect.

$$(x+4)(x+1) - 22 = x(x+3)$$

$$x^2 + 5x + 4 - 22 = x^2 + 3x$$

$$2x = 18$$

$$x = 9$$

$9m \rightarrow$  Ancho rect.

$$\Rightarrow x+3 = 9+3 = 12m \rightarrow \text{Long. rect.}$$

2.  $x \rightarrow$  Una de las dimensiones

$2x \rightarrow$  La otra dimensión

$$(x+5)(2x+5) - 160 = 2x^2$$

$$2x^2 + 15x + 25 - 160 = 2x^2$$

$$15x = 135$$

$$x = 9$$

$9m \cdot 18m \rightarrow$  Dimensiones

3.  $x+2 \rightarrow$  Una dimensión

$x \rightarrow$  Otra dimensión

$$(x-5)(x-3) + 115 = x(x+2)$$

$$x^2 - 8x + 15 + 115 = x^2 + 2x$$

$$-10x = -130$$

$$x = 13$$

$15m \cdot 13m \rightarrow$  Dimensiones

4.  $\frac{x}{2} + 24 \rightarrow$  Long. del rect.

$$\frac{x}{2} - 12 \rightarrow \text{Ancho del rect.}$$

$$\left(\frac{x}{2} + 24\right)\left(\frac{x}{2} - 12\right) = x\left(\frac{x}{2} - 12\right)$$

**Continúa**

8.  $x \rightarrow$  ganó cada uno

$$54 + x + 32 + x = 4x + 66$$

$$2x + 86 = 4x + 66$$

$$20 = 2x$$

$$10 = x$$

\$ 10  $\rightarrow$  ganó cada uno

9.  $x \rightarrow$  Le dió A a B

$$153 - x = \frac{1}{4}(12 + x) \quad mcm = 4$$

$$612 - 4x = 12 + x$$

$$600 = 5x$$

$$120 = x$$

120bs.  $\rightarrow$  Le dió A a B

## EJERCICIO 154

1.  $x \rightarrow$  Numerador

$x-2 \rightarrow$  Denominador

$$\frac{x}{x-2+7} = \frac{1}{2}$$

$$\frac{x}{x+5} = \frac{1}{2}$$

$$2x = x + 5$$

$$x = 5$$

5  $\rightarrow$  Numerador

$5-2=3 \rightarrow$  Denominador

$$\frac{5}{3} \rightarrow \text{fracción}$$

2.  $x \rightarrow$  Numerador

$x+1 \rightarrow$  Denominador

$$\frac{x}{x+1+15} = \frac{1}{3}$$

$$\frac{x}{x+16} = \frac{1}{3}$$

$$3x = x + 16$$

$$2x = 16$$

$$x = 8$$

8  $\rightarrow$  Numerador

$8+1=9 \rightarrow$  Denominador

$$\frac{8}{9} \rightarrow \text{Fracción}$$

3.  $x-8 \rightarrow$  Numerador

$x \rightarrow$  Denominador

$$\frac{x-8+1}{x+1} = \frac{3}{4}$$

$$\frac{x-7}{x+1} = \frac{3}{4}$$

$$4(x-7) = 3(x+1)$$

$$4x - 28 = 3x + 3$$

$$x = 31$$

$31-8=23 \rightarrow$  Numerador

31  $\rightarrow$  Denominador

$$\frac{23}{31} \rightarrow \text{Fracción}$$

### Continuación

4.  $\frac{x}{2} + 24 = x \quad mcm = 2$

$$x + 48 = 2x$$

$$48 = x$$

$48m \cdot 12m \rightarrow$  Dimensiones

5.  $x \rightarrow$  Long. del cuadrado

Equiv. al rect.

$x+7 \rightarrow$  Long. del rect.

$x-6 \rightarrow$  Ancho del rect.

$$(x+7)(x-6) = x^2$$

$$x^2 + x - 42 = x^2$$

$$x = 42$$

$\Rightarrow x+7 = 42+7 = 49 \rightarrow$  Long. del rect.

$\Rightarrow x-6 = 42-6 = 36 \rightarrow$  Ancho del rect.

$49m \cdot 36m \rightarrow$  Dimensiones

6.  $x \rightarrow$  Ancho

$x+30 \rightarrow$  Longitud

$$(x+30-20)(x+15) + 150 = x(x+30)$$

$$(x+10)(x+15) + 150 = x^2 + 30x$$

$$x^2 + 25x + 150 + 150 = x^2 + 30x$$

$$300 = 5x$$

$$60 = x$$

$60m \rightarrow$  Ancho

$\Rightarrow x+30 = 60+30 = 90m \rightarrow$  Long.

$90m \cdot 60m \rightarrow$  Dimensiones

7.  $x \rightarrow$  Ancho

$x+10 \rightarrow$  Longitud

$$(x+8)(x+1) = x(x+10)$$

$$x^2 + 9x + 8 = x^2 + 10x$$

$$8 = x \rightarrow \text{Ancho}$$

$\Rightarrow x+10 = 8+10 = 18 \rightarrow$  Long.

$18m \cdot 8m \rightarrow$  Dimensiones

4.  $x \rightarrow$  Numerador

$2x+1 \rightarrow$  Deno min ador

$$\frac{x-4}{2x+1} = \frac{1}{3}$$

$$3(x-4) = 2x+1$$

$$3x-12 = 2x+1$$

$$x = 13$$

13  $\rightarrow$  Numerador

$2 \cdot 13 + 1 = 27 \rightarrow$  Deno min ador

$\frac{13}{27} \rightarrow$  Fracción

7.  $x \rightarrow$  Numerador

$3x-1 \rightarrow$  Deno min ador

$$\frac{x+8}{3x-1+4} = \frac{11}{12}$$

$$\frac{x+8}{3x+3} = \frac{11}{12}$$

$$12(x+8) = 33(x+1)$$

$$12x+96 = 33x+33$$

$$63 = 21x$$

$$3 = x$$

3  $\rightarrow$  Numerador

$3 \cdot 3 - 1 = 8 \rightarrow$  Deno min ador

$\frac{3}{8} \rightarrow$  Fracción

5.  $x \rightarrow$  Numerador

$2x+6 \rightarrow$  Deno min ador

$$\frac{x+15}{2x+6-1} = \frac{4}{3}$$

$$\frac{x+15}{2x+5} = \frac{4}{3}$$

$$3(x+15) = 4(2x+5)$$

$$3x+45 = 8x+20$$

$$25 = 5x$$

$$5 = x$$

5  $\rightarrow$  Numerador

$2 \cdot 5 + 6 = 16 \rightarrow$  Deno min ador

$\frac{5}{16} \rightarrow$  Fracción

8.  $x \rightarrow$  Numerador

$x-22 \rightarrow$  Deno min ador

$$\frac{x}{x-22} - \frac{x-15}{x-22} = 3 \quad mcm = x-22$$

$$x - (x-15) = 3(x-22)$$

$$15 = 3x - 66$$

$$81 = 3x$$

$$27 = x$$

27  $\rightarrow$  Numerador

$27 - 22 = 5 \rightarrow$  Deno min ador

$\frac{27}{5} \rightarrow$  Fracción

6.  $x \rightarrow$  Numerador

$x+1 \rightarrow$  Deno min ador

$$\frac{x}{x+1+4} = 3\left(\frac{x}{x+1}\right) - 2$$

$$\frac{x}{x+5} = \frac{3x}{x+1} - 2 \quad mcm = (x+5)(x+1)$$

$$x(x+1) = 3x(x+5) - 2(x+5)(x+1)$$

$$x^2 + x = 3x^2 + 15x - 2x^2 - 12x - 10$$

$$x = 3x - 10$$

$$10 = 2x$$

$$5 = x$$

5  $\rightarrow$  Numerador

$5+1=6 \rightarrow$  Deno min ador

$\frac{5}{6} \rightarrow$  Fracción

## EJERCICIO 155

1.  $x \rightarrow$  cifra de unidades

$x+2 \rightarrow$  cifra de decenas

$$10(x+2) + x$$

$$10x + 20 + x$$

$11x + 20 \rightarrow$  El Número

$$\frac{11x+20}{2(x+1)} = 7$$

$$11x+20 = 14(x+1)$$

$$11x+20 = 14x+14$$

$$6 = 3x$$

$$2 = x$$

2  $\rightarrow$  cifra de unidades

$2+2=4 \rightarrow$  cifra de decenas

42  $\rightarrow$  N° buscado

2.  $x \rightarrow$  cifra de unidades

$x-4 \rightarrow$  cifra de decenas

$$10(x-4) + x$$

$$10x - 40 + x$$

$11x - 40 \rightarrow$  El Número

$$\frac{11x-40}{2(x-2)} = 4$$

$$11x-40 = 8x-16$$

$$3x = 24$$

$$x = 8$$

8  $\rightarrow$  cifra de unidades

$8-4=4 \rightarrow$  cifra de decenas

48  $\rightarrow$  N° buscado

3.  $x \rightarrow$  cifra de unidades

$2x \rightarrow$  cifra de decenas

$$10(2x) + x - 9$$

$21x - 9 \rightarrow$  N° disminuido en 9

$$\frac{21x-9}{3x} = 6$$

$$21x-9 = 18x$$

$$3x = 9$$

$$x = 3$$

63  $\rightarrow$  N° buscado

4.  $x \rightarrow$  cifra de unidades

$x+1 \rightarrow$  cifra de decenas

$$10(x+1)+x$$

$$3(11x+10)$$

$33x+30 \rightarrow$  N° *multip.\*3*

$$33x+30=21(2x+1)$$

$$33x+30=42x+21$$

$$9=9x$$

$$1=x$$

1  $\rightarrow$  Cifra de unidades

$1+1=2 \rightarrow$  Cifra de decenas

21  $\rightarrow$  N° buscado

5.  $x \rightarrow$  cifra de unidades

$7-x \rightarrow$  cifra de decenas

$$10(7-x)+x+8$$

$78-9x \rightarrow$  N° aumentado en 8

$$\frac{78-9x}{2(7-x)}=6$$

$$78-9x=12(7-x)$$

$$78-9x=84-12x$$

$$3x=6$$

$$x=2$$

52  $\rightarrow$  N° buscado

6.  $x \rightarrow$  cifra de unidades

$x+2 \rightarrow$  cifra de decenas

$$10(x+2)+x$$

$11x+20 \rightarrow$  El Número

$$11x+20-27=10x$$

$$11x-7=10x$$

$$x=7$$

7  $\rightarrow$  cifra de unidades

$7+2=9 \rightarrow$  cifra de decenas

97  $\rightarrow$  N° buscado

7.  $x \rightarrow$  cifra de unidades

$2x \rightarrow$  cifra de decenas

$$10(2x)+x-4$$

$21x-4 \rightarrow$  N° *dis min en 4*

$$\frac{21x-4}{2x-x}=20$$

$$21x-4=20x$$

$$x=4$$

84  $\rightarrow$  N° buscado

## EJERCICIO 156

1.  $x \rightarrow$  Días trabaj. juntos

$$\frac{1}{3}+\frac{1}{6}=\frac{1}{x} \quad mcm=6x$$

$$2x+x=6$$

$$3x=6$$

$$x=2$$

2 días  $\rightarrow$  Hacen la obra

2.  $x \rightarrow$  Tiempo en llenar depósito

$$\frac{1}{10}+\frac{1}{20}=\frac{1}{x} \quad mcm=20x$$

$$2x+x=20$$

$$3x=20$$

$$x=\frac{20}{3}$$

$$x=6\frac{2}{3}$$

$6\frac{2}{3}$  min.  $\rightarrow$  En llenar depósito

3.  $x \rightarrow$  Hacen obra juntos

$$\frac{1}{4}+\frac{1}{6}+\frac{1}{12}=\frac{1}{x} \quad mcm=12x$$

$$3x+2x+x=12$$

$$6x=12$$

$$x=2$$

2 días  $\rightarrow$  Hacen obra juntos

4.  $x \rightarrow$  Hacen obra juntos

$$\frac{1}{1\frac{1}{2}}+\frac{1}{6}+\frac{1}{2\frac{2}{5}}=\frac{1}{x}$$

$$\frac{2}{3}+\frac{1}{6}+\frac{5}{12}=\frac{1}{x} \quad mcm=12x$$

### Continuación

4.  $8x+2x+5x=12$

$$15x=12$$

$$x=\frac{12}{15}$$

$$x=\frac{4}{5}$$

$\frac{4}{5}$  de día hacen la obra

5.  $x \rightarrow$  Tiempo en llenar depósito

$$\frac{1}{5}+\frac{1}{6}+\frac{1}{12}=\frac{1}{x} \quad mcm=60x$$

$$12x+10x+5x=60$$

$$27x=60$$

$$x=\frac{60}{27}$$

$$x=2\frac{2}{9}$$

$2\frac{2}{9}$  min  $\rightarrow$  Llenar el depósito

6.  $x \rightarrow$  Tiempo en llenar depósito

$$\frac{1}{4}+\frac{1}{8}-\frac{1}{20}=\frac{1}{x} \quad mcm=40x$$

$$10x+5x-2x=40$$

$$13x=40$$

$$x=\frac{40}{13}$$

$$x=3\frac{1}{13}$$

$3\frac{1}{13}$  min.  $\rightarrow$  Llenar el depósito

### Continúa

## EJERCICIO 157

1.



$$ABCD=x$$

$$AB=5$$

$$BC=\frac{x}{12}$$

$$CD=30$$

$$x=5+30+\frac{x}{12}$$

$$x=35+\frac{x}{12}$$

$$12x=420+x$$

$$11x=420$$

$$x=\frac{420}{11}=38\frac{2}{11}$$

2.



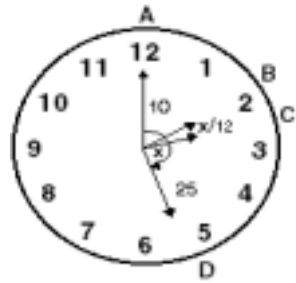
$$\begin{aligned} AB &= x \\ BD &= 15 \\ AC &= 50 \\ CD &= \frac{X}{12} \\ AB + BD &= AC + CD \\ x + 15 &= 50 + \frac{x}{12} \quad mcm=12 \\ 12x + 180 &= 600 + x \\ 11x &= 420 \\ x &= \frac{420}{11} \\ x &= 38\frac{2}{11} \end{aligned}$$

3.



$$\begin{aligned} AB &= x \\ BD &= 30 \\ AC &= 40 \\ CD &= \frac{x}{12} \\ AB + BD &= AC + CD \\ x + 30 &= 40 + \frac{x}{12} \quad mcm=12 \\ 12x + 360 &= 480 + x \\ 11x &= 120 \\ x &= \frac{120}{11} \\ x &= 10\frac{10}{11} \end{aligned}$$

5.

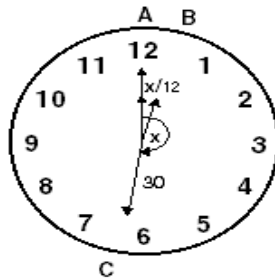


$$\begin{aligned} ABCD &= x \\ AB &= 10 \\ BC &= \frac{x}{12} \\ CD &= 15 \\ ABCD &= AB + BC + CD \\ x &= 10 + \frac{x}{12} + 15 \\ x &= 25 + \frac{x}{12} \\ mcm &= 12 \\ 12x &= 300 + x \\ 11x &= 300 \\ x &= \frac{300}{11} \\ x &= 27\frac{3}{11} \end{aligned}$$



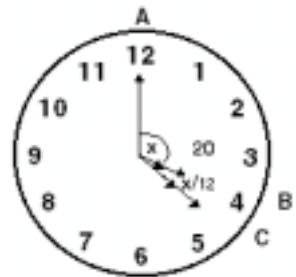
$$\begin{aligned} AB &= x \\ BD &= 45 \\ AC &= 50 \\ CD &= \frac{x}{12} \\ AC + CD &= AB + BD \\ 50 + \frac{x}{12} &= x + 45 \quad mcm=12 \\ 600 + x &= 12x + 540 \\ 60 &= 11x \\ \frac{60}{11} &= x \\ 5\frac{5}{11} &= x \end{aligned}$$

4.



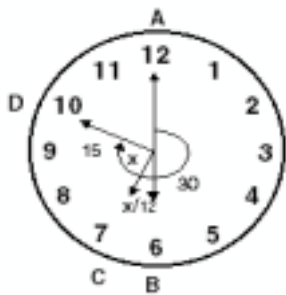
$$\begin{aligned} AB &= \frac{x}{12} \\ BC &= 30 \\ ABC &= x \\ ABC &= AB + BC \\ x &= \frac{x}{12} + 30 \quad mcm=12 \\ 12x &= x + 360 \\ 11x &= 360 \\ x &= \frac{360}{11} \\ x &= 32\frac{8}{11} \end{aligned}$$

6.



$$\begin{aligned} ABC &= x \\ AB &= 20 \\ BC &= \frac{x}{12} \\ ABC &= AB + BC \\ x &= 20 + \frac{x}{12} \quad mcm=12 \\ 12x &= 240 + x \\ 11x &= 240 \\ x &= \frac{240}{11} \\ x &= 21\frac{9}{11} \end{aligned}$$

7.



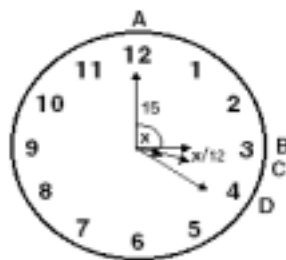
$$\begin{aligned}
 ABCD &= x \\
 AB &= 30 \\
 BC &= \frac{x}{12} \\
 CD &= 15 \\
 ABCD &= AB + BC + CD \\
 x &= 30 + \frac{x}{12} + 15 \quad mcm=12 \\
 12x &= 360 + x + 180 \\
 11x &= 540 \\
 x &= \frac{540}{11} \\
 x &= 49\frac{1}{11}
 \end{aligned}$$

8.



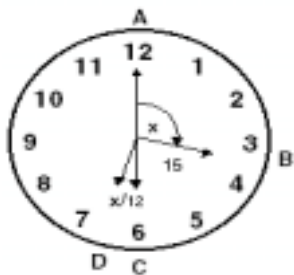
$$\begin{aligned}
 ABC &= x \\
 AB &= 50 \\
 BC &= \frac{x}{12} \\
 ABC &= AB + BC \\
 x &= 50 + \frac{x}{12} \quad mcm=12 \\
 12x &= 600 + x \\
 11x &= 600 \\
 x &= \frac{600}{11} \\
 x &= 54\frac{6}{11}
 \end{aligned}$$

10.

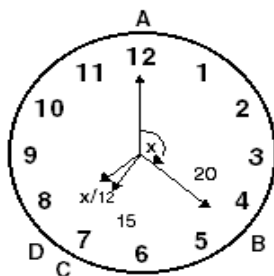


$$\begin{aligned}
 ABCD &= x \\
 AB &= 15 \\
 BC &= \frac{x}{12} \\
 CD &= 5 \\
 ABCD &= AB + BC + CD \\
 x &= 15 + \frac{x}{12} + 5 \\
 x &= 20 + \frac{x}{12} \quad mcm=12 \\
 12x &= 240 + x \\
 11x &= 240 \\
 x &= \frac{240}{11} \\
 x &= 21\frac{9}{11}
 \end{aligned}$$

9.

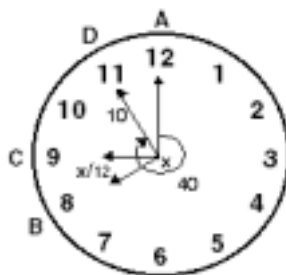


$$\begin{aligned}
 AB &= x \\
 BD &= 15 \\
 AC &= 30 \\
 CD &= \frac{x}{12} \\
 AB + BD &= AC + CD \\
 x + 15 &= 30 + \frac{x}{12} \\
 x - \frac{x}{12} &= 15 \quad mcm=12 \\
 12x - x &= 180 \\
 11x &= 180 \\
 x &= \frac{180}{11} \\
 x &= 16\frac{4}{11}
 \end{aligned}$$



$$\begin{aligned}
 AB &= x \\
 BD &= 15 \\
 AC &= 35 \\
 CD &= \frac{x}{12} \\
 AB + BD &= AC + CD \\
 x + 15 &= 35 + \frac{x}{12} \\
 12x + 180 &= 420 + x \\
 11x &= 240 \\
 x &= \frac{240}{11} \\
 x &= 21\frac{9}{11}
 \end{aligned}$$

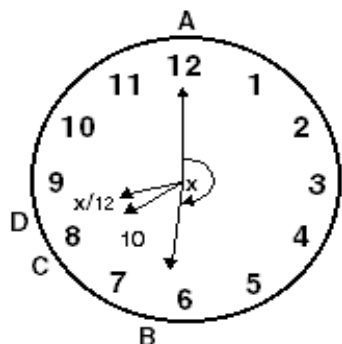
11.



$$\begin{aligned}
 ABCD &= x \\
 AB &= 40 \\
 BC &= \frac{x}{12} \\
 CD &= 10 \\
 ABCD &= AB + BC + CD \\
 x &= 40 + \frac{x}{12} + 10 \\
 x &= 50 + \frac{x}{12} \quad mcm=12 \\
 12x &= 600 + x \\
 11x &= 600 \\
 x &= \frac{600}{11} \\
 x &= 54\frac{6}{11}
 \end{aligned}$$

**Continúa**

### 11. Continuación



$$\begin{aligned}
 AB &= x \\
 BD &= 10 \\
 AC &= 40 \\
 CD &= \frac{x}{12} \\
 AB + BD &= AC + CD \\
 x + 10 &= 40 + \frac{x}{12} \\
 x - \frac{x}{12} &= 30 \\
 mcm &= 12 \\
 12x - x &= 360 \\
 11x &= 360 \\
 x &= \frac{360}{11} \\
 x &= 32\frac{8}{11}
 \end{aligned}$$

### 3. $x \rightarrow$ Nº buscado

$$\begin{aligned}
 \frac{x+6}{8} + 5 \\
 \frac{x+46}{8} &\rightarrow \text{Cociente sumado 5} \\
 \frac{x+46}{8} \\
 \frac{8}{2} = \frac{x+46}{16} &\rightarrow \text{Nueva sum} \div \text{en 2} \\
 \frac{x+46}{16} &= 4 \\
 x+46 &= 64 \\
 x &= 18 \rightarrow \text{Nº buscado}
 \end{aligned}$$

## EJERCICIO 158

### 1. $x \rightarrow$ Nº mayor

$$\begin{aligned}
 x - 6 &\rightarrow \text{Nº menor} \\
 \frac{x}{2} - 10 &= \frac{3}{8}(x - 6) \quad mcm = 8 \\
 4x - 80 &= 3x - 18 \\
 x = 62 &\rightarrow \text{Nº mayor} \\
 62 - 6 &= 56 \rightarrow \text{Nº menor}
 \end{aligned}$$

### 2. $x \rightarrow$ Ledió A a B

$$\begin{aligned}
 \frac{11}{10}(120 - x) &= 90 + x \quad mcm = 10 \\
 1.320 - 11x &= 900 + 10x \\
 420 &= 21x \\
 20 &= x \\
 \$ 20 &\rightarrow \text{Ledió A a B}
 \end{aligned}$$

### 4. $x \rightarrow$ Persona favorecida

$$\begin{aligned}
 \frac{5}{7}x &\rightarrow \text{Persona que recibió menos} \\
 x + \frac{5}{7}x &= 48.000 \quad mcm = 7 \\
 7x + 5x &= 336.000 \\
 12x &= 336.000 \\
 x &= 28.000 \\
 28.000 \text{ soles} &\rightarrow \text{Pers. favorecida} \\
 \frac{5}{7} \cdot 28.000 &= 20.000 \\
 20.000 \text{ soles} &\rightarrow \text{Pers. que rec. men.}
 \end{aligned}$$

5.  $x \rightarrow$  Parte mayor  
 $84 - x \rightarrow$  Parte menor  
 $\frac{1}{10}x = \frac{1}{4}(84 - x) \quad mcm = 20$   
 $2x = 5(84 - x)$   
 $2x = 420 - 5x$   
 $7x = 420$   
 $x = 60$   
 $60 \rightarrow$  Parte mayor  
 $84 - 60 = 24 \rightarrow$  Parte menor

6.  $x \rightarrow$  Parte mayor  
 $120 - x \rightarrow$  Parte menor  
 $120 - x = \frac{3}{5}x \quad mcm = 5$   
 $600 - 5x = 3x$   
 $600 = 8x$   
 $75 = x \rightarrow$  Parte mayor  
 $120 - 75 = 45 \rightarrow$  Parte menor

7.  $x \rightarrow$  Sueldo mensual  
 $\frac{x}{2} + \frac{3}{8}x = \frac{7}{8}x \rightarrow$  mensual  
 $15x - 15\left(\frac{7}{8}x\right) = 300 \quad mcm = 8$   
 $120x - 105x = 2.400$   
 $15x = 2.400$   
 $x = 160$   
 $\$160 \rightarrow$  Sueldo mensual

8.  $x \rightarrow$  Lo que tenía  
 $\frac{1}{5}x \rightarrow$  Gastó en ropa  
 $\frac{3}{8}x \rightarrow$  Gastó en libros  
 $x - \frac{1}{5}x - \frac{3}{8}x - 102 = 0 \quad mcm = 40$   
 $40x - 8x - 15x - 4.080 = 0$   
 $17x = 4.080$   
 $x = 240$   
 $\frac{1}{5} \cdot 240 = \$48 \rightarrow$  Gastó en ropa  
 $\frac{3}{8} \cdot 240 = \$90 \rightarrow$  Gastó en libros

9.  $x \rightarrow$  Edad de A  
 $\frac{2}{5}x \rightarrow$  Edad de B  
 $\frac{2}{3} \cdot \frac{2}{5}x = \frac{4}{15}x \rightarrow$  Edad de C  
 $x + \frac{2}{5}x + \frac{4}{15}x = 25 \quad mcm = 15$   
 $15x + 6x + 4x = 375$   
 $25x = 375$   
 $x = 15$   
 $15 \text{ años} \rightarrow$  Edad de A

$\frac{2}{5} \cdot 15 = 6 \text{ años} \rightarrow$  Edad de B  
 $\frac{4}{15} \cdot 15 = 4 \text{ años} \rightarrow$  Edad de C

10.  $x \rightarrow$  Costo auto  
 $8.000 + \frac{x}{3} = x + 2.000 \quad mcm = 3$   
 $24.000 + x = 3x + 6.000$   
 $18.000 = 2x$   
 $9.000 = x$   
 $9.000 \text{ bs} \rightarrow$  Costo auto

11.  $x \rightarrow$  Libros compre  
 $\frac{7x}{2} - \frac{5x}{2} = 8 \quad mcm = 2$   
 $7x - 5x = 16$   
 $2x = 16$   
 $x = 8 \rightarrow$  Lib. compre

12.  $x \rightarrow$  Cierta N° de libros  
 $\frac{3x}{4} \rightarrow$  Vr. cierta N° de libros  
 $\frac{3x}{4} \left(\frac{7}{10}\right) = \frac{21x}{40} \rightarrow$  Vr.  $\frac{3}{4}$  del N°  
de lib. ant.  
 $\frac{3x}{4} + \frac{21x}{40} = \frac{51x}{40} \rightarrow$  Vr. total de lib. compré

$x + \frac{3x}{4} = \frac{7x}{4} \rightarrow$  total lib. comp.

## 12. Continuación

$\frac{7x}{4} \cdot \frac{3}{2} = \frac{21x}{8} \rightarrow$  Vr. total vta.  
de todos los lib.

Luego

$\frac{21x}{8} - \frac{51x}{40} = 54 \quad mcm = 40$   
 $105x - 51x = 2.160$   
 $54x = 2.160$   
 $x = 40$

$\frac{7x}{4} = \frac{7 \cdot 40}{4} = 70$   
 $70 \rightarrow$  Total libros comprados

13.  $x \rightarrow$  1ª parte  
 $\frac{5x}{6} \rightarrow$  2ª parte  
 $\frac{3}{5} \cdot \frac{5x}{6} = \frac{1}{2}x \rightarrow$  3ª parte  
 $\frac{1}{3} \cdot \frac{1}{2}x = \frac{1}{6}x \rightarrow$  4ª parte  
 $x + \frac{5x}{6} + \frac{1}{2}x + \frac{1}{6}x = 150$   
 $mcm = 6$   
 $6x + 5x + 3x + x = 900$   
 $15x = 900$   
 $x = 60$   
 $60 \rightarrow$  1ª parte

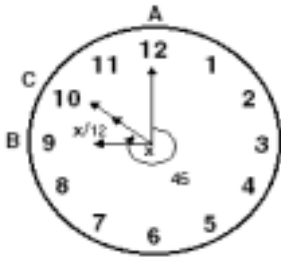
$\frac{5}{6} \cdot 60 = 50 \rightarrow$  2ª parte

$\frac{1}{2} \cdot 60 = 30 \rightarrow$  3ª parte

$\frac{1}{6} \cdot 60 = 10 \rightarrow$  4ª parte

Continúa

14.



$$ABC = x$$

$$AB = 45$$

$$BC = \frac{x}{12}$$

$$ABC = AB + BC$$

$$x = 45 + \frac{x}{12} \quad mcm = 12$$

$$12x = 540 + x$$

$$11x = 540$$

$$x = \frac{540}{11}$$

$$x = 49 \frac{1}{11}$$

15.  $x \rightarrow$  Edad A

$x - 10 \rightarrow$  Edad B

$$x - 10 - 15 = \frac{3}{4}(x - 15) \quad mcm = 4$$

$$4x - 40 - 60 = 3x - 45$$

$$4x - 100 = 3x - 45$$

$$x = 55$$

55 años  $\rightarrow$  Edad A

$55 - 10 = 45$  años  $\rightarrow$  Edad B

16.  $x \rightarrow$  Puede hacerla A

$$\frac{1}{10} + \frac{1}{x} = \frac{1}{6} \quad mcm = 60x$$

$$6x + 60 = 10x$$

$$60 = 4x$$

$$15 = x$$

15 días  $\rightarrow$  Puede hacerla A

17.  $x \rightarrow$  Parte mayor

$650 - x \rightarrow$  Parte menor

$$\frac{x}{5} = 650 - x - 50$$

$$\frac{x}{5} = 600 - x \quad mcm = 5$$

$$x = 3.000 - 5x$$

$$6x = 3.000$$

$$x = 500$$

500  $\rightarrow$  Parte mayor

$\Rightarrow 650 - 500 = 150 \rightarrow$  Parte menor

18.  $x \rightarrow$  Edad actual B

$$\frac{x}{4} \rightarrow$$
 Edad actual A

$$\frac{x}{4} - 10 = \frac{1}{10}(x - 10) \quad mcm = 40$$

$$10x - 400 = 4x - 40$$

$$6x = 360$$

$$x = 60$$

60 años  $\rightarrow$  Edad actual B

$$\frac{60}{4} = 15 \text{ años} \rightarrow$$
 Edad actual A

19.  $x \rightarrow$  N° mayor

$x - 1 \rightarrow$  N° menor

$$x^2 - (x - 1)^2 - 43 = \frac{1}{11}(x - 1)$$

$$x^2 - x^2 + 2x - 1 - 43 = \frac{1}{11}(x - 1)$$

$$2x - 44 = \frac{1}{11}(x - 1)$$

$$11(2x - 44) = x - 1$$

$$22x - 484 = x - 1$$

$$21x = 483$$

$$x = 23$$

23  $\rightarrow$  N° mayor

$23 - 1 = 22 \rightarrow$  N° menor

20.  $x \rightarrow$  Vr. sortija

$$7\left(\frac{3.000 + x}{12}\right) = 1.500 + x \quad mcm = 12$$

$$21.000 + 7x = 18.000 + 12x$$

$$3.000 = 5x$$

$$600 = x$$

600 sucres  $\rightarrow$  Vr. sortija

21.  $x \rightarrow$  N° personas

$$x + \frac{1}{5}x = \frac{6x}{5} \rightarrow$$
 N° más de pers.

$$\frac{120}{6x} = \frac{100}{x}$$

$$\frac{100}{x} = \frac{120}{x} - 2 \quad mcm = x$$

$$100 = 120 - 2x$$

$$2x = 20$$

$$x = 10$$

10 personas  $\rightarrow$  Se repartió \$

22.  $x \rightarrow$  libros que compró

$$x + \frac{x}{4} = \frac{5x}{4} \rightarrow$$
 Libros más

$$\frac{400}{5x} = \frac{320}{x}$$

$$\frac{320}{x} = \frac{400}{x} - 2 \quad mcm = x$$

$$320 = 400 - 2x$$

$$2x = 80$$

$$x = 40$$

40 libros  $\rightarrow$  compró

$$\frac{400}{40} = \$10 \rightarrow$$
 Pagó por c/u

23.  $x \rightarrow$  Suma repartida

$$\frac{x}{2} - 30 \rightarrow$$
 Recibió A

$$\frac{3x}{7} + 20 \rightarrow$$
 Recibió B

$$\frac{x}{2} - 30 + \frac{3x}{7} + 20 + 30 = x$$

$$mcm = 14$$

$$7x + 6x + 280 = 14x$$

$$280 = x$$

$$\frac{280}{2} - 30 = \$110 \rightarrow$$
 Rec. A

$$\frac{3(280)}{7} + 20 = \$140 \rightarrow$$
 Rec. B

24.  $x \rightarrow$  Lib. comprad.

$$\frac{6x}{5} \rightarrow$$
 Vr. de x lib.

$$x - \frac{x}{3} = \frac{2x}{3} \rightarrow$$
 Resto

$$\frac{2x}{3} - \frac{9}{4} = \frac{3x}{2} \rightarrow$$
 Vr. vta resto

$$\frac{3x}{2} - \frac{6x}{5} = 9 \quad mcm = 10$$

$$15x - 12x = 90$$

$$3x = 90$$

$$x = 30$$

30  $\rightarrow$  Libros comprados

25.  $x \rightarrow$  Fortuna

$$x - \frac{x}{2} - \frac{x}{4} - \frac{x}{6} = 2.500$$

$$mcm = 12$$

$$12x - 6x - 3x - 2x = 30.000$$

$$x = 30.000$$

30.000 colones  $\rightarrow$  Fortuna



26.  $x \rightarrow$  sueldo anual

$$x - \frac{3x}{5} - \frac{x}{8} - \frac{x}{20} = 810$$

$$mcm = 40$$

$$40x - 24x - 5x - 2x = 32.400$$

$$9x = 32.400$$

$$x = 3.600$$

3.600 balboas  $\rightarrow$  sueldo anual

27.  $x \rightarrow$  Ahorros

$$x - \frac{3x}{8} - \frac{5x}{12} = \frac{5x}{24} \rightarrow \text{Le quedaba}$$

$$\frac{3}{5} \cdot \frac{5x}{24} = \frac{x}{8}$$

$$\frac{5x}{24} - \frac{x}{8} = 400 \quad mcm = 24$$

$$5x - 3x = 9.600$$

$$2x = 9.600$$

$$x = 4.800$$

\$4.800  $\rightarrow$  ahorros

28.  $x \rightarrow$  Parte mayor

$350 - x \rightarrow$  Parte menor

$$350 - x - \frac{3x}{5} = x - \frac{17}{15}(350 - x)$$

$$mcm = 15$$

$$5 \cdot 250 - 15x - 9x = 15x - 5 \cdot 950 + 17x$$

$$-24x - 32x = -11.200$$

$$-56x = -11.200$$

$$x = 200$$

200  $\rightarrow$  Parte mayor

$350 - 200 = 150 \rightarrow$  Parte menor

29.  $x \rightarrow$  Suma repartida

\$15  $\rightarrow$  Recibió A

$$x - 15 = B + C$$

$$x - 15 = C + B$$

$$C = A + B$$

$$C = 15 + (x - 15 - C)$$

$$C = x - C$$

$$2C = x$$

$$C = \frac{x}{2}$$

$$15 + 15 + \frac{2}{3} \cdot \frac{x}{2} + \frac{x}{2} = x$$

$$30 + \frac{x}{3} + \frac{x}{2} = x \quad mcm = 6$$

$$180 + 2x + 3x = 6x$$

$$180 = x$$

\$180  $\rightarrow$  Suma recibida

30.  $x \rightarrow$  Pesos

$$\frac{3}{4}x \rightarrow \text{N}^\circ \text{ piezas de } 20 \text{ ctvs}$$

$$\frac{2}{3} \cdot \frac{3x}{4} = \frac{x}{2} \rightarrow \text{N}^\circ \text{ piezas de } 10 \text{ ctvs}$$

$$x + \frac{3}{4}(0,20x) + \frac{0,10x}{2} = 9,60$$

$$mcm = 4$$

$$4x + 0,6x + 0,2x = 38,4$$

$$4,8x = 38,4$$

$$x = 8$$

8  $\rightarrow$  Pesos

$$\frac{3}{4} \cdot 8 = 6 \rightarrow \text{piezas de } 20 \text{ ctvs}$$

$$\frac{8}{2} = 4 \rightarrow \text{piezas de } 10 \text{ ctvs}$$

31.  $x \rightarrow$  Capital primitivo

$$\frac{1}{5}x \rightarrow 1^\text{er} \text{ año}$$

$$x - \frac{x}{5} = \frac{4x}{5} \rightarrow \text{Le quedaba}$$

$$\frac{3}{10} \cdot \frac{4x}{5} = \frac{6x}{25} \rightarrow 2^\text{o} \text{ año}$$

$$\frac{4x}{5} + \frac{6x}{25} = \frac{26x}{25} \rightarrow \text{Tenía al term.}$$

el 2º año

$$\frac{3}{5} \cdot \frac{26x}{25} = \frac{78x}{125} \rightarrow 3^\text{er} \text{ año}$$

$$x - \frac{x}{5} + \frac{6x}{25} + \frac{78x}{125} = 13.312$$

$$125x - 25x + 30x + 78x = 1'664.000$$

$$208x = 1'664.000$$

$$x = 8.000$$

8.000 Q.  $\rightarrow$  Capital primitivo

32.  $x \rightarrow$  Edad de A

$$x - 10 = \frac{2}{3}(x + 5) \quad mcm = 3$$

$$3x - 30 = 2x + 10$$

$$x = 40$$

40 años  $\rightarrow$  Edad de A

33.  $x \rightarrow$  Cant. hombres

en el lado del 1º cuadrado

$$x^2 + 36 \rightarrow \text{Hombres en la tropa}$$

$$(x + 1)^2 = x^2 + 36 + 75$$

Continúa

## Continuación

33.  $x^2 + 2x + 1 = x^2 + 111$

$$2x = 110$$

$$x = 55$$

55  $\rightarrow$  hombres en el lado

del 1º cuadrado

$$(55)^2 + 36$$

$$= 3.061 \rightarrow \text{Homb. en la tropa}$$

34.  $x \rightarrow$  Lo que tenía

$$x - \frac{5x}{8} - 20 = \frac{x}{4} + 16$$

$$mcm = 8$$

$$8x - 5x - 160 = 2x + 128$$

$$x = 288$$

\$288  $\rightarrow$  tenía

35.  $x \rightarrow$  Empezó a jugar

$2x - 60 \rightarrow$  Le quedaba

$$\frac{3}{10}(2x - 60) = \frac{6x - 180}{10}$$

$$x + x - 60 - \left( \frac{6x - 180}{10} \right) - \frac{7x}{8} = 0$$

$$mcm = 40$$

$$80x - 2.400 - 24x + 720 - 35x = 0$$

$$21x = 1.680$$

$$x = 80$$

80 Lempiras  $\rightarrow$  Empezó a jugar

36.  $x \rightarrow$  Cifra unidades

$x + 5 \rightarrow$  Cifra decenas

$$10(x + 5) + x - 18 = 6(x + 5 + x)$$

$$10x + 50 + x - 18 = 12x + 30$$

$$2 = x$$

2  $\rightarrow$  Cifra unidades

$2 + 5 = 7 \rightarrow$  Cifra decenas

72  $\rightarrow$  Nº buscado

37.  $x \rightarrow$  Unidades

$9 - x \rightarrow$  Decenas

$$10(9 - x) + x - 27 = 10x + 9 - x$$

$$90 - 10x + x - 27 = 10x + 9 - x$$

$$54 = 18x$$

$$3 = x$$

3  $\rightarrow$  Unidades

$9 - 3 = 6 \rightarrow$  Decenas

63  $\rightarrow$  Nº buscado

38.  $x \rightarrow$  Mangos que había

$$x - \frac{x}{3} - 4 = \frac{2x-12}{3} \rightarrow \text{Quedaban}$$

$$\frac{1}{3} \left( \frac{2x-12}{3} \right) + 6 = \frac{2x+42}{9}$$

$$\frac{2x+42}{9} + 9 = \frac{x+102}{9}$$

$$x - \frac{x}{3} - 4 - \left( \frac{2x+42}{9} \right) - \left( \frac{x+102}{9} \right) = 0$$

mcm=9

$$9x - 3x - 36 - 2x - 42 - x - 102 = 0$$

$$3x = 180$$

$$x = 60$$

60  $\rightarrow$  Mangos había

39.  $x \rightarrow$  Ganó c/u

$$\frac{7}{10}(80+x) = 50+x \quad \text{mcm}=10$$

$$560+7x=500+10x$$

$$60=3x$$

$$20=x$$

\$20  $\rightarrow$  Ganó c/u

40.  $x \rightarrow$  Pluma fuente

$$\frac{3}{5}x \rightarrow \text{Lapicero}$$

$$\frac{5}{6}(x-0,20) = \frac{3}{5}x + 0,30$$

mcm=30

$$25x-5=18x+9$$

$$7x=14$$

$$x=2$$

\$2  $\rightarrow$  Costo la pluma

$$\frac{3 \cdot 2}{5} = \$1,20 \rightarrow \text{Costo lapicero}$$

41.  $x \rightarrow$  Tenía el lunes antes de

$$\frac{x}{2} + 2 = \frac{x+4}{2} \rightarrow \text{Lunes}$$

$$x - \left( \frac{x+4}{2} \right) = \frac{x-4}{2} \rightarrow \text{Quedaba}$$

$$\frac{x-4}{2} + 2 = \frac{x+4}{4} \rightarrow \text{Martes}$$

$$\frac{x-4}{2} - \left( \frac{x+4}{4} \right) = \frac{x-12}{4} \rightarrow \text{Quedaba}$$

$$\frac{x-12}{4} + 2 = \frac{x+4}{8} \rightarrow \text{Miercoles}$$

Continúa

Continuación

41.  $\frac{x-12}{4} - \left( \frac{x+4}{8} \right) = 0 \quad \text{mcm}=8$

$$2x - 24 - x - 4 = 0$$

$$x - 28 = 0$$

$$x = 28$$

$\Rightarrow$  \$28  $\rightarrow$  Tenía el lunes antes de

42.  $x \rightarrow$  Capital primitivo

$$x + \frac{x}{2} - 6.000 = \frac{3x-12.000}{2} \rightarrow \text{Tenía}$$

$$\frac{3x-12.000}{2}$$

$$\frac{2}{2} - 6.000 = \frac{3x-36.000}{4} \rightarrow 2^\circ \text{ año}$$

$$\frac{3x-12.000}{2} + \frac{3x-36.000}{4} = \frac{9x-60.000}{4} \rightarrow \text{Tenía}$$

$$\frac{9x-60.000}{4}$$

$$\frac{4}{2} - 6.000 = \frac{9x-108.000}{8} \rightarrow 3^\circ \text{ año}$$

$$\frac{9x-60.000}{4} + \frac{9x-108.000}{8} = 32.250 \quad \text{mcm}=8$$

$$18x - 120.000 + 9x - 108.000 = 258.000$$

$$27x = 486.000$$

$$x = 18.000$$

\$18.000  $\rightarrow$  Capital primitivo

43.  $x \rightarrow$  Precio traje

\$15  $\rightarrow$  Precio bastón

$$s + 15 = \frac{3x}{4}$$

$$x + 15 - 5 = 2s$$

$$\frac{x+10}{2} \rightarrow \text{Precio sombrero}$$

$$\frac{x+10}{2} + 15 = \frac{3x}{4} \quad \text{mcm}=4$$

$$2x + 20 + 60 = 3x$$

$$80 = x$$

\$80  $\rightarrow$  Precio traje

$$\frac{80+10}{2} = \$45 \rightarrow \text{Precio sombrero}$$

44.  $x \rightarrow$  Espacio recorrido por perro y conejo

Perro Conejo

sup uesto 2 5

Pr egunta ? 50

Luego:  $\frac{2:50}{5} \rightarrow$  Saltos del perro con respecto a la ventaja

Perro Conejo

sup uesto 3 8

Pr egunta x ?

Luego:  $\frac{8x}{3} \rightarrow$  Saltos que avanza el conejo

al ser alcanzado

Continúa

### Continuación

44. 

Perro	Conejo
-------	--------

supuesto      2      5

Pr egunta      x      ?

Luego:  $\frac{5x}{2} \rightarrow$  Saltos que da el perro

para alcanzar al conejo

Entonces:

$$\frac{8x}{3} - \frac{2 \cdot 50}{5} = \frac{5x}{2} \quad mcm=6$$

$$16x - 120 = 15x$$

$$x = 120$$

$$\frac{5 \cdot 120}{2} = 300 \rightarrow \text{Saltos del perro}$$

para alcanzar al conejo

45.  $x \rightarrow$  Espacio recorrido  
por perro y liebre

Perro	Liebre
-------	--------

supuesto      3      4

Pr egunta      ?      60

Luego:  $\frac{3 \cdot 60}{4} \rightarrow$  Saltos del perro con

respecto a la ventaja

Perro	Liebre
-------	--------

supuesto      5      8

Pr egunta      x      ?

Luego:  $\frac{8x}{5} \rightarrow$  Saltos que avanza la

liebre al ser alcanzada

Perro	Liebre
-------	--------

supuesto      3      4

Pr egunta      x      ?

Luego:  $\frac{4x}{3} \rightarrow$  Saltos que da el perro

para alcanzar a la liebre

Entonces:

$$\frac{8x}{5} - \frac{3 \cdot 60}{4} = \frac{4x}{3}$$

$$\frac{8x}{5} - 45 = \frac{4x}{3} \quad mcm=15$$

$$24x - 675 = 20x$$

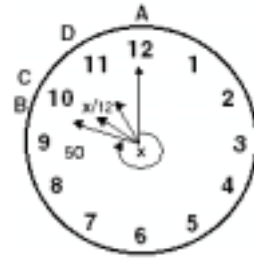
$$4x = 675$$

$$x = 168,75$$

$\frac{4}{3} \cdot 168,75 = 225 \rightarrow$  Saltos del perro

para alcanzar la liebre

46.



$$AB = x$$

$$AC = 50$$

$$CD = \frac{x}{12}$$

$$BD = 6$$

$$AB + BD = AC + CD$$

$$x + 6 = 50 + \frac{x}{12}$$

$$x - \frac{x}{12} = 44 \quad mcm=12$$

$$12x - x = 528$$

$$11x = 528$$

$$x = \frac{528}{11}$$

$$x = 48$$

47.  $x \rightarrow$  Aporta A

$\frac{3}{4}x \rightarrow$  Aporta B

$$x - \frac{x}{5} = \frac{4x}{5} \rightarrow 1^{\text{er}} \text{ año A}$$

$$\frac{3x}{4} + 3.000 = \frac{3x + 12.000}{4} \rightarrow 1^{\text{er}} \text{ año B}$$

$$\frac{4x}{5} + 1.600 = \frac{4x + 8.000}{5} \rightarrow 2^{\text{o}} \text{ año A}$$

$$\frac{3x + 12.000}{4} - \frac{1}{9} \left( \frac{3x + 12.000}{4} \right) \quad mcm = 36$$

$$\frac{27x + 108.000 - 3x - 12.000}{36}$$

$$\frac{24x + 96.000}{36} = \frac{3(8x + 32.000)}{36}$$

$$\frac{8x + 32.000}{12} \rightarrow 2^{\text{o}} \text{ año B}$$

Entonces:

$$\frac{4x + 8.000}{5} = \frac{8x + 32.000}{12} \quad mcm = 60$$

$$48x + 96.000 = 40x + 160.000$$

$$8x = 64.000$$

$$x = 8.000$$

8.000bs  $\rightarrow$  Aportó A

$$\frac{3 \cdot 8.000}{4} = 6.000 \text{ bs} \rightarrow \text{Aportó B}$$

48.  $x \rightarrow$  Años para que la edad del padre sea = a la suma de sus hijos

$$60 + x = 16 + x + 14 + x$$

$$60 + x = 30 + 2x$$

$$30 = x$$

30 años  $\rightarrow$  Edad del padre sea igual a la suma de sus hijos

49.  $x \rightarrow$  Km. recorridos

$$\frac{x}{50} + \frac{x}{10} = 12 \quad mcm=50$$

$$x + 5x = 600$$

$$6x = 600$$

$$x = 100$$

100  $\rightarrow$  Km. recorridos

50. Buey  $\rightarrow$  \$80

$$P + 80 = 2C$$

$$C + 80 = \frac{13P}{2}$$

Luego:

$$\frac{P + 80}{2} = C$$

$$\frac{P + 80}{2} + 80 = \frac{13P}{2} \quad mcm=2$$

$$P + 80 + 160 = 13P$$

$$240 = 12P$$

$$20 = P$$

\$20  $\rightarrow$  Costo el perro

$$\frac{20 + 80}{2} = C \quad mcm=2$$

$$20 + 80 = 2C$$

$$100 = 2C$$

$$50 = C$$

\$50  $\rightarrow$  Costo el caballo

## EJERCICIO 159

1.  $a = 30m$

$$v = 8 \frac{m}{s}$$

$$v' = 5 \frac{m}{s}$$

$$x = \frac{30 \cdot 8}{8 - 5}$$

$$x = \frac{240}{3}$$

$$x = 80m$$

2.  $a = 160 Km$

$$v = 50 \frac{Km}{h}$$

$$v' = -30 \frac{Km}{h}$$

$$x = \frac{160 \cdot 50}{50 - (-30)}$$

$$x = \frac{8.000}{80}$$

$$x = 100 Km.$$

3.  $a = 200 Km$

$$v = 90 \frac{Km}{h}$$

$$v' = 40 \frac{Km}{h}$$

$$x = \frac{200 \cdot 90}{90 - 40}$$

Continúa

### Continuación

3.  $x = \frac{18.000}{50}$

$x = 360 Km$  de A

De B.

Como la distancia entre A y B es 200 Km

Entonces B recorrió

$$360 Km - 200 Km = 160 Km$$

4.  $a = 80 Km$

$$v = 90 \frac{Km}{h}$$

$$v' = 70 \frac{Km}{h}$$

$$x = \frac{80 \cdot 90}{90 - 70}$$

$$x = \frac{7.200}{20}$$

$$x = 360 Km$$

El tiempo empleado en encontrarse será.

$$\frac{360 Km}{90 \frac{Km}{h}} = 4 horas$$

5.  $a = 550 Km$

$$v = 100 \frac{Km}{h}$$

$$v' = -120 \frac{Km}{h}$$

De A.

$$x = \frac{550 \cdot 100}{100 - (-120)}$$

$$x = \frac{55.000}{220}$$

$$x = 250 Km$$

Como los trenes pasan por A y B a las 8am

Entonces De A.

$$x = 250 Km$$

$$v = 100 \frac{Km}{h}$$

Tiempo empleado para los 250 Km. es

$$\frac{250 Km}{100 \frac{Km}{h}} = 2,5 horas$$

2,5 horas  $\rightarrow$  2 h 30 min.

Luego:

8am + 2 h 30 min = 10:30

10:30 am  $\rightarrow$  Se encuentran

6.  $a = 70 \text{ Km}$

$$v = 9 \text{ Km/h}$$

$$v' = -5 \text{ Km/h}$$

$x \rightarrow$  Distancia recorrida por  
A al encontrarse

$$x = \frac{70 \cdot 9}{9 - (-5)}$$

$$x = \frac{630}{14}$$

$$x = 45 \text{ Km} \rightarrow A$$

Como A recorrió 45 Km

Entonces B

$$70 \text{ Km} - 45 \text{ Km} = 25 \text{ Km} \rightarrow B$$

9.  $a = 186 \text{ Km}$

$$v = v$$

$$v' = -v$$

$$x = \frac{186v}{v - (-v)}$$

$$x = \frac{186v}{2v}$$

$$x = 93 \text{ Km.}$$

7. A y B distantes  $29\frac{1}{2} \text{ Km}$

$$\Rightarrow 29\frac{1}{2} \text{ Km} - 2\frac{1}{2} \text{ Km} = 27 \text{ Km}$$

$$a = 27 \text{ Km}$$

$$v = 5 \text{ Km/h}$$

$$v' = -4 \text{ Km/h}$$

$$x = \frac{27 \cdot 5}{5 - (-4)}$$

$$x = \frac{135}{9}$$

$$x = 15 \text{ Km}$$

Luego A recorre

$$15 \text{ Km} + 2\frac{1}{2} \text{ Km} = 17\frac{1}{2} \text{ Km}$$

B recorre

$$29\frac{1}{2} \text{ Km} - 17\frac{1}{2} \text{ Km} = 12 \text{ Km}$$

8. Recorrido tren de carga  
en 3 horas es

$$42 \frac{\text{Km}}{h} (3h) = 126 \text{ Km}$$

$$a = 126 \text{ Km}$$

$$v = 60 \text{ Km/h}$$

$$v' = 42 \text{ Km/h}$$

$$x = \frac{126 \cdot 60}{60 - 42}$$

$$x = \frac{7.560}{18}$$

$$x = 420 \text{ Km}$$

420 Km  $\rightarrow$  Alcanza el tren de  
pasajeros al de carga

El tiempo empleado es:

$$\frac{420 \text{ Km}}{60 \text{ Km/h}} = 7 \text{ horas}$$

## EJERCICIO 162

1.  $b = 10 \text{ cm}$

$$h = 8 \text{ cm}$$

$$A = \frac{b \cdot h}{2}$$

$$A = \frac{10 \text{ cm} \cdot 8 \text{ cm}}{2}$$

$$A = 40 \text{ cm}^2$$

2.  $d = 8 \text{ m}$

$$A = \frac{d^2}{2}$$

$$A = \frac{(8 \text{ m})^2}{2}$$

$$A = 32 \text{ m}^2$$

3.  $t = 15 \text{ s}$

$$v = 9 \text{ m/s}$$

$$e = v \cdot t$$

$$e = (15 \text{ s}) (9 \text{ m/s})$$

$$e = 135 \text{ m}$$

4.  $v = 9 \text{ m/s}$

$$e = 108 \text{ m}$$

$$t = \frac{e}{v} \Rightarrow t = \frac{108 \text{ m}}{9 \text{ m/s}}$$

$$t = 12 \text{ s}$$

5.  $b = 4 \text{ m}$

$$c = 3 \text{ m}$$

$$a^2 = b^2 + c^2$$

$$a^2 = (4 \text{ m})^2 + (3 \text{ m})^2$$

$$a^2 = 16 \text{ m}^2 + 9 \text{ m}^2$$

$$a^2 = 25 \text{ m}^2$$

$$a = \sqrt{25 \text{ m}^2}$$

$$a = 5 \text{ m}$$

6.  $a = 13 \text{ m}$

$$c = 5 \text{ m}$$

$$b^2 = a^2 - c^2$$

$$b^2 = (13 \text{ m})^2 - (5 \text{ m})^2$$

$$b^2 = 169 \text{ m}^2 - 25 \text{ m}^2$$

$$b^2 = 144 \text{ m}^2$$

$$b = \sqrt{144 \text{ m}^2}$$

$$b = 12 \text{ m}$$

7.  $r = 5 \text{ m}$

$$\pi = 3,14$$

$$A = \pi \cdot r^2$$

$$A = 3,14 (5 \text{ m})^2$$

$$A = 3,14 \cdot 25 \text{ m}^2$$

$$A = 78,5 \text{ m}^2$$

8.  $r = 5 \text{ m}$

$$\pi = 3,14$$

$$C = 2\pi \cdot r$$

$$C = 2 \cdot 3,14 \cdot 5 \text{ m}$$

$$C = 10 \text{ m} \cdot 3,14$$

$$C = 31,4 \text{ m}$$

9.  $h = 9 \text{ m}$

$$r = 2 \text{ m}$$

$$\pi = 3,14$$

$$v = \frac{h \cdot \pi \cdot r^2}{3}$$

$$v = \frac{9 \text{ m} \cdot 3,14 (2 \text{ m})^2}{3}$$

$$v = 12 \text{ m}^2 \cdot 3,14$$

$$v = 37,68 \text{ m}^2$$

10.  $P = 8,24 \text{ g}$

$$V = 8 \text{ cm}^3$$

$$D = \frac{P}{V}$$

$$D = \frac{8,24 \text{ g}}{8 \text{ cm}^3}$$

$$D = 1,03 \text{ g/cm}^3$$

11.  $L = 4 \text{ m}$

$$A = \frac{L^2 \sqrt{3}}{4}$$

$$A = \frac{(4 \text{ m})^2 \sqrt{3}}{4}$$

$$A = 4 \text{ m}^2 \sqrt{3}$$

$$A = 6,92 \text{ m}^2$$

12.  $N = 6$

$$S = 180^\circ (6 - 2)$$

$$S = 180^\circ (4)$$

$$S = 720^\circ$$

## EJERCICIO 163

1.  $e = v \cdot t$

$$v = \frac{e}{t} \text{ Rta}$$

$$t = \frac{e}{v} \text{ Rta}$$

2.  $A = h \left( \frac{b+b'}{2} \right)$

$$2A = h(b+b')$$

$$\frac{2A}{b+b'} = h \text{ Rta}$$

3.  $e = \frac{1}{2} a \cdot t^2$

$$2e = a \cdot t^2$$

$$\frac{2e}{t^2} = a \text{ Rta}$$

4.  $A = \frac{1}{2} a \cdot l \cdot n$

$$2A = a \cdot l \cdot n$$

$$\frac{2A}{l \cdot n} = a \text{ Rta}$$

$$\frac{2A}{n \cdot a} = l \text{ Rta}$$

$$\frac{2A}{l \cdot a} = n \text{ Rta}$$

5.  $A = \pi \cdot r^2$

$$\frac{A}{\pi} = r^2$$

$$\sqrt{\frac{A}{\pi}} = r \text{ Rta}$$

6.  $a^2 = b^2 + c^2 - 2bx$

$$a^2 - b^2 - c^2 = -2bx$$

$$-\frac{a^2 - b^2 - c^2}{2b} = x$$

$$\frac{b^2 + c^2 - a^2}{2b} = x \text{ Rta}$$

7.  $\bar{V} = V_0 + a \cdot t$

$$\bar{V} - a \cdot t = V_0 \text{ Rta}$$

$$\bar{V} - V_0 = a \cdot t$$

$$\frac{\bar{V} - V_0}{t} = a \text{ Rta}$$

$$\frac{\bar{V} - V_0}{a} = t \text{ Rta}$$

8.  $\bar{V} = V_0 - a \cdot t$

$$\bar{V} + a \cdot t = V_0 \text{ Rta}$$

$$a \cdot t = V_0 - \bar{V}$$

$$a = \frac{V_0 - \bar{V}}{t} \text{ Rta}$$

$$t = \frac{V_0 - \bar{V}}{a} \text{ Rta}$$

9.  $D = \frac{P}{V}$

$$DV = P$$

$$V = \frac{P}{D} \text{ Rta}$$

$$P = VD \text{ Rta}$$

10.  $a^2 = b^2 + c^2$

$$a^2 - c^2 = b^2$$

$$\sqrt{a^2 - c^2} = b \text{ Rta}$$

$$a^2 - b^2 = c^2$$

$$\sqrt{a^2 - b^2} = c \text{ Rta}$$

11.  $V = a \cdot t$

$$\frac{V}{a} = t \text{ Rta}$$

$$a = \frac{V}{t} \text{ Rta}$$

12.  $\frac{1}{f} = \frac{1}{p'} - \frac{1}{p}$

$$\frac{p' \cdot p}{f \cdot p' \cdot p} = \frac{f \cdot p - f \cdot p'}{f \cdot p' \cdot p}$$

$$p' \cdot p = f(p - p')$$

$$p' = \frac{f(p - p')}{p}$$

$$p' = \frac{f \cdot p - f \cdot p'}{p}$$

$$p' = f - \frac{f \cdot p'}{p}$$

$$p' + \frac{f \cdot p'}{p} = f$$

$$\frac{p' \cdot p + f \cdot p'}{p} = f$$

$$p'(p + f) = p \cdot f$$

$$p' = \frac{p \cdot f}{p + f} \text{ Rta}$$

**Continúa**

## Continuación

12.  $\frac{p' \cdot p + f \cdot p'}{p} = f$

$$\frac{p' \cdot p + f \cdot p'}{p} = f$$

$$p' + \frac{f \cdot p'}{p} = f$$

$$\frac{f \cdot p'}{p} = f - p'$$

$$f \cdot p' = p(f - p')$$

$$\frac{f \cdot p'}{f - p'} = p \text{ Rta}$$

13.  $v = \sqrt{\frac{e}{d}}$

$$v^2 = \frac{e}{d}$$

$$v^2 \cdot d = e \text{ Rta}$$

$$d = \frac{e}{v^2} \text{ Rta}$$

14.  $e = V_0 \cdot t + \frac{1}{2} a \cdot t^2$

$$2e = 2V_0 \cdot t + a \cdot t^2$$

$$2e - a \cdot t^2 = 2V_0 \cdot t$$

$$\frac{2e - a \cdot t^2}{2 \cdot t} = V_0 \text{ Rta}$$

15.  $e = V_0 \cdot t - \frac{1}{2} a \cdot t^2$

$$2e = 2V_0 \cdot t - a \cdot t^2$$

$$2e + a \cdot t^2 = 2V_0 \cdot t$$

$$\frac{2e + a \cdot t^2}{2 \cdot t} = V_0 \text{ Rta}$$

$$a \cdot t^2 = 2V_0 \cdot t - 2e$$

$$a = \frac{2V_0 \cdot t - 2e}{t^2}$$

$$a = \frac{2(V_0 \cdot t - e)}{t^2} \text{ Rta}$$

16.  $V = \frac{h \cdot \pi \cdot r^2}{3}$

$$\frac{3V}{\pi \cdot r^2} = h \text{ Rta}$$

$$\frac{3V}{\pi \cdot h} = r^2$$

$$\sqrt{\frac{3V}{\pi \cdot h}} = r \text{ Rta}$$

17.  $l = \frac{c \cdot t \cdot r}{100}$

$$100l = c \cdot t \cdot r$$

$$\frac{100l}{t \cdot r} = c \text{ Rta}$$

$$\frac{100l}{r \cdot c} = t \text{ Rta}$$

$$\frac{100l}{c \cdot t} = r \text{ Rta}$$

18.  $E = I \cdot R$

$$\frac{E}{I} = R \text{ Rta}$$

$$\frac{E}{R} = I \text{ Rta}$$

19.  $e = \frac{V^2}{2a}$

$$2ae = V^2$$

$$\sqrt{2ae} = V \text{ Rta}$$

20.  $u = a + (n-1)r$

$$u - (n-1)r = a \text{ Rta}$$

$$u - a = (n-1)r$$

$$\frac{u - a}{r} = n - 1$$

$$\frac{u - a}{r} + 1 = n$$

$$\frac{u - a + r}{r} = n \text{ Rta}$$

$$u - a + r = nr$$

$$u - a = nr - r$$

$$u - a = r(n-1)$$

$$\frac{u - a}{n - 1} = r \text{ Rta}$$

21.  $u = a \cdot r^{n-1}$

$$\frac{u}{r^{n-1}} = a \text{ Rta}$$

$$\frac{u}{a} = r^{n-1}$$

$${}^{n-1}\sqrt{\frac{u}{a}} = r \text{ Rta}$$

22.  $l = \frac{Q}{t}$

$$Q = l \cdot t \text{ Rta}$$

$$\frac{Q}{l} = t \text{ Rta}$$

## EJERCICIO 164

1.  $x-5 < 2x-6$   
 $-5+6 < 2x-x$   
 $1 < x$   
 $1 \rightarrow \text{Lim. inferior de } x$
2.  $5x-12 > 3x-4$   
 $5x-3x > 12-4$   
 $2x > 8$   
 $x > 4$   
 $4 \rightarrow \text{Lim. inferior de } x$
3.  $x-6 > 21-8x$   
 $x+8x > 21+6$   
 $9x > 27$   
 $x > 3$   
 $3 \rightarrow \text{Lim. inferior de } x$
4.  $3x-14 < 7x-2$   
 $-14+2 < 7x-3x$   
 $-12 < 4x$   
 $-3 < x$
5.  $2x - \frac{5}{3} > \frac{x}{3} + 10$   
 $6x-5 > x+30$   
 $6x-x > 30+5$   
 $5x > 35$   
 $x > 7$
6.  $3x-4 + \frac{x}{4} < \frac{5x}{2} + 2$   
 $12x-16+x < 10x+8$   
 $12x+x-10x < 16+8$   
 $3x < 24$   
 $x < 8$
7.  $(x-1)^2 - 7 > (x-2)^2$   
 $x^2-2x+1-7 > x^2-4x+4$   
 $-6-4 > -4x+2x$   
 $-10 > -2x$   
 $10 < 2x$   
 $5 < x$
8.  $(x+2)(x-1) + 26 < (x+4)(x+5)$   
 $x^2+x-2+26 < x^2+9x+20$   
 $24-20 < 9x-x$   
 $4 < 8x$   
 $\frac{1}{2} < x$
9.  $3(x-2) + 2x(x+3) > (2x-1)(x+4)$   
 $3x-6+2x^2+6x > 2x^2+7x-4$   
 $9x-6 > 7x-4$   
 $9x-7x > -4+6$   
 $2x > 2$   
 $x > 1$
10.  $6(x^2+1) - (2x-4)(3x+2) < 3(5x+21)$   
 $6x^2+6-6x^2+8x+8 < 15x+63$   
 $8x+14 < 15x+63$   
 $8x-15x < 63-14$   
 $-7x < 49$   
 $7x > -49$   
 $x > -7$
11.  $(x-4)(x+5) < (x-3)(x-2)$   
 $x^2+x-20 < x^2-5x+6$   
 $5x+x < 20+6$   
 $6x < 26$   
 $x < \frac{26}{6}$   
 $x < \frac{13}{3}$
12.  $(2x-3)^2 + 4x^2(x-7) < 4(x-2)^3$   
 $4x^2-12x+9+4x^3-28x^2 < 4x^3-24x^2+48x-32$   
 $-12x-48x < -9-32$   
 $-60x < -41$   
 $60x > 41$   
 $x > \frac{41}{60}$
13.  $\frac{2x+1}{3x-1} > \frac{2x+5}{3x+2}$   
 $(3x+2)(2x+1) > (2x+5)(3x-1)$   
 $6x^2+7x+2 > 6x^2+13x-5$   
 $2+5 > 13x-7x$   
 $7 > 6x$   
 $\frac{7}{6} > x$
14.  $\frac{x+3}{3} - \frac{4}{x+2} > \frac{x}{3}$   
 $(x+2)(x+3) - 12 > x(x+2)$   
 $x^2+5x+6-12 > x^2+2x$   
 $5x-2x > 6$   
 $3x > 6$   
 $x > 2$
15.  $\frac{5}{3x+1} - \frac{20}{9x^2-1} < \frac{2}{3x-1}$   
 $5(3x-1) - 20 < 2(3x+1)$   
 $15x-5-20 < 6x+2$   
 $15x-6x < 25+2$   
 $9x < 27$   
 $x < 3$
16.  $\frac{1}{x^2+x} > \frac{1}{x^2-x} - \frac{1}{x^2-1}$   
 $x-1 > x+1-x$   
 $x > 2$
17.  $x \rightarrow \mathbb{N}^0$  s. enteros  
 $\frac{x}{3} + 15 > \frac{x}{2} + 1$   
 $2x+90 > 3x+6$   
 $90-6 > 3x-2x$   
 $84 > x$   
 $\mathbb{N}^0$  s. enteros menores que 84 Rta

## EJERCICIO 165

1.  $x-3 > 5$  y  $2x+5 > 17$   
 $x-3 > 5$        $2x+5 > 17$   
 $x > 5+3$        $2x > 12$   
 $x > 8$        $x > 6$   
 $x > 8$  Rta
2.  $5-x > -6$  y  $2x+9 > 3x$   
 $-x > -6-5$        $-x > -9$   
 $x < 11$        $x < 9$   
 $x < 9$  Rta
3.  $6x+5 > 4x+11$        $4-2x > 10-5x$   
 $2x > 6$        $3x > 6$   
 $x > 3$        $x > 2$   
 $x > 3$  Rta

$$4. \begin{aligned} 5x-4 > 7x-16 & \text{ y } 8-7x < 16-15x \\ 12 > 2x & \quad 8x < 8 \\ 6 > x & \quad x < 1 \\ x < 1 & \text{ Rta} \end{aligned}$$

$$5. \begin{aligned} \frac{x}{2}-3 > \frac{x}{4}+2 & \text{ y } 2x+\frac{3}{5} < 6x-23\frac{2}{5} \\ 2x-12 > x+8 & \quad 10x+3 < 30x-117 \\ x > 20 & \quad 120 < 20x \\ & \quad 6 < x \\ x > 20 & \text{ Rta} \end{aligned}$$

$$6. \begin{aligned} 2x-3 < x+10 & \text{ y } 6x-4 > 5x+6 \\ 2x-x < 10+3 & \quad 6x-5x > 6+4 \\ x < 13 & \quad x > 10 \\ 10 < x < 13 & \text{ Rta} \end{aligned}$$

$$7. \begin{aligned} \frac{x}{4}-1 > \frac{x}{3}-1\frac{1}{2} & \text{ y } 2x-3\frac{3}{5} > x+\frac{2}{5} \\ 3x-12 > 4x-18 & \quad 10x-18 > 5x+2 \\ 18-12 > 4x-3x & \quad 5x > 20 \\ 6 > x & \quad x > 4 \\ 4 < x < 6 & \text{ Rta} \end{aligned}$$

$$8. \begin{aligned} (x-1)(x+2) < (x+2)(x-3) & \text{ y } (x+3)(x+5) > (x+4)(x+3) \\ x^2+x-2 < x^2-x-6 & \quad x^2+8x+15 > x^2+7x+12 \\ 2x < -4 & \quad x > -3 \\ x < -2 & \end{aligned}$$

$$-3 < x < -2 \text{ Rta}$$

$$9. \begin{aligned} \frac{x+2}{x+8} > \frac{x-2}{x+3} & \text{ y } \frac{x-1}{x+4} < \frac{x-5}{x-1} \\ (x+2)(x+3) > (x-2)(x+8) & \quad (x-1)^2 < (x-5)(x+4) \\ x^2+5x+6 > x^2+6x-16 & \quad x^2-2x+1 < x^2-x-20 \\ 22 > x & \quad 21 < x \\ 21 < x < 22 & \text{ Rta} \end{aligned}$$

$$10. x \rightarrow \mathbb{N}^0 \text{ s. enteros}$$

$$\begin{aligned} 3x-6 > \frac{x}{2}+4 & \text{ y } 4x+8 < 3x+15 \\ 6x-12 > x+8 & \quad x < 7 \\ 5x > 20 & \quad x > 4 \\ 4 < x < 7 & \text{ Luego son 5 y 6 Rta} \end{aligned}$$

## EJERCICIO 166

1. $x = Ky$ $9 = K6$ $\frac{9}{6} = K$ $x = \frac{3}{2} \cdot 8$ $x = 12$	2. $x = Ky$ $2 = K3$ $\frac{2}{3} = K$ $24 = \frac{2}{3}y$ $\frac{3 \cdot 24}{2} = y$ $36 = y$	3. $A = KBC$ $30 = K(2)(5)$ $\frac{30}{10} = K$ $3 = K$ $A = 3(7)(4)$ $A = 84$	4. $x = KYZ$ $4 = K(3)(6)$ $\frac{4}{18} = K$ $\frac{2}{9} = K$ $10 = Ky9$ $10 = \frac{2}{9}y9$ $10 = 2y$ $5 = y$	5. $A = \frac{K}{B}$ $3 = \frac{K}{5}$ $15 = K$ $A = \frac{K}{7}$ $A = \frac{15}{7} = 2\frac{1}{7}$	6. $B = \frac{K}{A}$ $\frac{1}{3} = \frac{K}{1}$ $\frac{1}{3} = 2K$ $\frac{1}{6} = K$ $\frac{1}{12} = \frac{1}{6} \Rightarrow \frac{1}{12} = \frac{1}{6A}$ $\Rightarrow 6A = 12 \Rightarrow A = 2$
7. $A = \frac{KB}{C}$ $8 = \frac{K12}{3}$ $8 = 4K$ $2 = K$ $A = \frac{2 \cdot 7}{14}$ $A = 1$	8. $x = \frac{Ky}{Z}$ $3 = \frac{4K}{8}$ $24 = 4K$ $6 = K$ $10 = \frac{7 \cdot 6}{Z}$ $Z = \frac{42}{10}$ $Z = 4\frac{1}{5}$	9. $x = K(y^2 - 1)$ $48 = K(5^2 - 1)$ $48 = K(25 - 1)$ $\frac{48}{24} = K$ $2 = K$ $x = 2(7^2 - 1)$ $x = 2 \cdot 48$ $x = 96$	10. $x = \frac{K}{y^2 - 1}$ $9 = \frac{K}{(3^2 - 1)}$ $9 = \frac{K}{8}$ $72 = K$ $x = \frac{72}{(5^2 - 1)}$ $x = \frac{72}{24}$ $x = 3$	11. $A \rightarrow$ Area del cuadrado $d \rightarrow$ Diagonal $A = Kd^2$ $18m^2 = K(6m)^2$ $\frac{18m^2}{36m^2} = K$ $\frac{1}{2} = K$ $A = \frac{1}{2}(10m)^2$ $A = \frac{100m^2}{2}$ $A = 50m^2$	12. $Ap \rightarrow$ Area piramide $a \rightarrow$ apotema $pb \rightarrow$ perim. de la b. $Ap = Kapb$ $480m^2 = K(12m)(80m)$ $480m^2 = K(960m^2)$ $\frac{480m^2}{960m^2} = K$ $\frac{1}{2} = K$ $Ap = \frac{1}{2}(6m)(40m)$ $Ap = \frac{240m^2}{2}$ $Ap = 120m^2$



13.  $Vp \rightarrow$  Vol. piramide

$h \rightarrow$  Altura

$Ab \rightarrow$  Area base

$Vp = KhAb$

$96m^3 = K \cdot 8m(36m^2)$

$96m^3 = K(288m^3)$

$\frac{1}{3} = K$

$Vp = \frac{1}{3} \cdot 12m(64m^2)$

$Vp = \frac{768m^3}{3}$

$Vp = 256m^3$

14.  $Ao \rightarrow$  Area circulo

$r \rightarrow$  Radio

$Ao = Kr^2$

$616cm^2 = K(14cm)^2$

$\frac{616cm^2}{196cm^2} = K$

$\frac{22}{7} = K$

$Ao = \frac{22}{7}(7cm)^2$

$Ao = 22 \cdot 7cm^2$

$Ao = 154cm^2$

15.  $Lo \rightarrow$  Long. circunf.

$r \rightarrow$  Radio

$Lo = Kr$

$44cm = K \cdot 7cm$

$\frac{44}{7} = K$

$66cm = \frac{44r}{7}$

$462cm = 44r$

$\frac{462}{44}cm = r$

$10\frac{1}{2}cm = r$

16.  $x = \frac{K}{y^2}$

$4 = \frac{K}{6^2}$

$36 \cdot 4 = K$

$144 = K$

$9 = \frac{144}{y^2}$

$y^2 = \frac{144}{9}$

$y = \pm \sqrt{\frac{144}{9}}$

$y = \pm \frac{12}{3}$

$y = \pm 4$

## EJERCICIO 167

1.  $A = KB$

$10 = K5$

$2 = K \Rightarrow A = 2B$

2.  $e \rightarrow$  Espacio

$V \rightarrow$  Velocidad

$t \rightarrow$  Tiempo

$e = Kvt$

Si  $K=1 \Rightarrow e = vt$

3.  $Ar \rightarrow$  Area rombo

$D \rightarrow$  Diag mayor

$D' \rightarrow$  Diag menor

$A = KDD'$

$24cm^2 = K \cdot 8cm \cdot 6cm$

$24cm^2 = K \cdot 48cm^2$

$\frac{1}{2} = K$

$A = \frac{1}{2}DD'$

4.  $A = \frac{KB}{C}$

$K=3 \Rightarrow A = \frac{3B}{C}$

5.  $C = Kr$

$132cm = K \cdot 21cm$

$\frac{132cm}{21cm} = K$

$\frac{44}{7} = K$

$C = \frac{44}{7}r$

6.  $C \rightarrow$  Espacio (h)

$t \rightarrow$  Tiempo

$h \rightarrow$  Altura (e)

$e = K \cdot t^2$

$19,6m = K(2s)^2$

$\frac{19,6m}{4s^2} = K$

$4,9\frac{m}{s^2} = K$

$e = 4,9t^2$

7.  $F = \frac{KmV^2}{r}$

8.  $y \rightarrow$  Función

$x \rightarrow$  Vble. indep.

$y = 2x + 3$

9.  $L \rightarrow$  Lado de un cuad.

inscrito en un circulo

$r \rightarrow$  Radio

$L = K \cdot r$

$K = \sqrt{2}$

$L = \sqrt{2} \cdot r$

10.  $y \rightarrow$  Función

$x \rightarrow$  Vble. indep.

$y = \frac{x^2}{2} + 2$

11.  $y = \frac{5-2x}{3}$

12.  $F \rightarrow$  Fuerza de atracc.

$m \rightarrow$  Masa cuerpo1

$m' \rightarrow$  Masa cuerpo2

$d \rightarrow$  Distancia

$F = \frac{K \cdot m \cdot m'}{d^2}$

13.  $h \rightarrow$  Altura  $\Delta$

$A \rightarrow$  Area del  $\Delta$

$B \rightarrow$  Base

$h = \frac{K \cdot A}{B}$

$10cm = \frac{K \cdot 20cm^2}{4cm}$

$10cm = K \cdot 5cm$

$2 = K$

$h = \frac{2A}{B}$

14.  $W \rightarrow$  Energ. cinetica

$m \rightarrow$  Masa

$V \rightarrow$  Velocidad

$W = KmV^2$

$K = \frac{1}{2}$

$W = \frac{1}{2}mV^2$

15.  $B \rightarrow$  Area base piramide

$V \rightarrow$  Volumen

$h \rightarrow$  Altura

$$B = \frac{KV}{h}$$

$$100 = \frac{K \cdot 400}{12}$$

$$1.200 = K \cdot 400$$

$$3 = K$$

$$B = \frac{3V}{h}$$

16.  $x = \frac{K}{y}$

$$2 = \frac{K}{5}$$

$$10 = K$$

$$x = \frac{10}{y}$$

17.  $x = \frac{K}{y^2}$

$$3 = \frac{K}{2^2}$$

$$12 = K$$

$$x = \frac{12}{y^2}$$

18.  $A = \frac{KB}{C}$

$$3 = \frac{K \cdot 24}{4}$$

$$12 = K \cdot 24$$

$$\frac{1}{2} = K$$

$$A = \frac{\frac{1}{2}B}{C}$$

$$A = \frac{B}{2C}$$

## EJERCICIO 173

1.  $x + y = 5$

$$y = 5 - x$$

$$5 - x \rightarrow \text{Entero } y +$$

Para que  $y$  sea entero

$y$  + el mayor valor que

podemos dar a  $x$  es 4.

Por tan to las soluciones

enteras  $y$  + son:

$$x=1 \quad y=4$$

$$x=2 \quad y=3$$

$$x=3 \quad y=2$$

$$x=4 \quad y=1$$

2.  $2x + 3y = 37$

$$2x = 37 - 3y$$

$$x = \frac{37 - 3y}{2}$$

$$x = \frac{36}{2} + \frac{1}{2} - \frac{2y}{2} - \frac{y}{2}$$

$$x = 18 - y + \frac{1-y}{2}$$

$$x - 18 + y = \frac{1-y}{2}$$

$$\frac{1-y}{2} \rightarrow \text{Entero}$$

$$\frac{3-3y}{2} \rightarrow \text{Entero}$$

$$\frac{2}{2} + \frac{1}{2} - \frac{2y}{2} - \frac{y}{2}$$

$$1 - y + \frac{1-y}{2} \rightarrow \text{Entero}$$

Continúa

2. Continuación

$$\frac{1-y}{2} = m$$

$$1 - y = 2m$$

$$-y = 2m - 1$$

$$y = 1 - 2m$$

$$\Rightarrow 2x + 3(1 - 2m) = 37$$

$$2x + 3 - 6m = 37$$

$$2x = 34 + 6m$$

$$x = \frac{2(17 + 3m)}{2}$$

$$x = 17 + 3m$$

$$y = 1 - 2m \rightarrow m \text{ entero}$$

$$x = 17 + 3m$$

$$m=0 \quad y=1 \quad x=17 \quad \text{sol}$$

$$m=1 \quad y=-1 \rightarrow \text{no}$$

$$m=-1 \quad y=3 \quad x=14 \quad \text{sol}$$

$$m=-2 \quad y=5 \quad x=11 \quad \text{sol}$$

$$m=-3 \quad y=7 \quad x=8 \quad \text{sol}$$

$$m=-4 \quad y=9 \quad x=5 \quad \text{sol}$$

$$m=-5 \quad y=11 \quad x=2 \quad \text{sol}$$

$$m=-6 \quad y=13 \quad x=-1 \rightarrow \text{no}$$

3.  $3x + 5y = 43$

$$3x = 43 - 5y$$

$$x = \frac{43 - 5y}{3}$$

$$x = \frac{42}{3} + \frac{1}{3} - \frac{3y}{3} - \frac{2y}{3}$$

$$x = 14 - y + \frac{1-2y}{3}$$

Continúa

3. Continuación

$$x - 14 + y = \frac{1-2y}{3}$$

$$\frac{1-2y}{3} \rightarrow \text{Entero}$$

$$\frac{2-4y}{3} \rightarrow \text{Entero}$$

$$\frac{2}{3} - \frac{3y}{3} - \frac{1y}{3}$$

$$-y + \frac{2-y}{3}$$

$$\frac{2-y}{3} = m$$

$$2 - y = 3m$$

$$-y = 3m - 2$$

$$y = 2 - 3m$$

$$3x + 5(2 - 3m) = 43$$

$$3x + 10 - 15m = 43$$

$$3x = 33 + 15m$$

$$x = \frac{3(11 + 5m)}{3}$$

$$x = 11 + 5m$$

$$y = 2 - 3m$$

$$x = 11 + 5m$$

$$m=0 \quad x=11 \quad y=2 \quad \text{sol}$$

$$m=1 \quad x=16 \quad y=-1 \rightarrow \text{no}$$

$$m=-1 \quad x=6 \quad y=5 \quad \text{sol}$$

$$m=-2 \quad x=1 \quad y=8 \quad \text{sol}$$

$$m=-3 \quad x=-4 \rightarrow \text{No}$$

4.  $x+3y=9$

$$\begin{aligned} x &= 9-3y \\ 9-3y &\rightarrow \text{Entero} \\ 3-y &\rightarrow \text{Entero} \\ 3-y &= m \\ -y &= m-3 \\ y &= 3-m \\ x+3(3-m) &= 9 \\ x+9-3m &= 9 \\ x &= 3m \end{aligned}$$

$$\begin{aligned} y &= 3-m \\ x &= 3m \\ m=0 \quad x=0 \quad y=3 &\rightarrow \text{No} \\ m=1 \quad x=3 \quad y=2 &\text{ sol} \\ m=2 \quad x=6 \quad y=1 &\text{ sol} \\ m=3 \quad x=9 \quad y=0 &\rightarrow \text{No} \\ m=4 \quad x=12 \quad y=-1 &\rightarrow \text{No} \end{aligned}$$

5.  $7x+8y=115$

$$\begin{aligned} 7x &= 115-8y \\ x &= \frac{115-8y}{7} \\ x &= \frac{112}{7} + \frac{3}{7} - \frac{7y}{7} - \frac{y}{7} \\ x &= 16 - y + \frac{3-y}{7} \end{aligned}$$

$$\begin{aligned} \frac{3-y}{7} &\rightarrow \text{Entero} \\ \frac{24-8y}{7} &\rightarrow \text{Entero} \\ \frac{24}{7} - \frac{7y}{7} - \frac{y}{7} \\ -y + \frac{24-y}{7} \\ \frac{24-y}{7} &= m \\ 24-y &= 7m \\ -y &= 7m-24 \\ y &= 24-7m \end{aligned}$$

$$\begin{aligned} 7x+8(24-7m) &= 115 \\ 7x+192-56m &= 115 \\ 7x-56m &= -77 \\ x &= \frac{7(8m-11)}{7} \\ x &= 8m-11 \end{aligned}$$

**Continúa**

**5. Continuación**

$$\begin{aligned} y &= 24-7m \\ x &= 8m-11 \\ m=0 \quad x &= -11 \rightarrow \text{No} \\ m=1 \quad x &= -3 \rightarrow \text{No} \\ m=2 \quad x &= 5 \quad y=10 \text{ sol} \\ m=3 \quad x &= 13 \quad y=3 \text{ sol} \\ m=4 \quad x &= 21 \quad y=-4 \rightarrow \text{No} \\ m=-1 \quad x &= -19 \rightarrow \text{No} \end{aligned}$$

6.  $15x+7y=136$

$$\begin{aligned} 7y &= 136-15x \\ y &= \frac{136-15x}{7} \\ y &= \frac{133}{7} + \frac{3}{7} - \frac{14x}{7} - \frac{x}{7} \\ y &= 19-2x + \frac{3-x}{7} \end{aligned}$$

$$\begin{aligned} y-19+2x &= \frac{3-x}{7} \\ \frac{3-x}{7} &\rightarrow \text{Entero} \\ \frac{24-8x}{7} &\rightarrow \text{Entero} \\ \frac{24}{7} - \frac{7x}{7} - \frac{x}{7} \\ -x + \frac{24-x}{7} \end{aligned}$$

$$\begin{aligned} \frac{24-x}{7} &= m \\ 24-x &= 7m \\ -x &= 7m-24 \\ x &= 24-7m \\ 15(24-7m)+7y &= 136 \\ 360-105m+7y &= 136 \\ -105m+7y &= -224 \\ y &= \frac{7(15m-32)}{7} \\ y &= 15m-32 \end{aligned}$$

$$\begin{aligned} x &= 24-7m \\ y &= 15m-32 \\ m=0 \quad x &= 24 \quad y=-32 \rightarrow \text{No} \\ m=1 \quad x &= 17 \quad y=-17 \rightarrow \text{No} \\ m=2 \quad x &= 10 \quad y=-2 \rightarrow \text{No} \\ m=3 \quad x &= 3 \quad y=13 \text{ sol} \\ m=4 \quad x &= -4 \rightarrow \text{No} \\ m=-1 \quad x &= -31 \rightarrow \text{No} \\ x &= 31 \quad y &= -47 \rightarrow \text{No} \end{aligned}$$

7.  $x+5y=24$

$$\begin{aligned} x &= 24-5y \\ x &= 24+1-1-5y \\ x &= \frac{25}{5} - \frac{1}{5} - \frac{5y}{5} \\ x + \frac{1}{5} &= 5 - y \\ 5 - y &= m \\ -y &= m-5 \\ y &= 5-m \\ x+5(5-m) &= 24 \\ x+25-5m &= 24 \\ x &= 5m-1 \\ y &= 5-m \\ x &= 5m-1 \\ m=0 \quad x &= -1 \rightarrow \text{No} \\ m=1 \quad x &= 4 \quad y=4 \text{ sol} \\ m=2 \quad x &= 9 \quad y=3 \text{ sol} \\ m=3 \quad x &= 14 \quad y=2 \text{ sol} \\ m=4 \quad x &= 19 \quad y=1 \text{ sol} \\ m=5 \quad x &= 24 \quad y=0 \rightarrow \text{No} \\ m=6 \quad x &= 29 \quad y=-1 \rightarrow \text{No} \\ m=-1 \quad x &= -6 \rightarrow \text{No} \end{aligned}$$

8.  $9x+11y=203$

$$\begin{aligned} 9x &= 203-11y \\ x &= \frac{203-11y}{9} \\ x &= \frac{198}{9} + \frac{5}{9} - \frac{9y}{9} - \frac{2y}{9} \\ x &= 22 - y + \frac{5-2y}{9} \\ x-22+y &= \frac{5-2y}{9} \\ \frac{5-2y}{9} &\rightarrow \text{Entero} \\ \frac{25-10y}{9} &\rightarrow \text{Entero} \\ \frac{18}{9} + \frac{7}{9} - \frac{9y}{9} - \frac{y}{9} \\ 2-y + \frac{7-y}{9} \\ \frac{7-y}{9} &= m \\ 7-y &= 9m \\ -y &= 9m-7 \\ y &= 7-9m \end{aligned}$$

**Continúa**

## 8. Continuación

$$9x + 11(7 - 9m) = 203$$

$$9x + 77 - 99m = 203$$

$$x = \frac{9(14 + 11m)}{9}$$

$$x = 14 + 11m$$

$$y = 7 - 9m$$

$$x = 14 + 11m$$

$$m = 0 \quad x = 14 \quad y = 7 \quad \text{sol}$$

$$m = 1 \quad x = 25 \quad y = -2 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 3 \quad y = 16 \quad \text{sol}$$

$$m = -2 \quad x = -8 \quad \rightarrow \text{No}$$

## 9. $5x + 2y = 73$

$$2y = 73 - 5x$$

$$y = \frac{73 - 5x}{2}$$

$$y = \frac{72}{2} + \frac{1}{2} - \frac{4x}{2} - \frac{x}{2}$$

$$y = 36 - 2x + \frac{1 - x}{2}$$

$$y - 36 + 2x = \frac{1 - x}{2}$$

$$\frac{1 - x}{2} = m$$

$$1 - x = 2m$$

$$-x = 2m - 1$$

$$x = 1 - 2m$$

$$5(1 - 2m) + 2y = 73$$

$$5 - 10m + 2y = 73$$

$$y = \frac{2(34 + 5m)}{2}$$

$$y = 34 + 5m$$

$$x = 1 - 2m$$

$$y = 34 + 5m$$

$$m = 0 \quad x = 1 \quad y = 34 \quad \text{sol}$$

$$m = 1 \quad x = -1 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 3 \quad y = 29 \quad \text{sol}$$

$$m = -2 \quad x = 5 \quad y = 24 \quad \text{sol}$$

$$m = -3 \quad x = 7 \quad y = 19 \quad \text{sol}$$

$$m = -4 \quad x = 9 \quad y = 14 \quad \text{sol}$$

$$m = -5 \quad x = 11 \quad y = 9 \quad \text{sol}$$

$$m = -6 \quad x = 13 \quad y = 4 \quad \text{sol}$$

$$m = -7 \quad x = 15 \quad y = -1 \quad \rightarrow \text{No}$$

## 10. $8x + 13y = 162$

$$8x = 162 - 13y$$

$$x = \frac{162 - 13y}{8}$$

$$x = \frac{160}{8} + \frac{2}{8} - \frac{8y}{8} - \frac{5y}{8}$$

$$x = 20 - y + \frac{2 - 5y}{8}$$

$$x - 20 + y = \frac{2 - 5y}{8}$$

$$\frac{2 - 5y}{8} \rightarrow \text{Entero}$$

$$\frac{10 - 25y}{8} \rightarrow \text{Entero}$$

$$\frac{10}{8} - \frac{24y}{8} - \frac{y}{8}$$

$$-3y + \frac{10 - y}{8}$$

$$\frac{10 - y}{8} = m$$

$$10 - y = 8m$$

$$-y = 8m - 10$$

$$y = 10 - 8m$$

$$8x + 13(10 - 8m) = 162$$

$$8x + 130 - 104m = 162$$

$$x = \frac{8(4 + 13m)}{8}$$

$$x = 4 + 13m$$

$$y = 10 - 8m$$

$$x = 4 + 13m$$

$$m = 0 \quad x = 4 \quad y = 10 \quad \text{sol}$$

$$m = 1 \quad x = 17 \quad y = 2 \quad \text{sol}$$

$$m = 2 \quad x = 30 \quad y = -6 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = -9 \quad \rightarrow \text{No}$$

## 11. $7x + 5y = 104$

$$5y = 104 - 7x$$

$$y = \frac{104 - 7x}{5}$$

$$y = \frac{100}{5} + \frac{4}{5} - \frac{5x}{5} - \frac{2x}{5}$$

$$y = 20 - x + \frac{4 - 2x}{5}$$

$$y - 20 + x = \frac{4 - 2x}{5}$$

$$\frac{4 - 2x}{5} \rightarrow \text{Entero}$$

$$\frac{12 - 6x}{5} \rightarrow \text{Entero}$$

Continúa

## 11. Continuación

$$\frac{10}{5} + \frac{2}{5} - \frac{5x}{5} - \frac{x}{5}$$

$$2 - x + \frac{2 - x}{5}$$

$$2 - x + \frac{2 - x}{5}$$

$$\frac{2 - x}{5} = m$$

$$2 - x = 5m$$

$$-x = 5m - 2$$

$$x = 2 - 5m$$

$$7(2 - 5m) + 5y = 104$$

$$14 - 35m + 5y = 104$$

$$y = \frac{5(18 + 7m)}{5}$$

$$y = 18 + 7m$$

$$x = 12 - 5m$$

$$y = 18 + 7m$$

$$m = 0 \quad x = 12 \quad y = 18 \quad \text{sol}$$

$$m = 1 \quad x = 7 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 17 \quad y = 11 \quad \text{sol}$$

$$m = -2 \quad x = 12 \quad y = 4 \quad \text{sol}$$

$$m = -3 \quad x = 17 \quad y = -3 \quad \rightarrow \text{No}$$

## 12. $10x + y = 32$

$$y = 32 - 10x$$

$$y = 32 + 2 - 2 - 10x$$

$$y = \frac{30}{10} + \frac{2}{10} - \frac{10x}{10}$$

$$y = 3 + \frac{2}{10} - x$$

$$y - \frac{2}{10} = 3 - x$$

$$3 - x = m$$

$$-x = m - 3$$

$$x = 3 - m$$

$$10(3 - m) + y = 32$$

$$30 - 10m + y = 32$$

$$y = 2 + 10m$$

$$m = 0 \quad x = 3 \quad y = 2 \quad \text{sol}$$

$$m = 1 \quad x = 2 \quad y = 12 \quad \text{sol}$$

$$m = 2 \quad x = 1 \quad y = 22 \quad \text{sol}$$

$$m = 3 \quad x = 0 \quad y = 32 \rightarrow \text{No}$$

$$m = 4 \quad x = -1 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 4 \quad y = -8 \rightarrow \text{No}$$

13.  $9x + 4y = 86$

$$4y = 86 - 9x$$

$$y = \frac{86 - 9x}{4}$$

$$y = \frac{84}{4} + \frac{2}{4} - \frac{8x}{4} - \frac{x}{4}$$

$$y = 21 - 2x + \frac{2 - x}{4}$$

$$y - 21 + 2x = \frac{2 - x}{4}$$

$$\frac{2 - x}{4} = m$$

$$2 - x = 4m$$

$$-x = 4m - 2$$

$$x = 2 - 4m$$

$$9(2 - 4m) + 4y = 86$$

$$18 - 36m + 4y = 86$$

$$y = \frac{4(17 + 9m)}{4}$$

$$y = 17 + 9m$$

$$x = 2 - 4m$$

$$m = 0 \quad x = 2 \quad y = 17 \quad \text{sol}$$

$$m = 1 \quad x = -2 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 6 \quad y = 8 \quad \text{sol}$$

$$m = -2 \quad x = 10 \quad y = -1 \quad \rightarrow \text{No}$$

14.  $9x + 11y = 207$

$$9x = 207 - 11y$$

$$x = \frac{207 - 11y}{9}$$

$$x = \frac{198}{9} + \frac{9}{9} - \frac{9y}{9} - \frac{2y}{9}$$

$$x = 22 - y + \frac{9 - 2y}{9}$$

$$x - 22 + y = \frac{9 - 2y}{9}$$

$$\frac{9 - 2y}{9} \rightarrow \text{Entero}$$

$$\frac{45 - 10y}{9} \rightarrow \text{Entero}$$

$$\frac{45}{9} - \frac{9y}{9} - \frac{y}{9}$$

$$\frac{45 - y}{9} = m$$

$$45 - y = 9m$$

$$-y = 9m - 45$$

$$y = 45 - 9m$$

**Continúa**

#### 14. Continuación

$$9x + 11(45 - 9m) = 207$$

$$9x + 495 - 99m = 207$$

$$x = \frac{9(11m - 32)}{9}$$

$$x = 11m - 32$$

$$y = 45 - 9m$$

$$x = 11m - 32$$

$$m = 0 \quad x = -32 \quad \rightarrow \text{No}$$

$$m = 1 \quad x = -21 \quad \rightarrow \text{No}$$

$$m = 2 \quad x = -10 \quad \rightarrow \text{No}$$

$$m = 3 \quad x = 1 \quad y = 18 \quad \text{sol}$$

$$m = 4 \quad x = 12 \quad y = 9 \quad \text{sol}$$

$$m = 5 \quad x = 23 \quad y = 0 \quad \rightarrow \text{No}$$

$$m = 6 \quad x = 34 \quad y = -9 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = -43 \quad \rightarrow \text{No}$$

15.  $11x + 12y = 354$

$$11x = 354 - 12y$$

$$x = \frac{354 - 12y}{11}$$

$$x = \frac{352}{11} + \frac{2}{11} - \frac{11y}{11} - \frac{y}{11}$$

$$x = 32 - y + \frac{2 - y}{11}$$

$$x - 32 + y = \frac{2 - y}{11}$$

$$\frac{2 - y}{11} = m$$

$$2 - y = 11m$$

$$-y = 11m - 2$$

$$y = 2 - 11m$$

$$11x + 12(2 - 11m) = 354$$

$$11x + 24 - 132m = 354$$

$$x = \frac{11(30 + 12m)}{11}$$

$$x = 30 + 12m$$

$$y = 2 - 11m$$

$$m = 0 \quad x = 30 \quad y = 2 \quad \text{sol}$$

$$m = 1 \quad x = 42 \quad y = -9 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 18 \quad y = 13 \quad \text{sol}$$

$$m = -2 \quad x = 6 \quad y = 24 \quad \text{sol}$$

$$m = -3 \quad x = -6 \quad \rightarrow \text{No}$$

16.  $10x + 13y = 294$

$$10x = 294 - 13y$$

$$x = \frac{294 - 13y}{10}$$

$$x = \frac{290}{10} + \frac{4}{10} - \frac{10y}{10} - \frac{3y}{10}$$

$$x - 29 + y = \frac{4 - 3y}{10}$$

$$\frac{4 - 3y}{10} \rightarrow \text{Entero}$$

$$\frac{28 - 21y}{10} \rightarrow \text{Entero}$$

$$\frac{28}{10} - \frac{20y}{10} - \frac{y}{10}$$

$$-2y + \frac{28 - y}{10}$$

$$\frac{28 - y}{10} = m$$

$$28 - y = 10m$$

$$-y = 10m - 28$$

$$y = 28 - 10m$$

$$10x + 13(28 - 10m) = 294$$

$$10x + 364 - 130m = 294$$

$$x = \frac{10(13m - 7)}{10}$$

$$x = 13m - 7$$

$$y = 28 - 10m$$

$$m = 0 \quad x = -7 \quad \rightarrow \text{No}$$

$$m = 1 \quad x = 6 \quad y = 18 \quad \text{sol}$$

$$m = 2 \quad x = 19 \quad y = 8 \quad \text{sol}$$

$$m = 3 \quad x = 32 \quad y = -2 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = -20 \quad \rightarrow \text{No}$$

17.  $11x + 8y = 300$

$$8y = 300 - 11x$$

$$y = \frac{300 - 11x}{8}$$

$$y = \frac{296}{8} + \frac{4}{8} - \frac{3x}{8} - \frac{8x}{8}$$

$$y = 37 - x + \frac{4 - 3x}{8}$$

$$y - 37 + x = \frac{4 - 3x}{8}$$

$$\frac{4 - 3x}{8} \rightarrow \text{Entero}$$

$$\frac{12 - 9x}{8} \rightarrow \text{Entero}$$

**Continúa**

**Continuación**

$$17. \frac{12}{8} - \frac{8x}{8} - \frac{x}{8}$$

$$\frac{12-x}{8} = m$$

$$12-x=8m$$

$$-x=8m-12$$

$$x=12-8m$$

$$11(12-8m)+8y=300$$

$$132-88m+8y=300$$

$$y = \frac{8(21+11m)}{8}$$

$$y=21+11m$$

$$x=12-8m$$

$$m=0 \quad x=12 \quad y=21 \quad \text{sol}$$

$$m=1 \quad x=4 \quad y=32 \quad \text{sol}$$

$$m=2 \quad x=-4 \quad \rightarrow \text{No}$$

$$m=-1 \quad x=20 \quad y=10 \quad \text{sol}$$

$$m=-2 \quad x=28 \quad y=-1 \quad \rightarrow \text{No}$$

$$18. 21x+25y=705$$

$$21x=705-25y$$

$$x = \frac{705-25y}{21}$$

$$x = \frac{693}{21} + \frac{12}{21} - \frac{21y}{21} - \frac{4y}{21}$$

$$x = 33 - y + \frac{12-4y}{21}$$

$$\frac{12-4y}{21} \rightarrow \text{Entero}$$

$$\frac{192-64y}{21} \rightarrow \text{Entero}$$

$$\frac{192}{21} - \frac{63y}{21} - \frac{y}{21}$$

$$-3y + \frac{192-y}{21}$$

$$\frac{192-y}{21} = m$$

$$192-y=21m$$

$$-y=21m-192$$

$$y=192-21m$$

$$21x+25(192-21m)=705$$

$$21x+4.800-525m=705$$

$$x = \frac{21(25m-195)}{21}$$

$$x=25m-195$$

**Continúa****18. Continuación**

$$y=192-21m$$

$$m=0 \quad x=-195 \rightarrow \text{No}$$

$$m=7 \quad x=-20 \rightarrow \text{No}$$

$$m=8 \quad x=5 \quad y=24 \quad \text{sol}$$

$$m=9 \quad x=30 \quad y=3 \quad \text{sol}$$

$$m=10 \quad x=55 \quad y=-18 \rightarrow \text{No}$$

$$m=-1 \quad x=-220 \rightarrow \text{No}$$

$$19. 3x-4y=5$$

$$3x=5+4y$$

$$x = \frac{5+4y}{3}$$

$$x = \frac{2}{3} + \frac{3}{3} + \frac{3y}{3} + \frac{y}{3}$$

$$x = 1 + y + \frac{2+y}{3}$$

$$x-1-y = \frac{2+y}{3}$$

$$\frac{2+y}{3} = m$$

$$2+y=3m$$

$$y=3m-2$$

$$3x-4(3m-2)=5$$

$$3x-12m+8=5$$

$$x = \frac{3(4m-1)}{3}$$

$$x=4m-1$$

$$y=3m-2$$

$$m=1 \quad x=3 \quad y=1 \quad \text{sol}$$

$$m=2 \quad x=7 \quad y=4 \quad \text{sol}$$

$$m=3 \quad x=11 \quad y=7 \quad \text{sol}$$

$$20. 5x-8y=1$$

$$5x=1+8y$$

$$x = \frac{1+8y}{5}$$

$$\frac{1+8y}{5} \rightarrow \text{Entero}$$

$$\frac{2+16y}{5} \rightarrow \text{Entero}$$

$$\frac{2}{5} + \frac{15y}{5} + \frac{y}{5}$$

$$3y + \frac{2+y}{5}$$

$$\frac{2+y}{5} = m$$

**Continúa****20. Continuación**

$$2+y=5m$$

$$y=5m-2$$

$$5x-8(5m-2)=1$$

$$5x-40m+16=1$$

$$x = \frac{5(8m-3)}{5}$$

$$x=8m-3$$

$$y=5m-2$$

$$m=1 \quad x=5 \quad y=3 \quad \text{sol}$$

$$m=2 \quad x=13 \quad y=8 \quad \text{sol}$$

$$m=3 \quad x=21 \quad y=13 \quad \text{sol}$$

$$21. 7x-13y=43$$

$$7x=43+13y$$

$$x = \frac{43+13y}{7}$$

$$x = \frac{42}{7} + \frac{1}{7} + \frac{7y}{7} + \frac{6y}{7}$$

$$x = 6 + y + \frac{1+6y}{7}$$

$$x-6-y = \frac{1+6y}{7}$$

$$\frac{1+6y}{7} \rightarrow \text{Entero}$$

$$\frac{6+36y}{7} \rightarrow \text{Entero}$$

$$\frac{6}{7} + \frac{35y}{7} + \frac{y}{7}$$

$$5y + \frac{6+y}{7}$$

$$\frac{6+y}{7} = m$$

$$6+y=7m$$

$$y=7m-6$$

$$7x-13(7m-6)=43$$

$$7x-91m+78=43$$

$$x = \frac{7(13m-5)}{7}$$

$$x=13m-5$$

$$y=7m-6$$

$$m=1 \quad x=8 \quad y=1 \quad \text{sol}$$

$$m=2 \quad x=21 \quad y=8 \quad \text{sol}$$

$$m=3 \quad x=34 \quad y=15 \quad \text{sol}$$

22.  $11x - 12y = 0$

$$11x = 12y$$

$$x = \frac{12y}{11}$$

$$x = \frac{11y}{11} + \frac{y}{11}$$

$$x - y = \frac{y}{11}$$

$$\frac{y}{11} = m$$

$$y = 11m$$

$$11x - 12(11m) = 0$$

$$11x - 132m = 0$$

$$x = 12m$$

$$y = 11m$$

$$m = 1 \quad x = 12 \quad y = 11 \quad \text{sol}$$

$$m = 2 \quad x = 24 \quad y = 22 \quad \text{sol}$$

$$m = 3 \quad x = 36 \quad y = 33 \quad \text{sol}$$

23.  $14x - 17y = 32$

$$14x = 32 + 17y$$

$$x = \frac{32 + 17y}{14}$$

$$x = \frac{28}{14} + \frac{4}{14} + \frac{14y}{14} + \frac{3y}{14}$$

$$x = 2 + y + \frac{4 + 3y}{14}$$

$$\frac{4 + 3y}{14} \rightarrow \text{Entero}$$

$$\frac{20 + 15y}{14} \rightarrow \text{Entero}$$

$$\frac{14}{14} + \frac{6}{14} + \frac{14y}{14} + \frac{y}{14}$$

$$1 + y + \frac{6 + y}{14}$$

$$\frac{6 + y}{14} = m$$

$$6 + y = 14m$$

$$y = 14m - 6$$

$$14x - 17(14m - 6) = 32$$

$$14x - 238m + 102 = 32$$

$$x = \frac{14(17m - 5)}{14}$$

$$x = 17m - 5$$

$$y = 14m - 6$$

$$m = 1 \quad x = 12 \quad y = 8 \quad \text{sol}$$

$$m = 2 \quad x = 29 \quad y = 22 \quad \text{sol}$$

$$m = 3 \quad x = 46 \quad y = 36 \quad \text{sol}$$

24.  $7x - 11y = 83$

$$7x = 83 + 11y$$

$$x = \frac{83 + 11y}{7}$$

$$x = \frac{77}{7} + \frac{6}{7} + \frac{7y}{7} + \frac{4y}{7}$$

$$x = 11 + y + \frac{6 + 4y}{7}$$

$$x - 11 - y = \frac{6 + 4y}{7}$$

$$\frac{6 + 4y}{7} \rightarrow \text{Entero}$$

$$\frac{12 + 8y}{7} \rightarrow \text{Entero}$$

$$\frac{7}{7} + \frac{5}{7} + \frac{7y}{7} + \frac{y}{7}$$

$$1 + y + \frac{5 + y}{7}$$

$$\frac{5 + y}{7} = m$$

$$5 + y = 7m$$

$$y = 7m - 5$$

$$7x - 11(7m - 5) = 83$$

$$7x - 77m + 55 = 83$$

$$x = \frac{7(11m + 4)}{7}$$

$$x = 11m + 4$$

$$y = 7m - 5$$

$$m = 1 \quad x = 15 \quad y = 2 \quad \text{sol}$$

$$m = 2 \quad x = 26 \quad y = 9 \quad \text{sol}$$

$$m = 3 \quad x = 37 \quad y = 16 \quad \text{sol}$$

25.  $8x - 13y = 407$

$$8x = 407 + 13y$$

$$x = \frac{407 + 13y}{8}$$

$$x = \frac{400}{8} + \frac{7}{8} + \frac{8y}{8} + \frac{5y}{8}$$

$$x = 50 + y + \frac{7 + 5y}{8}$$

$$x - 50 - y = \frac{7 + 5y}{8}$$

$$\frac{7 + 5y}{8} \rightarrow \text{Entero}$$

$$\frac{35 + 25y}{8} \rightarrow \text{Entero}$$

$$\frac{32}{8} + \frac{3}{8} + \frac{24y}{8} + \frac{y}{8}$$

**Continúa**

## 25. Continuación

$$4 + 3y + \frac{3 + y}{8}$$

$$\frac{3 + y}{8} = m$$

$$3 + y = 8m$$

$$y = 8m - 3$$

$$8x - 13(8m - 3) = 407$$

$$8x - 104m + 39 = 407$$

$$x = \frac{8(13m + 46)}{8}$$

$$x = 13m + 46$$

$$y = 8m - 3$$

$$m = 1 \quad x = 59 \quad y = 5 \quad \text{sol}$$

$$m = 2 \quad x = 72 \quad y = 13 \quad \text{sol}$$

$$m = 3 \quad x = 85 \quad y = 21 \quad \text{sol}$$

26.  $20y - 23x = 411$

$$20y = 411 + 23x$$

$$y = \frac{411 + 23x}{20}$$

$$y = \frac{400}{20} + \frac{11}{20} + \frac{20x}{20} + \frac{3x}{20}$$

$$y = 20 + x + \frac{11 + 3x}{20}$$

$$y - 20 - x = \frac{11 + 3x}{20}$$

$$\frac{11 + 3x}{20} \rightarrow \text{Entero}$$

$$\frac{77 + 21x}{20} \rightarrow \text{Entero}$$

$$\frac{60}{20} + \frac{17}{20} + \frac{20x}{20} + \frac{x}{20}$$

$$3 + x + \frac{17 + x}{20}$$

$$\frac{17 + x}{20} = m$$

$$17 + x = 20m$$

$$x = 20m - 17$$

$$20y - 23(20m - 17) = 411$$

$$20y - 460m + 391 = 411$$

$$y = \frac{20(23m + 1)}{20}$$

$$x = 20m - 17$$

$$y = 23m + 1$$

$$m = 1 \quad x = 3 \quad y = 24 \quad \text{sol}$$

$$m = 2 \quad x = 23 \quad y = 47 \quad \text{sol}$$

$$m = 3 \quad x = 43 \quad y = 70 \quad \text{sol}$$

27.  $5y - 7x = 312$

$$5y = 312 + 7x$$

$$y = \frac{312 + 7x}{5}$$

$$y = \frac{310}{5} + \frac{2}{5} + \frac{5x}{5} + \frac{2x}{5}$$

$$y = 62 + x + \frac{2+2x}{5}$$

$$y - 62 - x = \frac{2+2x}{5}$$

$$\frac{2+2x}{5} \rightarrow \text{Entero}$$

$$\frac{6+6x}{5} \rightarrow \text{Entero}$$

$$\frac{5}{5} + \frac{1}{5} + \frac{5x}{5} + \frac{x}{5}$$

$$1 + x + \frac{1+x}{5}$$

$$\frac{1+x}{5} = m$$

$$1 + x = 5m$$

$$x = 5m - 1$$

$$5y - 7(5m - 1) = 312$$

$$5y - 35m + 7 = 312$$

$$y = \frac{5(7m + 61)}{5}$$

$$y = 7m + 61$$

$$x = 5m - 1$$

$$m = 1 \quad x = 4 \quad y = 68$$

$$m = 2 \quad x = 9 \quad y = 75$$

$$m = 3 \quad x = 14 \quad y = 82$$

### EJERCICIO 174

1.  $x \rightarrow$  Billetes \$2

$y \rightarrow$  Billetes \$5

$2x + 5y = 42$

$2x = 42 - 5y$

$x = \frac{42 - 5y}{2}$

$x = \frac{40}{2} + \frac{2}{2} - \frac{3y}{2} - \frac{2y}{2}$

$x = 20 - y + \frac{2-3y}{2}$

$x - 20 + y = \frac{2-3y}{2}$

$\frac{2-3y}{2} \rightarrow \text{Entero}$

Continúa

### 1. Continuación

$\frac{2}{2} - \frac{2y}{2} - \frac{y}{2}$

$-y + \frac{2-y}{2}$

$\frac{2-y}{2} = m$

$2 - y = 2m$

$-y = 2m - 2$

$y = 2 - 2m$

$2x + 5(2 - 2m) = 42$

$2x + 10 - 10m = 42$

$x = \frac{2(5m + 16)}{2}$

$x = 5m + 16$

$y = 2 - 2m$

$m = 0 \quad x = 16 \quad y = 2 \quad \text{sol}$

$m = 1 \quad x = 21 \quad y = 0 \quad \rightarrow \text{No}$

$m = 2 \quad x = 26 \quad y = -2 \quad \rightarrow \text{No}$

$m = -1 \quad x = 11 \quad y = 4 \quad \text{sol}$

$m = -2 \quad x = 6 \quad y = 6 \quad \text{sol}$

$m = -3 \quad x = 1 \quad y = 8 \quad \text{sol}$

$m = -4 \quad x = -4 \quad \rightarrow \text{No}$

1 de \$2 y 8 de \$5

6 de \$2 y 6 de \$5

11 de \$2 y 4 de \$5 ó

16 de \$2 y 2 de \$5

2.  $x \rightarrow$  Monedas de \$5

$y \rightarrow$  Monedas de \$10

$5x + 10y = 45$

$5x = 45 - 10y$

$x = \frac{45 - 10y}{5}$

$x = \frac{40}{5} + \frac{5}{5} - \frac{5y}{5} - \frac{5y}{5}$

$x = 8 - y + \frac{5-5y}{5}$

$x - 8 + y = 1 - y$

$1 - y = m$

$-y = m - 1$

$y = 1 - m$

$5x + 10(1 - m) = 45$

$5x + 10 - 10m = 45$

$x = \frac{5(2m + 7)}{5}$

$x = 2m + 7$

Continúa

### 2. Continuación

$y = 1 - m$

$m = 0 \quad x = 7 \quad y = 1 \quad \text{sol}$

$m = 1 \quad x = 9 \quad y = 0 \quad \rightarrow \text{No}$

$m = -1 \quad x = 5 \quad y = 2 \quad \text{sol}$

$m = -2 \quad x = 3 \quad y = 3 \quad \text{sol}$

$m = -3 \quad x = 1 \quad y = 4 \quad \text{sol}$

$m = -4 \quad x = -1 \quad \rightarrow \text{No}$

1 de \$5 y 4 de \$10

3 de \$5 y 3 de \$10

5 de \$5 y 2 de \$10

7 de \$5 y 1 de \$10

3.  $5x + 3y = 62$

$3y = 62 - 5x$

$y = \frac{62 - 5x}{3}$

$y = \frac{60}{3} + \frac{2}{3} - \frac{3x}{3} - \frac{2x}{3}$

$y = 20 - x + \frac{2-2x}{3}$

$y - 20 + x = \frac{2-2x}{3}$

$\frac{2-2x}{3} \rightarrow \text{Entero}$

$\frac{10-10x}{3} \rightarrow \text{Entero}$

$\frac{9}{3} + \frac{1}{3} - \frac{9x}{3} - \frac{x}{3}$

$3 - 3x + \frac{1-x}{3}$

$\frac{1-x}{3} = m$

$1 - x = 3m$

$-x = 3m - 1$

$x = 1 - 3m$

$5(1 - 3m) + 3y = 62$

$5 - 15m + 3y = 62$

$y = \frac{3(5m + 19)}{3}$

$y = 5m + 19$

$x = 1 - 3m$

$m = 0 \quad x = 1 \quad y = 19 \quad \text{sol}$

$m = 1 \quad x = -2 \quad \rightarrow \text{No}$

$m = -1 \quad x = 4 \quad y = 14 \quad \text{sol}$

$m = -2 \quad x = 7 \quad y = 9 \quad \text{sol}$

$m = -3 \quad x = 10 \quad y = 4 \quad \text{sol}$

1 y 19 ; 4 y 14 ; 7 y 9 ;

10 y 4



4.  $x \rightarrow$  Sombreros

$y \rightarrow$  Pares de zapatos

$$8x + 15y = 340$$

$$8x = 340 - 15y$$

$$x = \frac{340 - 15y}{8}$$

$$x = \frac{336}{8} + \frac{4}{8} - \frac{8y}{8} - \frac{7y}{8}$$

$$x = 42 - y + \frac{4 - 7y}{8}$$

$$x - 42 + y = \frac{4 - 7y}{8}$$

$$\frac{4 - 7y}{8} \rightarrow \text{Entero}$$

$$\frac{28 - 49y}{8} \rightarrow \text{Entero}$$

$$\frac{24}{8} + \frac{4}{8} - \frac{48y}{8} - \frac{y}{8}$$

$$3 - 6y + \frac{4 - y}{8}$$

$$\frac{4 - y}{8} = m$$

$$4 - y = 8m$$

$$-y = 8m - 4$$

$$y = 4 - 8m$$

$$8x + 15(4 - 8m) = 340$$

$$8x + 60 - 120m = 340$$

$$x = \frac{8(15m + 35)}{8}$$

$$x = 15m + 35$$

$$y = 4 - 8m$$

$$m = 0 \quad x = 35 \quad y = 4 \quad \text{sol}$$

$$m = 1 \quad x = 50 \quad y = -4 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 20 \quad y = 12 \quad \text{sol}$$

$$m = -2 \quad x = 5 \quad y = 20 \quad \text{sol}$$

$$m = -3 \quad x = -10 \quad \rightarrow \text{No}$$

$$5 \text{ sombreros y } 20 \text{ pares de zap.}$$

$$20 \text{ sombreros y } 12 \text{ pares de zap.}$$

$$35 \text{ sombreros y } 4 \text{ pares de zap.}$$

5.  $x \rightarrow$  Metros de lana

$y \rightarrow$  Metros de seda

$$1,50x + 2,50y = 42$$

$\rightarrow$  Si multiplico por 2 la

ecuación inicial no se

altera. Luego

$$3x + 5y = 84$$

$$3x = 84 - 5y$$

$$x = \frac{84 - 5y}{3}$$

$$x = \frac{81}{3} + \frac{3}{3} - \frac{3y}{3} - \frac{2y}{3}$$

$$x = 27 - y + \frac{3 - 2y}{3}$$

$$x - 27 + y = \frac{3 - 2y}{3}$$

$$\frac{3 - 2y}{3} \rightarrow \text{Entero}$$

$$\frac{15 - 10y}{3} \rightarrow \text{Entero}$$

$$\frac{12}{3} + \frac{3}{3} - \frac{9y}{3} - \frac{y}{3}$$

$$4 - 3y + \frac{3 - y}{3}$$

$$\frac{3 - y}{3} = m$$

$$3 - y = 3m$$

$$-y = 3m - 3$$

$$y = 3 - 3m$$

$$3x + 5(3 - 3m) = 84$$

$$3x + 15 - 15m = 84$$

$$x = \frac{3(5m + 23)}{3}$$

$$x = 5m + 23$$

$$y = 3 - 3m$$

$$m = 0 \quad x = 23 \quad y = 3 \quad \text{sol}$$

$$m = 1 \quad x = 28 \quad y = 0 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 18 \quad y = 6 \quad \text{sol}$$

$$m = -2 \quad x = 13 \quad y = 9 \quad \text{sol}$$

$$m = -3 \quad x = 8 \quad y = 12 \quad \text{sol}$$

$$m = -4 \quad x = 3 \quad y = 15 \quad \text{sol}$$

$$m = -5 \quad x = -2 \quad \rightarrow \text{No}$$

$$3m \text{ de lana y } 15m \text{ de seda}$$

$$8m \text{ de lana y } 12m \text{ de seda}$$

$$13m \text{ de lana y } 9m \text{ de seda}$$

$$18m \text{ de lana y } 6m \text{ de seda}$$

$$23m \text{ de lana y } 3m \text{ de seda}$$

6.  $x \rightarrow$  niños

$y \rightarrow$  adultos

$$0,45x + y = 17 \quad (20)$$

$$9x + 20y = 340$$

$$9x = 340 - 20y$$

$$x = \frac{340 - 20y}{9}$$

$$x = \frac{333}{9} + \frac{7}{9} - \frac{18y}{9} - \frac{2y}{9}$$

$$x = 37 - 2y + \frac{7 - 2y}{9}$$

$$x - 37 + 2y = \frac{7 - 2y}{9}$$

$$\frac{7 - 2y}{9} \rightarrow \text{Entero}$$

$$\frac{98 - 28y}{9} \rightarrow \text{Entero}$$

$$\frac{90}{9} + \frac{8}{9} - \frac{27y}{9} - \frac{y}{9}$$

$$10 - 3y + \frac{8 - y}{9}$$

$$\frac{8 - y}{9} = m$$

$$8 - y = 9m$$

$$-y = 9m - 8$$

$$y = 8 - 9m$$

$$9x + 20(8 - 9m) = 340$$

$$9x + 160 - 180m = 340$$

$$x = \frac{9(20m + 20)}{9}$$

$$x = 20m + 20$$

$$y = 8 - 9m$$

$$m = 0 \quad x = 20 \quad y = 8 \quad \text{sol}$$

$$m = 1 \quad x = 0 \quad y = -1 \quad \rightarrow \text{No}$$

$$m = -1 \quad x = 0 \quad y = 17 \quad \rightarrow \text{No}$$

$$m = -2 \quad x = -20 \quad \rightarrow \text{No}$$

$$20 \text{ niños y } 8 \text{ adultos}$$

7.  $x \rightarrow$  Caballos

$y \rightarrow$  Vacas

$$460x + 440y = 41.000 \quad (+20)$$

$$23x + 22y = 2.050$$

$$22y = 2.050 - 23x$$

$$y = \frac{2.050 - 23x}{22}$$

$$y = \frac{2.046}{22} + \frac{4}{22} - \frac{22x}{22} - \frac{x}{22}$$

**Continúa**

## 7. Continuación

$$y = 93 - x + \frac{4-x}{22}$$

$$\frac{4-x}{22} = m$$

$$4-x = 22m$$

$$-x = 22m - 4$$

$$x = 4 - 22m$$

$$23(4 - 22m) + 22y = 2.050$$

$$92 - 506m + 22y = 2.050$$

$$y = \frac{22(23m + 89)}{22}$$

$$y = 23m + 89$$

$$x = 4 - 22m$$

$$m=0 \quad x=4 \quad y=89 \quad \text{sol}$$

$$m=1 \quad x=-18 \quad \rightarrow \text{No}$$

$$m=-1 \quad x=26 \quad y=66 \quad \text{sol}$$

$$m=-2 \quad x=48 \quad y=43 \quad \text{sol}$$

$$m=-3 \quad x=70 \quad y=20 \quad \text{sol}$$

$$m=-4 \quad x=92 \quad y=-3 \quad \rightarrow \text{No}$$

$$4 \text{ caballos} \quad y \quad 89 \text{ vacas}$$

$$26 \text{ caballos} \quad y \quad 66 \text{ vacas}$$

$$48 \text{ caballos} \quad y \quad 43 \text{ vacas}$$

$$70 \text{ caballos} \quad y \quad 20 \text{ vacas}$$

## 8. $3x + 3 = 5y + 5$

$$3x - 5y = 2$$

$$3x = 2 + 5y$$

$$x = \frac{2 + 5y}{3}$$

$$\frac{2 + 5y}{3} \rightarrow \text{Entero}$$

$$\frac{4 + 10y}{3} \rightarrow \text{Entero}$$

$$\frac{3}{3} + \frac{1}{3} + \frac{9y}{3} + \frac{y}{3}$$

$$1 + 3y + \frac{1 + y}{3}$$

$$\frac{1 + y}{3} = m$$

$$1 + y = 3m$$

$$y = 3m - 1$$

$$3x - 5(3m - 1) = 2$$

$$3x - 15m + 5 = 2$$

$$x = \frac{3(5m - 1)}{3}$$

$$x = 5m - 1$$

Continúa

## 8. Continuación

$$y = 3m - 1$$

$$m=0 \quad x=-1 \quad \rightarrow \text{No}$$

$$m=1 \quad x=4 \quad y=2 \quad \text{sol}$$

Los N°s son 4 y 2

## 9. $x \rightarrow$ Monedas de 0,25

$$y \rightarrow \text{Monedas de 0,10}$$

$$0,25x + 0,10y = 2,10 \quad (100)$$

$$25x + 10y = 210$$

$$10y = 210 - 25x$$

$$y = \frac{210 - 25x}{10}$$

$$y = \frac{200}{10} + \frac{10}{10} - \frac{20x}{10} - \frac{5x}{10}$$

$$y = 20 - 2x + \frac{10 - 5x}{10}$$

$$y - 20 + 2x = \frac{2 - x}{2}$$

$$\frac{2 - x}{2} = m$$

$$2 - x = 2m$$

$$-x = 2m - 2$$

$$x = 2 - 2m$$

$$25(2 - 2m) + 10y = 210$$

$$50 - 50m + 10y = 210$$

$$y = \frac{10(5m + 16)}{10}$$

$$y = 5m + 16$$

$$x = 2 - 2m$$

$$m=0 \quad x=2 \quad y=16 \quad \text{sol}$$

$$m=1 \quad x=0 \quad \rightarrow \text{No}$$

$$m=-1 \quad x=4 \quad y=11 \quad \text{sol}$$

$$m=-2 \quad x=6 \quad y=6 \quad \text{sol}$$

$$m=-3 \quad x=8 \quad y=1 \quad \text{sol}$$

$$m=-4 \quad x=10 \quad y=-4 \quad \rightarrow \text{No}$$

$$2 \text{ mon. de } 0,25 \quad y \quad 16 \text{ mon. de } 0,10$$

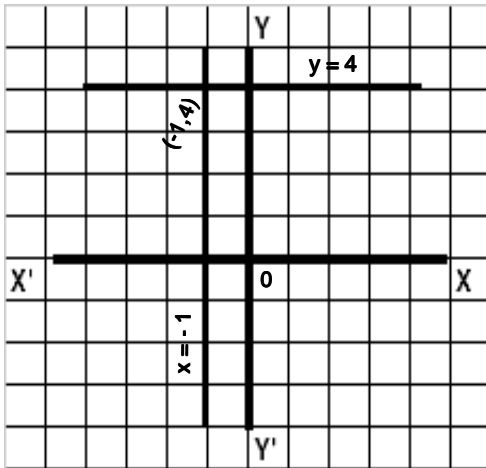
$$4 \text{ mon. de } 0,25 \quad y \quad 11 \text{ mon. de } 0,10$$

$$6 \text{ mon. de } 0,25 \quad y \quad 6 \text{ mon. de } 0,10$$

$$8 \text{ mon. de } 0,25 \quad y \quad 1 \text{ mon. de } 0,10$$

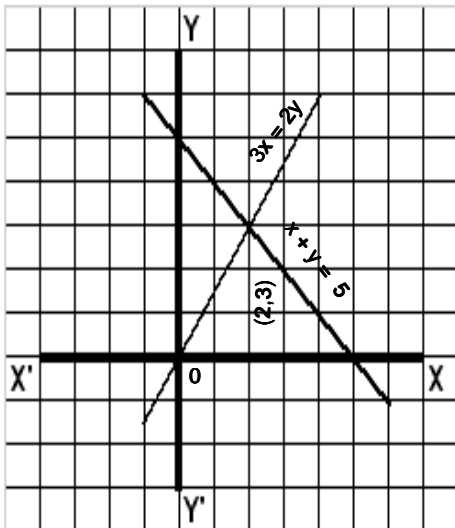
## EJERCICIO 175

21.  $x+1=0$       $y-4=0$   
 $x=-1$          $y=4$



Intersección  $\rightarrow (-1, 4)$

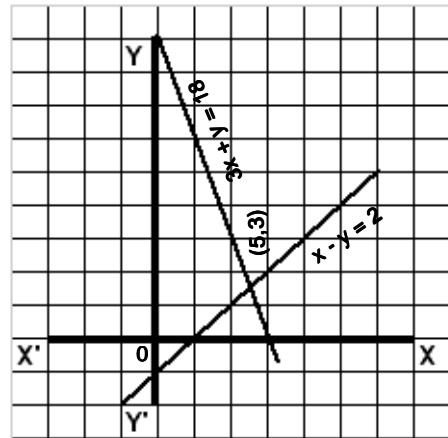
22.  $3x=2y$      con      $x+y=5$   
 $3x-2y=0$       $x=0$     $y=5$   
 $x=1$     $y=1\frac{1}{2}$       $x=5$     $y=0$



Intersección  $\rightarrow (2, 3)$

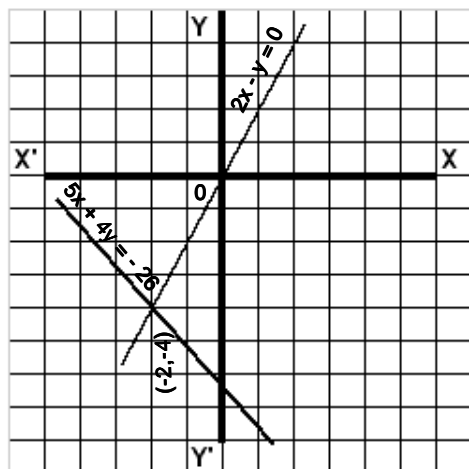
23.  $x-y=2$      con      $3x+y=18$   
 $x=0$     $y=-2$       $x=0$     $y=18$   
 $x=2$     $y=0$       $x=6$     $y=0$

Escala 1:2



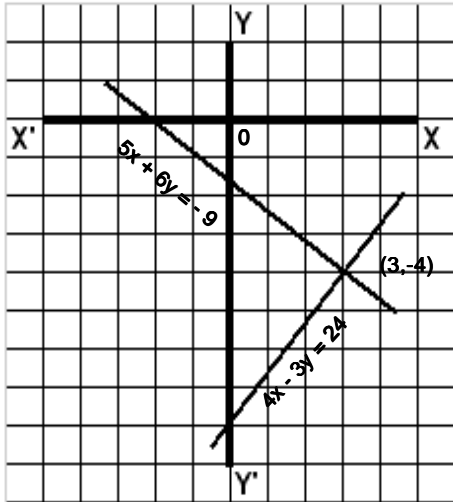
Intersección  $\rightarrow (5, 3)$

24.  $2x-y=0$      con      $5x+4y=-26$   
 $x=1$     $y=2$       $x=0$     $y=-6\frac{1}{2}$   
 $x=-2$     $y=-4$



Intersección  $\rightarrow (-2, -4)$

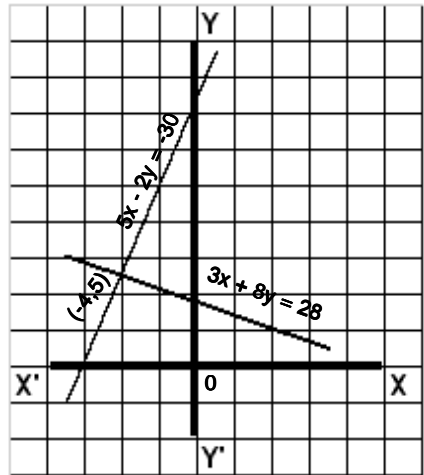
25.  $5x+6y=-9$  con  $4x-3y=24$   
 $x=0$   $y=-1\frac{1}{2}$        $x=0$   $y=-8$   
 $x=3$   $y=-4$        $x=3$   $y=-4$



Intersección  $\rightarrow (3, -4)$

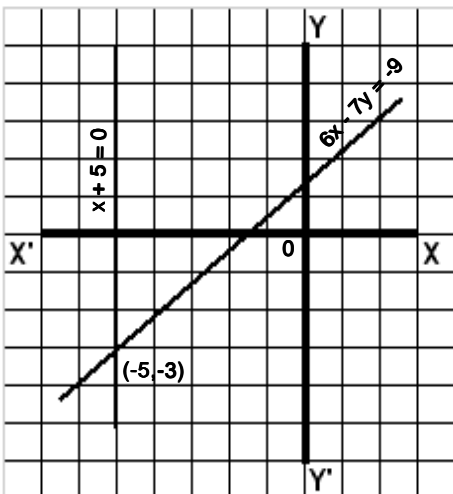
27.  $3x+8y=28$  con  $5x-2y=-30$   
 $x=4$   $y=2$        $x=0$   $y=15$   
 $x=0$   $y=3\frac{1}{2}$        $x=-2$   $y=10$

Escala 1:2



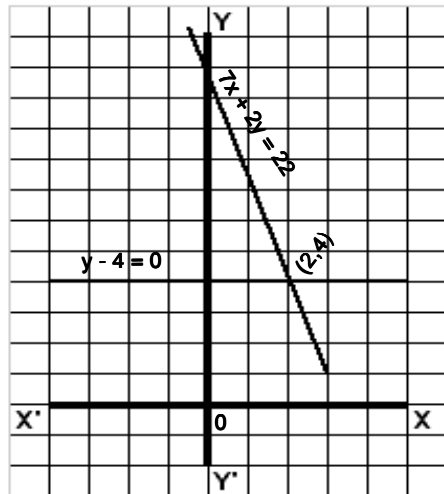
Intersección  $\rightarrow (-4, 5)$

26.  $x+5=0$  con  $6x-7y=-9$   
 $x=-5$        $x=2$   $y=3$   
 $x=-5$   $y=-3$



Intersección  $\rightarrow (-5, -3)$

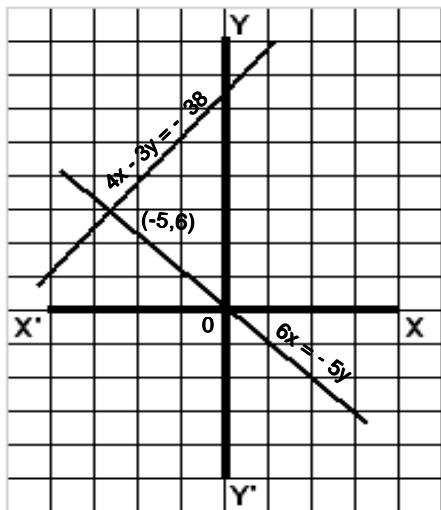
28.  $y-4=0$  con  $7x+2y=22$   
 $y=4$        $x=0$   $y=11$   
 $x=2$   $y=4$



Intersección  $\rightarrow (2, 4)$

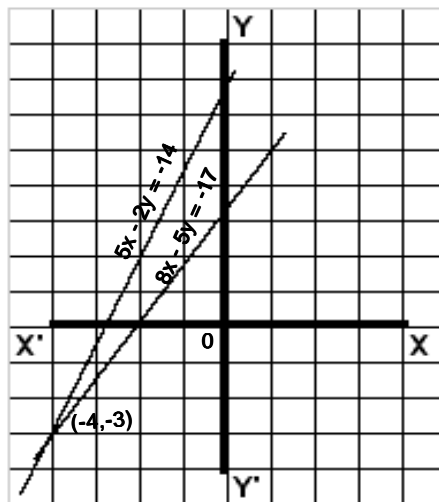
29.  $6x = -5y$  con  $4x - 3y = -38$   
 $6x + 5y = 0$   $x = -2$   $y = 10$   
 $x = 5$   $y = -6$   $x = 1$   $y = 14$

Escala 1:2



Intersección  $\rightarrow (-5, 6)$

30.  $5x - 2y = -14$  con  $8x - 5y = -17$   
 $x = 0$   $y = 7$   $x = 1$   $y = 5$   
 $x = -2$   $y = 2$   $x = -4$   $y = -3$



Intersección  $\rightarrow (-4, -3)$

## EJERCICIO 176

1.  $x + 6y = 27$  ;  $7x - 3y = 9$   
 $x = 27 - 6y$   $7x = 9 + 3y$   
 $x = \frac{9 + 3y}{7}$

$$27 - 6y = \frac{9 + 3y}{7}$$

$$7(27 - 6y) = 9 + 3y$$

$$189 - 42y = 9 + 3y$$

$$180 = 45y$$

$$4 = y$$

$$x + 6(4) = 27$$

$$x + 24 = 27$$

$$x = 3$$

$$\text{sol: } x = 3 \quad y = 4$$

2.  $3x - 2y = -2$  ;  $5x + 8y = -60$   
 $3x = -2 + 2y$   $5x = -60 - 8y$   
 $x = -\frac{2 - 2y}{3}$   $x = -\frac{60 + 8y}{5}$

$$-\frac{2 - 2y}{3} = -\frac{60 + 8y}{5}$$

$$5(2 - 2y) = 3(60 + 8y)$$

$$10 - 10y = 180 + 24y$$

$$-170 = 34y$$

$$-5 = y$$

$$3x - 2(-5) = -2$$

$$3x + 10 = -2$$

$$3x = -12$$

$$x = -4$$

$$\text{sol: } x = -4 \quad y = -5$$

3.  $3x + 5y = 7$  ;  $2x - y = -4$   
 $5y = 7 - 3x$   $-y = -4 - 2x$   
 $y = \frac{7 - 3x}{5}$   $y = 4 + 2x$

$$\frac{7 - 3x}{5} = 4 + 2x$$

$$7 - 3x = 5(4 + 2x)$$

$$7 - 3x = 20 + 10x$$

$$-13 = 13x$$

$$-1 = x$$

$$2(-1) - y = -4$$

$$-2 - y = -4$$

$$-y = -2$$

$$y = 2$$

$$\text{sol: } x = -1 \quad y = 2$$

4.  $7x - 4y = 5$  ;  $9x + 8y = 13$

$$7x = 5 + 4y \quad 9x = 13 - 8y$$

$$x = \frac{5 + 4y}{7} \quad x = \frac{13 - 8y}{9}$$

$$9(5 + 4y) = 7(13 - 8y)$$

$$45 + 36y = 91 - 56y$$

$$92y = 46$$

$$y = \frac{46}{92} = \frac{1}{2}$$

$$9x + 8\left(\frac{1}{2}\right) = 13$$

$$9x + 4 = 13$$

$$9x = 9$$

$$x = 1$$

$$\text{sol: } x = 1 \quad y = \frac{1}{2}$$

5.  $9x + 16y = 7$  ;  $4y - 3x = 0$

$$16y = 7 - 9x \quad 4y = 3x$$

$$y = \frac{7 - 9x}{16} \quad y = \frac{3x}{4}$$

$$4(7 - 9x) = 16(3x)$$

$$28 - 36x = 48x$$

$$28 = 84x$$

$$x = \frac{28}{84} = \frac{1}{3}$$

$$4y - 1 = 0$$

$$4y = 1$$

$$y = \frac{1}{4}$$

$$\text{sol: } x = \frac{1}{3} \quad y = \frac{1}{4}$$

6.  $14x - 11y = -29$  ;  $13y - 8x = 30$

$$14x = 11y - 29 \quad -8x = 30 - 13y$$

$$x = \frac{11y - 29}{14} \quad x = \frac{13y - 30}{8}$$

$$8(11y - 29) = 14(13y - 30)$$

$$88y - 232 = 182y - 420$$

$$188 = 94y$$

$$2 = y$$

$$13(2) - 8x = 30$$

$$26 - 8x = 30$$

$$-8x = 4$$

$$x = -\frac{1}{2}$$

$$\text{sol: } x = -\frac{1}{2} \quad y = 2$$

7.  $15x - 11y = -87$

$$15x = 11y - 87$$

$$x = \frac{11y - 87}{15}$$

$$-12x - 5y = -27$$

$$12x = 27 - 5y$$

$$x = \frac{27 - 5y}{12}$$

$$12(11y - 87) = 15(27 - 5y)$$

$$132y - 1.044 = 405 - 75y$$

$$207y = 1.449$$

$$y = \frac{1.449}{207} = 7$$

$$12x + 5(7) = 27$$

$$12x + 35 = 27$$

$$12x = -8$$

$$x = -\frac{8}{12} = -\frac{2}{3}$$

$$\text{sol: } x = -\frac{2}{3} \quad y = 7$$

8.  $7x + 9y = 42$

$$9y = 42 - 7x$$

$$y = \frac{42 - 7x}{9}$$

$$12x + 10y = -4$$

$$10y = -4 - 12x$$

$$y = -\frac{4 + 12x}{10}$$

$$10(42 - 7x) = -9(4 + 12x)$$

$$420 - 70x = -36 - 108x$$

$$38x = -456$$

$$x = -12$$

$$12(-12) + 10y = -4$$

$$-144 + 10y = -4$$

$$10y = 140$$

$$y = 14$$

$$\text{sol: } x = -12 \quad y = 14$$

$$\begin{aligned}
 9. \quad & 6x - 18y = -85 ; \quad 24x - 5y = -5 \\
 & -18y = -6x - 85 \quad -5y = -5 - 24x \\
 & y = \frac{6x + 85}{18} \quad y = \frac{5 + 24x}{5} \\
 & 5(6x + 85) = 18(5 + 24x) \\
 & 30x + 425 = 90 + 432x \\
 & 335 = 402x \\
 & x = \frac{335}{402} = \frac{5}{6} \\
 & 6\left(\frac{5}{6}\right) - 18y = -85 \\
 & 5 - 18y = -85 \\
 & -18y = -90 \\
 & y = 5 \\
 \text{sol: } & x = \frac{5}{6} \quad y = 5
 \end{aligned}$$

## EJERCICIO 177

$$\begin{aligned}
 1. \quad & x + 3y = 6 ; \quad 5x - 2y = 13 \\
 & x = 6 - 3y \\
 & 5(6 - 3y) - 2y = 13 \\
 & 30 - 15y - 2y = 13 \\
 & -17y = -17 \\
 & y = 1 \\
 & x + 3(1) = 6 \\
 & x + 3 = 6 \\
 & x = 3 \\
 \text{sol: } & x = 3 \quad y = 1
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 5x + 7y = -1 ; \quad -3x + 4y = -24 \\
 & 5x = -1 - 7y \\
 & x = -\frac{1 + 7y}{5} \\
 & 3\left(\frac{1 + 7y}{5}\right) + 4y = -24 \\
 & \frac{3 + 21y}{5} + 4y = -24 \\
 & 3 + 21y + 20y = -120 \\
 & 41y = -123 \\
 & y = -3 \\
 & -3x + 4(-3) = -24 \\
 & -3x - 12 = -24 \\
 & -3x = -12 \\
 & x = 4 \\
 \text{sol: } & x = 4 \quad y = -3
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & x - 5y = 8 ; \quad -7x + 8y = 25 \\
 & 8y = 25 + 7x \\
 & y = \frac{25 + 7x}{8}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 3x + 4y = 8 ; \quad 8x - 9y = -77 \\
 & 4y = 8 - 3x \\
 & y = \frac{8 - 3x}{4} \\
 & 8x - 9\left(\frac{8 - 3x}{4}\right) = -77 \\
 & 32x - 9(8 - 3x) = -308 \\
 & 32x - 72 + 27x = -308 \\
 & 59x = -236 \\
 & x = -4 \\
 & 3(-4) + 4y = 8 \\
 & -12 + 4y = 8 \\
 & 4y = 20 \\
 & y = 5 \\
 \text{sol: } & x = -4 \quad y = 5
 \end{aligned}$$

$$\begin{aligned}
 & x - 5\left(\frac{25 + 7x}{8}\right) = 8 \\
 & 8x - 5(25 + 7x) = 64 \\
 & 8x - 125 - 35x = 64 \\
 & -27x = 189 \\
 & x = -7 \\
 & -7 - 5y = 8 \\
 & -5y = 15 \\
 & y = -3 \\
 \text{sol: } & x = -7 \quad y = -3
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & 15x + 11y = 32 ; \quad 7y - 9x = 8 \\
 & 7y = 8 + 9x \\
 & y = \frac{8 + 9x}{7}
 \end{aligned}$$

$$\begin{aligned}
 & 10x + 18y = -11 ; \quad 16x - 9y = -5 \\
 & 10x = -11 - 18y \\
 & x = -\frac{11 + 18y}{10} \\
 & -16\left(\frac{11 + 18y}{10}\right) - 9y = -5 \\
 & -16(11 + 18y) - 90y = -50 \\
 & -176 - 288y - 90y = -50 \\
 & -378y = 126 \\
 & y = -\frac{126}{378} = -\frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 & 15x + 11\left(\frac{8 + 9x}{7}\right) = 32 \\
 & 105x + 11(8 + 9x) = 224 \\
 & 105x + 88 + 99x = 224 \\
 & 204x = 136 \\
 & x = \frac{136}{204} = \frac{2}{3}
 \end{aligned}$$

$$\begin{aligned}
 & 10x + 18\left(-\frac{1}{3}\right) = -11 \\
 & 10x - 6 = -11 \\
 & 10x = -5 \\
 & x = -\frac{1}{2} \\
 \text{sol: } & x = -\frac{1}{2} \quad y = -\frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 & 10x + 18\left(-\frac{1}{3}\right) = -11 \\
 & 10x - 6 = -11 \\
 & 10x = -5 \\
 & x = -\frac{1}{2} \\
 \text{sol: } & x = -\frac{1}{2} \quad y = -\frac{1}{3}
 \end{aligned}$$

$$7. \quad 4x + 5y = 5; \quad -4x - 10y = -7$$

$$10y = 7 - 4x$$

$$y = \frac{7-4x}{10}$$

$$4x + 5\left(\frac{7-4x}{10}\right) = 5$$

$$8x + 7 - 4x = 10$$

$$4x = 3$$

$$x = \frac{3}{4}$$

$$4\left(\frac{3}{4}\right) + 5y = 5$$

$$3 + 5y = 5$$

$$5y = 2$$

$$y = \frac{2}{5}$$

$$\text{sol: } x = \frac{3}{4} \quad y = \frac{2}{5}$$

$$8. \quad 32x - 25y = 13; \quad 16x + 15y = 1$$

$$16x = 1 - 15y$$

$$x = \frac{1-15y}{16}$$

$$32\left(\frac{1-15y}{16}\right) - 25y = 13$$

$$2(1-15y) - 25y = 13$$

$$2 - 30y - 25y = 13$$

$$2 - 55y = 13$$

$$-55y = 11$$

$$y = -\frac{1}{5}$$

$$16x + 15\left(-\frac{1}{5}\right) = 1$$

$$16x - 3 = 1$$

$$16x = 4$$

$$x = \frac{1}{4}$$

$$\text{sol: } x = \frac{1}{4} \quad y = -\frac{1}{5}$$

$$9. \quad 11x - 13y = -163; \quad -8x + 7y = 94$$

$$11x = -163 + 13y$$

$$x = -\frac{163-13y}{11}$$

$$8\left(\frac{163-13y}{11}\right) + 7y = 94$$

$$8(163-13y) + 77y = 1.034$$

$$1.304 - 104y + 77y = 1.034$$

$$-27y = -270$$

$$y = 10$$

$$11x - 13(10) = -163$$

$$11x - 130 = -163$$

$$11x = -33$$

$$x = -3$$

$$\text{sol: } x = -3 \quad y = 10$$

## EJERCICIO 178

$$1. \quad 6x - 5y = -9 \quad (2)$$

$$4x + 3y = 13 \quad (-3)$$

$$\underline{12x - 10y = -18}$$

$$\underline{-12x - 9y = -39}$$

$$-19y = -57$$

$$y = 3$$

$$4x + 3(3) = 13$$

$$4x + 9 = 13$$

$$4x = 4$$

$$x = 1$$

$$\text{sol: } x = 1 \quad y = 3$$

$$3. \quad 3x - 4y = 41 \quad (3)$$

$$11x + 6y = 47 \quad (2)$$

$$\underline{9x - 12y = 123}$$

$$\underline{22x + 12y = 94}$$

$$31x = 217$$

$$x = 7$$

$$3(7) - 4y = 41$$

$$21 - 4y = 41$$

$$-4y = 20$$

$$y = -5$$

$$\text{sol: } x = 7 \quad y = -5$$

$$5. \quad 10x - 3y = 36$$

$$2x + 5y = -4 \quad (-5)$$

$$\underline{10x - 3y = 36}$$

$$\underline{-10x - 25y = 20}$$

$$-28y = 56$$

$$y = -2$$

$$10x - 3(-2) = 36$$

$$10x = 30$$

$$x = 3$$

$$\text{sol: } x = 3 \quad y = -2$$

$$2. \quad 7x - 15y = 1$$

$$-x - 6y = 8 \quad (7)$$

$$\underline{7x - 15y = 1}$$

$$\underline{-7x - 42y = 56}$$

$$-57y = 57$$

$$y = -1$$

$$7x - 15(-1) = 1$$

$$7x + 15 = 1$$

$$7x = -14$$

$$x = -2$$

$$\text{sol: } x = -2 \quad y = -1$$

$$4. \quad 9x + 11y = -14 \quad (4)$$

$$6x - 5y = -34 \quad (-6)$$

$$\underline{36x + 44y = -56}$$

$$\underline{-36x + 30y = 204}$$

$$74y = 148$$

$$y = 2$$

$$6x - 5(2) = -34$$

$$6x - 10 = -34$$

$$6x = -24$$

$$x = -4$$

$$\text{sol: } x = -4 \quad y = 2$$

$$6. \quad 11x - 9y = 2 \quad (5)$$

$$13x - 15y = -2 \quad (-3)$$

$$\underline{55x - 45y = 10}$$

$$\underline{-39x + 45y = 6}$$

$$16x = 16$$

$$x = 1$$

$$11(1) - 9y = 2$$

$$11 - 9y = 2$$

$$-9y = -9$$

$$y = 1$$

$$\text{sol: } x = 1 \quad y = 1$$



$$7. \quad 18x + 5y = -11 \quad (2)$$

$$12x + 11y = 31 \quad (-3)$$

$$\begin{array}{r} 36x + 10y = -22 \\ -36x - 33y = -93 \\ \hline -23y = -115 \\ y = 5 \end{array}$$

$$18x + 5(5) = -11$$

$$18x + 25 = -11$$

$$18x = -36$$

$$x = -2$$

$$\text{sol: } x = -2 \quad y = 5$$

$$8. \quad 9x + 7y = -4 \quad (-11)$$

$$11x - 13y = -48 \quad (9)$$

$$\begin{array}{r} -99x - 77y = 44 \\ 99x - 117y = -432 \\ \hline -194y = -388 \\ y = 2 \end{array}$$

$$9x + 7(2) = -4$$

$$9x + 14 = -4$$

$$9x = -18$$

$$x = -2$$

$$\text{sol: } x = -2 \quad y = 2$$

$$9. \quad 12x - 14y = 20 \quad (7)$$

$$-14x + 12y = -19 \quad (6)$$

$$\begin{array}{r} 84x - 98y = 140 \\ -84x + 72y = -114 \\ \hline -26y = 26 \\ y = -1 \end{array}$$

$$12x - 14(-1) = 20$$

$$12x + 14 = 20$$

$$12x = 6$$

$$x = \frac{1}{2}$$

$$\text{sol: } x = \frac{1}{2} \quad y = -1$$

$$10. \quad 15x - y = 40 \quad (8)$$

$$\begin{array}{r} 19x + 8y = 236 \\ 120x - 8y = 320 \\ \hline 19x + 8y = 236 \\ 139x = 556 \\ x = 4 \end{array}$$

$$15(4) - y = 40$$

$$60 - y = 40$$

$$-y = -20$$

$$y = 20$$

$$\text{sol: } x = 4 \quad y = 20$$

$$11. \quad 36x - 11y = -14 \quad (2)$$

$$24x - 17y = 10 \quad (-3)$$

$$\begin{array}{r} 72x - 22y = -28 \\ -72x + 51y = -30 \\ \hline 29y = -58 \\ y = -2 \end{array}$$

$$36x - 11(-2) = -14$$

$$36x + 22 = -14$$

$$36x = -36$$

$$x = -1$$

$$\text{sol: } x = -1 \quad y = -2$$

$$12. \quad 12x - 17y = 104 \quad (5)$$

$$15x + 19y = -31 \quad (-4)$$

$$\begin{array}{r} 60x - 85y = 520 \\ -60x - 76y = 124 \\ \hline -161y = 644 \\ y = -4 \end{array}$$

$$12x - 17(-4) = 104$$

$$12x + 68 = 104$$

$$12x = 36$$

$$x = 3$$

$$\text{sol: } x = 3 \quad y = -4$$

## EJERCICIO 179

$$1. \quad 8x - 5 = 7y - 9$$

$$8x - 7y = -9 + 5$$

$$8x - 7y = -4$$

$$6x = 3y + 6$$

$$6x - 3y = 6$$

$$8x - 7y = -4 \quad (3)$$

$$6x - 3y = 6 \quad (-4)$$

$$24x - 21y = -12$$

$$-24x + 12y = -24$$

$$-9y = -36$$

$$y = 4$$

$$6x - 3(4) = 6$$

$$6x - 12 = 6$$

$$6x = 18$$

$$x = 3$$

$$\text{sol: } x = 3 \quad y = 4$$

$$2. \quad x - 1 = y + 1$$

$$x - y = 2$$

$$x - 3 = 3y - 7$$

$$x - 3y = -4$$

$$x - y = 2$$

$$x - 3y = -4 \quad (-1)$$

$$x - y = 2$$

$$-x + 3y = 4$$

$$2y = 6$$

$$y = 3$$

$$x - 3 = 2$$

$$x = 5$$

$$\text{sol: } x = 5 \quad y = 3$$

$$3. \quad 3(x+2) = 2y \quad 2(y+5) = 7x$$

$$3x + 6 = 2y \quad 2y + 10 = 7x$$

$$3x - 2y = -6 \quad 7x - 2y = 10$$

$$3x - 2y = -6 \quad ; \quad 7x - 2y = 10$$

$$3x = -6 + 2y \quad 7x = 10 + 2y$$

$$x = -\frac{6-2y}{3} \quad x = \frac{10+2y}{7}$$

$$-7(6-2y) = 3(10+2y)$$

$$-42 + 14y = 30 + 6y$$

$$8y = 72$$

$$y = 9$$

$$7x - 2(9) = 10$$

$$7x - 18 = 10$$

$$7x = 28$$

$$x = 4$$

$$\text{sol: } x = 4 \quad y = 9$$

4.  $x-1=2(y+6)$

$$x-1=2y+12$$

$$x-2y=13$$

$$x=13+2y$$

$$x+6=3(1-2y)$$

$$x+6=3-6y$$

$$x+6y=-3$$

$$x=-3-6y$$

$$13+2y=-3-6y$$

$$-3-6y-2y=13$$

$$-8y=16$$

$$y=-2$$

$$x-2(-2)=13$$

$$x+4=13$$

$$x=9$$

$$\text{sol: } x=9 \quad y=-2$$

5.  $30-(8-x)=2y+30$

$$30-8+x=2y+30$$

$$x-2y=8$$

$$5x-29=x-(5-4y)$$

$$5x-29=x-5+4y$$

$$4x-4y=24$$

$$x-y=6$$

$$x-2y=8$$

$$\frac{x-y=6}{x-2y=8} \quad (-1)$$

$$x-2y=8$$

$$-x+y=-6$$

$$-y=2$$

$$y=-2$$

$$x-2(-2)=8$$

$$x+4=8$$

$$x=4$$

$$\text{sol: } x=4 \quad y=-2$$

6.  $3x-(9x+y)=5y-(2x+9y)$

$$3x-9x-y=5y-2x-9y$$

$$-4x+3y=0$$

$$4x-(3y+7)=5y-47$$

$$4x-3y-7=5y-47$$

$$4x-8y=-40$$

$$x-2y=-10$$

$$-4x+3y=0$$

$$\frac{x-2y=-10}{-4x+3y=0} \quad (4)$$

$$-4x+3y=0$$

$$4x-8y=-40$$

Continúa

### 6. Continuación

$$-5y=-40$$

$$y=8$$

$$x-2(8)=-10$$

$$x-16=-10$$

$$x=6$$

$$\text{sol: } x=6 \quad y=8$$

7.  $(x-y)-(6x+8y)=-10x+5y+3$

$$x-y-6x-8y=-10x-5y-3$$

$$-5x-9y=-10x-5y-3$$

$$5x-4y=-3$$

$$(x+y)-(9y-11x)=2y-2x$$

$$x+y-9y+11x=2y-2x$$

$$12x-8y=2y-2x$$

$$14x-10y=0$$

$$5x-4y=-3 \quad (5)$$

$$\frac{14x-10y=0}{25x-20y=-15} \quad (-2)$$

$$25x-20y=-15$$

$$-28x+20y=0$$

$$-3x=-15$$

$$x=5$$

$$5(5)-4y=-3$$

$$25-4y=-3$$

$$-4y=-28$$

$$y=7$$

$$\text{sol: } x=5 \quad y=7$$

8.  $5(x+3y)-(7x+8y)=-6$

$$5x+15y-7x-8y=-6$$

$$-2x+7y=-6$$

$$7x-9y-2(x-18y)=0$$

$$7x-9y-2x+36y=0$$

$$5x+27y=0$$

$$-2x+7y=-6 \quad (5)$$

$$\frac{5x+27y=0}{-10x+35y=-30} \quad (2)$$

$$-10x+35y=-30$$

$$10x+54y=0$$

$$89y=-30$$

$$y=-\frac{30}{89}$$

Continúa

### 8. Continuación

$$-2x+7\left(-\frac{30}{89}\right)=-6$$

$$-178x-210=-534$$

$$-178x=-324$$

$$x=\frac{324}{178}=1\frac{73}{89}$$

$$\text{sol: } x=1\frac{73}{89} \quad y=-\frac{30}{89}$$

9.  $2(x+5)=4(y-4x)$

$$2x+10=4y-16x$$

$$18x-4y=-10$$

$$10(y-x)=11y-12x$$

$$10y-10x=11y-12x$$

$$2x-y=0$$

$$18x-4y=-10$$

$$\frac{2x-y=0}{18x-4y=-10} \quad (-9)$$

$$18x-4y=-10$$

$$-18x+9y=0$$

$$5y=-10$$

$$y=-2$$

$$2x-(-2)=0$$

$$2x+2=0$$

$$2x=-2$$

$$x=-1$$

$$\text{sol: } x=-1 \quad y=-2$$

10.  $3x-4y-2(2x-7)=0$

$$3x-4y-4x+14=0$$

$$-x-4y=-14$$

$$x+4y=14$$

$$5(x-1)-(2y-1)=0$$

$$5x-5-2y+1=0$$

$$5x-2y=4$$

$$x+4y=14$$

$$\frac{5x-2y=4}{x+4y=14} \quad (2)$$

$$x+4y=14$$

$$10x-4y=8$$

$$11x=22$$

$$x=2$$

$$2+4y=14$$

$$4y=12$$

$$y=3$$

$$\text{sol: } x=2 \quad y=3$$

$$11. 12(x+2y)-8(2x+y)=2(5x-6y)$$

$$12x+24y-16x-8y=10x-12y$$

$$-4x+16y=10x-12y$$

$$-14x+28y=0$$

$$-x+2y=0$$

$$20(x-4y)=-10$$

$$20x-80y=-10$$

$$2x-8y=-1$$

$$-x+2y=0 \quad (2)$$

$$\underline{2x-8y=-1}$$

$$-2x+4y=0$$

$$\underline{2x-8y=-1}$$

$$-4y=-1$$

$$y=\frac{1}{4}$$

$$-x+2\left(\frac{1}{4}\right)=0$$

$$-4x+2=0$$

$$-4x=-2$$

$$x=\frac{1}{2}$$

$$sol: x=\frac{1}{2} \quad y=\frac{1}{4}$$

$$12. x(y-2)-y(x-3)=-14$$

$$xy-2x-xy+3y=-14$$

$$-2x+3y=-14$$

$$y(x-6)-x(y+9)=54$$

$$xy-6y-xy-9x=54$$

$$-9x-6y=54$$

$$3x+2y=-18$$

$$-2x+3y=-14 \quad (3)$$

$$\underline{3x+2y=-18 \quad (2)}$$

$$-6x+9y=-42$$

$$\underline{6x+4y=-36}$$

$$13y=-78$$

$$y=-6$$

$$-2x+3(-6)=-14$$

$$-2x-18=-14$$

$$-2x=4$$

$$x=-2$$

$$sol: x=-2 \quad y=-6$$

## EJERCICIO 180

$$1. \frac{3x}{2}+y=11$$

$$3x+2y=22$$

$$x+\frac{y}{2}=7$$

$$2x+y=14$$

$$3x+2y=22 \quad ; \quad 2x+y=14$$

$$3x=22-2y \quad 2x=14-y$$

$$x=\frac{22-2y}{3} \quad x=\frac{14-y}{2}$$

$$2(22-2y)=3(14-y)$$

$$44-4y=42-3y$$

$$-y=-2$$

$$y=2$$

$$2x+2=14$$

$$2x=12$$

$$x=6$$

$$sol: x=6 \quad y=2$$

$$2. \frac{5x}{12}-y=9 \quad ; \quad x-\frac{3y}{4}=15$$

$$5x-12y=108 \quad ; \quad 4x-3y=60$$

$$5x=108+12y$$

$$x=\frac{108+12y}{5}$$

$$4\left(\frac{108+12y}{5}\right)-3y=60$$

$$4(108+12y)-15y=300$$

$$432+48y-15y=300$$

$$33y=-132$$

$$y=-4$$

$$4x-3(-4)=60$$

$$4x+12=60$$

$$4x=48$$

$$x=12$$

$$sol: x=12 \quad y=-4$$

$$3. \frac{x}{7}+\frac{y}{3}=5 \quad ; \quad 3y-\frac{x}{14}=26$$

$$3x+7y=105 \quad ; \quad 42y-x=364$$

$$3x+7y=105$$

$$\underline{-x+42y=364 \quad (3)}$$

$$3x+7y=105$$

$$\underline{-3x+126y=1.092}$$

$$133y=1.197$$

$$y=9$$

$$3x+7(9)=105$$

$$3x+63=105$$

$$3x=42$$

$$x=14$$

$$sol: x=14 \quad y=9$$

$$\begin{aligned}
 4. \quad \frac{x}{5} = \frac{y}{4} &; \quad \frac{y}{3} = \frac{x}{3} - 1 \\
 4x = 5y &\quad y = x - 3 \\
 4x - 5y = 0 &\quad x - y = 3 \\
 4x - 5y = 0 & \\
 \frac{x - y = 3}{4x - 5y = 0} &\quad (-4) \\
 \frac{-4x + 4y = -12}{-4x - 5y = -12} & \\
 -y = -12 & \\
 y = 12 & \\
 x - 12 = 3 & \\
 x = 15 & \\
 \text{sol: } x = 15 \quad y = 12 &
 \end{aligned}$$

$$\begin{aligned}
 5. \quad \frac{3x}{5} - \frac{1}{4}y = 2 &; \quad 2x = \frac{5y}{2} \\
 12x - 5y = 40 &\quad 4x = 5y \\
 4x - 5y = 0 & \\
 \frac{12x - 5y = 40}{4x - 5y = 0} &\quad (-1) \\
 \frac{-12x + 5y = -40}{-8x = -40} & \\
 -8x = -40 & \\
 x = 5 & \\
 4(5) - 5y = 0 & \\
 20 - 5y = 0 & \\
 -5y = -20 & \\
 y = 4 & \\
 \text{sol: } x = 5 \quad y = 4 &
 \end{aligned}$$

$$\begin{aligned}
 6. \quad \frac{2x}{3} - \frac{3y}{4} = 1 &; \quad \frac{1}{8}y - \frac{5x}{6} = 2 \\
 8x - 9y = 12 &; \quad 3y - 20x = 48 \\
 8x - 9y = 12 & \\
 \frac{-20x + 3y = 48}{8x - 9y = 12} &\quad (3) \\
 \frac{-60x + 9y = 144}{-52x = 156} & \\
 -52x = 156 & \\
 x = -3 & \\
 8(-3) - 9y = 12 & \\
 -24 - 9y = 12 & \\
 -9y = 36 & \\
 y = -4 & \\
 \text{sol: } x = -3 \quad y = -4 &
 \end{aligned}$$

$$\begin{aligned}
 7. \quad \frac{x}{8} - \frac{y}{5} = -\frac{11}{10} &; \quad \frac{x}{5} + \frac{y}{4} = -\frac{59}{40} \\
 5x - 8y = -44 &; \quad 8x + 10y = -59 \\
 5x - 8y = -44 &\quad (5) \\
 8x + 10y = -59 &\quad (4) \\
 \frac{25x - 40y = -220}{32x + 40y = -236} & \\
 57x = -456 & \\
 x = -8 & \\
 5(-8) - 8y = -44 & \\
 -40 - 8y = -44 & \\
 -8y = -4 & \\
 y = \frac{1}{2} & \\
 \text{sol: } x = -8 \quad y = \frac{1}{2} &
 \end{aligned}$$

$$\begin{aligned}
 8. \quad \frac{x}{7} + \frac{y}{8} = 0 &; \quad \frac{1}{7}x - \frac{3y}{4} = 7 \\
 8x + 7y = 0 &; \quad 4x - 21y = 196 \\
 8x = -7y &\quad 4x = 196 + 21y \\
 x = \frac{-7y}{8} &\quad x = \frac{196 + 21y}{4} \\
 -28y = 8(196 + 21y) & \\
 -28y = 1.568 + 168y & \\
 -196y = 1.568 & \\
 y = -8 & \\
 x = \frac{-7(-8)}{8} & \\
 x = 7 & \\
 \text{sol: } x = 7 \quad y = -8 &
 \end{aligned}$$

$$\begin{aligned}
 9. \quad \frac{2x+1}{5} = \frac{y}{4} &; \quad 2x - 3y = -8 \\
 4(2x+1) = 5y & \\
 8x + 4 = 5y & \\
 8x - 5y = -4 & \\
 2x - 3y = -8 &\quad (-4) \\
 \frac{8x - 5y = -4}{-8x + 12y = 32} & \\
 \frac{8x - 5y = -4}{7y = 28} & \\
 y = 4 &
 \end{aligned}$$

Continúa

## 9. Continuación

$$\begin{aligned}
 8x - 5(4) = -4 & \\
 8x - 20 = -4 & \\
 8x = 16 & \\
 x = 2 & \\
 \text{sol: } x = 2 \quad y = 4 &
 \end{aligned}$$

$$\begin{aligned}
 10. \quad 12x + 5y + 6 = 0 & \\
 12x + 5y = -6 & \\
 \frac{5x}{3} - \frac{7y}{6} = -12 & \\
 10x - 7y = -72 & \\
 12x + 5y = -6 &\quad (5) \\
 \frac{10x - 7y = -72}{60x + 25y = -30} &\quad (-6) \\
 \frac{-60x + 42y = 432}{67y = 402} & \\
 y = 6 & \\
 10x - 7(6) = -72 & \\
 10x - 42 = -72 & \\
 10x = -30 & \\
 x = -3 & \\
 \text{sol: } x = -3 \quad y = 6 &
 \end{aligned}$$

$$\begin{aligned}
 11. \quad \frac{x}{5} = 3(y+2) & \\
 x = 15(y+2) & \\
 x = 15y + 30 & \\
 \frac{y}{5} + 3x = \frac{224}{5} & \\
 y + 15x = 224 & \\
 15x = 224 - y & \\
 x = \frac{224 - y}{15} & \\
 15(15y + 30) = 224 - y & \\
 225y + 450 = 224 - y & \\
 226y = -226 & \\
 y = -1 & \\
 x = 15(-1) + 30 & \\
 x = -15 + 30 & \\
 x = 15 & \\
 \text{sol: } x = 15 \quad y = -1 &
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{x}{5} - \frac{y}{6} = -\frac{1}{30} ; \quad \frac{x}{3} - \frac{y}{20} = \frac{13}{12} \\
 & 6x - 5y = -1 \quad ; \quad 20x - 3y = 65 \\
 & \quad 6x - 5y = -1 \quad (3) \\
 & \quad 20x - 3y = 65 \quad (-5) \\
 \hline
 & 18x - 15y = -3 \\
 & -100x + 15y = -325 \\
 \hline
 & -82x = -328 \\
 & \quad x = 4 \\
 & 6(4) - 5y = -1 \\
 & \quad -5y = -25 \\
 & \quad y = 5 \\
 & \text{sol: } x=4 \quad y=5
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{x-3}{3} - \frac{y-4}{4} = 0 ; \quad \frac{x-4}{2} + \frac{y+2}{5} = 3 \\
 & 4(x-3) - 3(y-4) = 0 ; \quad 5(x-4) + 2(y+2) = 30 \\
 & 4x - 12 - 3y + 12 = 0 ; \quad 5x - 20 + 2y + 4 = 30 \\
 & \quad 4x - 3y = 0 \quad \quad \quad 5x + 2y = 46 \\
 & \quad \quad \quad x = \frac{3y}{4} \\
 & 5\left(\frac{3y}{4}\right) + 2y = 46 \\
 & \quad 15y + 8y = 184 \\
 & \quad 23y = 184 \\
 & \quad y = 8 \\
 & x = \frac{3(8)}{4} \\
 & x = 6 \\
 & \text{sol: } x=6 \quad y=8
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{x-1}{2} - \frac{y-1}{3} = -\frac{13}{36} ; \quad \frac{x+1}{3} - \frac{y+1}{2} = -\frac{2}{3} \\
 & 18(x-1) - 12(y-1) = -13 \quad ; \quad 2x+2-3y-3 = -4 \\
 & \quad 18x - 12y = -7 \quad \quad \quad 2x - 3y = -3 \\
 & 18x - 12y = -7 \\
 & \quad 2x - 3y = -3 \quad (-4) \\
 \hline
 & 18x - 12y = -7 \\
 & -8x + 12y = 12 \\
 \hline
 & 10x = 5 \\
 & \quad x = \frac{1}{2} \\
 & 2\left(\frac{1}{2}\right) - 3y = -3 \\
 & \quad -3y = -4 \\
 & \quad y = \frac{4}{3} \\
 & \text{sol: } x = \frac{1}{2} \quad y = \frac{4}{3}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{x+1}{10} = \frac{y-4}{5} ; \quad \frac{x-4}{5} = \frac{y-2}{10} \\
 & x+1 = 2(y-4) ; \quad 2(x-4) = y-2 \\
 & x+1 = 2y-8 \quad ; \quad 2x-8 = y-2 \\
 & x-2y = -9 \quad \quad \quad 2x-y = 6 \\
 & \quad \quad \quad x = 2y-9 \\
 & 2(2y-9) - y = 6 \\
 & \quad 4y - 18 - y = 6 \\
 & \quad \quad 3y = 24 \\
 & \quad \quad y = 8 \\
 & x = 2(8) - 9 \\
 & x = 7 \\
 & \text{sol: } x=7 \quad y=8
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & x = -\frac{3y+3}{4} ; \quad y = -\frac{1+5x}{4} \\
 & 4x = -3y-3 \quad ; \quad 4y = -1-5x \\
 & 4x + 3y = -3 \quad \quad \quad 4y + 5x = -1 \\
 & \quad 4x + 3y = -3 \quad (4) \\
 \hline
 & \quad 5x + 4y = -1 \quad (-3) \\
 \hline
 & 16x + 12y = -12 \\
 & -15x - 12y = 3 \\
 \hline
 & \quad x = -9 \\
 & 4(-9) + 3y = -3 \\
 & \quad -36 + 3y = -3 \\
 & \quad \quad 3y = 33 \\
 & \quad \quad y = 11 \\
 & \text{sol: } x=-9 \quad y=11
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{x+y}{6} = \frac{x-y}{12} ; \quad \frac{2x}{3} = y+3 \\
 & 2(x+y) = x-y \quad ; \quad 2x = 3(y+3) \\
 & 2x+2y = x-y \quad ; \quad 2x = 3y+9 \\
 & x+3y = 0 \quad ; \quad 2x-3y = 9 \\
 & \quad \quad \quad x = -3y \\
 & 2(-3y) - 3y = 9 \\
 & \quad -6y - 3y = 9 \\
 & \quad \quad -9y = 9 \\
 & \quad \quad y = -1 \\
 & x = -3(-1) \\
 & x = 3 \\
 & \text{sol: } x=3 \quad y=-1
 \end{aligned}$$

$$18. 3x - \frac{y-3}{5} = 6$$

$$15x - y + 3 = 30$$

$$15x - y = 27$$

$$15x = 27 + y$$

$$x = \frac{27+y}{15}$$

$$3y - \frac{x-2}{7} = 9$$

$$21y - x + 2 = 63$$

$$-x + 21y = 61$$

$$-x = 61 - 21y$$

$$x = 21y - 61$$

$$27 + y = 15(21y - 61)$$

$$27 + y = 315y - 915$$

$$-314y = -942$$

$$y = 3$$

$$x = \frac{27+3}{15}$$

$$x = 2$$

$$\text{sol: } x=2 \quad y=3$$

$$19. \frac{x+y}{6} - \frac{y-x}{3} = \frac{7}{24}$$

$$4(x+y) - 8(y-x) = 7$$

$$4x + 4y - 8y + 8x = 7$$

$$12x - 4y = 7$$

$$\frac{x}{2} + \frac{x-y}{6} = \frac{5}{12}$$

$$6x + 2(x-y) = 5$$

$$6x + 2x - 2y = 5$$

$$8x - 2y = 5$$

$$12x - 4y = 7$$

$$\frac{8x - 2y = 5}{12x - 4y = 7} \quad (-2)$$

$$12x - 4y = 7$$

$$-16x + 4y = -10$$

$$-4x = -3$$

$$x = \frac{3}{4}$$

$$12\left(\frac{3}{4}\right) - 4y = 7$$

$$9 - 4y = 7$$

$$-4y = -2$$

$$y = \frac{1}{2}$$

$$\text{sol: } x = \frac{3}{4} \quad y = \frac{1}{2}$$

$$20. \frac{x-2}{4} - \frac{y-x}{2} = x-7$$

$$x - 2 - 2(y-x) = 4(x-7)$$

$$3x - 4x - 2y = -28 + 2$$

$$x + 2y = 26$$

$$\frac{3x-y}{8} - \frac{3y-x}{6} = y-13$$

$$3(3x-y) - 4(3y-x) = 24(y-13)$$

$$13x - 15y - 24y = -312$$

$$13x - 39y = -312$$

$$x + 2y = 26 \quad (-13)$$

$$\frac{13x - 39y = -312}{-13x - 26y = -338}$$

$$-13x - 26y = -338$$

$$\frac{13x - 39y = -312}{-65y = -650}$$

$$-65y = -650$$

$$y = 10$$

$$x + 2(10) = 26$$

$$x + 20 = 26$$

$$x = 6$$

$$\text{sol: } x=6 \quad y=10$$

$$21. 12 - \frac{3x-2y}{6} = 3y+2$$

$$72 - 3x + 2y = 6(3y+2)$$

$$-3x + 2y - 18y = 12 - 72$$

$$3x + 16y = 60$$

$$\frac{5y-3x}{3} = x-y$$

$$5y - 3x = 3(x-y)$$

$$-3x - 3x + 5y + 3y = 0$$

$$6x - 8y = 0$$

$$3x + 16y = 60$$

$$\frac{6x - 8y = 0}{3x + 16y = 60} \quad (2)$$

$$3x + 16y = 60$$

$$\frac{12x - 16y = 0}{15x = 60}$$

$$15x = 60$$

$$x = 4$$

$$6(4) - 8y = 0$$

$$-8y = -24$$

$$y = 3$$

$$\text{sol: } x=4 \quad y=3$$

$$22. y(x-4) = x(y-6)$$

$$xy - 4y = xy - 6x$$

$$6x - 4y = 0$$

$$\frac{5}{x-3} - \frac{11}{y-1} = 0$$

$$5(y-1) - 11(x-3) = 0$$

$$5y - 5 - 11x + 33 = 0$$

$$11x - 5y = 28$$

$$6x - 4y = 0 \quad (5)$$

$$\frac{11x - 5y = 28}{30x - 20y = 0} \quad (-4)$$

$$30x - 20y = 0$$

$$-44x + 20y = -112$$

$$\frac{-44x + 20y = -112}{-14x = -112}$$

$$x = 8$$

$$11(8) - 5y = 28$$

$$-5y = 28 - 88$$

$$-5y = -60$$

$$y = 12$$

$$\text{sol: } x=8 \quad y=12$$

$$23. \frac{3(x+3y)}{5x+6y} = \frac{21}{17}$$

$$51(x+3y) = 21(5x+6y)$$

$$51x + 153y = 105x + 126y$$

$$-54x + 27y = 0$$

$$2x - y = 0$$

$$\frac{4x-7y}{2y+1} = -2$$

$$4x - 7y = -2(2y+1)$$

$$4x - 7y = -4y - 2$$

$$4x - 3y = -2$$

$$2x - y = 0 \quad (-2)$$

$$\frac{4x - 3y = -2}{-4x + 2y = 0}$$

$$-4x + 2y = 0$$

$$\frac{4x - 3y = -2}{y = 2}$$

$$y = 2$$

$$2x - 2 = 0$$

$$2x = 2$$

$$x = 1$$

$$\text{sol: } x=1 \quad y=2$$

$$\begin{aligned}
 24. \quad & \frac{7}{2x-3y+6} = -\frac{7}{3x-2y-1} \\
 & 7(3x-2y-1) = -7(2x-3y+6) \\
 & 21x-14y-7 = -14x+21y-42 \\
 & 35x-35y = -35 \\
 & x-y = -1 \\
 & \frac{6}{x-y+4} = \frac{10}{y+2} \\
 & 6(y+2) = 10(x-y+4) \\
 & 6y+12 = 10x-10y+40 \\
 & -28 = 10x-16y \\
 & -14 = 5x-8y \\
 & x-y = -1 \quad (-8) \\
 & \frac{5x-8y = -14}{-8x+8y = 8} \\
 & \frac{5x-8y = -14}{-3x = -6} \\
 & x = 2 \\
 & 2-y = -1 \\
 & -y = -3 \\
 & y = 3 \\
 & \text{sol: } x=2 \quad y=3
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & \frac{x+y}{x-y} = -7 \\
 & x+y = -7(x-y) \\
 & x+y = -7x+7y \\
 & 8x-6y = 0 \\
 & \frac{x+y+1}{x+y-1} = \frac{3}{4} \\
 & 4(x+y+1) = 3(x+y-1) \\
 & 4x+4y+4 = 3x+3y-3 \\
 & x+y = -7 \\
 & 8x-6y = 0 \\
 & \frac{x+y}{x+y} = -7 \quad (6) \\
 & 8x-6y = 0 \\
 & \frac{6x+6y = -42}{14x = -42} \\
 & x = -3 \\
 & -3+y = -7 \\
 & y = -4 \\
 & \text{sol: } x=-3 \quad y=-4
 \end{aligned}$$

$$\begin{aligned}
 26. \quad & \frac{x}{4} - 8 = \frac{3y}{2} - \frac{33}{4} \\
 & x-32 = 6y-33 \\
 & x-6y = -1 \\
 & \frac{y-x}{3} - \frac{2x+y}{2} = -\frac{17}{24} \\
 & 8(y-x) - 12(2x+y) = -17 \\
 & 8y-8x-24x-12y = -17 \\
 & 32x+4y = 17 \\
 & x-6y = -1 \quad (2) \\
 & 32x+4y = 17 \quad (3) \\
 & 2x-12y = -2 \\
 & \frac{96x+12y = 51}{98x = 49} \\
 & x = \frac{1}{2} \\
 & \frac{1}{2} - 6y = -1 \\
 & 1-12y = -2 \\
 & -12y = -3 \\
 & y = \frac{1}{4} \\
 & \text{sol: } x = \frac{1}{2} \quad y = \frac{1}{4}
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & \frac{x-2}{x+2} = \frac{y-7}{y-5} \\
 & (y-5)(x-2) = (y-7)(x+2) \\
 & xy-2y-5x+10 = xy+2y-7x-14 \\
 & 2x-4y = -24 \\
 & x-2y = -12 \\
 & x = -12+2y \\
 & \frac{x+1}{x-1} = \frac{y-3}{y-5} \\
 & (y-5)(x+1) = (x-1)(y-3) \\
 & xy+y-5x-5 = xy-3x-y+3 \\
 & -2x+2y = 8 \\
 & -x+y = 4 \\
 & x = y-4 \\
 & -12+2y = y-4 \\
 & y = 8 \\
 & x = 8-4 \\
 & x = 4 \\
 & \text{sol: } x=4 \quad y=8
 \end{aligned}$$

$$\begin{aligned}
 28. \quad & \frac{x-y-1}{x+y+1} = -\frac{3}{17} \\
 & 17(x-y-1) = -3(x+y+1) \\
 & 17x-17y-17 = -3x-3y-3 \\
 & 20x-14y = 14 \\
 & 10x-7y = 7 \\
 & \frac{x+y-1}{x-y+1} = -15 \\
 & x+y-1 = -15(x-y+1) \\
 & x+y-1 = -15x+15y-15 \\
 & 16x-14y = -14 \\
 & 8x-7y = -7 \\
 & 10x-7y = 7 \\
 & \frac{8x-7y = -7}{10x-7y = 7} \quad (-1) \\
 & \frac{-8x+7y = 7}{2x = 14} \\
 & x = 7 \\
 & 10(7)-7y = 7 \\
 & -7y = -63 \\
 & y = 9 \\
 & \text{sol: } x=7 \quad y=9
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & \frac{6x+9y-4}{4x-6y+5} = \frac{2}{5} \\
 & 5(6x+9y-4) = 2(4x-6y+5) \\
 & 30x+45y-20 = 8x-12y+10 \\
 & 22x+57y = 30 \\
 & \frac{2x+3y-3}{3x+2y-4} = \frac{6}{11} \\
 & 11(2x+3y-3) = 6(3x+2y-4) \\
 & 22x+33y-33 = 18x+12y-24 \\
 & 4x+21y = 9 \\
 & 22x+57y = 30 \quad (2) \\
 & \frac{4x+21y = 9}{44x+114y = 60} \quad (-11) \\
 & \frac{-44x-231y = -99}{-117y = -39} \\
 & y = \frac{1}{3} \\
 & 4x+21\left(\frac{1}{3}\right) = 9 \\
 & 4x+7 = 9 \\
 & 4x = 2 \\
 & x = \frac{1}{2} \\
 & \text{sol: } x = \frac{1}{2} \quad y = \frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 30. \quad & \frac{3x+2y}{x+y-15} = -9 \\
 & 3x+2y = -9(x+y-15) \\
 & 3x+2y = -9x-9y+135 \\
 & 12x+11y = 135 \\
 & \frac{4x}{3} - \frac{5(y-1)}{8} = -1 \\
 & 32x - 15(y-1) = -24 \\
 & 32x - 15y + 15 = -24 \\
 & 32x - 15y = -39 \\
 & 12x + 11y = 135 \quad (8) \\
 & 32x - 15y = -39 \quad (-3) \\
 \hline
 & 96x + 88y = 1.080 \\
 & -96x + 45y = 117 \\
 \hline
 & 133y = 1.197 \\
 & y = 9 \\
 & 12x + 11(9) = 135 \\
 & 12x = 135 - 99 \\
 & 12x = 36 \\
 & x = 3 \\
 & \text{sol: } x=3 \quad y=9
 \end{aligned}$$

$$\begin{aligned}
 31. \quad & \frac{2x+5}{17} - (5-y) = -60 \\
 & 2x+5-17(5-y) = -1.020 \\
 & 2x-85+17y = -1.025 \\
 & 2x+17y = -940 \\
 & \frac{y+62}{2} - (1-x) = 40 \\
 & y+62-2(1-x) = 80 \\
 & y-2+2x = 18 \\
 & 2x+y = 20 \\
 & 2x+17y = -940 \\
 & 2x+y = 20 \quad (-1) \\
 \hline
 & 2x+17y = -940 \\
 & -2x-y = -20 \\
 \hline
 & 16y = -960 \\
 & y = -60 \\
 & 2x-60 = 20 \\
 & 2x = 80 \\
 & x = 40 \\
 & \text{sol: } x=40 \quad y=-60
 \end{aligned}$$

$$\begin{aligned}
 32. \quad & \frac{3x+4y}{x-6y} = -\frac{30}{23} \\
 & 23(3x+4y) = -30(x-6y) \\
 & 69x+92y = -30x+180y \\
 & 99x-88y = 0 \\
 & 9x-8y = 0 \\
 & \frac{9x-y}{3+x-y} = -\frac{63}{37} \\
 & 37(9x-y) = -63(3+x-y) \\
 & 333x-37y = -189-63x+63y \\
 & 396x-100y = -189 \\
 & 396x-100y = -189 \\
 & 9x-8y = 0 \quad (-44) \\
 \hline
 & 396x-100y = -189 \\
 & -396x+352y = 0 \\
 \hline
 & 252y = -189 \\
 & y = \frac{-3}{4} \\
 & 9x-8\left(\frac{-3}{4}\right) = 0 \\
 & 9x+6 = 0 \\
 & 9x = -6 \\
 & x = \frac{-2}{3} \\
 & \text{sol: } x = \frac{-2}{3} \quad y = \frac{-3}{4} \\
 33. \quad & x - \frac{4x+1}{9} = \frac{2y-5}{3} \\
 & 9x - (4x+1) = 3(2y-5) \\
 & 9x-4x-1 = 6y-15 \\
 & 5x-6y = -14 \\
 & y - \frac{3y+2}{7} = \frac{x+18}{10} \\
 & 70y-10(3y+2) = 7(x+18) \\
 & 70y-30y-20 = 7x+126 \\
 & -146 = 7x-40y \\
 & 7x-40y = -146 \quad (-5) \\
 \hline
 & 5x-6y = -14 \quad (7) \\
 & -35x+200y = 730 \\
 & 35x-42y = -98 \\
 \hline
 & 158y = 632 \\
 & y = 4 \\
 & 5x-6(4) = -14 \\
 & 5x = -14+24 \\
 & x = 2 \\
 & \text{sol: } x=2 \quad y=4
 \end{aligned}$$

## EJERCICIO 181

$$\begin{aligned}
 1. \quad & x+y=a+b; \quad x-y=a-b \\
 & x+y=a+b \\
 & x-y=a-b \\
 \hline
 & x = a \\
 & a+y=a+b \\
 & y=b \\
 & \text{sol: } x=a \quad y=b \\
 2. \quad & 2x+y=b+2 \\
 & 2bx+by=b^2+2b \\
 & bx-y=0 \\
 & -2bx+2y=0 \\
 & -2bx+2y = 0 \\
 \hline
 & 2bx + by = b^2 + 2b \\
 & 2y+by=b^2+2b \\
 & y(2+b)=b(b+2) \\
 & y=b \\
 & 2x+b=b+2 \\
 & 2x=2 \\
 & x=1 \\
 & \text{sol: } x=1 \quad y=b \\
 3. \quad & 2x-y=3a; \\
 & x-2y=0 \\
 & -2x+4y=0 \\
 & 2x-y=3a \\
 & -2x+4y=0 \\
 \hline
 & 3y=3a \\
 & y=a \\
 & 2x-a=3a \\
 & 2x=4a \\
 & x=2a \\
 & \text{sol: } x=2a \quad y=a \\
 4. \quad & x-y=1-a; \quad x+y=1+a \\
 & x-y=1-a \\
 & x+y=1+a \\
 \hline
 & 2x = 2 \\
 & x=1 \\
 & 1+y=1+a \\
 & y=a \\
 & \text{sol: } x=1 \quad y=a
 \end{aligned}$$



$$\begin{aligned}
5. \quad \frac{x}{a} + y &= 2ab \quad ; \quad \frac{x}{b} - y = a - b \\
x + ay &= 2ab \quad ; \quad x - by = ab - b^2 \\
x + ay &= 2ab \\
\frac{-x + by}{ay + by} &= \frac{b^2 - ab}{b^2 + ab} \\
y(a+b) &= b(b+a) \\
y &= b \\
x + ab &= 2ab \\
x &= ab \\
\text{sol: } x &= ab \quad y = b
\end{aligned}$$

$$\begin{aligned}
6. \quad \frac{x}{b} + \frac{y}{a} &= 2 \\
ax + by &= 2ab \\
abx + b^2y &= 2ab^2 \\
\frac{x}{a} + \frac{y}{b} &= \frac{a^2 + b^2}{ab} \\
bx + ay &= a^2 + b^2 \\
\frac{-abx - a^2y}{abx + b^2y} &= \frac{-a^3 - ab^2}{2ab^2} \\
\frac{-abx - a^2y}{b^2y - a^2y} &= \frac{-a^3 - ab^2}{-a^3 + ab^2} \\
y(b^2 - a^2) &= a(b^2 - a^2) \\
y &= a \\
ax + ba &= 2ab \\
a(x+b) &= 2ab \\
x+b &= 2b \\
x &= b \\
\text{sol: } x &= b \quad y = a
\end{aligned}$$

$$\begin{aligned}
7. \quad x + y &= a + b \\
-ax - ay &= -a^2 - ab \\
ax + by &= a^2 + b^2 \\
\frac{-ax - ay}{ax + by} &= \frac{-a^2 - ab}{a^2 + b^2} \\
\frac{by - ay}{by - ay} &= \frac{b^2 - ab}{b^2 - ab} \\
y(b-a) &= b(b-a) \\
y &= b \\
x + b &= a + b \\
x &= a \\
\text{sol: } x &= a \quad y = b
\end{aligned}$$

$$\begin{aligned}
8. \quad ax - by &= 0 \quad ; \quad x + y = \frac{a+b}{ab} \\
abx - b^2y &= 0 \quad abx + aby = a + b \\
abx - b^2y &= 0 \\
\frac{-abx}{-abx} &= \frac{-aby}{-a-b} \\
-b^2y - aby &= -(a+b) \\
-yb(b+a) &= -(a+b) \\
-yb &= -1 \Rightarrow y = \frac{1}{b} \\
ax - b\left(\frac{1}{b}\right) &= 0 \\
ax &= 1 \Rightarrow x = \frac{1}{a} \\
\text{sol: } x &= \frac{1}{a} \quad y = \frac{1}{b}
\end{aligned}$$

$$\begin{aligned}
9. \quad mx - ny &= m^2 + n^2 \quad ; \quad nx + my = m^2 + n^2 \\
mnx - n^2y &= m^2n + n^3 \quad mnx + m^2y = m^3 + mn^2 \\
\frac{-mnx + n^2y}{mnx + m^2y} &= \frac{-m^2n - n^3}{m^3 + mn^2} \\
\frac{n^2y + m^2y}{n^2y + m^2y} &= \frac{m^3 - m^2n + mn^2 - n^3}{m^3 + mn^2} \\
y(m^2 + n^2) &= m^2(m-n) + n^2(m-n) \\
y(m^2 + n^2) &= (m^2 + n^2)(m-n) \\
y &= m - n \\
\frac{m^2x - mny}{n^2x + mny} &= \frac{m^3 + mn^2}{m^2n + n^3} \\
\frac{m^2x + n^2x}{m^2x + n^2x} &= \frac{m^3 + mn^2 + m^2n + n^3}{m^3 + mn^2 + m^2n + n^3} \\
x(m^2 + n^2) &= m(m^2 + n^2) + n(m^2 + n^2) \\
x(m^2 + n^2) &= (m+n)(m^2 + n^2) \\
x &= m + n \\
\text{sol: } x &= m + n \quad y = m - n
\end{aligned}$$

$$\begin{aligned}
10. \quad \frac{x}{m} + \frac{y}{n} &= 2m \quad ; \quad mx - ny = m^3 - mn^2 \\
xn + ym &= 2m^2n \quad xmn - n^2y = m^3n - mn^3 \\
\frac{xmn + ym^2}{-xmn + n^2y} &= \frac{2m^3n}{mn^3 - m^3n} \\
\frac{ym^2 + yn^2}{ym^2 + yn^2} &= \frac{mn^3 - m^3n}{mn^3 + m^3n} \\
y(m^2 + n^2) &= mn(n^2 + m^2) \\
y &= mn \\
xn + m^2n &= 2m^2n \\
xn &= m^2n \Rightarrow x = m^2 \\
\text{sol: } x &= m^2 \quad y = mn
\end{aligned}$$

11.  $x + y = a$

$$ax + ay = a^2$$

$$ax - by = a(a+b) + b^2$$

$$ax - by = a^2 + ab + b^2$$

$$-ax - ay = -a^2$$

$$\frac{ax \quad -by = a^2 + ab + b^2}{-ay - by = \quad ab + b^2}$$

$$-y(a+b) = b(a+b)$$

$$-y = b$$

$$y = -b$$

$$x - b = a$$

$$x = a + b$$

$$\text{sol: } x = a + b \quad y = -b$$

12.  $x - y = m - n$

$$mx - my = m^2 - mn$$

$$mx \quad -ny = \quad m^2 \quad -n^2$$

$$-mx + my = -m^2 + mn$$

$$\frac{mx - ny = m^2 - n^2}{-mx + my = -m^2 + mn}$$

$$my - ny = mn - n^2$$

$$y(m-n) = n(m-n)$$

$$y = n$$

$$x - n = m - n$$

$$x = m$$

$$\text{sol: } x = m \quad y = n$$

13.  $\frac{x}{a} + \frac{y}{b} = 0$  ;  $\frac{x}{b} + \frac{2y}{a} = \frac{2b^2 - a^2}{ab}$

$$bx + ay = 0 \quad ax + 2by = 2b^2 - a^2$$

$$-abx \quad -a^2y = 0$$

$$\frac{abx + 2b^2y = 2b^3 - a^2b}{2b^2y - a^2y = 2b^3 - a^2b}$$

$$y(2b^2 - a^2) = b(2b^2 - a^2)$$

$$y = b$$

$$\frac{x}{a} + \frac{b}{b} = 0$$

$$bx + ab = 0$$

$$bx = -ab$$

$$x = -a$$

$$\text{sol: } x = -a \quad y = b$$

14.  $x + y = 2c$  ;  $a^2(x - y) = 2a^3$

$$-a^2x - a^2y = -2a^2c$$

$$-a^2x - a^2y = -2a^2c$$

$$\frac{a^2x - a^2y = 2a^3}{-2a^2y = 2a^3 - 2a^2c}$$

$$-2a^2y = 2a^2(a - c)$$

$$-y = a - c$$

$$y = c - a$$

$$x + c - a = 2c$$

$$x - a = c \Rightarrow x = c + a$$

$$\text{sol: } x = a + c \quad y = c - a$$

15.  $ax - by = 0$  ;  $ay - bx = \frac{a^2 - b^2}{ab}$

$$b^2ax - b^3y = 0 \quad a^2by - b^2ax = a^2 - b^2$$

$$b^2ax \quad -b^3y = 0$$

$$\frac{-b^2ax + a^2by = a^2 - b^2}{a^2by - b^3y = a^2 - b^2}$$

$$by(a^2 - b^2) = a^2 - b^2$$

$$by = 1$$

$$y = \frac{1}{b}$$

$$ax - b\left(\frac{1}{b}\right) = 0$$

$$ax = 1$$

$$x = \frac{1}{a}$$

$$\text{sol: } x = \frac{1}{a} \quad y = \frac{1}{b}$$

16.  $\frac{x}{b^2} + \frac{y}{a^2} = a + b$  ;  $x - y = ab(b - a)$

$$a^2x + b^2y = a^3b^2 + a^2b^3$$

$$x - y = ab^2 - a^2b$$

$$-a^2x - b^2y = -a^3b^2 - a^2b^3$$

$$\frac{a^2x \quad -a^2y = a^3b^2 \quad -a^4b}{-b^2y - a^2y = -a^2b^3 - a^4b}$$

$$-y(a^2 + b^2) = -a^2b(b^2 + a^2)$$

$$-y = -a^2b$$

$$y = a^2b$$

$$\frac{x}{b^2} + \frac{a^2b}{a^2} = a + b$$

$$x + b^3 = ab^2 + b^3$$

$$x = ab^2$$

$$\text{sol: } x = ab^2 \quad y = a^2b$$

$$\begin{aligned}
 17. \quad nx + my &= m + n & ; & \quad mx - ny = \frac{m^3 - n^3}{mn} \\
 m^2nx + m^3y &= m^3 + m^2n & \quad m^2nx - mn^2y &= m^3 - n^3 \\
 -m^2nx - m^3y &= -m^3 - m^2n \\
 \hline
 m^2nx & - mn^2y = m^3 & - n^3 \\
 -m^3y - mn^2y &= -m^2n - n^3 \\
 -ym(m^2 + n^2) &= -n(m^2 + n^2) \\
 ym &= n \\
 y &= \frac{n}{m} \\
 nx + m\left(\frac{n}{m}\right) &= m + n \\
 nx + n &= m + n \\
 nx &= m \\
 x &= \frac{m}{n} \\
 \text{sol: } x &= \frac{m}{n} \quad y = \frac{n}{m}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad (a-b)x - (a+b)y &= b^2 - 3ab \\
 ax - bx - ay - by &= b^2 - 3ab \\
 (a+b)x - (a-b)y &= ab - b^2 \\
 ax + bx - ay + by &= ab - b^2 \\
 -ax + bx + ay + by &= -b^2 + 3ab \\
 \hline
 ax + bx - ay + by &= -b^2 + ab \\
 2bx + 2by &= -2b^2 + 4ab \\
 2b(x+y) &= 2b(2a-b) \\
 x+y &= 2a-b \\
 ax - bx - ay - by &= b^2 - 3ab \\
 ax + bx - ay + by &= -b^2 + ab \\
 \hline
 2ax - 2ay &= -2ab \\
 2a(x-y) &= -2ab \\
 x-y &= -b \\
 x+y &= 2a-b \\
 x-y &= -b \\
 \hline
 2x &= 2(a-b) \\
 x &= a-b \\
 a-b-y &= -b \\
 -y &= -a \\
 y &= a \\
 \text{sol: } x &= a-b \quad y = a
 \end{aligned}$$

$$\begin{aligned}
 19. \quad \frac{x+b}{a} + \frac{y-b}{b} &= \frac{a+b}{b} \\
 b(x+b) + a(y-b) &= a(a+b) \\
 bx + b^2 + ay - ab &= a^2 + ab \\
 abx + ab^2 + a^2y - a^2b &= a^3 + a^2b \\
 -abx - ab^2 - a^2y &= -a^3 - 2a^2b \\
 \hline
 \frac{x-a}{b} - \frac{y-a}{a} &= -\frac{a+b}{a} \\
 a(x-a) - b(y-a) &= -b(a+b) \\
 ax - a^2 - by + ba &= -ba - b^2 \\
 abx - a^2b - b^2y + b^2a &= -b^2a - b^3 \\
 abx - a^2b - b^2y &= -2b^2a - b^3 \\
 -abx - ab^2 - a^2y &= -a^3 - 2a^2b \\
 \hline
 abx & - a^2b & - b^2y &= & -2b^2a - b^3 \\
 -ab^2 - a^2b - a^2y - b^2y &= -a^3 - 2a^2b - 2b^2a - b^3 \\
 ab^2 + a^2b + a^3 + b^3 &= a^2y + b^2y \\
 b^2(a+b) + a^2(b+a) &= y(a^2 + b^2) \\
 (b^2 + a^2)(a+b) &= y(a^2 + b^2) \\
 a+b &= y
 \end{aligned}$$

$$\begin{aligned}
 \frac{x+b}{a} + \frac{a+b-b}{b} &= \frac{a+b}{b} \\
 b(x+b) + a^2 &= a(a+b) \\
 bx + b^2 + a^2 &= a^2 + ab \\
 bx &= ab - b^2 \Rightarrow bx = b(a-b) \Rightarrow x = a-b \\
 \text{sol: } x &= a-b \quad y = a+b
 \end{aligned}$$

$$\begin{aligned}
 20. \quad \frac{x}{a+b} + \frac{y}{a+b} &= \frac{1}{ab} & ; & \quad \frac{x}{b} + \frac{y}{a} = \frac{a^2 + b^2}{a^2b^2} \\
 abx + aby &= a+b & \quad a^2bx + ab^2y &= a^2 + b^2 \\
 -a^2bx - a^2by &= -a^2 - ab \\
 -a^2bx & - a^2by &= -a^2 & - ab \\
 \hline
 a^2bx + ab^2y &= a^2 + b^2 \\
 ab^2y - a^2by &= b^2 - ab \\
 ayb(b-a) &= b(b-a) \\
 ayb &= b \\
 ay &= 1 \\
 y &= \frac{1}{a} \\
 abx + ab\left(\frac{1}{a}\right) &= a+b \\
 abx + b &= a+b \\
 abx &= a \Rightarrow bx = 1 \Rightarrow x = \frac{1}{b} \\
 \text{sol: } x &= \frac{1}{b} \quad y = \frac{1}{a}
 \end{aligned}$$

$$\text{sol: } x = \frac{1}{b} \quad y = \frac{1}{a}$$

## EJERCICIO 182

$$1. \frac{1}{x} + \frac{2}{y} = \frac{7}{6}; \quad \frac{2}{x} + \frac{1}{y} = \frac{4}{3}$$

$$\frac{2}{x} - \frac{4}{y} = -\frac{7}{3}$$

$$\frac{2}{x} + \frac{1}{y} = \frac{4}{3}$$

$$\frac{-3}{y} = -1$$

$$3=y$$

$$\frac{2}{x} + \frac{1}{3} = \frac{4}{3}$$

$$6+x=4x$$

$$6=3x \Rightarrow 2=x$$

$$\text{sol: } x=2 \quad y=3$$

$$2. \frac{3}{x} - \frac{2}{y} = \frac{1}{2}; \quad \frac{2}{x} + \frac{5}{y} = \frac{23}{12}$$

$$-\frac{6}{x} + \frac{4}{y} = -1$$

$$\frac{6}{x} + \frac{15}{y} = \frac{23}{4}$$

$$\frac{19}{y} = \frac{19}{4}$$

$$4=y$$

$$\frac{3}{x} - \frac{2}{4} = \frac{1}{2}$$

$$6-x=x$$

$$6=2x$$

$$3=x$$

$$\text{sol: } x=3 \quad y=4$$

$$3. \frac{5}{x} + \frac{4}{y} = 7; \quad \frac{7}{x} - \frac{6}{y} = 4$$

$$\frac{15}{x} + \frac{12}{y} = 21$$

$$\frac{14}{x} - \frac{12}{y} = 8$$

$$\frac{29}{x} = 29$$

$$1=x$$

$$\frac{5}{1} + \frac{4}{y} = 7$$

$$5y+4=7y$$

$$4=2y$$

$$2=y$$

$$\text{sol: } x=1 \quad y=2$$

$$4. \frac{12}{x} + \frac{5}{y} = -\frac{13}{2}; \quad \frac{18}{x} + \frac{7}{y} = -\frac{19}{2}$$

$$\frac{36}{x} + \frac{15}{y} = -\frac{39}{2}$$

$$\frac{36}{x} + \frac{14}{y} = -\frac{38}{2}$$

$$-\frac{1}{y} = \frac{1}{2}$$

$$-2=y$$

$$36-7x=-19x$$

$$12x=-36$$

$$x=-3$$

$$\text{sol: } x=-3 \quad y=-2$$

$$5. \frac{9}{x} + \frac{3}{y} = 27; \quad \frac{5}{x} + \frac{4}{y} = 22$$

$$\frac{3}{x} + \frac{1}{y} = 9$$

$$-\frac{12}{x} - \frac{4}{y} = -36$$

$$\frac{5}{x} + \frac{4}{y} = 22$$

$$-\frac{7}{x} = -14$$

$$\frac{1}{2}=x$$

$$\frac{5}{\frac{1}{2}} + \frac{4}{y} = 22 \Rightarrow 10 + \frac{4}{y} = 22$$

$$10y+4=22y$$

$$4=12y$$

$$\frac{1}{3}=y$$

$$\text{sol: } x=\frac{1}{2} \quad y=\frac{1}{3}$$

$$6. \frac{6}{x} - \frac{8}{y} = -23; \quad \frac{4}{x} + \frac{11}{y} = 50$$

$$-\frac{12}{x} + \frac{16}{y} = 46$$

$$\frac{12}{x} + \frac{33}{y} = 150$$

$$\frac{49}{y} = 196$$

$$\frac{1}{4}=y$$

Continúa

## 6. Continuación

$$\frac{4}{x} + \frac{11}{\frac{1}{4}} = 50$$

$$\frac{4}{x} + 44 = 50$$

$$4+44x=50x$$

$$4=6x$$

$$\frac{2}{3}=x$$

$$\text{sol: } x=\frac{2}{3} \quad y=\frac{1}{4}$$

$$7. \frac{9}{x} + \frac{10}{y} = -11; \quad \frac{7}{x} - \frac{15}{y} = -4$$

$$\frac{27}{x} + \frac{30}{y} = -33$$

$$\frac{14}{x} - \frac{30}{y} = -8$$

$$\frac{41}{x} = -41$$

$$-1=x$$

$$-\frac{7}{1} - \frac{15}{y} = -4$$

$$-7y-15=-4y$$

$$-15=3y$$

$$-5=y$$

$$\text{sol: } x=-1 \quad y=-5$$

$$8. \frac{1}{2x} - \frac{3}{y} = \frac{3}{4}; \quad \frac{1}{x} + \frac{5}{2y} = -\frac{4}{3}$$

$$\frac{1}{2x} - \frac{3}{y} = \frac{3}{4}$$

$$-\frac{1}{2x} - \frac{5}{4y} = \frac{2}{3}$$

$$-\frac{17}{4y} = \frac{17}{12}$$

$$-12=4y$$

$$-3=y$$

$$\frac{1}{x} + \frac{5}{2(-3)} = -\frac{4}{3}$$

$$6-5x=-8x$$

$$3x=-6$$

$$x=-2$$

$$\text{sol: } x=-2 \quad y=-3$$

$$9. \frac{2}{5x} - \frac{1}{3y} = -\frac{11}{45}; \frac{1}{10x} - \frac{3}{5y} = \frac{4}{5}$$

$$-\frac{2}{10x} + \frac{1}{6y} = \frac{11}{90}$$

$$\frac{2}{10x} - \frac{6}{5y} = \frac{8}{5}$$

$$-\frac{31}{30y} = \frac{31}{18}$$

$$-18 = 30y$$

$$-\frac{3}{5} = y$$

$$\frac{1}{10x} + \frac{3}{5\left(\frac{3}{5}\right)} = \frac{4}{5}$$

$$3 + 30x = 24x$$

$$6x = -3 \Rightarrow x = -\frac{1}{2}$$

$$sol: x = -\frac{1}{2} \quad y = -\frac{3}{5}$$

$$12. \frac{1}{x} + \frac{1}{y} = a; \frac{1}{x} - \frac{1}{y} = b$$

$$\frac{1}{x} + \frac{1}{y} = a$$

$$-\frac{1}{x} + \frac{1}{y} = -b$$

$$\frac{2}{y} = a - b \Rightarrow \frac{2}{a-b} = y$$

$$\frac{1}{x} - \frac{1}{\frac{2}{a-b}} = b$$

$$2 - x(a-b) = 2bx$$

$$2 - ax + xb = 2bx$$

$$-ax = bx - 2$$

$$-ax - bx = -2$$

$$x(a+b) = 2 \Rightarrow x = \frac{2}{a+b}$$

$$sol: x = \frac{2}{a+b} \quad y = \frac{2}{a-b}$$

$$10. \frac{3}{x} - \frac{7}{3y} = \frac{2}{3}; \frac{1}{4x} + \frac{8}{y} = \frac{103}{84}$$

$$\frac{3}{4x} - \frac{7}{12y} = \frac{1}{6}$$

$$-\frac{3}{4x} - \frac{24}{y} = -\frac{309}{84}$$

$$-\frac{295}{12y} = -\frac{295}{84}$$

$$y = 7$$

$$\frac{3}{x} - \frac{7}{3(7)} = \frac{2}{3}$$

$$9 - x = 2x$$

$$9 = 3x$$

$$3 = x$$

$$sol: x = 3 \quad y = 7$$

$$13. \frac{2}{x} - \frac{3b}{y} = \frac{2-3a}{a}; \frac{a}{x} + \frac{b}{y} = 2$$

$$\frac{2a}{x} - \frac{3ab}{y} = 2 - 3a$$

$$-\frac{2a}{x} - \frac{2b}{y} = -4$$

$$\frac{b(-3a-2)}{y} = -3a-2$$

$$b = y$$

$$\frac{a}{x} + \frac{b}{b} = 2$$

$$a + x = 2x$$

$$a = x$$

$$sol: x = a \quad y = b$$

$$11. \frac{3}{10x} + \frac{1}{3y} = \frac{107}{60}; \frac{6}{5x} + \frac{1}{4y} = \frac{14}{5}$$

$$\frac{3}{5x} + \frac{2}{3y} = \frac{107}{30}$$

$$-\frac{3}{5x} - \frac{1}{8y} = -\frac{7}{5}$$

$$\frac{13}{24y} = \frac{13}{6}$$

$$\frac{1}{4} = y$$

$$\frac{6}{5x} + \frac{1}{4\left(\frac{1}{4}\right)} = \frac{14}{5}$$

$$6 + 5x = 14x$$

$$6 = 9x$$

$$\frac{2}{3} = x$$

$$sol: x = \frac{2}{3} \quad y = \frac{1}{4}$$

$$14. \frac{2}{x} + \frac{2}{y} = \frac{m+n}{mn}; \frac{m}{x} - \frac{n}{y} = 0$$

$$\frac{2n}{x} + \frac{2n}{y} = \frac{m+n}{m}$$

$$\frac{2m}{x} - \frac{2n}{y} = 0$$

$$\frac{2(m+n)}{x} = \frac{m+n}{m}$$

$$2m = x$$

$$\frac{m}{2m} - \frac{n}{y} = 0$$

$$y - 2n = 0$$

$$y = 2n$$

$$sol: x = 2m \quad y = 2n$$

## EJERCICIO 183

$$1. \begin{vmatrix} 4 & 5 \\ 2 & 3 \end{vmatrix} 4 \cdot 3 - 2 \cdot 5 = 12 - 10 = 2$$

$$5. \begin{vmatrix} 5 & -3 \\ -2 & -8 \end{vmatrix} 5(-8) - (-3)(-2) = -40 - 6 = -46$$

$$2. \begin{vmatrix} 2 & 7 \\ 3 & 5 \end{vmatrix} 2 \cdot 5 - 3 \cdot 7 = 10 - 21 = -11$$

$$6. \begin{vmatrix} 9 & -11 \\ -3 & 7 \end{vmatrix} 9 \cdot 7 - (-11)(-3) = 63 - 33 = 30$$

$$3. \begin{vmatrix} -2 & 5 \\ 4 & 3 \end{vmatrix} -2 \cdot 3 - 4 \cdot 5 = -6 - 20 = -26$$

$$7. \begin{vmatrix} -15 & -1 \\ 13 & 2 \end{vmatrix} -15 \cdot 2 - 13(-1) = -30 + 13 = -17$$

$$4. \begin{vmatrix} 7 & 9 \\ 5 & -2 \end{vmatrix} 7(-2) - 9 \cdot 5 = -14 - 45 = -59$$

$$8. \begin{vmatrix} 12 & -1 \\ 13 & -9 \end{vmatrix} 12(-9) - (13)(-1) = -108 + 13 = -95$$

$$9. \begin{vmatrix} 10 & 3 \\ 17 & 13 \end{vmatrix} 10 \cdot 13 - 3 \cdot 17 = 130 - 51 = 79$$

$$11. \begin{vmatrix} 8 & 2 \\ -3 & 0 \end{vmatrix} 8(0) - 2(-3) = 0 + 6 = 6$$

$$10. \begin{vmatrix} -5 & -8 \\ -19 & -21 \end{vmatrix} (-5)(-21) - (-8)(-19) = 105 - 152 = -47$$

$$12. \begin{vmatrix} 31 & -85 \\ -20 & 43 \end{vmatrix} 31 \cdot 43 - (-85)(-20) = 1.333 - 1.700 = -367$$

## EJERCICIO 184

1.  $7x + 8y = 29$

$5x + 11y = 26$

$$x = \frac{\begin{vmatrix} 29 & 8 \\ 26 & 11 \end{vmatrix}}{\begin{vmatrix} 7 & 8 \\ 5 & 11 \end{vmatrix}} = \frac{319 - 208}{77 - 40} = \frac{111}{37} = 3$$

$$y = \frac{\begin{vmatrix} 7 & 29 \\ 5 & 26 \end{vmatrix}}{\begin{vmatrix} 7 & 8 \\ 5 & 11 \end{vmatrix}} = \frac{182 - 145}{37} = \frac{37}{37} = 1$$

sol:  $x=3$   $y=1$

2.  $3x - 4y = 13$

$8x - 5y = -5$

$$x = \frac{\begin{vmatrix} 13 & -4 \\ -5 & -5 \end{vmatrix}}{\begin{vmatrix} 3 & -4 \\ 8 & -5 \end{vmatrix}} = \frac{-65 - 20}{-15 + 32} = \frac{-85}{17} = -5$$

$$y = \frac{\begin{vmatrix} 3 & 13 \\ 8 & -5 \end{vmatrix}}{\begin{vmatrix} 3 & -4 \\ 8 & -5 \end{vmatrix}} = \frac{-15 - 104}{17} = \frac{-119}{17} = -7$$

sol:  $x=-5$   $y=-7$

3.  $13x - 31y = -326$

$25x + 37y = 146$

$$x = \frac{\begin{vmatrix} -326 & -31 \\ 146 & 37 \end{vmatrix}}{\begin{vmatrix} 13 & -31 \\ 25 & 37 \end{vmatrix}} = \frac{-12.062 + 4.526}{481 + 775} = \frac{-7.536}{1.256} = -6$$

$$y = \frac{\begin{vmatrix} 13 & -326 \\ 25 & 146 \end{vmatrix}}{\begin{vmatrix} 13 & -31 \\ 25 & 37 \end{vmatrix}} = \frac{1.898 + 8.150}{1.256} = \frac{10.048}{1.256} = 8$$

sol:  $x=-6$   $y=8$

4.  $15x - 44y = -6$

$-27x + 32y = -1$

$$x = \frac{\begin{vmatrix} -6 & -44 \\ -1 & 32 \end{vmatrix}}{\begin{vmatrix} 15 & -44 \\ -27 & 32 \end{vmatrix}} = \frac{-192 - 44}{480 - 1.188} = \frac{-236}{-708} = \frac{1}{3}$$

$$y = \frac{\begin{vmatrix} 15 & -6 \\ -27 & -1 \end{vmatrix}}{\begin{vmatrix} 15 & -44 \\ -27 & 32 \end{vmatrix}} = \frac{-15 - 162}{-708} = \frac{-177}{-708} = \frac{1}{4}$$

sol:  $x=\frac{1}{3}$   $y=\frac{1}{4}$

5.  $8x = -9y$

$8x + 9y = 0$

$2x + 5 + 3y = \frac{7}{2}$

$4x + 10 + 6y = 7$

$4x + 6y = -3$

$$x = \frac{\begin{vmatrix} 0 & 9 \\ -3 & 6 \end{vmatrix}}{\begin{vmatrix} 8 & 9 \\ 4 & 6 \end{vmatrix}} = \frac{0 + 27}{48 - 36} = \frac{27}{12} = \frac{9}{4} = 2\frac{1}{4}$$

$$y = \frac{\begin{vmatrix} 8 & 0 \\ 4 & -3 \end{vmatrix}}{\begin{vmatrix} 8 & 9 \\ 4 & 6 \end{vmatrix}} = \frac{-24 - 0}{48 - 36} = \frac{-24}{12} = -2$$

sol:  $x=2\frac{1}{4}$   $y=-2$

6.  $ax - by = -1$

$ax + by = 7$

$$x = \frac{\begin{vmatrix} -1 & -b \\ 7 & b \end{vmatrix}}{\begin{vmatrix} a & -b \\ a & b \end{vmatrix}} = \frac{-b + 7b}{ab + ab} = \frac{6b}{2ab} = \frac{3}{a}$$

$$y = \frac{\begin{vmatrix} a & -1 \\ a & 7 \end{vmatrix}}{\begin{vmatrix} a & -b \\ a & b \end{vmatrix}} = \frac{7a + a}{2ab} = \frac{8a}{2ab} = \frac{4}{b}$$

sol:  $x=\frac{3}{a}$   $y=\frac{4}{b}$

7.  $3x - (y + 2) = 2y + 1$

$3x - y - 2 = 2y + 1$

$3x - 3y = 3$

$x - y = 1$

$5y - (x + 3) = 3x + 1$

$5y - x - 3 = 3x + 1$

$-4x + 5y = 4$

$$x = \frac{\begin{vmatrix} 1 & -1 \\ 4 & 5 \end{vmatrix}}{\begin{vmatrix} 1 & -1 \\ -4 & 5 \end{vmatrix}} = \frac{5 + 4}{5 - 4} = 9$$

$$y = \frac{\begin{vmatrix} 1 & 1 \\ -4 & 4 \end{vmatrix}}{\begin{vmatrix} 1 & -1 \\ -4 & 5 \end{vmatrix}} = \frac{4 + 4}{5 - 4} = 8$$

sol:  $x=9$   $y=8$

8.  $ax+2y=2$

$$\frac{ax}{2} - 3y = -1$$

$$ax - 6y = -2$$

$$x = \frac{\begin{vmatrix} 2 & 2 \\ -2 & -6 \end{vmatrix}}{\begin{vmatrix} a & 2 \\ a & -6 \end{vmatrix}} = \frac{-12+4}{-6a-2a} = \frac{-8}{-8a} = \frac{1}{a}$$

$$y = \frac{\begin{vmatrix} a & 2 \\ a & -2 \end{vmatrix}}{\begin{vmatrix} a & 2 \\ a & -6 \end{vmatrix}} = \frac{-2a-2a}{-8a} = \frac{-4a}{-8a} = \frac{1}{2}$$

sol:  $x = \frac{1}{a}$   $y = \frac{1}{2}$

9.  $\frac{x}{4} + \frac{y}{6} = -4$

$$3x + 2y = -48$$

$$\frac{x}{8} - \frac{y}{12} = 0$$

$$3x - 2y = 0$$

$$x = \frac{\begin{vmatrix} -48 & 2 \\ 0 & -2 \end{vmatrix}}{\begin{vmatrix} 3 & 2 \\ 3 & -2 \end{vmatrix}} = \frac{96-0}{-6-6} = \frac{96}{-12} = -8$$

$$y = \frac{\begin{vmatrix} 3 & -48 \\ 3 & 0 \end{vmatrix}}{\begin{vmatrix} 3 & 2 \\ 3 & -2 \end{vmatrix}} = \frac{0+144}{-12} = -12$$

sol:  $x = -8$   $y = -12$

10.  $3x+ay=3a+1$

$$\frac{x}{a} + ay = 2$$

$$x + a^2y = 2a$$

$$x = \frac{\begin{vmatrix} 3a+1 & a \\ 2a & a^2 \end{vmatrix}}{\begin{vmatrix} 3 & a \\ 1 & a^2 \end{vmatrix}}$$

$$x = \frac{3a^3 + a^2 - 2a^2}{3a^2 - a} = \frac{a^2(3a-1)}{a(3a-1)} = a$$

$$y = \frac{\begin{vmatrix} 3 & 3a+1 \\ 1 & 2a \end{vmatrix}}{\begin{vmatrix} 3 & a \\ 1 & a^2 \end{vmatrix}}$$

$$y = \frac{6a - 3a - 1}{a(3a-1)} = \frac{3a-1}{a(3a-1)} = \frac{1}{a}$$

sol:  $x = a$   $y = \frac{1}{a}$

11.  $\frac{x+2}{3} - \frac{y-3}{8} = \frac{5}{6}$

$$8(x+2) - 3(y-3) = 50$$

$$8x + 16 - 3y + 9 = 50$$

$$8x - 3y + 25 = 50$$

$$8x - 3y = 25$$

$$\frac{y-5}{6} - \frac{2x-3}{5} = 0$$

$$5(y-5) - 6(2x-3) = 0$$

$$5y - 25 - 12x + 18 = 0$$

$$-12x + 5y - 7 = 0$$

$$-12x + 5y = 7$$

$$x = \frac{\begin{vmatrix} -5 & -3 \\ 7 & 5 \end{vmatrix}}{\begin{vmatrix} 8 & -3 \\ -12 & 5 \end{vmatrix}}$$

$$x = \frac{-25+21}{40-36} = \frac{-4}{4} = -1$$

$$y = \frac{\begin{vmatrix} 8 & -5 \\ -12 & 7 \end{vmatrix}}{\begin{vmatrix} 8 & -3 \\ -12 & 5 \end{vmatrix}}$$

$$y = \frac{56-60}{40-36} = \frac{-4}{4} = -1$$

sol:  $x = -1$   $y = -1$

12.  $3x-2y=5$

$$mx+4y=2(m+1)$$

$$x = \frac{\begin{vmatrix} 5 & -2 \\ 2(m+1) & 4 \end{vmatrix}}{\begin{vmatrix} 3 & -2 \\ m & 4 \end{vmatrix}}$$

$$x = \frac{20+4(m+1)}{12+2m} = \frac{4(6+m)}{2(6+m)} = 2$$

$$y = \frac{\begin{vmatrix} 3 & 5 \\ m & 2(m+1) \end{vmatrix}}{\begin{vmatrix} 3 & -2 \\ m & 4 \end{vmatrix}}$$

$$y = \frac{6(m+1)-5m}{2(6+m)} = \frac{m+6}{2(6+m)} = \frac{1}{2}$$

sol:  $x = 2$   $y = \frac{1}{2}$

13.  $2x - \frac{2y+3}{17} = y+2$

$$34x - (2y+3) = 17(y+2)$$

$$34x - 2y - 3 = 17y + 34$$

$$34x - 19y = 37$$

$$3y - \frac{4x+1}{21} = 3x+5$$

$$63y - (4x+1) = 21(3x+5)$$

$$63y - 4x - 1 = 63x + 105$$

$$-67x + 63y = 106$$

$$x = \frac{\begin{vmatrix} 37 & -19 \\ 106 & 63 \end{vmatrix}}{\begin{vmatrix} 34 & -19 \\ -67 & 63 \end{vmatrix}}$$

$$x = \frac{2.331+2.014}{2.142-1.273} = \frac{4.345}{869} = 5$$

$$y = \frac{\begin{vmatrix} 34 & 37 \\ -67 & 106 \end{vmatrix}}{\begin{vmatrix} 34 & -19 \\ -67 & 63 \end{vmatrix}}$$

$$y = \frac{3.604+2.479}{869} = 7$$

sol:  $x = 5$   $y = 7$

14.  $\frac{x+y}{x-y} = 4$

$$x+y = 4(x-y)$$

$$x+y = 4x-4y$$

$$-3x+5y=0$$

$$\frac{x-y-1}{x+y+1} = \frac{1}{9}$$

$$9(x-y-1) = x+y+1$$

$$9x-9y-9 = x+y+1$$

$$8x-10y=10$$

$$4x-5y=5$$

$$x = \frac{\begin{vmatrix} 0 & 5 \\ 5 & -5 \end{vmatrix}}{\begin{vmatrix} -3 & 5 \\ 4 & -5 \end{vmatrix}} = \frac{0-25}{-15-20} = \frac{-25}{-5} = 5$$

$$y = \frac{\begin{vmatrix} -3 & 0 \\ 4 & 5 \end{vmatrix}}{\begin{vmatrix} -3 & 5 \\ 4 & -5 \end{vmatrix}} = \frac{-15-0}{-5} = 3$$

sol:  $x = 5$   $y = 3$

15.  $x - y = 2b$

$$\frac{x}{a+b} + \frac{y}{a-b} = 2$$

$$x(a-b) + y(a+b) = 2(a^2 - b^2)$$

$$x = \begin{vmatrix} 2b & -1 \\ 2(a^2 - b^2) & a+b \\ 1 & -1 \\ a-b & a+b \end{vmatrix}$$

$$x = \frac{2b(a+b) + 2(a^2 - b^2)}{a+b+a-b} = \frac{2a(b+a)}{2a} = b+a$$

$$y = \begin{vmatrix} 1 & 2b \\ a-b & 2(a^2 - b^2) \\ 1 & -1 \\ a-b & a+b \end{vmatrix}$$

$$y = \frac{2(a^2 - b^2) - 2b(a-b)}{2a} = \frac{2a(a-b)}{2a} = a-b$$

sol:  $x = a+b$   $y = a-b$

16.  $\frac{x+9}{x-9} = \frac{y+21}{y+39}$

$$(x+9)(y+39) = (x-9)(y+21)$$

$$xy + 39x + 9y + 351 = xy + 21x - 9y - 189$$

$$18x + 18y = -540$$

$$x + y = -30$$

$$\frac{x+8}{x-8} = \frac{y+19}{y+11}$$

$$(y+11)(x+8) = (y+19)(x-8)$$

$$xy + 8y + 11x + 88 = xy - 8y + 19x - 152$$

$$-8x + 16y = -240$$

$$-x + 2y = -30$$

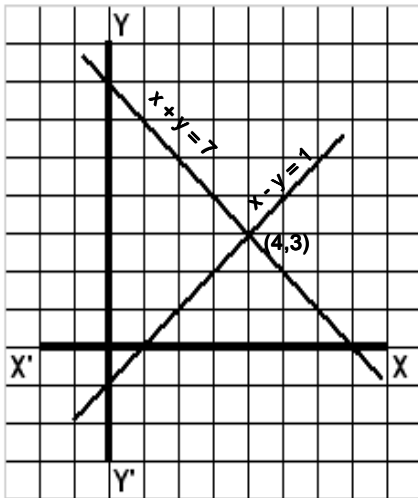
$$x = \begin{vmatrix} -30 & 1 \\ -30 & 2 \\ 1 & 1 \\ -1 & 2 \end{vmatrix} = \frac{-60 + 30}{2 + 1} = \frac{-30}{3} = -10$$

$$y = \begin{vmatrix} 1 & -30 \\ -1 & -30 \\ 1 & 1 \\ -1 & 2 \end{vmatrix} = \frac{-30 - 30}{3} = \frac{-60}{3} = -20$$

sol:  $x = -10$   $y = -20$

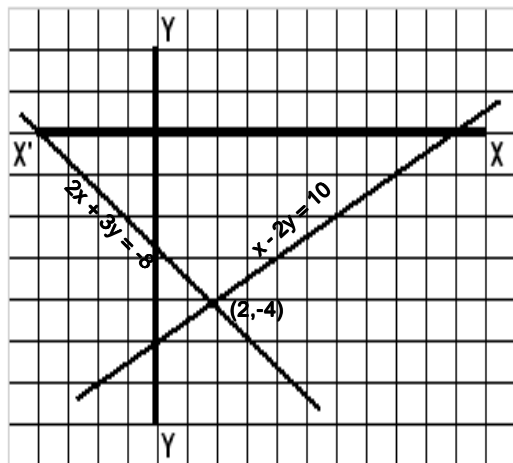
### EJERCICIO 185

1.  $x - y = 1$        $x + y = 7$   
 $x = 0$   $y = -1$      $x = 0$   $y = 7$   
 $y = 0$   $x = 1$        $y = 0$   $x = 7$



sol:  $x = 4$   $y = 3$

2.  $x - 2y = 10$        $2x + 3y = -8$   
 $x = 0$   $y = -5$      $x = 0$   $y = -2\frac{2}{3}$   
 $y = 0$   $x = 10$        $y = 0$   $x = -4$

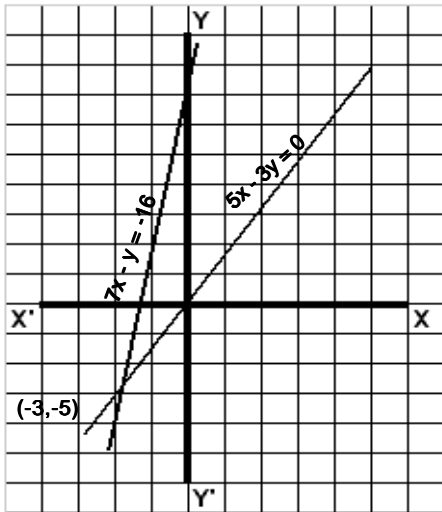


sol:  $x = 2$   $Y = -4$



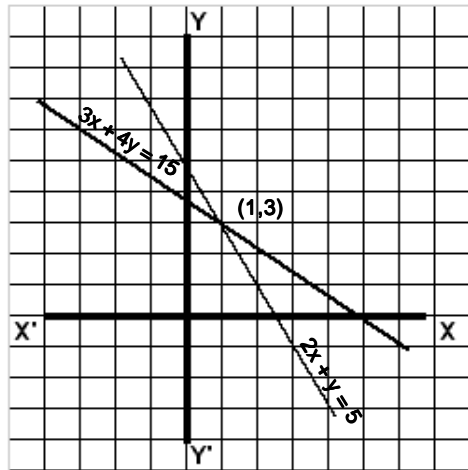
3.  $5x - 3y = 0$        $7x - y = -16$   
 $x = 3$     $y = 5$        $x = 0$     $y = 16$   
 $y = 0$     $x = -2\frac{2}{7}$

Escala 1:2



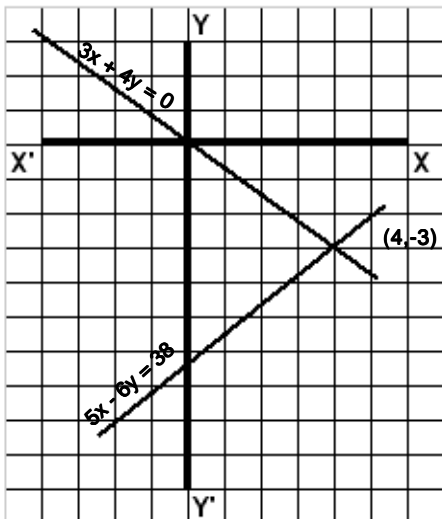
sol :  $x = -3$     $y = -5$

5.  $3x + 4y = 15$        $2x + y = 5$   
 $x = 5$     $y = 0$        $x = 0$     $y = 5$   
 $x = 1$     $y = 3$        $x = 2$     $y = 1$



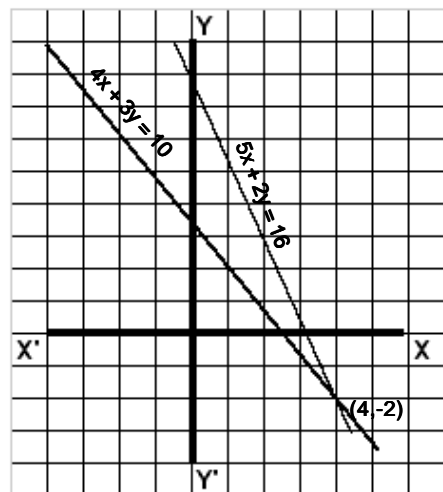
sol :  $x = 1$     $y = 3$

4.  $3x = -4y$        $5x - 6y = 38$   
 $3x + 4y = 0$        $x = -2$     $y = -8$   
 $x = 4$     $y = -3$        $y = -3$     $x = 4$



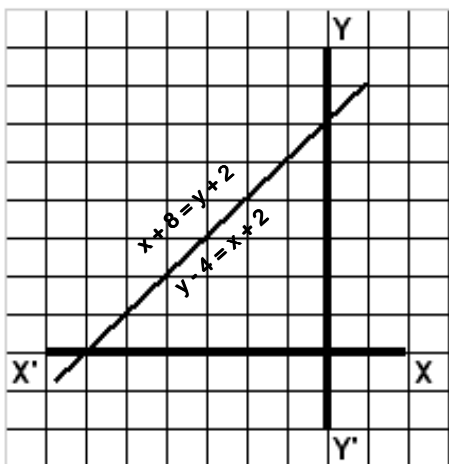
sol :  $x = 4$     $y = -3$

6.  $5x + 2y = 16$        $4x + 3y = 10$   
 $x = 2$     $y = 3$        $x = -2$     $y = 6$   
 $x = 4$     $y = -2$        $x = 1$     $y = 2$



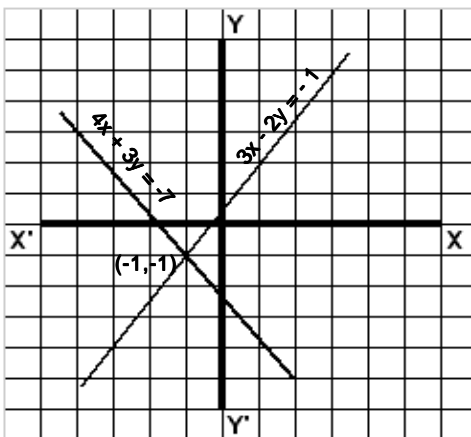
sol :  $x = 4$     $y = -2$

7.  $x+8=y+2$        $y-4=x+2$   
 $x-y=-6$        $-x+y=6$   
 $x=0$   $y=6$        $x=0$   $y=6$   
 $x=-6$   $y=0$        $x=-6$   $y=0$



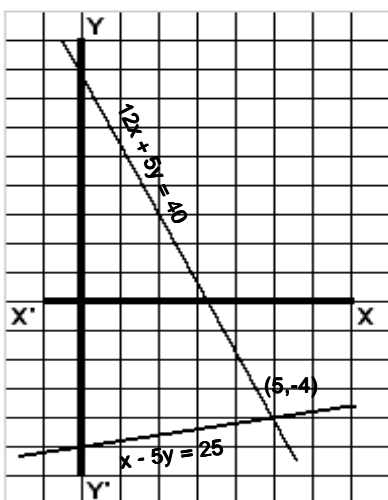
sol : Equivalentes

9.  $\frac{x}{2} - \frac{y}{3} = -\frac{1}{6}$        $3x-2y=-1$   
 $x=3$   $y=5$  ;  $x=-3$   $y=-4$   
 $\frac{x}{3} + \frac{y}{4} = -\frac{7}{12}$        $4x+3y=-7$   
 $x=-1$   $y=-1$  ;  $x=-4$   $y=3$



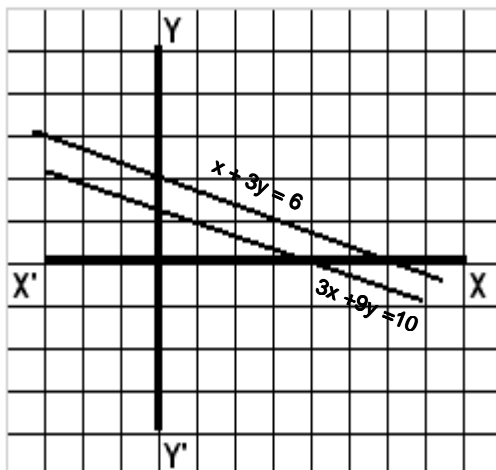
sol :  $x = -1$     $y = -1$

8.  $\frac{3x}{5} + \frac{y}{4} = 2$        $x-5y=25$   
 $12x+5y=40$        $x=0$   $y=-5$   
 $x=0$   $y=8$        $x=5$   $y=-4$   
 $x=5$   $y=-4$



sol :  $x = 5$     $y = -4$

10.  $x+3y=6$        $3x+9y=10$   
 $x=0$   $y=2$        $x=0$   $y=1\frac{1}{3}$   
 $x=6$   $y=0$        $x=3\frac{1}{3}$   $y=0$



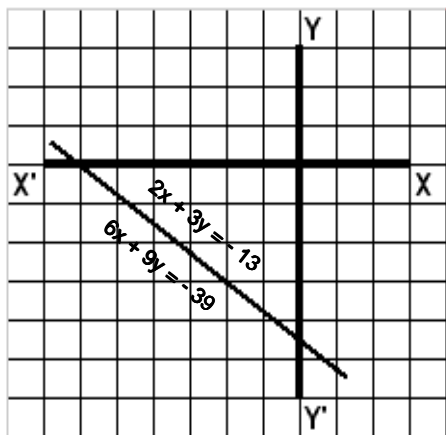
sol : Incompatibles

11.  $2x+3y=-13$

$x=-2 \quad y=-3; \quad x=-5 \quad y=-1$

$6x+9y=-39$

$x=-2 \quad y=-3, \quad x=-5 \quad y=-1$



sol : Equivalentes

12.  $\frac{x-2}{2} - \frac{y-3}{3} = 4$        $\frac{y-2}{2} + \frac{x-3}{3} = -\frac{11}{3}$

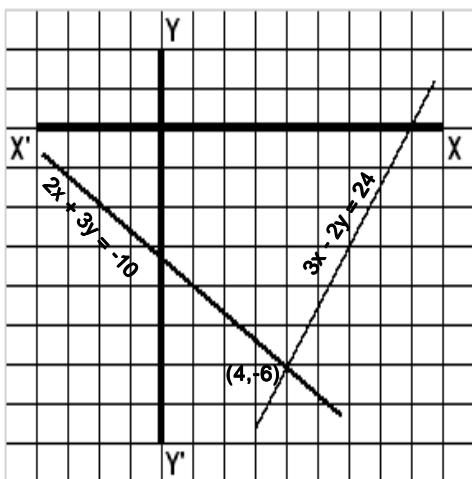
$3(x-2) - 2(y-3) = 24$        $3(y-2) + 2(x-3) = -22$

$3x - 6 - 2y + 6 = 24$        $3y - 6 + 2x - 6 = -22$

$3x - 2y = 24$        $2x + 3y = -10$

$x = 6 \quad y = -3$        $x = 4 \quad y = -6$

$x = 4 \quad y = -6$        $x = -2 \quad y = -2$



sol :  $x = 4 \quad y = -6$

13.  $x+y=9$

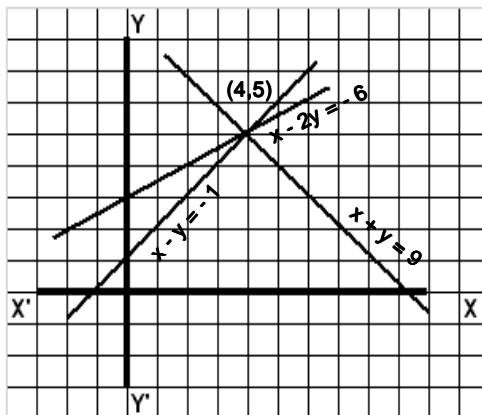
$x=6 \quad y=3 ; \quad x=4 \quad y=5$

$x-y=-1$

$x=0 \quad y=1 ; \quad x=2 \quad y=3$

$x-2y=-6$

$x=0 \quad y=3 ; \quad x=2 \quad y=4$



sol :  $x = 4 \quad y = 5$

14.  $x+y=5$

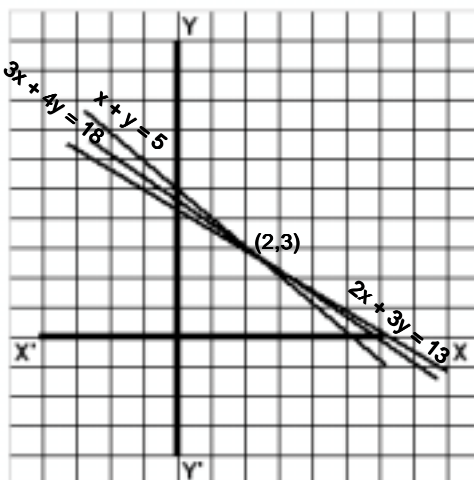
$x=0 \quad y=5 ; \quad x=2 \quad y=3$

$3x+4y=18$

$x=2 \quad y=3 ; \quad x=-2 \quad y=6$

$2x+3y=13$

$x=2 \quad y=3 ; \quad x=5 \quad y=1$



sol :  $x = 2 \quad y = 3$

15.  $2x+y=-1$

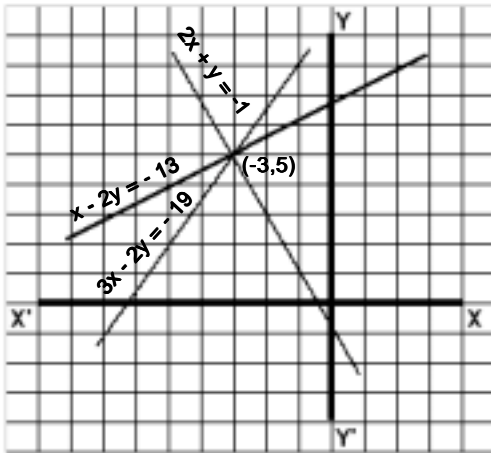
$x=0 \quad y=-1 ; x=-1 \quad y=1$

$x-2y=-13$

$x=-5 \quad y=4 ; x=-3 \quad y=5$

$3x-2y=-19$

$x=-5 \quad y=2 ; x=-3 \quad y=5$

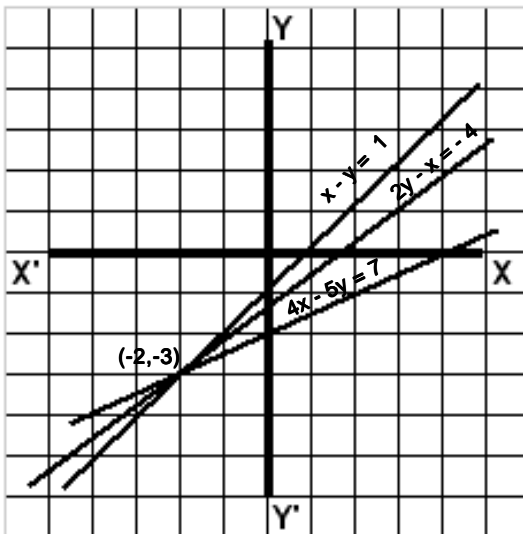


sol :  $x = -3 \quad y = 5$

16.  $x-y=1 \quad 2y-x=-4 \quad 4x-5y=7$

$x=0 \quad y=-1 \quad x=0 \quad y=-2 \quad x=-2 \quad y=-3$

$x=1 \quad y=0 \quad x=2 \quad y=-1 \quad x=3 \quad y=1$



sol :  $x = -2 \quad y = -3$

## EJERCICIO 186

1.  $x+y+z=6$

$x-y+2z=5$

$x-y-3z=-10$

$x+y+z=6$

$x-y+2z=5$

$2x+3z=11$

$x+y+z=6$

$x-y-3z=-10$

$2x-2z=-4$

$x-z=-2$

$2x+3z=11$

$x-z=-2 \quad (3)$

$2x+3z=11$

$3x-3z=-6$

$5x=5$

$x=1$

$2(1)+3z=11$

$2+3z=11$

$3z=9$

$z=3$

$1+y+3=6$

$y+4=6$

$y=2$

sol:  $x=1 \quad y=2 \quad z=3$

2.  $x+y+z=12$

$2x-y+z=7$

$x+2y-z=6$

$x+y+z=12$

$2x-y+z=7$

$3x+2z=19$

$2x-y+z=7 \quad (2)$

$x+2y-z=6$

$4x-2y+2z=14$

$x+2y-z=6$

$5x+z=20$

$3x+2z=19$

$5x+z=20 \quad (-2)$

$3x+2z=19$

$-10x-2z=-40$

$-7x=-21$

$x=3$

Continúa

## 2. Continuación

$$5(3) + z = 20$$

$$15 + z = 20$$

$$z = 5$$

$$3 + y + 5 = 12$$

$$y + 8 = 12$$

$$y = 4$$

$$\text{sol: } x=3 \quad y=4 \quad z=5$$

3.  $x - y + z = 2$

$$x + y + z = 4$$

$$2x + 2y - z = -4$$

$$x - y + z = 2$$

$$x + y + z = 4$$

$$2x + 2z = 6$$

$$x + z = 3$$

$$x - y + z = 2 \quad (2)$$

$$2x + 2y - z = -4$$

$$2x - 2y + 2z = 4$$

$$2x + 2y - z = -4$$

$$4x + z = 0$$

$$x + z = 3 \quad (-1)$$

$$4x + z = 0$$

$$-x - z = -3$$

$$4x + z = 0$$

$$3x = -3$$

$$x = -1$$

$$-1 + z = 3$$

$$z = 4$$

$$-1 - y + 4 = 2$$

$$-y + 3 = 2$$

$$-y = -1$$

$$y = 1$$

$$\text{sol: } x=-1 \quad y=1 \quad z=4$$

4.  $2x + y - 3z = -1$

$$x - 3y - 2z = -12$$

$$3x - 2y - z = -5$$

$$2x + y - 3z = -1 \quad (2)$$

$$3x - 2y - z = -5$$

$$4x + 2y - 6z = -2$$

$$3x - 2y - z = -5$$

$$7x - 7z = -7$$

$$x - z = -1$$

Continúa

## 4. Continuación

$$2x + y - 3z = -1 \quad (3)$$

$$x - 3y - 2z = -12$$

$$6x + 3y - 9z = -3$$

$$x - 3y - 2z = -12$$

$$7x - 11z = -15$$

$$x - z = -1 \quad (-7)$$

$$7x - 11z = -15$$

$$-7x + 7z = 7$$

$$7x - 11z = -15$$

$$-4z = -8$$

$$z = 2$$

$$x - 2 = -1$$

$$x = 1$$

$$2(1) + y - 3(2) = -1$$

$$2 + y - 6 = -1$$

$$y - 4 = -1$$

$$y = 3$$

$$\text{sol: } x=1 \quad y=3 \quad z=2$$

5.  $2x + 3y + z = 1$

$$6x - 2y - z = -14$$

$$3x + y - z = 1$$

$$2x + 3y + z = 1$$

$$3x + y - z = 1$$

$$5x + 4y = 2$$

$$2x + 3y + z = 1$$

$$6x - 2y - z = -14$$

$$8x + y = -13$$

$$5x + 4y = 2$$

$$8x + y = -13 \quad (-4)$$

$$5x + 4y = 2$$

$$-32x - 4y = 52$$

$$-27x = 54$$

$$x = -2$$

$$8(-2) + y = -13$$

$$-16 + y = -13$$

$$y = 3$$

$$2(-2) + 3(3) + z = 1$$

$$-4 + 9 + z = 1$$

$$5 + z = 1$$

$$z = -4$$

$$\text{sol: } x=-2 \quad y=3 \quad z=-4$$

6.  $5x - 2y + z = 24$

$$2x + 5y - 2z = -14$$

$$x - 4y + 3z = 26$$

$$5x - 2y + z = 24 \quad (2)$$

$$2x + 5y - 2z = -14$$

$$10x - 4y + 2z = 48$$

$$2x + 5y - 2z = -14$$

$$12x + y = 34$$

$$5x - 2y + z = 24 \quad (-3)$$

$$x - 4y + 3z = 26$$

$$-15x + 6y - 3z = -72$$

$$x - 4y + 3z = 26$$

$$-14x + 2y = -46$$

$$12x + y = 34 \quad (-2)$$

$$-14x + 2y = -46$$

$$-24x - 2y = -68$$

$$-14x + 2y = -46$$

$$-38x = -114$$

$$x = 3$$

$$12(3) + y = 34$$

$$36 + y = 34$$

$$y = -2$$

$$3 - 4(-2) + 3z = 26$$

$$3 + 8 + 3z = 26$$

$$3z = 15$$

$$z = 5$$

$$\text{sol: } x=3 \quad y=-2 \quad z=5$$

7.  $4x + 2y + 3z = 8$

$$3x + 4y + 2z = -1$$

$$2x - y + 5z = 3$$

$$4x + 2y + 3z = 8 \quad (-2)$$

$$3x + 4y + 2z = -1$$

$$-8x - 4y - 6z = -16$$

$$3x + 4y + 2z = -1$$

$$-5x - 4z = -17$$

$$5x + 4z = 17$$

$$4x + 2y + 3z = 8$$

$$2x - y + 5z = 3 \quad (2)$$

$$4x + 2y + 3z = 8$$

$$4x - 2y + 10z = 6$$

$$8x + 13z = 14$$

Continúa

**7. Continuación**

$$8x + 13z = 14 \quad (-5)$$

$$\underline{5x + 4z = 17 \quad (8)}$$

$$-40x - 65z = -70$$

$$\underline{40x + 32z = 136}$$

$$-33z = 66$$

$$z = -2$$

$$5x + 4(-2) = 17$$

$$5x - 8 = 17$$

$$5x = 25$$

$$x = 5$$

$$2(5) - y + 5(-2) = 3$$

$$10 - y - 10 = 3$$

$$-y = 3$$

$$y = -3$$

$$\text{sol: } x=5 \quad y=-3 \quad z=-2$$

**8.  $6x + 3y + 2z = 12$** 

$$9x - y + 4z = 37$$

$$10x + 5y + 3z = 21$$

$$6x + 3y + 2z = 12$$

$$\underline{9x - y + 4z = 37 \quad (3)}$$

$$6x + 3y + 2z = 12$$

$$\underline{27x - 3y + 12z = 111}$$

$$33x + 14z = 123$$

$$9x - y + 4z = 37 \quad (5)$$

$$10x + 5y + 3z = 21$$

$$45x - 5y + 20z = 185$$

$$\underline{10x + 5y + 3z = 21}$$

$$55x + 23z = 206$$

$$33x + 14z = 123 \quad (5)$$

$$\underline{55x + 23z = 206 \quad (-3)}$$

$$165x + 70z = 615$$

$$\underline{-165x - 69z = -618}$$

$$z = -3$$

$$33x + 14(-3) = 123$$

$$33x - 42 = 123$$

$$33x = 165$$

$$x = 5$$

$$6(5) + 3y + 2(-3) = 12$$

$$30 + 3y - 6 = 12$$

$$3y + 24 = 12$$

$$3y = -12$$

$$y = -4$$

$$\text{sol: } x=5 \quad y=-4 \quad z=-3$$

**9.  $2x + 4y + 3z = 3$** 

$$10x - 8y - 9z = 0$$

$$4x + 4y - 3z = 2$$

$$2x + 4y + 3z = 3 \quad (3)$$

$$\underline{10x - 8y - 9z = 0}$$

$$6x + 12y + 9z = 9$$

$$\underline{10x - 8y - 9z = 0}$$

$$16x + 4y = 9$$

$$10x - 8y - 9z = 0$$

$$4x + 4y - 3z = 2 \quad (-3)$$

$$10x - 8y - 9z = 0$$

$$\underline{-12x - 12y + 9z = -6}$$

$$-2x - 20y = -6$$

$$x + 10y = 3$$

$$16x + 4y = 9 \quad (5)$$

$$\underline{x + 10y = 3 \quad (-2)}$$

$$80x + 20y = 45$$

$$\underline{-2x - 20y = -6}$$

$$78x = 39$$

$$x = \frac{1}{2}$$

$$16\left(\frac{1}{2}\right) + 4y = 9$$

$$8 + 4y = 9$$

$$4y = 1$$

$$y = \frac{1}{4}$$

$$2\left(\frac{1}{2}\right) + 4\left(\frac{1}{4}\right) + 3z = 3$$

$$1 + 1 + 3z = 3$$

$$3z = 1$$

$$z = \frac{1}{3}$$

$$\text{sol: } x = \frac{1}{2} \quad y = \frac{1}{4} \quad z = \frac{1}{3}$$

**10.  $3x + y + z = 1$** 

$$x + 2y - z = 1$$

$$x + y + 2z = -17$$

$$3x + y + z = 1$$

$$\underline{x + 2y - z = 1}$$

$$4x + 3y = 2$$

$$x + 2y - z = 1 \quad (2)$$

$$\underline{x + y + 2z = -17}$$

$$\text{Continúa}$$

**10. Continuación**

$$2x + 4y - 2z = 2$$

$$\underline{x + y + 2z = -17}$$

$$3x + 5y = -15$$

$$4x + 3y = 2 \quad (3)$$

$$\underline{3x + 5y = -15 \quad (-4)}$$

$$12x + 9y = 6$$

$$\underline{-12x - 20y = 60}$$

$$-11y = 66$$

$$y = -6$$

$$4x + 3(-6) = 2$$

$$4x - 18 = 2$$

$$4x = 20$$

$$x = 5$$

$$5 - 6 + 2z = -17$$

$$2z = -16$$

$$z = -8$$

$$\text{sol: } x=5 \quad y=-6 \quad z=-8$$

**11.  $7x + 3y - 4z = -35$** 

$$3x - 2y + 5z = 38$$

$$x + y - 6z = -27$$

$$7x + 3y - 4z = -35$$

$$\underline{x + y - 6z = -27 \quad (-3)}$$

$$7x + 3y - 4z = -35$$

$$\underline{-3x - 3y + 18z = 81}$$

$$4x + 14z = 46$$

$$2x + 7z = 23$$

$$3x - 2y + 5z = 38$$

$$\underline{x + y - 6z = -27 \quad (2)}$$

$$3x - 2y + 5z = 38$$

$$\underline{2x + 2y - 12z = -54}$$

$$5x - 7z = -16$$

$$2x + 7z = 23$$

$$\underline{5x - 7z = -16}$$

$$7x = 7$$

$$x = 1$$

$$2(1) + 7z = 23$$

$$7z = 21$$

$$z = 3$$

$$1 + y - 6(3) = -27$$

$$y - 17 = -27$$

$$y = -10$$

$$\text{sol: } x=1 \quad y=-10 \quad z=3$$

**12.  $4x - y + 5z = -6$** 

$$3x + 3y - 4z = 30$$

$$6x + 2y - 3z = 33$$

$$4x - y + 5z = -6 \quad (3)$$

$$\underline{3x + 3y - 4z = 30}$$

$$12x - 3y + 15z = -18$$

$$\underline{3x + 3y - 4z = 30}$$

$$15x + 11z = 12$$

$$4x - y + 5z = -6 \quad (2)$$

$$\underline{6x + 2y - 3z = 33}$$

$$8x - 2y + 10z = -12$$

$$\underline{6x + 2y - 3z = 33}$$

$$14x + 7z = 21$$

$$2x + z = 3$$

$$15x + 11z = 12$$

$$\underline{2x + z = 3 \quad (-11)}$$

$$15x + 11z = 12$$

$$\underline{-22x - 11z = -33}$$

$$-7x = -21$$

$$x = 3$$

$$2(3) + z = 3$$

$$z = -3$$

$$4(3) - y + 5(-3) = -6$$

$$12 - y - 15 = -6$$

$$-y - 3 = -6$$

$$-y = -3$$

$$y = 3$$

$$\text{sol: } x=3 \quad y=3 \quad z=-3$$

**13.  $9x + 4y - 10z = 6$** 

$$6x - 8y + 5z = -1$$

$$12x + 12y - 15z = 10$$

$$6x - 8y + 5z = -1 \quad (-2)$$

$$\underline{12x + 12y - 15z = 10}$$

$$-12x + 16y - 10z = 2$$

$$\underline{12x + 12y - 15z = 10}$$

$$28y - 25z = 12$$

$$9x + 4y - 10z = 6 \quad (2)$$

$$\underline{6x - 8y + 5z = -1 \quad (-3)}$$

$$18x + 8y - 20z = 12$$

$$\underline{-18x + 24y - 15z = 3}$$

$$32y - 35z = 15$$

$$\text{Continúa}$$

**13. Continuación**

$$28y - 25z = 12 \quad (-8)$$

$$\underline{32y - 35z = 15 \quad (7)}$$

$$-224y + 200z = -96$$

$$\underline{224y - 245z = 105}$$

$$-45z = 9$$

$$z = -\frac{1}{5}$$

$$28y - 25\left(-\frac{1}{5}\right) = 12$$

$$28y + 5 = 12$$

$$28y = 7$$

$$y = \frac{1}{4}$$

$$6x - 8\left(\frac{1}{4}\right) + 5\left(-\frac{1}{5}\right) = -1$$

$$6x - 2 - 1 = -1$$

$$6x = 2$$

$$x = \frac{1}{3}$$

$$\text{sol: } x = \frac{1}{3} \quad y = \frac{1}{4} \quad z = -\frac{1}{5}$$

**14. 5x + 3y - z = -11**

$$10x - y + z = 10$$

$$15x + 2y - z = -7$$

$$5x + 3y - z = -11$$

$$\underline{10x - y + z = 10}$$

$$15x + 2y = -1$$

$$10x - y + z = 10$$

$$\underline{15x + 2y - z = -7}$$

$$25x + y = 3$$

$$15x + 2y = -1$$

$$\underline{25x + y = 3 \quad (-2)}$$

$$15x + 2y = -1$$

$$\underline{-50x - 2y = -6}$$

$$-35x = -7$$

$$x = \frac{1}{5}$$

$$15\left(\frac{1}{5}\right) + 2y = -1$$

$$3 + 2y = -1$$

$$2y = -4$$

$$y = -2$$

**Continúa****14. Continuación**

$$10x - (-2) + z = 10$$

$$10\left(\frac{1}{5}\right) - (-2) + z = 10$$

$$2 + 2 + z = 10$$

$$z = 6$$

$$\text{sol: } x = \frac{1}{5} \quad y = -2 \quad z = 6$$

**15. x + y = 1**

$$y + z = -1$$

$$z + x = -6$$

$$x + y = 1$$

$$\underline{y + z = -1 \quad (-1)}$$

$$x + y = 1$$

$$\underline{-y - z = 1}$$

$$x - z = 2$$

$$x - z = 2$$

$$\underline{x + z = -6}$$

$$2x = -4$$

$$x = -2$$

$$-2 + y = 1$$

$$y = 3$$

$$3 + z = -1$$

$$z = -4$$

$$\text{sol: } x = -2 \quad y = 3 \quad z = -4$$

**16. x + 2y = -1**

$$2y + z = 0$$

$$x + 2z = 11$$

$$x + 2y = -1$$

$$\underline{2y + z = 0 \quad (-1)}$$

$$x + 2y = -1$$

$$\underline{-2y - z = 0}$$

$$x - z = -1$$

$$x - z = -1 \quad (-1)$$

$$\underline{x + 2z = 11}$$

$$-x + z = 1$$

$$\underline{x + 2z = 11}$$

$$3z = 12$$

$$z = 4$$

$$x - 4 = -1 \Rightarrow x = 3$$

$$3 + 2y = -1$$

$$2y = -4 \Rightarrow y = -2$$

$$\text{sol: } x = 3 \quad y = -2 \quad z = 4$$

**17. y + z = -8**

$$2x + z = 9$$

$$3y + 2x = -3$$

$$y + z = -8$$

$$\underline{2x + z = 9 \quad (-1)}$$

$$y + z = -8$$

$$\underline{-2x - z = -9}$$

$$-2x + y = -17$$

$$-2x + y = -17$$

$$\underline{2x + 3y = -3}$$

$$4y = -20$$

$$y = -5$$

$$-5 + z = -8$$

$$z = -3$$

$$2x - 3 = 9$$

$$2x = 12$$

$$x = 6$$

$$\text{sol: } x = 6 \quad y = -5 \quad z = -3$$

**18. 3x - 2y = 0**

$$3y - 4z = 25$$

$$z - 5x = -14$$

$$3y - 4z = 25$$

$$\underline{-5x + z = -14 \quad (4)}$$

$$3y - 4z = 25$$

$$\underline{-20x + 4z = -56}$$

$$-20x + 3y = -31$$

$$-20x + 3y = -31 \quad (2)$$

$$\underline{3x - 2y = 0 \quad (3)}$$

$$-40x + 6y = -62$$

$$\underline{9x - 6y = 0}$$

$$-31x = -62$$

$$x = 2$$

$$3(2) - 2y = 0$$

$$6 - 2y = 0$$

$$-2y = -6$$

$$y = 3$$

$$3(3) - 4z = 25$$

$$-4z = 16$$

$$z = -4$$

$$\text{sol: } x = 2 \quad y = 3 \quad z = -4$$

**19. 3z - 5x = 10**

$$5x - 3y = -7$$

$$3y - 5z = -13$$

$$-5x + 3z = 10$$

$$\underline{5x - 3y = -7}$$

$$-3y + 3z = 3$$

$$-y + z = 1$$

$$3y - 5z = -13$$

$$\underline{-y + z = 1 \quad (3)}$$

$$3y - 5z = -13$$

$$\underline{-3y + 3z = 3}$$

$$-2z = -10$$

$$z = 5$$

$$-y + 5 = 1$$

$$-y = -4$$

$$y = 4$$

$$5x - 3(4) = -7$$

$$5x - 12 = -7$$

$$5x = 5$$

$$x = 1$$

$$\text{sol: } x = 1 \quad y = 4 \quad z = 5$$

**20. x - 2y = 0**

$$y - 2z = 5$$

$$x + y + z = 8$$

$$x + y + z = 8$$

$$\underline{x - 2y = 0 \quad (-1)}$$

$$x + y + z = 8$$

$$\underline{-x + 2y = 0}$$

$$3y + z = 8$$

$$3y + z = 8 \quad (2)$$

$$\underline{y - 2z = 5}$$

$$6y + 2z = 16$$

$$\underline{y - 2z = 5}$$

$$7y = 21$$

$$y = 3$$

$$x - 2(3) = 0$$

$$x - 6 = 0$$

$$x = 6$$

$$6 + 3 + z = 8$$

$$z = -1$$

$$\text{sol: } x = 6 \quad y = 3 \quad z = -1$$

21.  $5x - 3z = 2$

$2z - y = -5$

$x + 2y - 4z = 8$

$x + 2y - 4z = 8$

$-y + 2z = -5 \quad (2)$

$x + 2y - 4z = 8$

$-2y + 4z = -10$

$x = -2$

$5(-2) - 3z = 2$

$-10 - 3z = 2$

$-3z = 12$

$z = -4$

$2(-4) - y = -5$

$-8 - y = -5$

$-y = 3$

$y = -3$

sol:  $x = -2 \quad y = -3 \quad z = -4$

22.  $2x - z = 14$

$4x + y - z = 41$

$3x - y + 5z = 53$

$4x + y - z = 41$

$3x - y + 5z = 53$

$7x + 4z = 94$

$7x + 4z = 94$

$2x - z = 14 \quad (4)$

$7x + 4z = 94$

$8x - 4z = 56$

$15x = 150$

$x = 10$

$2(10) - z = 14$

$20 - z = 14$

$-z = -6$

$z = 6$

$4(10) + y - 6 = 41$

$y + 34 = 41$

$y = 7$

sol:  $x = 10 \quad y = 7 \quad z = 6$

23.  $x + y - z = 1$

$z + x - y = 3$

$z - x + y = 7$

$z + x - y = 3$

$z - x + y = 7$

$2z = 10 \Rightarrow z = 5$

Continúa

23. Continuación

$x - y + z = 3$

$x + y - z = 1$

$2x = 4$

$x = 2$

$2 - y + 5 = 3$

$-y + 7 = 3$

$-y = -4$

$y = 4$

sol:  $x = 2 \quad y = 4 \quad z = 5$

24.  $\frac{x}{2} + \frac{y}{2} - \frac{z}{3} = 3$

$3x + 3y - 2z = 18$

$\frac{x}{3} + \frac{y}{6} - \frac{z}{2} = -5$

$2x + y - 3z = -30$

$\frac{x}{6} - \frac{y}{3} + \frac{z}{6} = 0$

$x - 2y + z = 0$

$3x + 3y - 2z = 18 \quad (2)$

$x - 2y + z = 0 \quad (3)$

$6x + 6y - 4z = 36$

$3x - 6y + 3z = 0$

$9x - z = 36$

$2x + y - 3z = -30 \quad (2)$

$x - 2y + z = 0$

$4x + 2y - 6z = -60$

$x - 2y + z = 0$

$5x - 5z = -60$

$x - z = -12$

$9x - z = 36$

$x - z = -12 \quad (-1)$

$9x - z = 36$

$-x + z = 12$

$8x = 48$

$x = 6$

$6 - z = -12$

$-z = -18$

$z = 18$

Continúa

24. Continuación

$6 - 2y + 18 = 0$

$-2y + 24 = 0$

$-2y = -24$

$y = 12$

sol:  $x = 6 \quad y = 12 \quad z = 18$

25.  $\frac{x}{3} + \frac{y}{4} + \frac{z}{3} = 21$

$4x + 3y + 4z = 252$

$\frac{x}{5} + \frac{y}{6} - \frac{z}{3} = 0$

$6x + 5y - 10z = 0$

$\frac{x}{10} + \frac{y}{3} - \frac{z}{6} = 3$

$3x + 10y - 5z = 90$

$6x + 5y - 10z = 0 \quad (-2)$

$3x + 10y - 5z = 90$

$-12x - 10y + 20z = 0$

$3x + 10y - 5z = 90$

$-9x + 15z = 90$

$-3x + 5z = 30$

$4x + 3y + 4z = 252 \quad (10)$

$3x + 10y - 5z = 90 \quad (-3)$

$40x + 30y + 40z = 2.520$

$-9x - 30y + 15z = -270$

$31x + 55z = 2.250$

$-3x + 5z = 30 \quad (-11)$

$31x + 55z = 2.250$

$33x - 55z = -330$

$31x + 55z = 2.250$

$64x = 1.920$

$x = 30$

$-3(30) + 5z = 30$

$-90 + 5z = 30$

$5z = 120$

$z = 24$

$6(30) + 5y - 10(24) = 0$

$180 - 240 + 5y = 0$

$5y = 60$

$y = 12$

sol:  $x = 30 \quad y = 12 \quad z = 24$



$$\begin{aligned}
26. \quad & x - \frac{y+z}{3} = 4 \\
& 3x - y - z = 12 \\
& y - \frac{x+z}{8} = 10 \\
& 8y - x - z = 80 \\
& z - \frac{y-x}{2} = 5 \\
& 2z - y + x = 10 \\
& \quad 3x - y - z = 12 \quad (-1) \\
& \quad \underline{-x + 8y - z = 80} \\
& \quad -3x + y + z = -12 \\
& \quad \underline{-x + 8y - z = 80} \\
& \quad -4x + 9y = 68 \\
& -x + 8y - z = 80 \quad (2) \\
& \quad \underline{x - y + 2z = 10} \\
& -2x + 16y - 2z = 160 \\
& \quad \underline{x - y + 2z = 10} \\
& -x + 15y = 170 \\
& \quad -4x + 9y = 68 \\
& \quad \underline{-x + 15y = 170} \quad (-4) \\
& \quad -4x + 9y = 68 \\
& \quad \underline{4x - 60y = -680} \\
& \quad -51y = -612 \\
& \quad \quad y = 12 \\
& -4x + 9(12) = 68 \\
& -4x + 108 = 68 \\
& \quad -4x = -40 \\
& \quad \quad x = 10 \\
& 3(10) - 12 - z = 12 \\
& \quad 30 - 12 - z = 12 \\
& \quad \quad 18 - z = 12 \\
& \quad \quad \quad z = 6 \\
& \text{sol: } x=10 \quad y=12 \quad z=6 \\
27. \quad & \frac{x+y}{7} = \frac{y+4}{5} \\
& 5(x+y) = 7(y+4) \\
& 5x + 5y = 7y + 28 \\
& 5x - 2y = 28 \\
& \quad \frac{x-z}{5} = \frac{y-4}{2} \\
& 2(x-z) = 5(y-4) \\
& 2x - 2z = 5y - 20 \\
& 2x - 5y - 2z = -20 \\
& \text{Continúa}
\end{aligned}$$

$$\begin{aligned}
27. \text{ Continuación} \\
& \quad \frac{y-z}{3} = \frac{x+2}{10} \\
& 10(y-z) = 3(x+2) \\
& 10y - 10z = 3x + 6 \\
& 3x - 10y + 10z = -6 \\
& \quad 2x - 5y - 2z = -20 \quad (5) \\
& \quad \underline{3x - 10y + 10z = -6} \\
& 10x - 25y - 10z = -100 \\
& \quad \underline{3x - 10y + 10z = -6} \\
& 13x - 35y = -106 \\
& 13x - 35y = -106 \quad (2) \\
& \quad \underline{5x - 2y = 28} \quad (-35) \\
& 26x - 70y = -212 \\
& -175x + 70y = -980 \\
& \underline{-149x} = -1.192 \\
& \quad \quad x = 8 \\
& 5(8) - 2y = 28 \\
& 40 - 2y = 28 \\
& \quad -2y = -12 \\
& \quad \quad y = 6 \\
& 2(8) - 5(6) - 2z = -20 \\
& 16 - 30 - 2z = -20 \\
& \quad -2z = -6 \\
& \quad \quad z = 3 \\
& \text{sol: } x=8 \quad y=6 \quad z=3 \\
28. \quad & y - \frac{z+4}{2} = x - 6 \\
& 2y - z - 4 = 2x - 12 \\
& -2x + 2y - z = -8 \\
& \quad z - \frac{x-7}{3} = y - 5 \\
& 3z - x + 7 = 3y - 15 \\
& -x - 3y + 3z = -22 \\
& x - \frac{y+2}{5} = z + 4 \\
& 5x - y - 2 = 5z + 20 \\
& 5x - y - 5z = 22 \\
& \quad -2x + 2y - z = -8 \\
& \quad \underline{-x - 3y + 3z = -22} \quad (-2) \\
& -2x + 2y - z = -8 \\
& \quad \underline{2x + 6y - 6z = 44} \\
& \quad \quad 8y - 7z = 36 \\
& \text{Continúa}
\end{aligned}$$

$$\begin{aligned}
28. \text{ Continuación} \\
& 5x - y - 5z = 22 \\
& \underline{-x - 3y + 3z = -22} \quad (5) \\
& 5x - y - 5z = 22 \\
& \underline{-5x - 15y + 15z = -110} \\
& \quad -16y + 10z = -88 \\
& \quad \quad -8y + 5z = -44 \\
& -8y + 5z = -44 \\
& \quad \underline{8y - 7z = 36} \\
& \quad -2z = -8 \\
& \quad \quad z = 4 \\
& 8y - 7(4) = 36 \\
& 8y - 28 = 36 \\
& \quad 8y = 64 \\
& \quad \quad y = 8 \\
& -x - 3(8) + 3(4) = -22 \\
& \quad -x - 12 = -22 \\
& \quad \quad x = 10 \\
& \text{sol: } x=10 \quad y=8 \quad z=4 \\
29. \quad & x - y + \frac{y-z}{2} = 3 \\
& 2x - 2y + y - z = 6 \\
& 2x - y - z = 6 \\
& \quad \frac{x-y}{2} - \frac{x-z}{4} = 0 \\
& 2x - 2y - x + z = 0 \\
& \quad x - 2y + z = 0 \\
& \quad \frac{y-z}{2} - x = -5 \\
& y - z - 2x = -10 \\
& \quad 2x - y - z = 6 \\
& \quad \underline{-2x + y - z = -10} \\
& \quad \quad -2z = -4 \\
& \quad \quad \quad z = 2 \\
& x - 2y + z = 0 \\
& \underline{2x - y - z = 6} \quad (-2) \\
& x - 2y + z = 0 \\
& \underline{-4x + 2y + 2z = -12} \\
& -3x + 3z = -12 \\
& -3x + 3(2) = -12 \\
& -3x + 6 = -12 \\
& \quad -3x = -18 \\
& \quad \quad x = 6 \\
& \text{Continúa}
\end{aligned}$$

**29. Continuación**

$$\begin{aligned}
 6-2y+2 &= 0 \\
 -2y+8 &= 0 \\
 -2y &= -8 \\
 y &= 4 \\
 \text{sol: } x=6 \quad y=4 \quad z=2
 \end{aligned}$$

**30.**  $\frac{1}{x} + \frac{1}{y} = 5$

$$\begin{aligned}
 \frac{\frac{1}{x} + \frac{1}{y}}{\frac{1}{x} + \frac{1}{z}} &= 6 \quad (-1) \\
 \frac{\frac{1}{x} + \frac{1}{y}}{\frac{1}{x} + \frac{1}{z}} &= 5 \\
 \frac{-\frac{1}{x} - \frac{1}{z}}{\frac{1}{y} - \frac{1}{z}} &= -6 \\
 \frac{\frac{1}{y} - \frac{1}{z}}{\frac{1}{y} - \frac{1}{z}} &= -1 \\
 \frac{\frac{1}{y} + \frac{1}{z}}{\frac{1}{y} + \frac{1}{z}} &= 7 \\
 \frac{\frac{2}{y}}{\frac{2}{y}} &= 6 \\
 \frac{1}{3} &= y
 \end{aligned}$$

$$\frac{\frac{1}{x} + \frac{1}{\frac{1}{3}}}{\frac{1}{x} + \frac{1}{3}} = 5$$

$$\frac{1}{x} + 3 = 5$$

$$\frac{1}{x} = 2$$

$$\frac{1}{2} = x$$

$$\frac{\frac{1}{\frac{1}{2}} + \frac{1}{z}}{\frac{1}{\frac{1}{2}} + \frac{1}{z}} = 6$$

$$2 + \frac{1}{z} = 6$$

$$\frac{1}{z} = 4$$

$$\frac{1}{4} = z$$

sol:  $x = \frac{1}{2} \quad y = \frac{1}{3} \quad z = \frac{1}{4}$

**31.**  $\frac{3}{x} + \frac{2}{y} = 2$

$$\frac{\frac{2}{y} + \frac{2}{z}}{\frac{2}{y} + \frac{2}{z}} = \frac{3}{2} \quad (-1)$$

$$\frac{3}{x} + \frac{2}{y} = 2$$

$$\frac{-\frac{2}{y} - \frac{2}{z}}{\frac{2}{y} + \frac{2}{z}} = -\frac{3}{2}$$

$$\frac{3}{x} - \frac{2}{z} = \frac{1}{2}$$

$$\frac{\frac{3}{x} - \frac{2}{z}}{\frac{1}{x} - \frac{4}{z}} = \frac{1}{2} \quad (2)$$

$$\frac{\frac{1}{x} + \frac{4}{z}}{\frac{1}{x} + \frac{4}{z}} = \frac{4}{3}$$

$$\frac{\frac{6}{x} - \frac{4}{z}}{\frac{6}{x} - \frac{4}{z}} = 1$$

$$\frac{\frac{1}{x} + \frac{4}{z}}{\frac{1}{x} + \frac{4}{z}} = \frac{4}{3}$$

$$\frac{7}{x} = \frac{7}{3}$$

$x=3$

$$\frac{3}{3} + \frac{2}{y} = 2$$

$$1 + \frac{2}{y} = 2$$

$$\frac{2}{y} = 1$$

$$2 = y$$

$$\frac{3}{3} - \frac{2}{z} = \frac{1}{2}$$

$$1 - \frac{2}{z} = \frac{1}{2}$$

$$-\frac{2}{z} = -\frac{1}{2}$$

$$4 = z$$

sol:  $x=3 \quad y=2 \quad z=4$

**32.**  $\frac{1}{x} + \frac{4}{y} + \frac{2}{z} = -6$

$$\frac{\frac{3}{x} + \frac{2}{y} + \frac{4}{z}}{\frac{3}{x} + \frac{2}{y} + \frac{4}{z}} = 3 \quad (-2)$$

$$\frac{\frac{1}{x} + \frac{4}{y} + \frac{2}{z}}{\frac{1}{x} + \frac{4}{y} + \frac{2}{z}} = -6$$

$$\frac{-\frac{6}{x} - \frac{4}{y} - \frac{8}{z}}{-\frac{6}{x} - \frac{4}{y} - \frac{8}{z}} = -6$$

$$\frac{-\frac{5}{x} - \frac{6}{z}}{-\frac{5}{x} - \frac{6}{z}} = -12$$

**32. Continuación**

$$\frac{1}{x} + \frac{4}{y} + \frac{2}{z} = -6 \quad (5)$$

$$\frac{6}{x} - \frac{5}{y} - \frac{6}{z} = 31 \quad (4)$$

$$\frac{\frac{5}{x} + \frac{20}{y} + \frac{10}{z}}{\frac{5}{x} + \frac{20}{y} + \frac{10}{z}} = -30$$

$$\frac{\frac{24}{x} - \frac{20}{y} - \frac{24}{z}}{\frac{24}{x} - \frac{20}{y} - \frac{24}{z}} = 124$$

$$\frac{\frac{29}{x} - \frac{14}{z}}{\frac{29}{x} - \frac{14}{z}} = 94$$

$$-\frac{5}{x} - \frac{6}{z} = 12 \quad (-7)$$

$$\frac{\frac{29}{x} - \frac{14}{z}}{\frac{29}{x} - \frac{14}{z}} = 94 \quad (3)$$

$$\frac{\frac{35}{x} + \frac{42}{z}}{\frac{35}{x} + \frac{42}{z}} = 84$$

$$\frac{\frac{87}{x} - \frac{42}{z}}{\frac{87}{x} - \frac{42}{z}} = 282$$

$$\frac{122}{x} = 366$$

$$122 = 366x$$

$$\frac{1}{3} = x$$

$$-\frac{5}{\frac{1}{3}} - \frac{6}{z} = -12$$

$$-15 - \frac{6}{z} = -12$$

$$-\frac{6}{z} = 3$$

$$-2 = z$$

$$\frac{\frac{1}{\frac{1}{3}} + \frac{4}{y} + \frac{2}{-2}}{\frac{1}{\frac{1}{3}} + \frac{4}{y} + \frac{2}{-2}} = -6$$

$$3 + \frac{4}{y} - 1 = -6$$

$$\frac{4}{y} = -8$$

$$-\frac{1}{2} = y$$

sol:  $x = \frac{1}{3} \quad y = -\frac{1}{2} \quad z = -2$

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## EJERCICIO 187

$$1. \begin{vmatrix} 1 & 2 & 1 \\ 1 & 3 & 4 \\ 1 & 0 & 2 \\ 1 & 2 & 1 \\ 1 & 3 & 4 \end{vmatrix}$$
$$\Rightarrow 6+0+8-3-0-4=7$$

$$2. \begin{vmatrix} 1 & 2 & -2 \\ 1 & -3 & 3 \\ -1 & 4 & 5 \\ 1 & 2 & -2 \\ 1 & -3 & 3 \end{vmatrix}$$
$$\Rightarrow -15-8-6+6-12-10=-45$$

$$3. \begin{vmatrix} -3 & 4 & 1 \\ 2 & -3 & 0 \\ 1 & 2 & 7 \\ -3 & 4 & 1 \\ 2 & -3 & 0 \end{vmatrix}$$
$$\Rightarrow 63+4+0+3+0-56=14$$

$$4. \begin{vmatrix} 2 & 5 & -1 \\ 3 & -4 & 3 \\ 6 & 2 & 4 \\ 2 & 5 & -1 \\ 3 & -4 & 3 \end{vmatrix}$$
$$\Rightarrow -32-6+90-24-12-60=-44$$

$$5. \begin{vmatrix} 5 & -1 & -6 \\ -2 & 5 & 3 \\ 3 & 4 & 2 \\ 5 & -1 & -6 \\ -2 & 5 & 3 \end{vmatrix}$$
$$\Rightarrow 50+48-9+90-60-4=115$$

$$6. \begin{vmatrix} 4 & 1 & 5 \\ 3 & 2 & -6 \\ 12 & 3 & 2 \\ 4 & 1 & 5 \\ 3 & 2 & -6 \end{vmatrix}$$
$$\Rightarrow 16+45-72-120+72-6=-65$$

$$7. \begin{vmatrix} 5 & 2 & -8 \\ -3 & -7 & 3 \\ 4 & 0 & -1 \\ 5 & 2 & -8 \\ -3 & -7 & 3 \end{vmatrix}$$
$$\Rightarrow 35+0+24-224+0-6=-171$$

$$8. \begin{vmatrix} 3 & 2 & 5 \\ -1 & -3 & 4 \\ 3 & 2 & 5 \\ 3 & 2 & 5 \\ -1 & -3 & 4 \end{vmatrix}$$
$$\Rightarrow -45-10+24+45-24+10=0$$

$$9. \begin{vmatrix} 5 & 2 & 3 \\ 6 & 1 & 2 \\ 3 & 4 & 5 \\ 5 & 2 & 3 \\ 6 & 1 & 2 \end{vmatrix}$$
$$\Rightarrow 25+72+12-9-40-60=0$$

$$10. \begin{vmatrix} 12 & 5 & 10 \\ 8 & -6 & 9 \\ 7 & 4 & -2 \\ 12 & 5 & 10 \\ 8 & -6 & 9 \end{vmatrix}$$
$$\Rightarrow 144+320+315+420-432+80=847$$

$$11. \begin{vmatrix} -9 & 3 & -4 \\ 7 & -5 & -3 \\ 4 & 6 & 1 \\ -9 & 3 & -4 \\ 7 & -5 & -3 \end{vmatrix}$$
$$\Rightarrow 45-168-36-80-162-21=-422$$

$$12. \begin{vmatrix} 11 & -5 & 7 \\ -12 & 3 & 8 \\ -13 & 1 & 9 \\ 11 & -5 & 7 \\ -12 & 3 & 8 \end{vmatrix}$$
$$\Rightarrow 297-84+520+273-88-540=378$$

## EJERCICIO 188

$$\begin{aligned} 1. \quad & x+y+z=11 \\ & x-y+3z=13 \\ & 2x+2y-z=7 \end{aligned}$$

$$x = \frac{\begin{vmatrix} 11 & 1 & 1 \\ 13 & -1 & 3 \\ 7 & 2 & -1 \\ 11 & 1 & 1 \\ 13 & -1 & 3 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1 & 3 \\ 2 & 2 & -1 \\ 1 & 1 & 1 \\ 1 & -1 & 3 \end{vmatrix}}$$

$$x = \frac{11+26+21+7-66+13}{1+2+6+2-6+1} = \frac{12}{6} = 2$$

$$y = \frac{\begin{vmatrix} 1 & 11 & 1 \\ 1 & 13 & 3 \\ 2 & 7 & -1 \\ 1 & 11 & 1 \\ 1 & 13 & 3 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1 & 3 \\ 2 & 2 & -1 \\ 1 & 1 & 1 \\ 1 & -1 & 3 \end{vmatrix}}$$

$$y = \frac{-13+7+66-26-21+11}{6} = \frac{24}{6} = 4$$

$$z = \frac{\begin{vmatrix} 1 & 1 & 11 \\ 1 & -1 & 13 \\ 2 & 2 & 7 \\ 1 & 1 & 11 \\ 1 & -1 & 13 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1 & 3 \\ 2 & 2 & -1 \\ 1 & 1 & 1 \\ 1 & -1 & 3 \end{vmatrix}}$$

$$z = \frac{-7+22+26+22-26-7}{6} = \frac{30}{6} = 5$$

$$\text{sol: } x=2 \quad y=4 \quad z=5$$

$$\begin{aligned} 2. \quad & x+y+z=-6 \\ & 2x+y-z=-1 \\ & x-2y+3z=-6 \end{aligned}$$

$$x = \frac{\begin{vmatrix} -6 & 1 & 1 \\ -1 & 1 & -1 \\ -6 & -2 & 3 \\ -6 & 1 & 1 \\ -1 & 1 & -1 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 2 & 1 & -1 \\ 1 & -2 & 3 \\ 1 & 1 & 1 \\ 2 & 1 & -1 \end{vmatrix}}$$

## 2. Continuación

$$x = \frac{-18+2+6+6+12+3}{3-4-1-1-2-6} = \frac{11}{-11} = -1$$

$$y = \frac{\begin{vmatrix} 1 & -6 & 1 \\ 2 & -1 & -1 \\ 1 & -6 & 3 \\ 1 & -6 & 1 \\ 2 & -1 & -1 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 2 & 1 & -1 \\ 1 & -2 & -6 \\ 1 & 1 & -6 \\ 2 & 1 & -1 \end{vmatrix}}$$

$$y = \frac{-3-12+6+1-6+36}{-11} = \frac{22}{-11} = -2$$

$$z = \frac{\begin{vmatrix} 1 & 1 & -6 \\ 2 & 1 & -1 \\ 1 & -2 & -6 \\ 1 & 1 & -6 \\ 2 & 1 & -1 \end{vmatrix}}{\begin{vmatrix} 1 & 1 & 1 \\ 2 & 1 & -1 \\ 1 & -2 & -6 \\ 1 & 1 & -6 \\ 2 & 1 & -1 \end{vmatrix}}$$

$$z = \frac{-6+24-1+6-2+12}{-11} = \frac{33}{-11} = -3$$

$$\text{sol: } x=-1 \quad y=-2 \quad z=-3$$

$$\begin{aligned} 3. \quad & 2x+3y+4z=3 \\ & 2x+6y+8z=5 \\ & 4x+9y-4z=4 \end{aligned}$$

$$x = \frac{\begin{vmatrix} 3 & 3 & 4 \\ 5 & 6 & 8 \\ 4 & 9 & -4 \\ 3 & 3 & 4 \\ 5 & 6 & 8 \end{vmatrix}}{\begin{vmatrix} 2 & 3 & 4 \\ 2 & 6 & 8 \\ 4 & 9 & -4 \\ 2 & 3 & 4 \\ 2 & 6 & 8 \end{vmatrix}}$$

$$x = \frac{-72+180+96-96-216+60}{-48+72+96-96-144+24} = \frac{-48}{-96} = \frac{1}{2}$$

$$y = \frac{\begin{vmatrix} 2 & 3 & 4 \\ 2 & 5 & 8 \\ 4 & 4 & -4 \\ 2 & 3 & 4 \\ 2 & 5 & 8 \end{vmatrix}}{\begin{vmatrix} 2 & 3 & 4 \\ 2 & 6 & 8 \\ 4 & 9 & -4 \\ 2 & 3 & 4 \\ 2 & 6 & 8 \end{vmatrix}}$$

$$y = \frac{-40+32+96-80-64+24}{-96} = \frac{-32}{-96} = \frac{1}{3}$$

$$z = \frac{\begin{vmatrix} 2 & 3 & 3 \\ 2 & 6 & 5 \\ 4 & 9 & 4 \\ 2 & 3 & 3 \\ 2 & 6 & 5 \end{vmatrix}}{\begin{vmatrix} 2 & 3 & 4 \\ 2 & 6 & 8 \\ 4 & 9 & -4 \\ 2 & 3 & 4 \\ 2 & 6 & 8 \end{vmatrix}}$$

$$z = \frac{48+54+60-72-90-24}{-96} = \frac{-24}{-96} = \frac{1}{4}$$

$$\text{sol: } x = \frac{1}{2} \quad y = \frac{1}{3} \quad z = \frac{1}{4}$$

4.  $4x - y + z = 4$

$2x + 2y - z = 2$

$6x - 2y + 3z = 12$

$$x = \begin{vmatrix} 4 & -1 & 1 \\ 2 & 2 & -1 \\ 12 & -2 & 3 \\ 4 & -1 & 1 \\ 2 & 2 & -1 \end{vmatrix}$$

$$x = \begin{vmatrix} 4 & -1 & 1 \\ 2 & 2 & -1 \\ 6 & -2 & 3 \\ 4 & -1 & 1 \\ 2 & 2 & -1 \end{vmatrix}$$

$$x = \frac{24 - 4 + 12 - 24 - 8 + 6}{24 - 4 + 6 - 12 - 8 + 6} = \frac{6}{12} = \frac{1}{2}$$

$$y = \begin{vmatrix} 4 & 4 & 1 \\ 2 & 2 & -1 \\ 6 & 12 & 3 \\ 4 & 4 & 1 \\ 2 & 2 & -1 \end{vmatrix}$$

$$y = \frac{24 + 24 - 24 - 12 + 48 - 24}{12} = \frac{36}{12} = 3$$

$$z = \begin{vmatrix} 4 & -1 & 4 \\ 2 & 2 & 2 \\ 6 & -2 & 12 \\ 4 & -1 & 4 \\ 2 & 2 & 2 \end{vmatrix}$$

$$z = \frac{96 - 16 - 12 - 48 + 16 + 24}{12} = \frac{60}{12} = 5$$

sol:  $x = \frac{1}{2}$   $y = 3$   $z = 5$

5.  $x + 4y + 5z = 11$

$3x - 2y + z = 5$

$4x + y - 3z = -26$

$$x = \begin{vmatrix} 11 & 4 & 5 \\ 5 & -2 & 1 \\ -26 & 1 & -3 \\ 11 & 4 & 5 \\ 5 & -2 & 1 \end{vmatrix}$$

$$x = \begin{vmatrix} 1 & 4 & 5 \\ 3 & -2 & 1 \\ 4 & 1 & -3 \\ 1 & 4 & 5 \\ 3 & -2 & 1 \end{vmatrix}$$

Continúa

5. Continuación

$$x = \frac{66 + 25 - 104 - 260 - 11 + 60}{6 + 15 + 16 + 40 - 1 + 36} = \frac{-224}{112} = -2$$

$$y = \begin{vmatrix} 1 & 11 & 5 \\ 3 & 5 & 1 \\ 4 & -26 & -3 \\ 1 & 11 & 5 \\ 3 & 5 & 1 \end{vmatrix}$$

$$y = \frac{-15 - 390 + 44 - 100 + 26 + 99}{112} = \frac{-336}{112} = -3$$

$$z = \begin{vmatrix} 1 & 4 & 11 \\ 3 & -2 & 5 \\ 4 & 1 & -26 \\ 1 & 4 & 11 \\ 3 & -2 & 5 \end{vmatrix}$$

$$z = \frac{52 + 33 + 80 + 88 - 5 + 312}{112} = \frac{560}{112} = 5$$

sol:  $x = -2$   $y = -3$   $z = 5$

6.  $7x + 10y + 4z = -2$

$5x - 2y + 6z = 38$

$3x + y - z = 21$

$$x = \begin{vmatrix} -2 & 10 & 4 \\ 38 & -2 & 6 \\ 21 & 1 & -1 \\ -2 & 10 & 4 \\ 38 & -2 & 6 \end{vmatrix}$$

$$x = \begin{vmatrix} 7 & 10 & 4 \\ 5 & -2 & 6 \\ 3 & 1 & -1 \\ 7 & 10 & 4 \\ 5 & -2 & 6 \end{vmatrix}$$

$$x = \frac{-4 + 152 + 1.260 + 168 + 12 + 380}{14 + 20 + 180 + 24 - 42 + 50} = \frac{1.968}{246} = 8$$

$$y = \begin{vmatrix} 7 & -2 & 4 \\ 5 & 38 & 6 \\ 3 & 21 & -1 \\ 7 & -2 & 4 \\ 5 & 38 & 6 \end{vmatrix}$$

$$z = \begin{vmatrix} 7 & 10 & -2 \\ 5 & -2 & 38 \\ 3 & 1 & 21 \\ 7 & 10 & -2 \\ 5 & -2 & 38 \end{vmatrix}$$

$$z = \frac{-266 + 420 - 36 - 456 - 882 - 10}{246} = \frac{-1.230}{246} = -5$$

sol:  $x = 8$   $y = -5$   $z = -2$

7.  $4x+7y+5z=-2$

$6x+3y+7z=6$

$x-y+9z=-21$

$$x = \begin{vmatrix} -2 & 7 & 5 \\ 6 & 3 & 7 \\ -21 & -1 & 9 \\ -2 & 7 & 5 \\ 6 & 3 & 7 \end{vmatrix}$$

$$x = \begin{vmatrix} 4 & 7 & 5 \\ 6 & 3 & 7 \\ 1 & -1 & 9 \\ 4 & 7 & 5 \\ 6 & 3 & 7 \end{vmatrix}$$

$$x = \frac{-54 - 30 - 1.029 + 315 - 14 - 378}{108 - 30 + 49 - 15 + 28 - 378} = \frac{-1.190}{-238} = 5$$

$$y = \begin{vmatrix} 4 & -2 & 5 \\ 6 & 6 & 7 \\ 1 & -21 & 9 \\ 4 & -2 & 5 \\ 6 & 6 & 7 \end{vmatrix}$$

$$y = \frac{216 - 630 - 14 - 30 + 588 + 108}{-238} = \frac{238}{-238} = -1$$

$$z = \begin{vmatrix} 4 & 7 & -2 \\ 6 & 3 & 6 \\ 1 & -1 & -21 \\ 4 & 7 & -2 \\ 6 & 3 & 6 \end{vmatrix}$$

$$z = \frac{-252 + 12 + 42 + 6 + 24 + 882}{-238} = \frac{714}{-238} = -3$$

sol:  $x=5$     $y=-1$     $z=-3$

8.  $3x-5y+2z=-22$

$2x-y+6z=32$

$8x+3y-5z=-33$

$$x = \begin{vmatrix} -22 & -5 & 2 \\ 32 & -1 & 6 \\ -33 & 3 & -5 \\ -22 & -5 & 2 \\ 32 & -1 & 6 \end{vmatrix}$$

$$x = \begin{vmatrix} 3 & -5 & 2 \\ 2 & -1 & 6 \\ 8 & 3 & -5 \\ 3 & -5 & 2 \\ 2 & -1 & 6 \end{vmatrix}$$

**Continúa**

**8. Continuación**

$$x = \frac{-110 + 192 + 990 - 66 + 396 - 800}{15 + 12 - 240 + 16 - 54 - 50} = \frac{602}{-301} = -2$$

$$y = \begin{vmatrix} 3 & -22 & 2 \\ 2 & 32 & 6 \\ 8 & -33 & -5 \\ 3 & -22 & 2 \\ 2 & 32 & 6 \end{vmatrix}$$

$$y = \frac{-480 - 132 - 1.056 - 512 + 594 - 220}{-301} = \frac{-1.806}{-301} = 6$$

$$z = \begin{vmatrix} 3 & -5 & -22 \\ 2 & -1 & 32 \\ 8 & 3 & -33 \\ 3 & -5 & -22 \\ 2 & -1 & 32 \end{vmatrix}$$

$$z = \frac{99 - 132 - 1.280 - 176 - 288 - 330}{-301} = \frac{-2.107}{-301} = 7$$

sol:  $x=-2$     $y=6$     $z=7$

9.  $x+y+z=3$

$x+2y=6$

$2x+3y=6$

$$x = \begin{vmatrix} 3 & 1 & 1 \\ 6 & 2 & 0 \\ 6 & 3 & 0 \\ 3 & 1 & 1 \\ 6 & 2 & 0 \end{vmatrix}$$

$$x = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 0 \\ 2 & 3 & 0 \\ 1 & 1 & 1 \\ 1 & 2 & 0 \end{vmatrix}$$

$$x = \frac{0 + 18 + 0 - 12 + 0 + 0}{0 + 3 + 0 - 4 + 0 + 0} = \frac{6}{-1} = -6$$

$$y = \begin{vmatrix} 1 & 3 & 1 \\ 1 & 6 & 0 \\ 2 & 6 & 0 \\ 1 & 3 & 1 \\ 1 & 6 & 0 \end{vmatrix}$$

$$y = \frac{0 + 6 + 0 - 12 + 0 + 0}{-1} = \frac{-6}{-1} = 6$$

$$z = \begin{vmatrix} 1 & 1 & 3 \\ 1 & 2 & 6 \\ 2 & 3 & 6 \\ 1 & 1 & 3 \\ 1 & 2 & 6 \end{vmatrix}$$

$$z = \frac{12 + 9 + 12 - 12 - 18 - 6}{-1} = \frac{-3}{-1} = 3$$

sol:  $x=-6$     $y=6$     $z=3$

10.  $3x - 2y = -1$

$4x + z = -28$

$x + 2y + 3z = -43$

$$\begin{array}{ccc|c} -1 & -2 & 0 & \\ -28 & 0 & 1 & \\ -43 & 2 & 3 & \\ -1 & -2 & 0 & \\ -28 & 0 & 1 & \end{array}$$

$$x = \frac{\begin{array}{ccc|c} 3 & -2 & 0 & \\ 4 & 0 & 1 & \\ 1 & 2 & 3 & \\ 3 & -2 & 0 & \\ 4 & 0 & 1 & \end{array}}{\begin{array}{ccc|c} 0+0+86+0+2-168 & & & -80 \\ 0+0-2+0-6+24 & & & 16 \end{array}} = -5$$

$$x = \frac{0+0+86+0+2-168}{0+0-2+0-6+24} = \frac{-80}{16} = -5$$

$$y = \frac{\begin{array}{ccc|c} 3 & -1 & 0 & \\ 4 & -28 & 1 & \\ 1 & -43 & 3 & \\ 3 & -1 & 0 & \\ 4 & -28 & 1 & \end{array}}{\begin{array}{ccc|c} -252+0-1+0+129+12 & & & -112 \\ & 16 & & 16 \end{array}} = -7$$

$$y = \frac{-252+0-1+0+129+12}{16} = \frac{-112}{16} = -7$$

$$z = \frac{\begin{array}{ccc|c} 3 & -2 & -1 & \\ 4 & 0 & -28 & \\ 1 & 2 & -43 & \\ 3 & -2 & -1 & \\ 4 & 0 & -28 & \end{array}}{\begin{array}{ccc|c} 0-8+56+0+168-344 & & & -128 \\ & 16 & & 16 \end{array}} = -8$$

$$z = \frac{0-8+56+0+168-344}{16} = \frac{-128}{16} = -8$$

sol:  $x = -5$     $y = -7$     $z = -8$

11.  $\frac{x}{3} - \frac{y}{4} + \frac{z}{4} = 1$

$4x - 3y + 3z = 12$

$\frac{x}{6} + \frac{y}{2} - z = 1$

$2x + 6y - 12z = 12$

$x + 3y - 6z = 6$

$\frac{x}{2} - \frac{y}{8} - \frac{z}{2} = 0$

$4x - y - 4z = 0$

$$x = \frac{\begin{array}{ccc|c} 12 & -3 & 3 & \\ 6 & 3 & -6 & \\ 0 & -1 & -4 & \\ 12 & -3 & 3 & \\ 6 & 3 & -6 & \\ 4 & -3 & 3 & \\ 1 & 3 & -6 & \\ 4 & -1 & -4 & \\ 4 & -3 & 3 & \\ 1 & 3 & -6 & \end{array}}{\begin{array}{ccc|c} 4-264+0+24+0-36 & & & -272 \\ & -34 & & -34 \end{array}} = 8$$

Continúa

11. Continuación

$$x = \frac{-144-18+0+0-72-72}{-48-3+72-36-24-12} = \frac{-306}{-51} = 6$$

$$y = \frac{\begin{array}{ccc|c} 4 & 12 & 3 & \\ 1 & 6 & -6 & \\ 4 & 0 & -4 & \\ 4 & 12 & 3 & \\ 1 & 6 & -6 & \end{array}}{\begin{array}{ccc|c} -96+0-288-72+0+48 & & & -408 \\ & -51 & & -51 \end{array}} = 8$$

$$y = \frac{-96+0-288-72+0+48}{-51} = \frac{-408}{-51} = 8$$

$$z = \frac{\begin{array}{ccc|c} 4 & -3 & 12 & \\ 1 & 3 & 6 & \\ 4 & -1 & 0 & \\ 4 & -3 & 12 & \\ 1 & 3 & 6 & \end{array}}{\begin{array}{ccc|c} 0-12-72-144+24+0 & & & -204 \\ & -51 & & -51 \end{array}} = 4$$

$$z = \frac{0-12-72-144+24+0}{-51} = \frac{-204}{-51} = 4$$

sol:  $x = 6$     $y = 8$     $z = 4$

12.  $\frac{x}{3} + y = 2z + 3$  ;  $x - y = 1$  ;  $x + z = \frac{y}{4} + 11$

$x + 3y = 6z + y$  ; ;  $4x + 4z = y + 44$

$x + 3y - 6z = 9$

$4x - y + 4z = 44$

$$x = \frac{\begin{array}{ccc|c} 9 & 3 & -6 & \\ 1 & -1 & 0 & \\ 44 & -1 & 4 & \\ 9 & 3 & -6 & \\ 1 & -1 & 0 & \end{array}}{\begin{array}{ccc|c} 1 & 3 & -6 & \\ 1 & -1 & 0 & \\ 4 & -1 & 4 & \\ 1 & 3 & -6 & \\ 1 & -1 & 0 & \end{array}}$$

$$x = \frac{\begin{array}{ccc|c} 9 & 3 & -6 & \\ 1 & -1 & 0 & \\ 44 & -1 & 4 & \\ 9 & 3 & -6 & \\ 1 & -1 & 0 & \end{array}}{\begin{array}{ccc|c} 1 & 3 & -6 & \\ 1 & -1 & 0 & \\ 4 & -1 & 4 & \\ 1 & 3 & -6 & \\ 1 & -1 & 0 & \end{array}}$$

$$x = \frac{-36+6+0-264+0-12}{-4+6+0-24+0-12} = \frac{-306}{-34} = 9$$

$$y = \frac{\begin{array}{ccc|c} 1 & 9 & -6 & \\ 1 & 1 & 0 & \\ 4 & 44 & 4 & \\ 1 & 9 & -6 & \\ 1 & 1 & 0 & \end{array}}{\begin{array}{ccc|c} 4-264+0+24+0-36 & & & -272 \\ & -34 & & -34 \end{array}} = 8$$

$$y = \frac{4-264+0+24+0-36}{-34} = \frac{-272}{-34} = 8$$

$$z = \frac{\begin{array}{ccc|c} 1 & 3 & 9 & \\ 1 & -1 & 1 & \\ 4 & -1 & 44 & \\ 1 & 3 & 9 & \\ 1 & -1 & 1 & \end{array}}{\begin{array}{ccc|c} -44-9+12+36+1-132 & & & -136 \\ & -34 & & -34 \end{array}} = 4$$

$$z = \frac{-44-9+12+36+1-132}{-34} = \frac{-136}{-34} = 4$$

sol:  $x = 9$     $y = 8$     $z = 4$

## EJERCICIO 191

1.  $x+2y+z=8$

Plano ABC  $x+2y+z=8$

Para  $y=0$   $z=0$   $x=8$

Para  $x=0$   $z=0$   $y=4$

Para  $x=0$   $y=0$   $z=8$

$2x+2y+z=9$

Plano DEF  $2x+2y+z=9$

Para  $y=0$   $z=0$   $x=4\frac{1}{2}$

Para  $x=0$   $z=0$   $y=4\frac{1}{2}$

Para  $x=0$   $y=0$   $z=9$

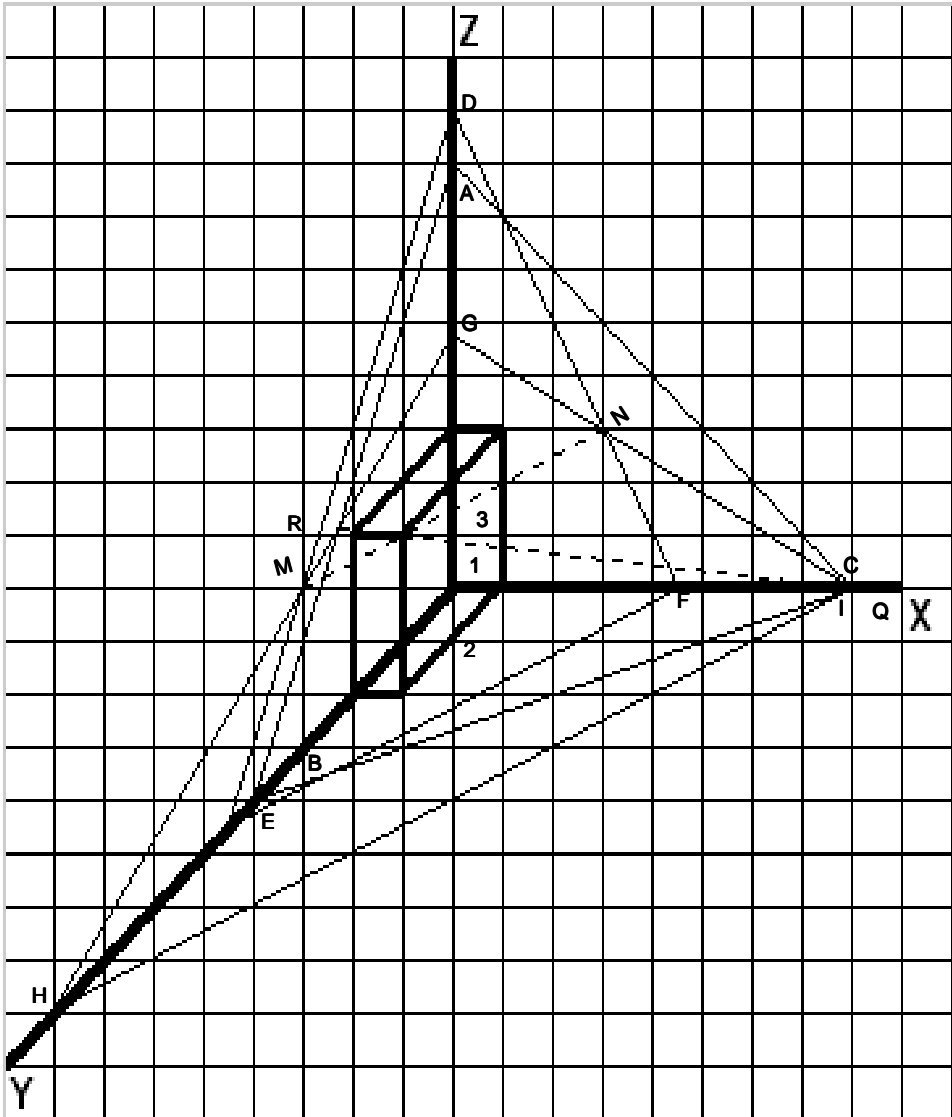
$3x+3y+5z=24$

Plano GHI  $3x+3y+5z=24$

Para  $y=0$   $z=0$   $x=8$

Para  $x=0$   $z=0$   $y=8$

Para  $x=0$   $y=0$   $z=4\frac{4}{5}$



Sol:  $x = 1$   $y = 2$   $z = 3$



2.  $x+y+z=5$

Plano ABC  $x+y+z=5$

Para  $y=0$   $z=0$   $x=5$

Para  $x=0$   $z=0$   $y=5$

Para  $x=0$   $y=0$   $z=5$

$3x+2y+z=8$

Plano DEF  $3x+2y+z=8$

Para  $y=0$   $z=0$   $x=2\frac{2}{3}$

Para  $x=0$   $z=0$   $y=4$

Para  $x=0$   $y=0$   $z=8$

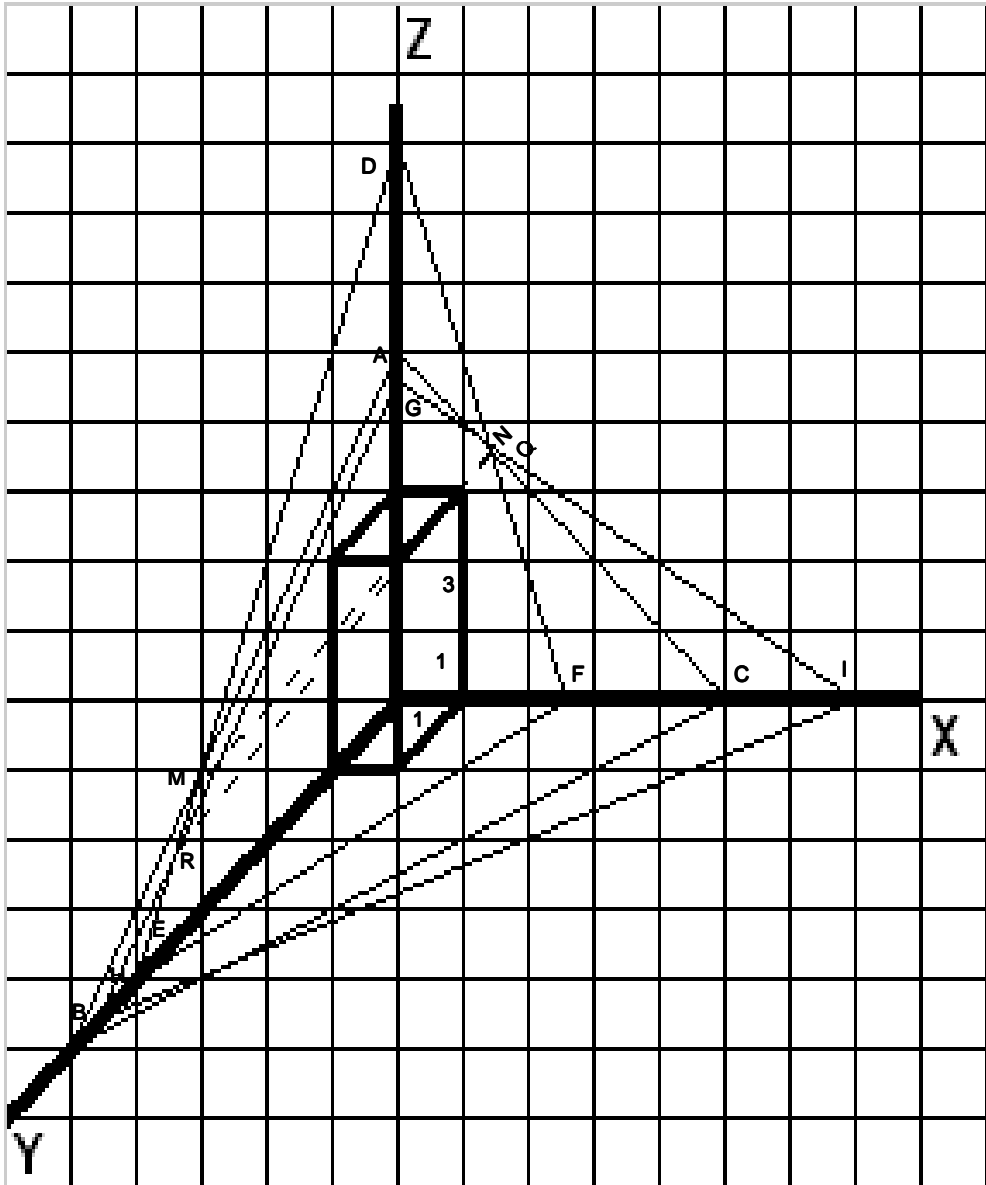
$2x+3y+3z=14$

Plano GHI  $2x+3y+3z=14$

Para  $y=0$   $z=0$   $x=7$

Para  $x=0$   $z=0$   $y=4\frac{2}{3}$

Para  $x=0$   $y=0$   $z=4\frac{2}{3}$



sol :  $x = 1$   $y = 1$   $z = 3$

3.  $2x + 2y + 3z = 23$

$2x + 3y + 2z = 20$

$4x + 3y + 2z = 24$

Plano ABC  $2x + 2y + 3z = 23$

Plano DEF  $2x + 3y + 2z = 20$

Plano GHI  $4x + 3y + 2z = 24$

Para  $y=0$   $z=0$   $x=11\frac{1}{2}$

Para  $y=0$   $z=0$   $x=10$

Para  $y=0$   $z=0$   $x=6$

Para  $x=0$   $z=0$   $y=11\frac{1}{2}$

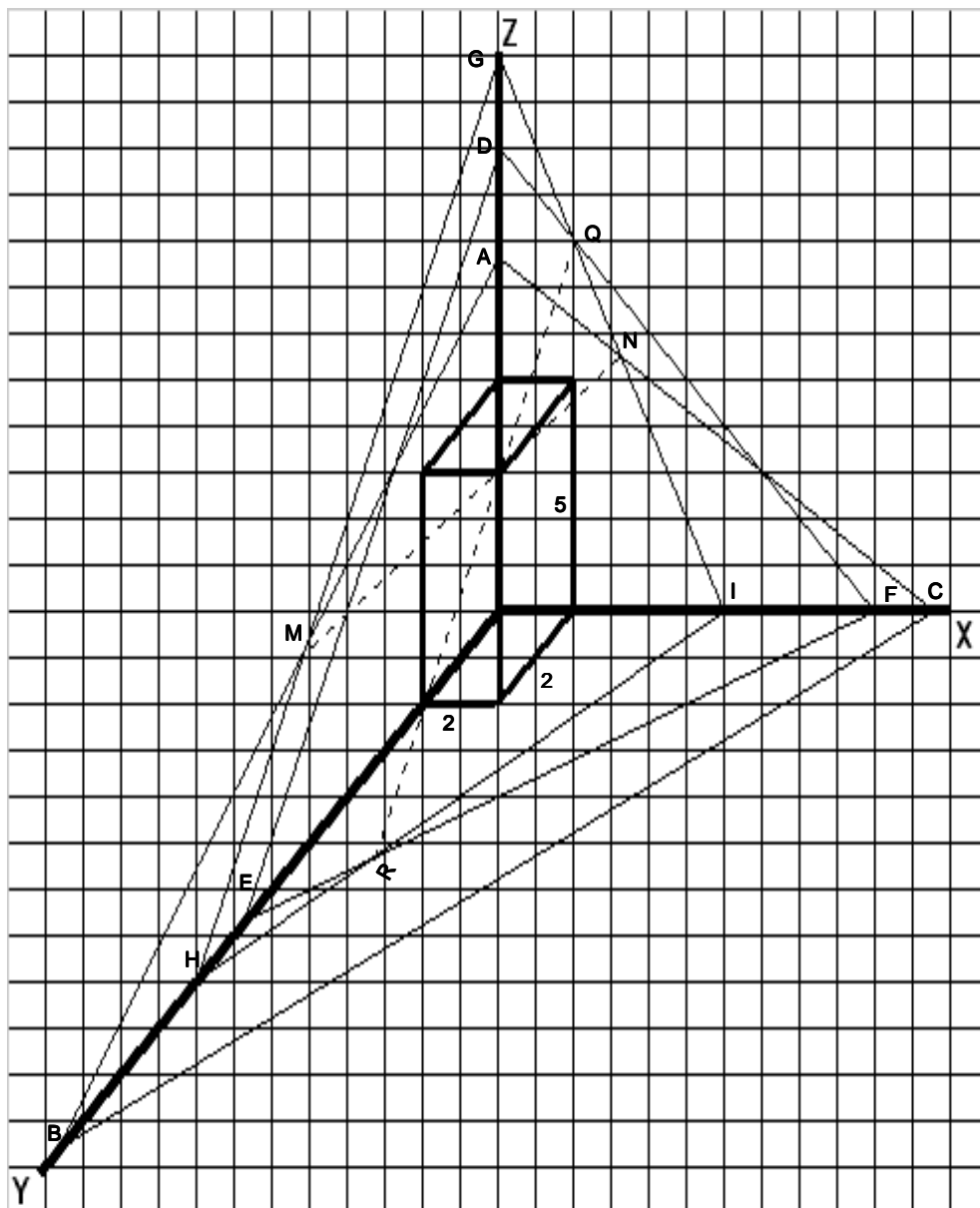
Para  $x=0$   $z=0$   $y=6\frac{2}{3}$

Para  $x=0$   $z=0$   $y=8$

Para  $x=0$   $y=0$   $z=7\frac{2}{3}$

Para  $x=0$   $y=0$   $z=10$

Para  $x=0$   $y=0$   $z=12$



sol :  $x = 2$     $y = 2$     $z = 5$



5.  $3x+4y+5z=35$

Plano ABC  $3x+4y+5z=35$

Para  $y=0$   $z=0$   $x=11\frac{2}{3}$

Para  $x=0$   $z=0$   $y=8\frac{3}{4}$

Para  $x=0$   $y=0$   $z=7$

$2x+5y+3z=27$

Plano DEF  $2x+5y+3z=27$

Para  $y=0$   $z=0$   $x=13\frac{1}{2}$

Para  $x=0$   $z=0$   $y=5\frac{2}{5}$

Para  $x=0$   $y=0$   $z=9$

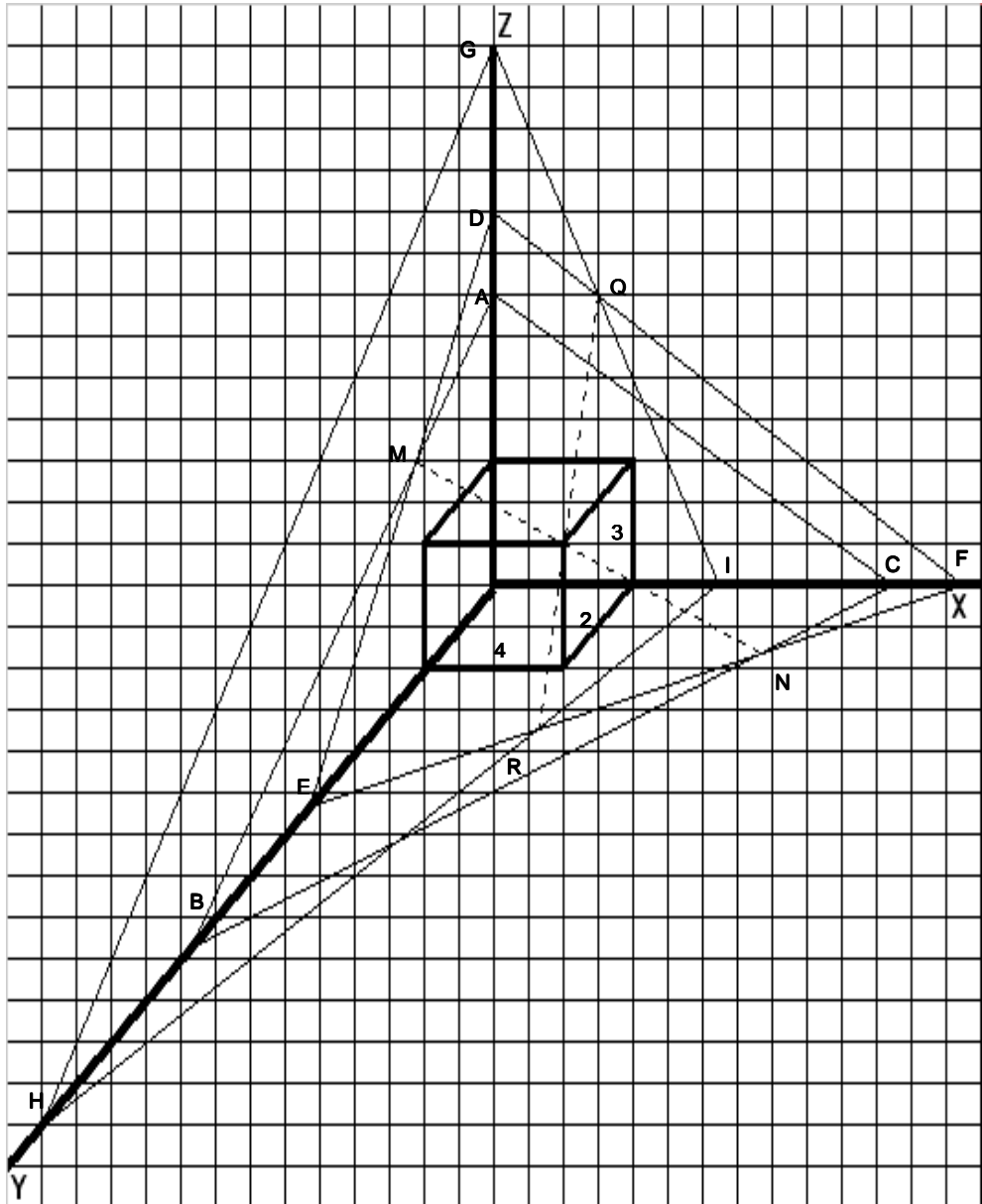
$2x+y+z=13$

Plano GHI  $2x+y+z=13$

Para  $y=0$   $z=0$   $x=6\frac{1}{2}$

Para  $x=0$   $z=0$   $y=13$

Para  $x=0$   $y=0$   $z=13$



sol:  $x=4$   $y=2$   $z=3$

6.  $4x+3y+5z=42$

Plano ABC  $4x+3y+5z=42$

Para  $y=0$   $z=0$   $x=10\frac{1}{2}$

Para  $x=0$   $z=0$   $y=14$

Para  $x=0$   $y=0$   $z=8\frac{2}{5}$

$3x+4y+3z=33$

Plano DEF  $3x+4y+3z=33$

Para  $y=0$   $z=0$   $x=11$

Para  $x=0$   $z=0$   $y=8\frac{1}{4}$

Para  $x=0$   $y=0$   $z=11$

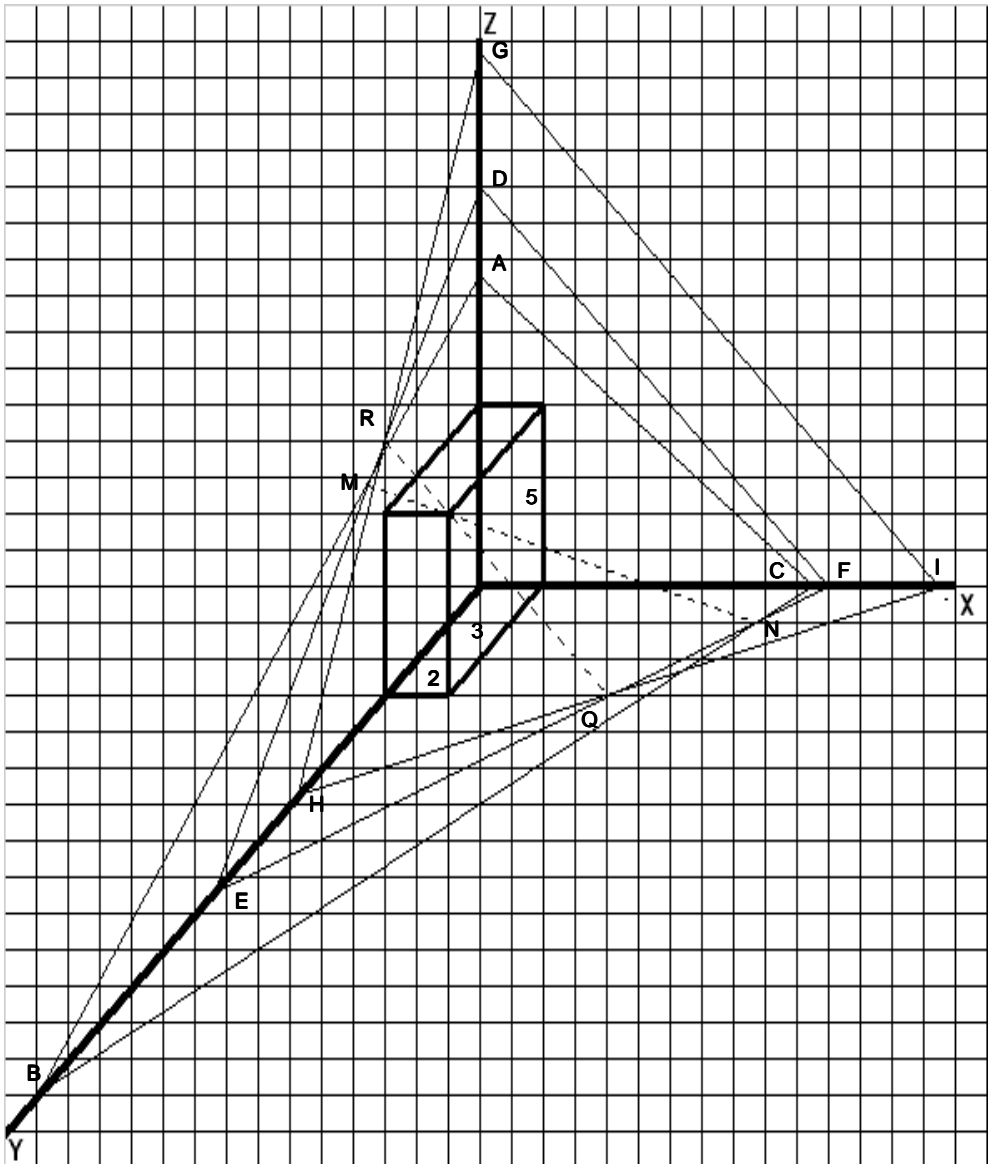
$2x+5y+2z=29$

Plano GHI  $2x+5y+2z=29$

Para  $y=0$   $z=0$   $x=14\frac{1}{2}$

Para  $x=0$   $z=0$   $y=5\frac{4}{5}$

Para  $x=0$   $y=0$   $z=14\frac{1}{2}$



sol:  $x=2$   $y=3$   $z=5$

5.  $x \rightarrow$  Cifra decenas  
 $y \rightarrow$  Cifra unidades

$$\frac{10x+y-17}{x+y}=5$$

$$10x+y-17=5(x+y)$$

$$5x-4y=17$$

$$\frac{10x+y-2}{y-2}=19$$

$$10x+y-2=19(y-2)$$

$$10x-18y=-36$$

$$5x-9y=-18$$

$$5x-4y=17$$

$$5x-9y=-18 \quad (-1)$$

$$5x-4y=17$$

$$-5x+9y=18$$

$$5y=35 \Rightarrow y=7$$

$$5x-4(7)=17$$

$$5x-28=17$$

$$5x=45 \Rightarrow x=9 \quad \text{sol: } 97$$

6.  $x \rightarrow$  Cifra decenas  
 $y \rightarrow$  Cifra unidades

$$10x+y+9=10y+x$$

$$9x-9y=-9$$

$$x-y=-1$$

$$\frac{10y+x-1}{7}=6$$

$$x+10y=43$$

$$x-y=-1 \quad (-1)$$

$$x+10y=43$$

$$-x+y=1$$

$$x+10y=43$$

$$11y=44 \Rightarrow y=4$$

$$x-4=-1 \Rightarrow x=3 \quad \text{sol: } 34$$

7.  $x \rightarrow$  Cifra decenas  
 $y \rightarrow$  Cifra unidades

$$x+y=9$$

$$10(x+1)+y-1=10y+x$$

$$10x+10+y-1=10y+x$$

$$9x-9y=-9$$

$$x-y=-1$$

$$x+y=9$$

$$x-y=-1$$

$$2x=8 \Rightarrow x=4$$

$$4+y=9 \Rightarrow y=5 \quad \text{sol: } 45$$

## EJERCICIO 199

1.  $x \rightarrow$  Monedas de 20 cts.

$$y \rightarrow$$
 Monedas de 10 cts.

$$x+y=78 \quad (-10)$$

$$20x+10y=1.130$$

$$-10x-10y=-780$$

$$20x+10y=1.130$$

$$10x=350$$

$$x=35$$

$$35+y=78$$

$$y=43$$

$$\text{sol: } 35 \text{ Mon. de 20 cts.}$$

$$43 \text{ Mon. de 10 cts.}$$

2.  $x \rightarrow$  Monedas de \$5

$$y \rightarrow$$
 Monedas de \$4

$$x+y=91 \quad (-4)$$

$$5x+4y=404$$

$$-4x-4y=-364$$

$$5x+4y=404$$

$$x=40$$

$$40+y=91$$

$$y=51$$

$$\text{sol: } 40 \text{ Mon. de } \$5$$

$$51 \text{ Mon. de } \$4$$

3.  $x \rightarrow$  N° de adultos

$$y \rightarrow$$
 N° de niños

$$x+y=700 \quad (-15)$$

$$40x+15y=18.000$$

$$-15x-15y=-10.500$$

$$40x+15y=18.000$$

$$25x=7.500$$

$$x=300$$

$$300+y=700$$

$$y=400$$

$$\text{sol: } 300 \text{ adultos y } 400 \text{ niños}$$

4.  $x \rightarrow$  Monedas de 20 cts.

$$y \rightarrow$$
 Monedas de 25 cts.

$$x+y=44 \quad (-20)$$

$$20x+25y=995$$

$$-20x-20y=-880$$

$$20x+25y=995$$

**Continúa**

4. Continuación

$$5y=115$$

$$y=23$$

$$x+23=44$$

$$x=21$$

$$\text{sol: } 21 \text{ Monedas de 20 cts.}$$

$$23 \text{ Monedas de 25 cts.}$$

5.  $x \rightarrow$  Billetes de \$1

$$y \rightarrow$$
 Billetes de \$2

$$x+y=287 \quad (-1)$$

$$x+2y=419$$

$$-x-y=-287$$

$$x+2y=419$$

$$y=132$$

$$x+132=287$$

$$x=155$$

$$\text{sol: } 155 \text{ Billetes de } \$1$$

$$132 \text{ Billetes de } \$2$$

6.  $x \rightarrow$  Libros de 3 col.

$$y \rightarrow$$
 Libros de 7 col.

$$x+y=34 \quad (-3)$$

$$3x+7y=174$$

$$-3x-3y=-102$$

$$3x+7y=174$$

$$4y=72$$

$$y=18$$

$$x+18=34$$

$$x=16$$

$$\text{sol: } 16 \text{ libros de 3 col.}$$

$$18 \text{ libros de 7 col.}$$

7.  $x \rightarrow$  N° de trajes

$$y \rightarrow$$
 N° de sombreros

$$x+y=54 \quad (-45)$$

$$375x+45y=6.720$$

$$-45x-45y=-2.430$$

$$375x+45y=6.720$$

$$330x=4.290$$

$$x=13$$

$$13+y=54 \Rightarrow y=41$$

$$\text{sol: } 13 \text{ trajes}$$

$$41 \text{ sombreros}$$

## EJERCICIO 200

1.  $A - 1 = B + 1$

$$A - B = 2$$

$$A + 1 = 3(B - 1)$$

$$A - 3B = -4$$

$$A - B = 2 \quad (-1)$$

$$\underline{A - 3B = -4}$$

$$-A + B = -2$$

$$\underline{A - 3B = -4}$$

$$-2B = -6$$

$$B = 3$$

$$A - 3 = 2$$

$$A = 5$$

sol:  $A \rightarrow \$5$   $B \rightarrow \$3$

2.  $B - 2 = A + 2$

$$A - B = -4$$

$$2(A - 2) = B + 2$$

$$2A - B = 6$$

$$A - B = -4 \quad (-1)$$

$$\underline{2A - B = 6}$$

$$-A + B = 4$$

$$\underline{2A - B = 6}$$

$$A = 10$$

$$10 - B = -4$$

$$-B = -14$$

$$B = 14$$

sol:  $A \rightarrow 10$  soles

$B \rightarrow 14$  soles

3.  $P \rightarrow$  Pedro

$J \rightarrow$  Juan

$$P - 3 = J + 3$$

$$P - J = 6$$

$$4(J - 3) = P + 3$$

$$P - 4J = -15$$

$$P - J = 6 \quad (-1)$$

$$\underline{P - 4J = -15}$$

$$-P + J = -6$$

$$\underline{P - 4J = -15}$$

$$-3J = -21$$

$$J = 7$$

$$P - 7 = 6 \Rightarrow P = 13$$

sol: Pedro  $\rightarrow$  \$13

Juan  $\rightarrow$  \$7

4.  $A - 10 = 2(B - 10)$

$$A - 2B = -10$$

$$\frac{3}{4}(A + 10) = B + 10$$

$$3(A + 10) = 4(B + 10)$$

$$3A - 4B = 10$$

$$A - 2B = -10 \quad (-2)$$

$$\underline{3A - 4B = 10}$$

$$-2A + 4B = 20$$

$$\underline{3A - 4B = 10}$$

$$A = 30$$

$$30 - 2B = -10$$

$$-2B = -40$$

$$B = 20$$

sol:  $A \rightarrow 30$  Años

$B \rightarrow 20$  Años

5.  $A - 6 = 2(B - 6)$

$$A - 2B = -6$$

$$A + 6 = \frac{8}{5}(B + 6)$$

$$5(A + 6) = 8(B + 6)$$

$$5A - 8B = 18$$

$$A - 2B = -6 \quad (-4)$$

$$\underline{5A - 8B = 18}$$

$$-4A + 8B = 24$$

$$\underline{5A - 8B = 18}$$

$$A = 42$$

$$42 - 2B = -6$$

$$-2B = -48$$

$$B = 24$$

sol:  $A \rightarrow 42$  Años

$B \rightarrow 24$  Años

6.  $A - 5 = \frac{3}{2}(B - 5)$

$$2(A - 5) = 3(B - 5)$$

$$2A - 3B = -5$$

$$\frac{7}{9}(A + 10) = B + 10$$

$$7(A + 10) = 9(B + 10)$$

$$7A - 9B = 20$$

$$2A - 3B = -5 \quad (-3)$$

$$\underline{7A - 9B = 20}$$

**Continúa**

## 6. Continuación

$$-6A + 9B = 15$$

$$\underline{7A - 9B = 20}$$

$$A = 35$$

$$2(35) - 3B = -5$$

$$70 - 3B = -5$$

$$B = 25$$

sol:  $A \rightarrow 35$  Años

$B \rightarrow 25$  Años

7.  $x \rightarrow$  Edad Hombre

$y \rightarrow$  Edad Esposa

$$x = \frac{9y}{5}$$

$$\frac{3}{5}(x + 4) = y + 4$$

$$3x + 12 = 5y + 20$$

$$3x - 5y = 8$$

$$5x - 9y = 0 \quad (3)$$

$$\underline{3x - 5y = 8 \quad (-5)}$$

$$15x - 27y = 0$$

$$\underline{-15x + 25y = -40}$$

$$y = 20$$

$$x = \frac{9}{5}(20)$$

$$x = 9(4)$$

$$x = 36$$

sol: 36 Años  $\rightarrow$  tiene el hombre

20 Años  $\rightarrow$  tiene la esposa

8.  $A - 25 = B + 25$

$$A - B = 50$$

$$\frac{5}{17}(A + 35) = B - 35$$

$$5A + 175 = 17B - 595$$

$$5A - 17B = -770$$

$$A - B = 50 \quad (-5)$$

$$\underline{5A - 17B = -770}$$

$$-5A + 5B = -250$$

$$\underline{5A - 17B = -770}$$

$$-12B = -1.020$$

$$B = 85$$

$$A - 85 = 50$$

$$A = 135$$

sol:  $A \rightarrow 135$  Lempiras

$B \rightarrow 85$  Lempiras

9.  $x \rightarrow$  Edad padre

$y \rightarrow$  Edad hijo

$$\frac{1}{5}(x-6) = y-6$$

$$x-6 = 5y-30$$

$$x-5y = -24$$

$$\frac{2}{5}(x+9) = y+9$$

$$2x+18 = 5y+45$$

$$2x-5y = 27$$

$$x-5y = -24 \quad (-1)$$

$$2x-5y = 27$$

$$-x+5y = 24$$

$$2x-5y = 27$$

$$x = 51$$

$$51-5y = -24$$

$$-5y = -75$$

$$y = 15$$

sol: 51 Años  $\rightarrow$  Edad padre

15 Años  $\rightarrow$  Edad hijo

10.  $P+15=5(J-15)$

$$P-5J = -90$$

$$3(P-20) = J+20$$

$$3P-J = 80$$

$$P-5J = -90 \quad (-3)$$

$$3P-J = 80$$

$$-3P+15J = 270$$

$$3P-J = 80$$

$$14J = 350$$

$$J = 25$$

$$3P-25 = 80$$

$$3P = 105$$

$$P = 35$$

sol: 35 cts.  $\rightarrow$  tenia Pedro

25 cts.  $\rightarrow$  tenia Juan

11.  $A + \frac{B}{2} + 60 = 4\left(B - \frac{B}{2} - 60\right)$

$$2A + B + 120 = 8B - 4B - 480$$

$$2A + B + 120 = 4B - 480$$

$$2A - 3B = -600$$

$$B + 80 - 310 = A - 80$$

$$B - 230 = A - 80$$

$$A - B = -150$$

$$2A - 3B = -600$$

$$A - B = -150 \quad (-2)$$

$$2A - 3B = -600$$

$$-2A + 2B = 300$$

$$B = 300$$

$$A - 300 = -150$$

$$A = 150 \text{ cts.}$$

sol: \$1,50  $\rightarrow$  tiene A

\$3  $\rightarrow$  tiene B

12.  $x \rightarrow$  Edad de Enrique

$y \rightarrow$  Edad hermana

$$x-6 = \frac{3}{2}(y-6)$$

$$2x-12 = 3y-18$$

$$2x-3y = -6$$

$$4(x+6) = 5(y+6)$$

$$4x+24 = 5y+30$$

$$4x-5y = 6$$

$$2x-3y = -6 \quad (-2)$$

$$4x-5y = 6$$

$$-4x+6y = 12$$

$$4x-5y = 6$$

$$y = 18$$

$$2x-3(18) = -6$$

$$2x-54 = -6$$

$$2x = 48$$

$$x = 24$$

sol: 24 Añ.  $\rightarrow$  Ed. Enrique

18 Añ.  $\rightarrow$  Ed. herm.

## EJERCICIO 201

1.  $x \rightarrow$  Veloc. bote agua tranq.

$y \rightarrow$  Veloc. del rio

$x+y \rightarrow$  Veloc. bote a favor  
del agua

$x-y \rightarrow$  Veloc. bote contra  
la corriente

$$\frac{10}{x+y} = 1$$

$$x+y = 10$$

$$\frac{4}{x-y} = 1$$

$$x-y = 4$$

$$x+y = 10$$

$$x-y = 4$$

$$2x = 14$$

$$x = 7$$

$$7-y = 4$$

$$y = 3$$

sol:  $7 \text{ Km/h} \rightarrow$  Veloc.

bote agua tranq.

$3 \text{ Km/h} \rightarrow$  Veloc. del rio

2.  $x \rightarrow$  Veloc. bote agua tranq.

$y \rightarrow$  Veloc. del rio

$x+y \rightarrow$  Veloc. bote a favor  
del agua

$x-y \rightarrow$  Veloc. bote contra  
agua

$$\frac{28}{x+y} = \frac{7}{4}$$

$$7x+7y = 112$$

$$x+y = 16$$

$$\frac{24}{x-y} = 3$$

$$3x-3y = 24$$

$$x-y = 8$$

$$x+y = 16$$

$$x-y = 8$$

$$2x = 24$$

$$x = 12$$

$$12-y = 8$$

$$y = 4$$

sol:  $12 \text{ Km/h} \rightarrow$  Bote

$4 \text{ Km/h} \rightarrow$  Rio

3.  $x \rightarrow$  Tiempo ida

$y \rightarrow$  Tiempo vuelta

$$x+y = 5$$

$$\frac{8}{x} = \frac{12}{y}$$

$$12x-8y = 0$$

$$x+y = 5 \quad (8)$$

$$12x-8y = 0$$

$$8x+8y = 40$$

$$20x = 40$$

$$x = 2$$

$$12(2)-8y = 0$$

$$-8y = -24$$

$$y = 3$$

sol:  $2h \rightarrow$  Tiempo ida

$3h \rightarrow$  Tiempo vuelta



4.  $x \rightarrow$  Veloc. bote agua tranq.  
 $y \rightarrow$  Veloc. rio  
 $x+y \rightarrow$  Veloc. bote a favor  
 de la cte  
 $x-y \rightarrow$  Veloc. bote en contra  
 de la cte

$$\frac{40}{x+y} = \frac{5}{2}$$

$$5x+5y=80$$

$$x+y=16$$

$$\frac{40}{x-y} = 5$$

$$5x-5y=40$$

$$x-y=8$$

$$x+y=16$$

$$x-y=8$$

$$2x = 24 \Rightarrow x=12$$

$$12-y=8 \Rightarrow y=4$$

sol: 12h  $\rightarrow$  Veloc. bote

4h  $\rightarrow$  Veloc. rio

5.  $x \rightarrow$  tiempo ida  
 $y \rightarrow$  tiempo vuelta  
 $x+y=6$

$$\frac{20}{x} = \frac{40}{y}$$

$$40x-20y=0$$

$$2x-y=0$$

$$x+y=6$$

$$2x-y=0$$

$$3x = 6 \Rightarrow x=2$$

$$2(2)-y=0$$

$$-y=-4 \Rightarrow y=4$$

sol: 2h  $\rightarrow$  tiempo ida

4h  $\rightarrow$  tiempo vuelta

6.  $x \rightarrow$  tiempo ida  
 $y \rightarrow$  tiempo vuelta

$$x+y=5$$

$$\frac{8}{x} = \frac{12}{y}$$

$$12x-8y=0$$

$$3x-2y=0$$

$$x+y=5 \quad (2)$$

$$3x-2y=0$$

$$2x+2y=10$$

$$3x-2y=0$$

$$5x = 10$$

$$x=2$$

$$2+y=5$$

$$y=3$$

sol: 2h  $\rightarrow$  tiempo ida

3h  $\rightarrow$  tiempo vuelta

Entonces

$$\frac{32\text{Km}}{2h} = 16\text{Km}/h \rightarrow \text{Veloc. rio abajo}$$

$$\frac{12\text{Km}}{3h} = 4\text{Km}/h \rightarrow \text{Veloc. rio arriba}$$

Luego

$x \rightarrow$  Veloc. bote

$y \rightarrow$  Veloc. rio

$$x+y=16$$

$$x-y=4$$

$$2x = 20$$

$$x=10$$

$$10+y=16$$

$$y=6$$

sol: 10 Km/h  $\rightarrow$  Veloc. bote

6 Km/h  $\rightarrow$  Veloc. rio

2.  $x \rightarrow$  Precio kilo azúcar  
 $y \rightarrow$  Precio kilo café  
 $z \rightarrow$  Precio kilo fríjoles

$$5x+3y+4z=1,18$$

$$4x+5y+3z=1,45$$

$$2x+y+2z=0,46$$

$$5x+3y+4z=1,18 \quad (-3)$$

$$4x+5y+3z=1,45 \quad (4)$$

**Continúa**

2. Continuación  
 $-15x-9y-12z=-3,54$

$$16x+20y+12z=5,80$$

$$x+11y = 2,26$$

$$4x+5y+3z=1,45 \quad (2)$$

$$2x+y+2z=0,46 \quad (-3)$$

$$8x+10y+6z=2,90$$

$$-6x-3y-6z=-1,38$$

**Continúa**

2. Continuación  
 $2x+7y = 1,52$

$$x+11y = 2,26 \quad (-2)$$

$$2x+7y = 1,52$$

$$-2x-22y = -4,52$$

$$2x+7y = 1,52$$

$$-15y = -3$$

$$y = \frac{1}{5}$$

$$y = 0,2$$

**Continúa**

## EJERCICIO 202

1.  $x \rightarrow$  N° mayor

$y \rightarrow$  N° medio

$z \rightarrow$  N° menor

$$z-1 = \frac{x+y}{3}$$

$$3z-3 = x+y$$

$$x+y-3z = -3$$

$$x+y+z = 37$$

$$y-z = x-13$$

$$x-y+z = 13$$

$$x+y+z = 37 \quad (-1)$$

$$x+y-3z = -3$$

$$-x-y-z = -37$$

$$x+y-3z = -3$$

$$-4z = -40$$

$$z = 10$$

$$x+y+z = 37$$

$$x-y+z = 13$$

$$2x + 2z = 50$$

$$2x + 2(10) = 50$$

$$2x = 30$$

$$x = 15$$

$$15 + y + 10 = 37$$

$$y + 25 = 37$$

$$y = 12$$

sol: 15, 12, 10

## 2. Continuación

$$2x+7(0,2)=1,52$$

$$2x+1,4=1,52$$

$$2x=0,12$$

$$x=0,06$$

$$2(0,06)+0,2+2z=0,46$$

$$0,12+0,2+2z=0,46$$

$$2z=0,14$$

$$z=0,07$$

sol: 6 cts.  $\rightarrow$  Kilo Az.

20 cts.  $\rightarrow$  Kilo café

7 cts.  $\rightarrow$  Kilo fríjoles

3.  $x \rightarrow$  Cifra centenas

$y \rightarrow$  Cifra decenas

$z \rightarrow$  Cifra unidades

$$x + y + z = 15$$

$$x + y = \frac{3z}{2}$$

$$2x + 2y = 3z$$

$$2x + 2y - 3z = 0$$

$$100x + 10y + z - 99 = 100z + 10y + x$$

$$99x - 99z = 99$$

$$x - z = 1$$

$$x + y + z = 15 \quad (-2)$$

$$2x + 2y - 3z = 0$$

$$-2x - 2y - 2z = -30$$

$$\frac{2x + 2y - 3z = 0}{-2x - 2y - 2z = -30}$$

$$-5z = -30$$

$$z = 6$$

$$x - 6 = 1$$

$$x = 7$$

$$7 + y + 6 = 15$$

$$y + 13 = 15$$

$$y = 2 \quad \text{sol: } 726$$

4.  $x \rightarrow$  N° mayor

$y \rightarrow$  N° medio

$z \rightarrow$  N° menor

$$x + y + z = 127$$

$$\frac{z}{2} + \frac{y}{3} + \frac{x}{9} = 39$$

$$2x + 6y + 9z = 702$$

$$x - 4 = \frac{y + z}{2}$$

$$2x - 8 = y + z$$

$$2x - y - z = 8$$

$$x + y + z = 127$$

$$2x - y - z = 8$$

$$3x = 135$$

$$x = 45$$

$$2x + 6y + 9z = 702$$

$$2x - y - z = 8 \quad (9)$$

$$2x + 6y + 9z = 702$$

$$18x - 9y - 9z = 72$$

$$20x - 3y = 774$$

Continúa

4. Continuación

$$20(45) - 3y = 774$$

$$900 - 3y = 774$$

$$-3y = -126$$

$$y = 42$$

$$45 + 42 + z = 127$$

$$z = 40$$

$$\text{sol: } 45, 42, 40$$

5.  $x \rightarrow$  Cifra centenas

$y \rightarrow$  Cifra decenas

$z \rightarrow$  Cifra unidades

$$x + y + z = 6$$

$$\frac{100x + 10y + z}{x + y} = 41$$

$$100x + 10y + z = 41x + 41y$$

$$59x - 31y + z = 0$$

$$100x + 10y + z + 198 = 100z + 10y + x$$

$$99x - 99z = -198$$

$$x - z = -2$$

$$x + y + z = 6 \quad (31)$$

$$59x - 31y + z = 0$$

$$31x + 31y + 31z = 186$$

$$59x - 31y + z = 0$$

$$90x + 32z = 186$$

$$45x + 16z = 93$$

$$x - z = -2 \quad (-45)$$

$$45x + 16z = 93$$

$$-45x + 45z = 90$$

$$45x + 16z = 93$$

$$61z = 183$$

$$z = 3$$

$$x - 3 = -2$$

$$x = 1$$

$$1 + y + 3 = 6$$

$$y + 4 = 6$$

$$y = 2 \quad \text{sol: } 123$$

6.  $x \rightarrow$  Angulo mayor

$y \rightarrow$  Angulo medio

$z \rightarrow$  Angulo menor

$$x + y + z = 180$$

$$x - 35 = z$$

$$x - z = 35$$

Continúa

6. Continuación

$$z - 20 = x - y$$

$$x - y - z = -20$$

$$x + y + z = 180$$

$$\frac{x - y - z = -20}{x + y + z = 180}$$

$$2x = 160$$

$$x = 80$$

$$80 - z = 35$$

$$z = 45$$

$$80 + y + 45 = 180$$

$$y + 125 = 180$$

$$y = 55$$

$$\text{sol: } 80^\circ, 55^\circ, 45^\circ$$

7.  $x \rightarrow$  N° de vacas

$y \rightarrow$  N° de caballos

$z \rightarrow$  N° de terneros

$$x + y + z = 110$$

$$\frac{x}{8} + \frac{y}{9} + \frac{z}{5} = 15$$

$$45x + 40y + 72z = 5.400$$

$$z + x = 65$$

$$x + y + z = 110$$

$$\frac{x + z = 65 \quad (-1)}{x + y + z = 110}$$

$$-x - z = -65$$

$$y = 45$$

$$-x - z = -65$$

$$y = 45$$

$$45x + 40y + 72z = 5.400$$

$$\frac{x + z = 65 \quad (-45)}{45x + 40y + 72z = 5.400}$$

$$-45x - 45z = -2.925$$

$$40y + 27z = 2.475$$

$$40(45) + 27z = 2.475$$

$$1.800 + 27z = 2.475$$

$$27z = 675$$

$$z = 25$$

$$x + 45 + 25 = 110$$

$$x + 70 = 110$$

$$x = 40$$

$$\text{sol: } 40 \text{ vacas;}$$

$$45 \text{ caballos;}$$

$$25 \text{ terneros}$$

8.  $x \rightarrow$  Cifra centenas

$y \rightarrow$  Cifra decenas

$z \rightarrow$  Cifra unidades

$$x + y + z = 10$$

$$x + y - 4 = z$$

$$x + y - z = 4$$

$$x + z - 6 = y$$

$$x - y + z = 6$$

$$x + y + z = 10$$

$$x + y - z = 4 \quad (-1)$$

$$x + y + z = 10$$

$$-x - y + z = -4$$

$$2z = 6$$

$$z = 3$$

$$x + y + z = 10$$

$$x - y + z = 6$$

$$2x + 2z = 16$$

$$x + z = 8$$

$$x + 3 = 8$$

$$x = 5$$

$$5 + y + 3 = 10$$

$$y = 2 \quad \text{sol: } 523$$

9.  $x \rightarrow$  Angulo mayor

$y \rightarrow$  Angulo medio

$z \rightarrow$  Angulo menor

$$x + y + z = 180$$

$$x + y = 135$$

$$y + z = 110$$

$$x + y + z = 180$$

$$y + z = 110 \quad (-1)$$

$$x + y + z = 180$$

$$-y - z = -110$$

$$x = 70$$

$$70 + y = 135$$

$$y = 65$$

$$70 + 65 + z = 180$$

$$135 + z = 180$$

$$z = 45$$

$$\text{sol: } 70^\circ, 65^\circ, 45^\circ$$

10.  $A + B + C = 140$

$$C = \frac{A}{2}$$

$$A - 2C = 0$$

$$A - 10 = B$$

$$A - B = 10$$

$$A + B + C = 140$$

$$\frac{A - B}{2A} = \frac{10}{150}$$

$$2A + C = 150 \quad (2)$$

$$\frac{A - 2C}{2A + C} = \frac{0}{150}$$

$$4A + 2C = 300$$

$$\frac{A - 2C}{4A + 2C} = \frac{0}{300}$$

$$5A = 300$$

$$A = 60$$

$$2(60) + C = 150$$

$$C = 30$$

$$60 + B + 30 = 140$$

$$B = 50$$

$$\text{sol: } A \rightarrow 60\text{bs. } B \rightarrow 50\text{bs.}$$

$$C \rightarrow 30\text{bs.}$$

11.  $A - 1 = C + 1$

$$A - C = 2$$

$$B - 1 = C$$

$$B - C = 1$$

$$A + 5 = 2C$$

$$A - 2C = -5$$

$$A - C = 2$$

$$\frac{B - C}{A - C} = \frac{1}{2}$$

$$A + B - 2C = 3$$

$$A + B - 2C = 3$$

$$\frac{A - 2C}{A + B - 2C} = \frac{-5}{3} \quad (-1)$$

$$A + B - 2C = 3$$

$$-A + 2C = 5$$

$$B = 8$$

$$8 - C = 1$$

$$C = 7$$

$$A - 7 = 2$$

$$A = 9$$

$$\text{sol: } A \rightarrow \$9$$

$$B \rightarrow \$8 \quad C \rightarrow \$7$$

12.  $x + y + z = 6$

$$100z + 10y + x = \frac{41(100x + 10y + z)}{107}$$

$$10.700z + 1.070y + 107x = 4.100x + 410y + 41z$$

$$3.993x - 660y - 10.659z = 0$$

$$1.331x - 220y - 3.553z = 0$$

$$100x = 300$$

$$x = 3$$

$$1.331x - 220y - 3.553z = 0$$

$$\frac{x + y + z}{1.331x - 220y - 3.553z} = \frac{6}{0} \quad (220)$$

$$1.331x - 220y - 3.553z = 0$$

$$\frac{220x + 220y + 220z}{1.331x - 220y - 3.553z} = \frac{1.320}{0}$$

$$1.551x - 3.333z = 1.320$$

$$1.551(3) - 3.333z = 1.320$$

$$4.653 - 3.333z = 1.320$$

$$z = 1$$

$$3 + y + 1 = 6$$

$$y + 4 = 6$$

$$y = 2$$

$$\text{sol: } 321$$

13.  $A - 2 = B + 2$

$$A - B = 4$$

$$B - 1 = C + 1$$

$$B - C = 2$$

$$A = \frac{8}{5}C$$

$$5A - 8C = 0$$

$$A - B = 4$$

$$\frac{B - C}{A - B} = \frac{2}{4}$$

$$A - C = 6$$

$$A - C = 6 \quad (-8)$$

$$5A - 8C = 0$$

$$-8A + 8C = -48$$

$$5A - 8C = 0$$

$$-3A = -48$$

$$A = 16$$

$$16 - B = 4$$

$$B = 12$$

$$12 - C = 2$$

$$C = 10$$

$$\text{sol: } A \rightarrow 16Q$$

$$B \rightarrow 12Q \quad C \rightarrow 10Q$$

14.  $x \rightarrow$  Cifra centena

$y \rightarrow$  Cifra decena

$z \rightarrow$  Cifra unidades

$$100x = 400$$

$$x = 4$$

$$x + y + z = 9$$

$$100z + 10y + x = \frac{16(100x + 10y + z)}{49}$$

$$4.900z + 490y + 49x = 1.600x + 160y + 16z$$

$$1.551x - 330y - 4.884z = 0$$

$$517x - 110y - 1.628z = 0$$

$$517x - 110y - 1.628z = 0$$

$$\underline{x + y + z = 9 \quad (110)}$$

$$517x - 110y - 1.628z = 0$$

$$\underline{110x + 110y + 110z = 990}$$

$$627x - 1.518z = 990$$

$$627(4) - 1.518z = 990$$

$$2.508 - 1.518z = 990$$

$$-1.518z = -1.518$$

$$z = 1$$

$$4 + y + 1 = 9$$

$$y + 5 = 9$$

$$y = 4 \quad \text{sol: } 441$$

15.  $2A + B = C + 32$

$$2A + B - C = 32$$

$$\frac{B}{3} + 2C = A + 9$$

$$B + 6C = 3A + 27$$

$$3A - B - 6C = -27$$

$$\frac{A+B}{3} = C - 1$$

$$A + B = 3C - 3$$

$$A + B - 3C = -3$$

$$2A + B - C = 32$$

$$3A - B - 6C = -27$$

$$5A - 7C = 5$$

$$3A - B - 6C = -27$$

$$\underline{A + B - 3C = -3}$$

$$4A - 9C = -30$$

$$5A - 7C = 5 \quad (-4)$$

$$\underline{4A - 9C = -30 \quad (5)}$$

$$-20A + 28C = -20$$

$$\underline{20A - 45C = -150}$$

$$-17C = -170$$

### 15. Continuación

$$C = 10$$

$$5A - 7(10) = 5$$

$$5A = 75$$

$$A = 15$$

$$2(15) + B - 10 = 32$$

$$B + 20 = 32$$

$$B = 12$$

$$\text{sol: } 15, 12, 10$$

## EJERCICIO 203

1.  $x \rightarrow$  Ancho

$y \rightarrow$  Largo

$$2(x + y) = 18$$

$$4y = 5x$$

$$5x - 4y = 0$$

$$x + y = 9 \quad (4)$$

$$\underline{5x - 4y = 0}$$

$$4x + 4y = 36$$

$$\underline{5x - 4y = 0}$$

$$9x = 36$$

$$x = 4$$

$$4 + y = 9$$

$$y = 5$$

$$\text{sol: } 5m \cdot 4m$$

2.  $A = 2B$

$$A - 2B = 0$$

$$A - 12 = B + 12$$

$$A - B = 24$$

**Continúa**

### 2. Continuación

$$A - 2B = 0$$

$$\underline{A - B = 24 \quad (-1)}$$

$$A - 2B = 0$$

$$-A + B = -24$$

$$B = 24$$

$$A - 24 = 24$$

$$A = 48$$

$$\text{sol: } A \rightarrow 48 \text{ balboas}$$

$$B \rightarrow 24 \text{ balboas}$$

### 3. $x \rightarrow$ Ancho

$y \rightarrow$  Largo

$$(x+1)(y+1) = 26 + xy$$

$$xy + x + y + 1 = 26 + xy$$

$$x + y = 25$$

$$(x+2)(y-3) = 19 + xy$$

$$xy - 3x + 2y - 6 = 19 + xy$$

$$-3x + 2y = 25$$

**Continúa**

### 3. Continuación

$$x + y = 25 \quad (3)$$

$$\underline{-3x + 2y = 25}$$

$$3x + 3y = 75$$

$$\underline{-3x + 2y = 25}$$

$$5y = 100$$

$$y = 20$$

$$x + 20 = 25$$

$$x = 5$$

$$\text{sol: } 20m \cdot 5m$$

### 4. $x \rightarrow$ Precio carro

$y \rightarrow$  Precio caballo

$z \rightarrow$  Precio arreos

$$x + y + z = 200$$

$$x + z = y + 20$$

$$x - y + z = 20$$

$$y + z = x + 40$$

$$x - y - z = -40$$

**Continúa**

### 4. Continuación

$$x + y + z = 200$$

$$\underline{x - y - z = -40}$$

$$2x = 160$$

$$x = 80$$

$$x + y + z = 200$$

$$\underline{x - y + z = 20}$$

$$2x + 2z = 220$$

$$x + z = 110$$

$$80 + z = 110$$

$$z = 30$$

$$80 + y + 30 = 200$$

$$y + 110 = 200$$

$$y = 90$$

$$\text{sol: } \$80 \rightarrow \text{Costo carro}$$

$$\$90 \rightarrow \text{Costo caballo}$$

$$\$30 \rightarrow \text{Costo arreos}$$

5.  $x \rightarrow 1^{\text{er}} \text{ Número}$

$y \rightarrow 2^{\text{o}} \text{ Número}$

$z \rightarrow 3^{\text{er}} \text{ Número}$

$$x+y=z+18$$

$$x+y-z=18$$

$$x+z-78=y$$

$$x-y+z=78$$

$$y+z=x+102$$

$$x-y-z=-102$$

$$x+y-z=18$$

$$x-y+z=78$$

$$\frac{2x}{2x} = 96$$

$$x=48$$

$$x-y+z=78$$

$$x-y-z=-102$$

$$2x-2y=-24$$

$$x-y=-12$$

$$48-y=-12$$

$$y=60$$

$$48+60-z=18$$

$$108-18=z$$

$$90=z$$

sol: 48, 60, 90

6.  $x \rightarrow \text{Cifra decenas}$

$y \rightarrow \text{Cifra unidades}$

$$x+y=6$$

$$10x+y-36=10y+x$$

$$9x-9y=36$$

$$x-y=4$$

$$x+y=6$$

$$x-y=4$$

$$2x=10$$

$$x=5$$

$$5+y=6$$

$$y=1 \quad \text{sol: } 51$$

7.  $x \rightarrow \text{Veloc. pájaro}$

$y \rightarrow \text{Veloc. viento}$

$x+y \rightarrow \text{Veloc. pájaro a favor}$

$x-y \rightarrow \text{Veloc. pájaro contra}$

$$\frac{55}{x+y}=1$$

$$x+y=55$$

$$\frac{25}{x-y}=1$$

Continúa

7. Continúa

$$x-y=25$$

$$x+y=55$$

$$2x=80$$

$$x=40$$

$$40-y=25$$

$$y=15$$

sol:  $40 \text{ Km/h} \rightarrow \text{Veloc. del pájaro tranq.}$

$15 \text{ Km/h} \rightarrow \text{Veloc. del viento}$

8.  $x \rightarrow \text{N}^{\circ} \text{ de libros}$

$y \rightarrow \text{Precio de } c/u$

$$xy=(x+5)(y-2)$$

$$xy=xy-2x+5y-10$$

$$2x-5y=-10$$

$$xy=(x-5)(y+4)$$

$$xy=xy+4x-5y-20$$

$$4x-5y=20$$

$$2x-5y=-10$$

$$\frac{4x-5y=20}{2x-5y=-10} \quad (-1)$$

$$2x-5y=-10$$

$$-4x+5y=-20$$

$$-2x=-30$$

$$x=15$$

$$2(15)-5y=-10$$

$$30-5y=-10$$

$$-5y=-40$$

$$y=8$$

sol: 15  $\rightarrow$  Libros compró

\$ 8  $\rightarrow$  costó  $c/u$

9.  $x \rightarrow \text{Precio kilo café}$

$y \rightarrow \text{Precio kilo té}$

$$7x+6y=4,8 \quad (-9)$$

$$8x+9y=6,45 \quad (6)$$

$$-63x-54y=-43,2$$

$$48x+54y=38,7$$

$$-15x=-4,5$$

$$x=0,3$$

Continúa

9. Continúa

$$7(0,3)+6y=4,8$$

$$2,1+6y=4,8$$

$$6y=2,7$$

$$y=0,45$$

sol: 30 cts.  $\rightarrow$  Costo kilo café

45 cts.  $\rightarrow$  Costo kilo té

10.  $x \rightarrow$  trajes de \$40

$y \rightarrow$  trajes de \$35

$$x+y=50 \quad (-40)$$

$$40x+35y=1.910$$

$$-40x-40y=-2.000$$

$$40x+35y=1.910$$

$$-5y=-90$$

$$y=18$$

$$x+18=50$$

$$x=32$$

sol: 32  $\rightarrow$  trajes de \$40

18  $\rightarrow$  trajes de \$35

11.  $x \rightarrow$  Numerador

$y \rightarrow$  Denominador

$$\frac{x-1}{y}=\frac{1}{3}$$

$$3x-3=y$$

$$3x-y=3$$

$$\frac{x}{y-2}=\frac{1}{2}$$

$$2x=y-2$$

$$-2x+y=2$$

$$3x-y=3$$

$$-2x+y=2$$

$$x=5$$

$$3(5)-y=3$$

$$-y=-12$$

$$y=12 \quad \text{sol: } \frac{5}{12}$$

12.  $x \rightarrow 1^{\text{a}} \text{ bolsa}$

$y \rightarrow 2^{\text{a}} \text{ bolsa}$

$$x+y=200$$

$$x-15=y+15$$

$$x-y=30$$

Continúa

**12. Continuación**

$$x+y=200$$

$$\underline{x-y=30}$$

$$2x = 230$$

$$x=115$$

$$115+y=200$$

$$y=85$$

sol: 115 soles  $\rightarrow$  1ª bolsa

85 soles  $\rightarrow$  2ª bolsa

**13.  $x \rightarrow$  Precio caballo**

$y \rightarrow$  Precio coche

$$x+20=3y$$

$$x-3y=-20$$

$$20+y=\frac{3x}{5}$$

$$3x=100+5y$$

$$3x-5y=100$$

$$\underline{x-3y=-20} \quad (-3)$$

$$3x-5y=100$$

$$-3x+9y=60$$

$$\underline{3x-5y=100}$$

$$4y=160$$

$$y=40$$

$$x-3(40)=-20$$

$$x=100$$

sol: 100 soles  $\rightarrow$  Costó el caballo

40 soles  $\rightarrow$  Costó el coche

**14.  $x \rightarrow$  Cifra decenas**

$y \rightarrow$  Cifra unidades

$$10x+y=6(x+y)$$

$$10x+y=6x+6y$$

$$4x-5y=0$$

$$10x+y-9=10y+x$$

$$9x-9y=9$$

$$x-y=1$$

$$4x-5y=0$$

$$\underline{x-y=1} \quad (-5)$$

$$4x-5y=0$$

$$-5x+5y=-5$$

$$-x = -5$$

$$x=5$$

$$5-y=1$$

$$y=4 \quad \text{sol: } 54$$

**15.  $x \rightarrow$  N° de personas**

$y \rightarrow$  Precio c/u

$$xy=(x+10)(y-5)$$

$$xy=xy-5x+10y-50$$

$$5x-10y=-50$$

$$x-2y=-10$$

$$xy=(x-6)(y+5)$$

$$xy=xy+5x-6y-30$$

$$5x-6y=30$$

$$5x-6y=30$$

$$\underline{x-2y=-10} \quad (-3)$$

$$5x-6y=30$$

$$-3x+6y=30$$

$$2x = 60$$

$$x=30$$

$$30-2y=-10$$

$$-2y=-40$$

$$y=20$$

sol: 30  $\rightarrow$  Personas

20bs.  $\rightarrow$  c/u

**16.  $A+B=1.080$** 

$$A-\frac{2A}{5}=B-\frac{B}{4}$$

$$20A-8A=20B-5B$$

$$12A-15B=0$$

$$4A-5B=0$$

$$A+B=1.080 \quad (5)$$

$$\underline{4A-5B=0}$$

$$5A+5B=5.400$$

$$\underline{4A-5B=0}$$

$$9A = 5.400$$

$$A=600$$

$$600+B=1.080$$

$$B=480$$

sol:  $A \rightarrow$  600 sucres

$B \rightarrow$  480 sucres

**17.  $x \rightarrow$  gané ayer**

$y \rightarrow$  gané hoy

$$y+10=x$$

$$y=\frac{5x}{6}$$

$$5x-6y=0$$

$$5x-6y=0$$

$$\underline{x-y=10} \quad (-6)$$

**Continúa**

**17. Continuación**

$$5x-6y=0$$

$$\underline{-6x+6y=-60}$$

$$-x = -60$$

$$x=60$$

$$60-y=10$$

$$y=50$$

sol: \$ 60  $\rightarrow$  gané ayer

\$ 50  $\rightarrow$  gané hoy

**18.  $x \rightarrow$  1º número**

$y \rightarrow$  2º número

$$\frac{x}{y}=\frac{3}{5}$$

$$\frac{x-10}{y-10}=\frac{1}{2}$$

$$5x-3y=0$$

$$\underline{2x-y=10} \quad (-3)$$

$$5x-3y=0$$

$$-6x+3y=-30$$

$$-x = -30$$

$$x=30$$

$$2(30)-y=10$$

$$60-y=10$$

$$y=50$$

sol: 30 , 50

**19.  $A+4=B-4$** 

$$A-B=-8$$

$$B+4=\frac{9}{5}(A-4)$$

$$5B+20=9A-36$$

$$9A-5B=56$$

$$A-B=-8 \quad (-5)$$

$$9A-5B=56$$

$$-5A+5B=40$$

$$\underline{9A-5B=56}$$

$$4A = 96$$

$$A=24$$

$$24-B=-8$$

$$B=32$$

sol:  $A \rightarrow$  24 lempiras

$B \rightarrow$  32 lempiras

20.  $A - 20 = 2(B - 20)$

$A - 2B = -20$

$A + 30 = \frac{9}{7}(B + 30)$

$7A + 210 = 9B + 270$

$7A - 9B = 60$

$A - 2B = -20 \quad (-7)$

$7A - 9B = 60$

$-7A + 14B = 140$

$7A - 9B = 60$

$5B = 200$

$B = 40$

$A - 2(40) = -20$

$A - 80 = -20$

$A = 60$

sol:  $A \rightarrow 60$  Años

$B \rightarrow 40$  Años

21.  $x \rightarrow$  tiempo ida

$y \rightarrow$  tiempo vuelta

$x + y = 3$

$\frac{4}{x} = \frac{8}{y}$

$8x - 4y = 0$

$2x - y = 0$

$x + y = 3$

$2x - y = 0$

$3x = 3$

$x = 1$

$1 + y = 3$

$y = 2$

Si  $1h \rightarrow$  tiempo de ida

$2h \rightarrow$  tiempo de vuelta

Entonces

$\frac{16Km}{1h} = 16Km/h \rightarrow$  Veloc. a favor

$\frac{16Km}{2h} = 8Km/h \rightarrow$  Veloc. en contra

Luego

$x \rightarrow$  Veloc. del bote

$y \rightarrow$  Veloc. del rio

$x + y = 16$

$x - y = 8$

$2x = 24$

$x = 12$

Continúa

21. Continuación

$12 + y = 16$

$y = 4$

sol:  $12Km/h \rightarrow$  Veloc. bote

$4Km/h \rightarrow$  Veloc. rio

22.  $\frac{A}{9} - 2 = \frac{B}{5}$

$5A - 90 = 9B$

$5A - 9B = 90$

$2B = A - 15$

$A - 2B = 15$

$5A - 9B = 90$

$A - 2B = 15 \quad (-5)$

$5A - 9B = 90$

$-5A + 10B = -75$

$B = 15$

$A - 2(15) = 15$

$A - 30 = 15$

$A = 45$

sol:  $A \rightarrow 45$  Años

$B \rightarrow 15$  Años

23.  $5A - 4 = 4B$

$5A - 4B = 4$

$7A - 2 = 6B$

$7A - 6B = 2$

$5A - 4B = 4 \quad (6)$

$7A - 6B = 2 \quad (-4)$

$30A - 24B = 24$

$-28A + 24B = -8$

$2A = 16$

$A = 8$

$5(8) - 4B = 4$

$40 - 4B = 4$

$-4B = -36$

$B = 9$

sol:  $A \rightarrow 8Km \quad B \rightarrow 9Km$

24.  $x \rightarrow$  Cifra decenas

$y \rightarrow$  Cifra unidades

$y - x = 4$

$10x + y + 10y + x = 66$

$11x + 11y = 66$

$x + y = 6$

Continúa

24. Continuación

$-x + y = 4$

$x + y = 6$

$2y = 10$

$y = 5$

$x + 5 = 6$

$x = 1$

sol: 15

25.  $x \rightarrow$  Largo

$y \rightarrow$  Ancho

$2(x + y) = 58$

$2x + 2y = 58$

$x + y = 29$

$(x + 2)(y - 2) = xy - 46$

$xy - 2x + 2y - 4 = xy - 46$

$-2x + 2y = -42$

$x - y = 21$

$x + y = 29$

$x - y = 21$

$2x = 50$

$x = 25$

$25 + y = 29$

$y = 4$

sol:  $25m \cdot 4m$

26.  $x \rightarrow$  Largo

$y \rightarrow$  Ancho

$2x + 2y = 56$

$x + y = 28$

$(y - 2)(x + 2) = xy$

$xy + 2y - 2x - 4 = xy$

$2x - 2y = -4$

$x - y = -4$

$x + y = 28$

$x - y = -4$

$2x = 24$

$x = 12$

$12 + y = 28$

$y = 16$

sol:  $16m \cdot 12m$

## EJERCICIO 204

1.  $m=6$   $n=3$

$${}^3A_6 = 6 \cdot 5 \dots (6-3+1)$$

$${}^3A_6 = 6 \cdot 5 \cdot 4$$

$${}^3A_6 = 120$$

2.  $P_5 = 5!$

$$P_5 = 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_5 = 120$$

3.  $m=7$   $n=5$

$${}^5C_7 = \frac{{}^5A_7}{P_5} = \frac{7 \cdot 6 \dots (7-5+1)}{5!}$$

$${}^5C_7 = \frac{7 \cdot 6 \cdot 5 \cdot 4 \cdot 3}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}$$

$${}^5C_7 = \frac{2 \cdot 520}{120}$$

$${}^5C_7 = 21$$

4.  $m=6$   $n=2$

$${}^2A_6 = 6 \cdot 5 \dots (6-2+1)$$

$${}^2A_6 = 6 \cdot 5$$

$${}^2A_6 = 30$$

5.  $m=5$   $n=3$

$${}^3A_5 = 5 \cdot 4 \dots (5-3+1)$$

$${}^3A_5 = 5 \cdot 4 \cdot 3$$

$${}^3A_5 = 60$$

6.  $m=12$   $n=5$

$${}^5C_{12} = \frac{{}^5A_{12}}{P_5} = \frac{12 \cdot 11 \dots (12-5+1)}{5!}$$

$${}^5C_{12} = \frac{12 \cdot 11 \cdot 10 \cdot 9 \cdot 8}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}$$

$${}^5C_{12} = 3 \cdot 11 \cdot 2 \cdot 3 \cdot 4$$

$${}^5C_{12} = 792$$

7.  $P_7 = 7!$

$$P_7 = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_7 = 5.040$$

8.  $m=7$   $n=4$

$${}^4C_7 = \frac{{}^4A_7}{P_4} = \frac{7 \cdot 6 \dots (7-4+1)}{4!}$$

$${}^4C_7 = \frac{7 \cdot 6 \cdot 5 \cdot 4}{4 \cdot 3 \cdot 2 \cdot 1}$$

$${}^4C_7 = 7 \cdot 5$$

$${}^4C_7 = 35$$

9.  $P_{5-1} = P_4$

$$P_4 = 4!$$

$$P_4 = 4 \cdot 3 \cdot 2$$

$$P_4 = 24$$

10.  $P_6 = 6!$

$$P_6 = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_6 = 720$$

11. Siendo el 1º

$$P_6 = 6!$$

$$P_6 = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_6 = 720$$

sin lugar fijo

$$P_7 = 7!$$

$$P_7 = 7P_6$$

$$P_7 = 7 \cdot 720$$

$$P_7 = 5.040$$

12. En un banco

$$P_6 = 720$$

En una mesa  
redonda

$$P_{6-1} = P_5$$

$$P_5 = 5!$$

$$P_5 = 120$$

13.  $m=9$   $n=3$

$${}^3A_9 = 9 \cdot 8 \dots (9-3+1)$$

$${}^3A_9 = 9 \cdot 8 \cdot 7$$

$${}^3A_9 = 504$$

14.  $P_{4-1} = P_3$

$$P_3 = 3!$$

$$P_3 = 6$$

15.  $m=5$   $n=3$

$${}^3C_5 = \frac{{}^3A_5}{P_3} = \frac{5 \cdot 4 \dots (5-3+1)}{3!}$$

$${}^3C_5 = \frac{5 \cdot 4 \cdot 3}{3 \cdot 2}$$

$${}^3C_5 = 5 \cdot 2$$

$${}^3C_5 = 10$$

16.  $P_{5-2} = P_3$

$$P_3 = 3!$$

$$P_3 = 3 \cdot 2$$

$$P_3 = 6$$

17.  $m=5$   $n=3$

$${}^3A_5 = 5 \cdot 4 \dots (5-3+1)$$

$${}^3A_5 = 5 \cdot 4 \cdot 3$$

$${}^3A_5 = 60$$

18.  $P_{11-1} = P_{10}$

$$P_{10} = 10!$$

$$P_{10} = 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_{10} = 3.628.800$$

19.  $m=8$   $n=3$

$${}^3C_8 = \frac{{}^3A_8}{P_3} = \frac{8 \cdot 7 \dots (8-3+1)}{3!}$$

$${}^3C_8 = \frac{8 \cdot 7 \cdot 6}{3 \cdot 2}$$

$${}^3C_8 = 4 \cdot 7 \cdot 2$$

$${}^3C_8 = 56$$

20.  $m=6$   $n=3$

$${}^5A_6 = 6 \cdot 5 \dots (6-3+1)$$

$${}^5A_6 = 6 \cdot 5 \cdot 4$$

$${}^5A_6 = 120$$

21. Palabras distintas

$$P_8 = 8!$$

$$P_8 = 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2$$

$$P_8 = 40.320$$

Vocales fijas

$$P_5 = 5!$$

$$P_5 = 120$$

22.  $P_{5-1} = P_4$

$$P_4 = 4!$$

$$P_4 = 4 \cdot 3 \cdot 2$$

$$P_4 = 24$$



## EJERCICIO 205

1.  $(4a^2)^2 = 16a^4$
2.  $(-5a)^3 = -125a^3$
3.  $(3xy)^3 = 27x^3y^3$
4.  $(-6a^2b)^2 = 36a^4b^2$
5.  $(-2x^2y^3)^3 = -8x^6y^9$
6.  $(4a^2b^3c^4)^3 = 64a^6b^9c^{12}$
7.  $(-6x^4y^5)^2 = 36x^8y^{10}$
8.  $(-7ab^3c^4)^3 = -343a^3b^9c^{12}$
9.  $(a^mb^n)^x = a^{mx}b^{nx}$
10.  $(-2x^3y^5z^6)^4 = 16x^{12}y^{20}z^{24}$
11.  $(-3m^3n)^3 = -27m^9n^3$
12.  $(a^2b^3c)^m = a^{2m}b^{3m}c^m$
13.  $(-m^2nx^3)^4 = m^8n^4x^{12}$
14.  $(-3a^2b)^5 = -243a^{10}b^5$
15.  $(7x^5y^6z^8)^2 = 49x^{10}y^{12}z^{16}$
16.  $\left(-\frac{x}{2y}\right)^2 = \frac{x^2}{4y^2}$
17.  $\left(-\frac{2m}{n^2}\right)^3 = -\frac{8m^3}{n^6}$
18.  $\left(\frac{ab^2}{5}\right)^3 = \frac{a^3b^6}{125}$
19.  $\left(-\frac{3x^2}{4y}\right)^2 = \frac{9x^4}{16y^2}$
20.  $\left(-\frac{2ab^2}{3m^3}\right)^4 = \frac{16a^4b^8}{81m^{12}}$
21.  $\left(\frac{2m^3n}{3x^4}\right)^5 = \frac{32m^{15}n^5}{243x^{20}}$
22.  $\left(-\frac{3a^3b^2}{4}\right)^2 = \frac{9a^6b^4}{16}$
23.  $\left(-\frac{mn^2}{3}\right)^4 = \frac{m^4n^8}{81}$
24.  $\left(-\frac{a^2b^4}{2}\right)^5 = -\frac{a^{10}b^{20}}{32}$

## EJERCICIO 206

1.  $(a^5 + 7b^4)^2$   
 $= a^{10} + 2a^5(7b^4) + 49b^8$   
 $= a^{10} + 14a^5b^4 + 49b^8$
2.  $(3x^4 - 5xy^3)^2$   
 $= 9x^8 - 2(3x^4)(5xy^3) + 25x^2y^6$   
 $= 9x^8 - 30x^5y^3 + 25x^2y^6$
3.  $(a^2b^3 - a^5)^2$   
 $= a^4b^6 - 2a^2b^3(a^5) + a^{10}$   
 $= a^4b^6 - 2a^7b^3 + a^{10}$
4.  $(7x^5 - 8x^3y^4)^2$   
 $= 49x^{10} - 2(7x^5)(8x^3y^4) + 64x^6y^8$   
 $= 49x^{10} - 112x^8y^4 + 64x^6y^8$
5.  $(9ab^2 + 5a^2b^3)^2$   
 $= 81a^2b^4 + 2(9ab^2)(5a^2b^3) + 25a^4b^6$   
 $= 81a^2b^4 + 90a^3b^5 + 25a^4b^6$
6.  $(3x^2y^3 - 7x^3y^2)^2$   
 $= 9x^4y^6 - 2(3x^2y^3)(7x^3y^2) + 49x^6y^4$   
 $= 9x^4y^6 - 42x^5y^5 + 49x^6y^4$
7.  $(xy - a^2b^2)^2$   
 $= x^2y^2 - 2(xy)(a^2b^2) + a^4b^4$   
 $= x^2y^2 - 2a^2b^2xy + a^4b^4$
8.  $\left(\frac{x}{2} + \frac{2y}{3}\right)^2$   
 $= \frac{x^2}{4} + 2\left(\frac{x}{2}\right)\left(\frac{2y}{3}\right) + \frac{4y^2}{9}$   
 $= \frac{x^2}{4} + \frac{2xy}{3} + \frac{4y^2}{9}$
9.  $\left(\frac{3a^2}{4} - \frac{2b^2}{5}\right)^2$   
 $= \frac{9a^4}{16} - 2\left(\frac{3a^2}{4}\right)\left(\frac{2b^2}{5}\right) + \frac{4b^4}{25}$   
 $= \frac{9a^4}{16} - \frac{3a^2b^2}{5} + \frac{4b^4}{25}$
10.  $\left(\frac{5x^3}{6} + \frac{3xy^2}{5}\right)^2$   
 $= \frac{25x^6}{36} + 2\left(\frac{5x^3}{6}\right)\left(\frac{3xy^2}{5}\right) + \frac{9x^2y^4}{25}$   
 $= \frac{25x^6}{36} + x^4y^2 + \frac{9x^2y^4}{25}$
11.  $\left(\frac{a^5}{9} - \frac{3a^3b^7}{7}\right)^2$   
 $= \frac{a^{10}}{81} - 2\left(\frac{a^5}{9}\right)\left(\frac{3a^3b^7}{7}\right) + \frac{9a^6b^{14}}{49}$   
 $= \frac{a^{10}}{81} - \frac{2a^8b^7}{21} + \frac{9a^6b^{14}}{49}$
12.  $\left(\frac{2m^4}{5} - \frac{5n^3}{4}\right)^2$   
 $= \frac{4m^8}{25} - 2\left(\frac{2m^4}{5}\right)\left(\frac{5n^3}{4}\right) + \frac{25n^6}{16}$   
 $= \frac{4m^8}{25} - m^4n^3 + \frac{25n^6}{16}$
13.  $\left(\frac{x}{3} + \frac{y}{4}\right)^2$   
 $= \frac{x^2}{9} + 2\left(\frac{x}{3}\right)\left(\frac{y}{4}\right) + \frac{y^2}{16}$   
 $= \frac{x^2}{9} + \frac{xy}{6} + \frac{y^2}{16}$
14.  $\left(\frac{2x}{3} - \frac{3y}{5}\right)^2$   
 $= \frac{4x^2}{9} - 2\left(\frac{2x}{3}\right)\left(\frac{3y}{5}\right) + \frac{9y^2}{25}$   
 $= \frac{4x^2}{9} - \frac{4xy}{5} + \frac{9y^2}{25}$

$$15. \left(\frac{a^3}{8} + \frac{4a^2}{7b}\right)^2 = \frac{a^6}{64} + 2\left(\frac{a^3}{8}\right)\left(\frac{4a^2}{7b}\right) + \frac{16a^4}{49b^2} = \frac{a^6}{64} + \frac{a^5}{7b} + \frac{16a^4}{49b^2}$$

$$16. \left(\frac{3}{2x} - \frac{2x^4}{3}\right)^2 = \frac{9}{4x^2} - 2\left(\frac{3}{2x}\right)\left(\frac{2x^4}{3}\right) + \frac{4x^8}{9} = \frac{9}{4x^2} - 2x^3 + \frac{4x^8}{9}$$

$$17. \left(\frac{5x^7}{6y^4} - \frac{3y^6}{10x^2}\right)^2 = \frac{25x^{14}}{36y^8} - 2\left(\frac{5x^7}{6y^4}\right)\left(\frac{3y^6}{10x^2}\right) + \frac{9y^{12}}{100x^4} = \frac{25x^{14}}{36y^8} - \frac{x^5y^2}{2} + \frac{9y^{12}}{100x^4}$$

$$18. \left(\frac{3a^6}{8} - \frac{4a^2}{9b^5}\right)^2 = \frac{9a^{12}}{64} - 2\left(\frac{3a^6}{8}\right)\left(\frac{4a^2}{9b^5}\right) + \frac{16a^4}{81b^{10}} = \frac{9a^{12}}{64} - \frac{a^8}{3b^5} + \frac{16a^4}{81b^{10}}$$

## EJERCICIO 207

$$1. (2a + 3b)^3 = 8a^3 + 3(4a^2)(3b) + 3(2a)(9b^2) + 27b^3 = 8a^3 + 36a^2b + 54ab^2 + 27b^3$$

$$2. (4a - 3b^2)^3 = 64a^3 - 3(16a^2)(3b^2) + 3(4a)(9b^4) - 27b^6 = 64a^3 - 144a^2b^2 + 108ab^4 - 27b^6$$

$$3. (5x^2 + 6y^3)^3 = 125x^6 + 3(25x^4)(6y^3) + 3(5x^2)(36y^6) + 216y^9 = 125x^6 + 450x^4y^3 + 540x^2y^6 + 216y^9$$

$$4. (4x^3 - 3xy^2)^3 = 64x^9 - 3(16x^6)(3xy^2) + 3(4x^3)(9x^2y^4) - 27x^3y^6 = 64x^9 - 144x^7y^2 + 108x^5y^4 - 27x^3y^6$$

$$5. (7a^4 - 5a^2b^3)^3 = 343a^{12} - 3(49a^8)(5a^2b^3) + 3(7a^4)(25a^4b^6) - 125a^6b^9 = 343a^{12} - 735a^{10}b^3 + 525a^8b^6 - 125a^6b^9$$

$$6. (a^8 + 9a^5x^4)^3 = a^{24} + 3(a^{16})(9a^5x^4) + 3(a^8)(81a^{10}x^8) + 729a^{15}x^{12} = a^{24} + 27a^{21}x^4 + 243a^{18}x^8 + 729a^{15}x^{12}$$

$$7. (8x^4 - 7x^2y^4)^3 = 512x^{12} - 3(64x^8)(7x^2y^4) + 3(8x^4)(49x^4y^8) - 343x^6y^{12} = 512x^{12} - 1.344x^{10}y^4 + 1.176x^8y^8 - 343x^6y^{12}$$

$$8. (3a^2b - 5a^3b^2)^3 = 27a^6b^3 - 3(9a^4b^2)(5a^3b^2) + 3(3a^2b)(25a^6b^4) - 125a^9b^6 = 27a^6b^3 - 135a^7b^4 + 225a^8b^5 - 125a^9b^6$$

$$9. \left(\frac{1}{2}a + \frac{2b^2}{3}\right)^3 = \frac{a^3}{8} + 3\left(\frac{a^2}{4}\right)\left(\frac{2b^2}{3}\right) + 3\left(\frac{a}{2}\right)\left(\frac{4b^4}{9}\right) + \frac{8b^6}{27} = \frac{a^3}{8} + \frac{a^2b^2}{2} + \frac{2ab^4}{3} + \frac{8b^6}{27}$$

$$10. \left(\frac{3a^2}{4} - \frac{4b^2}{5}\right)^3 = \frac{27a^6}{64} - 3\left(\frac{9a^4}{16}\right)\left(\frac{4b^2}{5}\right) + 3\left(\frac{3a^2}{4}\right)\left(\frac{16b^4}{25}\right) - \frac{64b^6}{125} = \frac{27a^6}{64} - \frac{27a^4b^2}{20} + \frac{36a^2b^4}{25} - \frac{64b^6}{125}$$

$$11. \left(\frac{5a^2b}{6} - \frac{3b^4}{10}\right)^3 = \frac{125a^6b^3}{216} - 3\left(\frac{25a^4b^2}{36}\right)\left(\frac{3b^4}{10}\right) + 3\left(\frac{5a^2b}{6}\right)\left(\frac{9b^8}{100}\right) - \frac{27b^{12}}{1.000} = \frac{125a^6b^3}{216} - \frac{5a^4b^6}{8} + \frac{9a^2b^9}{40} - \frac{27b^{12}}{1.000}$$

$$12. \left(\frac{7x^5}{8} - \frac{4y^6}{7}\right)^3 = \frac{343x^{15}}{512} - 3\left(\frac{49x^{10}}{64}\right)\left(\frac{4y^6}{7}\right) + 3\left(\frac{7x^5}{8}\right)\left(\frac{16y^{12}}{49}\right) - \frac{64y^{18}}{343} = \frac{343x^{15}}{512} - \frac{21x^{10}y^6}{16} + \frac{6x^5y^{12}}{7} - \frac{64y^{18}}{343}$$

$$13. \left(\frac{x}{2y} + \frac{3y}{x^2}\right)^3 = \frac{x^3}{8y^3} + 3\left(\frac{x^2}{4y^2}\right)\left(\frac{3y}{x^2}\right) + 3\left(\frac{x}{2y}\right)\left(\frac{9y^2}{x^4}\right) + \frac{27y^3}{x^6} = \frac{x^3}{8y^3} + \frac{9}{4y} + \frac{27y}{2x^3} + \frac{27y^3}{x^6}$$

$$14. \left(\frac{2a^2}{5} - \frac{5}{2b^3}\right)^3 = \frac{8a^6}{125} - 3\left(\frac{4a^4}{25}\right)\left(\frac{5}{2b^3}\right) + 3\left(\frac{2a^2}{5}\right)\left(\frac{25}{4b^6}\right) - \frac{125}{8b^9} = \frac{8a^6}{125} - \frac{6a^4}{5b^3} + \frac{15a^2}{2b^6} - \frac{125}{8b^9}$$

$$15. \left(4x^4 - \frac{3x}{y^3}\right)^3 = 64x^{12} - 3(16x^8)\left(\frac{3x}{y^3}\right) + 3(4x^4)\left(\frac{9x^2}{y^6}\right) - \frac{27x^3}{y^9} = 64x^{12} - \frac{144x^9}{y^3} + \frac{108x^6}{y^6} - \frac{27x^3}{y^9}$$

$$16. \left(\frac{3a}{2b} + \frac{4b^2}{5}\right)^3 = \frac{27a^3}{8b^3} + 3\left(\frac{9a^2}{4b^2}\right)\left(\frac{4b^2}{5}\right) + 3\left(\frac{3a}{2b}\right)\left(\frac{16b^4}{25}\right) + \frac{64b^6}{125} = \frac{27a^3}{8b^3} + \frac{27a^2}{5} + \frac{72ab^3}{25} + \frac{64b^6}{125}$$

$$17. \left(\frac{7}{8} - x^4y^5\right)^3 = \frac{343}{512} - 3\left(\frac{49}{64}\right)x^4y^5 + 3\left(\frac{7}{8}\right)x^8y^{10} - x^{12}y^{15} = \frac{343}{512} - \frac{147x^4y^5}{64} + \frac{21x^8y^{10}}{8} - x^{12}y^{15}$$

$$18. \left(\frac{m^3}{6} - \frac{6n^2}{m^2}\right)^3 = \frac{m^9}{216} - 3\left(\frac{m^6}{36}\right)\left(\frac{6n^2}{m^2}\right) + 3\left(\frac{m^3}{6}\right)\left(\frac{36n^4}{m^4}\right) - \frac{216n^6}{m^6} = \frac{m^9}{216} - \frac{m^4n^2}{2} + \frac{18n^4}{m} - \frac{216n^6}{m^6}$$

## EJERCICIO 208

$$1. x^2 - 2x + 1$$

$$= x^4 + 4x^2 + 1 + 2x^2(-2x) + 2x^2(1) + 2(-2x)(1) = x^4 + 4x^2 + 1 - 4x^3 + 2x^2 - 4x = x^4 - 4x^3 + 6x^2 - 4x + 1$$

$$2. 2x^2 + x + 1$$

$$= 4x^4 + x^2 + 1 + 2(2x^2)(x) + 2(2x^2)(1) + 2(x)(1) = 4x^4 + x^2 + 1 + 4x^3 + 4x^2 + 2x = 4x^4 + 4x^3 + 5x^2 + 2x + 1$$

$$3. x^2 - 5x + 2 = x^4 + 25x^2 + 4 + 2(x^2)(-5x) + 2(x^2)(2) + 2(-5x)(2) = x^4 + 25x^2 + 4 - 10x^3 + 4x^2 - 20x$$

$$= x^4 - 10x^3 + 29x^2 - 20x + 4$$

$$4. x^3 - 5x^2 + 6 = x^6 + 25x^4 + 36 + 2(x^3)(-5x^2) + 2(x^3)(6) + 2(-5x^2)(6) = x^6 + 25x^4 + 36 - 10x^5 + 12x^3 - 60x^2$$

$$= x^6 - 10x^5 + 25x^4 + 12x^3 - 60x^2 + 36$$

$$5. 4a^4 - 3a^2 + 5 = 16a^8 + 9a^4 + 25 + 2(4a^4)(-3a^2) + 2(4a^4)(5) + 2(-3a^2)(5)$$

$$= 16a^8 + 9a^4 + 25 - 24a^6 + 40a^4 - 30a^2 = 16a^8 - 24a^6 + 49a^4 - 30a^2 + 25$$

$$6. x + 2y - z = x^2 + 4y^2 + z^2 + 2(x)(2y) + 2(x)(-z) + 2(2y)(-z) = x^2 + 4y^2 + z^2 + 4xy - 2xz - 4yz$$

$$7. 3 - x^3 - x^6$$

$$= 9 + x^6 + x^{12} + 2(3)(-x^3) + 2(3)(-x^6) + 2(-x^3)(-x^6) = 9 + x^6 + x^{12} - 6x^3 - 6x^6 + 2x^9 = x^{12} + 2x^9 - 5x^6 - 6x^3 + 9$$

$$8. 5x^4 - 7x^2 + 3x = 25x^8 + 49x^4 + 9x^2 + 2(5x^4)(-7x^2) + 2(5x^4)(3x) + 2(-7x^2)(3x)$$

$$= 25x^8 + 49x^4 + 9x^2 - 70x^6 + 30x^5 - 42x^3 = 25x^8 - 70x^6 + 30x^5 + 49x^4 - 42x^3 + 9x^2$$

$$9. 2a^2 + 2ab - 3b^2 = 4a^4 + 4a^2b^2 + 9b^4 + 2(2a^2)(2ab) + 2(2a^2)(-3b^2) + 2(2ab)(-3b^2)$$

$$= 4a^4 + 4a^2b^2 + 9b^4 + 8a^3b - 12a^2b^2 - 12ab^3 = 4a^4 + 8a^3b - 8a^2b^2 - 12ab^3 + 9b^4$$

$$10. m^3 - 2m^2n + 2n^4 = m^6 + 4m^4n^2 + 4n^8 + 2(m^3)(-2m^2n) + 2(m^3)(2n^4) + 2(-2m^2n)(2n^4)$$

$$= m^6 + 4m^4n^2 + 4n^8 - 4m^5n + 4m^3n^4 - 8m^2n^5 = m^6 - 4m^5n + 4m^4n^2 + 4m^3n^4 - 8m^2n^5 + 4n^8$$

$$11. \frac{a}{2} - b + \frac{c}{4} = \frac{a^2}{4} + b^2 + \frac{c^2}{16} + 2\left(\frac{a}{2}\right)(-b) + 2\left(\frac{a}{2}\right)\left(\frac{c}{4}\right) + 2(-b)\left(\frac{c}{4}\right) = \frac{a^2}{4} + b^2 + \frac{c^2}{16} - ab + \frac{ac}{4} - \frac{bc}{2}$$

$$\begin{aligned}
 12. \quad \frac{x}{5} - 5y + \frac{5}{3} &= \frac{x^2}{25} + 25y^2 + \frac{25}{9} + 2\left(\frac{x}{5}\right)(-5y) + 2\left(\frac{x}{5}\right)\left(\frac{5}{3}\right) + 2(-5y)\left(\frac{5}{3}\right) = \frac{x^2}{25} + 25y^2 + \frac{25}{9} - 2xy + \frac{2x}{3} - \frac{50y}{3} \\
 &= \frac{x^2}{25} - 2xy + \frac{2x}{3} + 25y^2 - \frac{50y}{3} + \frac{25}{9}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad \frac{x^2}{2} - x + \frac{2}{3} &= \frac{x^4}{4} + x^2 + \frac{4}{9} + 2\left(\frac{x^2}{2}\right)(-x) + 2\left(\frac{x^2}{2}\right)\left(\frac{2}{3}\right) + 2\left(\frac{2}{3}\right)(-x) = \frac{x^4}{4} + x^2 + \frac{4}{9} - x^3 + \frac{2x^2}{3} - \frac{4x}{3} \\
 &= \frac{x^4}{4} - x^3 + \frac{5x^2}{3} - \frac{4x}{3} + \frac{4}{9}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad \frac{a}{x} - \frac{1}{3} + \frac{x}{a} &= \frac{a^2}{x^2} + \frac{1}{9} + \frac{x^2}{a^2} + 2\left(\frac{a}{x}\right)\left(-\frac{1}{3}\right) + 2\left(\frac{a}{x}\right)\left(\frac{x}{a}\right) + 2\left(-\frac{1}{3}\right)\left(\frac{x}{a}\right) = \frac{a^2}{x^2} + \frac{1}{9} + \frac{x^2}{a^2} - \frac{2a}{3x} + 2 - \frac{2x}{3a} \\
 &= \frac{a^2}{x^2} - \frac{2a}{3x} - \frac{2x}{3a} + \frac{x^2}{a^2} + \frac{19}{9}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad \frac{3a^2}{4} - \frac{a}{2} + \frac{4}{5} &= \frac{9a^4}{16} + \frac{a^2}{4} + \frac{16}{25} + 2\left(\frac{3a^2}{4}\right)\left(-\frac{a}{2}\right) + 2\left(\frac{3a^2}{4}\right)\left(\frac{4}{5}\right) + 2\left(-\frac{a}{2}\right)\left(\frac{4}{5}\right) \\
 &= \frac{9a^4}{16} + \frac{a^2}{4} + \frac{16}{25} - \frac{3a^3}{4} + \frac{6a^2}{5} - \frac{4a}{5} = \frac{9a^4}{16} - \frac{3a^3}{4} + \frac{29a^2}{20} - \frac{4a}{5} + \frac{16}{25}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad \frac{a^2}{4} - \frac{3}{5} + \frac{b^2}{9} &= \frac{a^4}{16} + \frac{9}{25} + \frac{b^4}{81} + 2\left(\frac{a^2}{4}\right)\left(-\frac{3}{5}\right) + 2\left(\frac{a^2}{4}\right)\left(\frac{b^2}{9}\right) + 2\left(-\frac{3}{5}\right)\left(\frac{b^2}{9}\right) \\
 &= \frac{a^4}{16} + \frac{9}{25} + \frac{b^4}{81} - \frac{3a^2}{10} + \frac{a^2b^2}{18} - \frac{2b^2}{15} = \frac{a^4}{16} - \frac{3a^2}{10} + \frac{a^2b^2}{18} + \frac{9}{25} - \frac{2b^2}{15} + \frac{b^4}{81}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad x^3 - x^2 + x + 1 &= x^6 + x^4 + x^2 + 1 + 2(x^3)(-x^2) + 2(x^3)(x) + 2x^3 + 2(-x^2)(x) + 2(-x^2) + 2x \\
 &= x^6 + x^4 + x^2 + 1 - 2x^5 + 2x^4 + 2x^3 - 2x^3 - 2x^2 + 2x = x^6 - 2x^5 + 3x^4 - x^2 + 2x + 1
 \end{aligned}$$

$$\begin{aligned}
 18. \quad x^3 - 3x^2 - 2x + 2 &= x^6 + 9x^4 + 4x^2 + 4 + 2(x^3)(-3x^2) + 2(x^3)(-2x) + 2(x^3)(2) + 2(-3x^2)(-2x) + 2(-3x^2)(2) + 2(-2x)(2) \\
 &= x^6 + 9x^4 + 4x^2 + 4 - 6x^5 - 4x^4 + 4x^3 + 12x^3 - 12x^2 - 8x = x^6 - 6x^5 + 5x^4 + 16x^3 - 8x^2 - 8x + 4
 \end{aligned}$$

$$\begin{aligned}
 19. \quad x^4 + 3x^2 - 4x + 5 &= x^8 + 9x^4 + 16x^2 + 25 + 2(x^4)(3x^2) + 2(x^4)(-4x) + 2(x^4)(5) + 2(3x^2)(-4x) + 2(3x^2)(5) + 2(-4x)(5) \\
 &= x^8 + 9x^4 + 16x^2 + 25 + 6x^6 - 8x^5 + 10x^4 - 24x^3 + 30x^2 - 40x = x^8 + 6x^6 - 8x^5 + 19x^4 - 24x^3 + 46x^2 - 40x + 25
 \end{aligned}$$

$$\begin{aligned}
 20. \quad x^4 - 4x^3 + 2x - 3 &= x^8 + 16x^6 + 4x^2 + 9 + 2(x^4)(-4x^3) + 2(x^4)(2x) + 2(x^4)(-3) + 2(-4x^3)(2x) + 2(-4x^3)(-3) + 2(2x)(-3) \\
 &= x^8 + 16x^6 + 4x^2 + 9 - 8x^7 + 4x^5 - 6x^4 - 16x^4 + 24x^3 - 12x = x^8 - 8x^7 + 16x^6 + 4x^5 - 22x^4 + 24x^3 + 4x^2 - 12x + 9
 \end{aligned}$$

$$\begin{aligned}
 21. \quad 3 - 6a + a^2 - a^3 &= 9 + 36a^2 + a^4 + a^6 + 2(3)(-6a) + 2(3)(a^2) + 2(3)(-a^3) + 2(-6a)(a^2) + 2(-6a)(-a^3) + 2(a^2)(-a^3) \\
 &= 9 + 36a^2 + a^4 + a^6 - 36a + 6a^2 - 6a^3 - 12a^3 + 12a^4 - 2a^5 = a^6 - 2a^5 + 13a^4 - 18a^3 + 42a^2 - 36a + 9
 \end{aligned}$$

$$\begin{aligned}
 22. \quad \frac{x^3}{2} - x^2 + \frac{2x}{3} + 2 &= \frac{x^6}{4} + x^4 + \frac{4x^2}{9} + 4 + 2\left(\frac{x^3}{2}\right)(-x^2) + 2\left(\frac{x^3}{2}\right)\left(\frac{2x}{3}\right) + 2\left(\frac{x^3}{2}\right)(2) + 2(-x^2)\left(\frac{2x}{3}\right) + 2(-x^2)(2) + 2\left(\frac{2x}{3}\right)(2) \\
 &= \frac{x^6}{4} + x^4 + \frac{4x^2}{9} + 4 - x^5 + \frac{2x^4}{3} + 2x^3 - \frac{4x^3}{3} - 4x^2 + \frac{8x}{3} = \frac{x^6}{4} - x^5 + \frac{5x^4}{3} + \frac{2x^3}{3} - \frac{32x^2}{9} + \frac{8x}{3} + 4
 \end{aligned}$$

$$\begin{aligned}
 23. & \frac{a^3}{2} - \frac{2a^2}{3} + \frac{3a}{4} - \frac{1}{2} \\
 &= \frac{a^6}{4} + \frac{4a^4}{9} + \frac{9a^2}{16} + \frac{1}{4} + 2\left(\frac{a^3}{2}\right)\left(-\frac{2a^2}{3}\right) + 2\left(\frac{a^3}{2}\right)\left(\frac{3a}{4}\right) + 2\left(\frac{a^3}{2}\right)\left(-\frac{1}{2}\right) + 2\left(-\frac{2a^2}{3}\right)\left(\frac{3a}{4}\right) + 2\left(-\frac{2a^2}{3}\right)\left(-\frac{1}{2}\right) + 2\left(\frac{3a}{4}\right)\left(-\frac{1}{2}\right) \\
 &= \frac{a^6}{4} + \frac{4a^4}{9} + \frac{9a^2}{16} + \frac{1}{4} - \frac{2a^5}{3} + \frac{3a^4}{4} - \frac{a^3}{2} - a^3 + \frac{2a^2}{3} - \frac{3a}{4} = \frac{a^6}{4} - \frac{2a^5}{3} + \frac{43a^4}{36} - \frac{3a^3}{2} + \frac{59a^2}{48} - \frac{3a}{4} + \frac{1}{4}
 \end{aligned}$$

$$\begin{aligned}
 24. & x^5 - x^4 + x^3 - x^2 + x - 2 \\
 &= x^{10} + x^8 + x^6 + x^4 + x^2 + 4 + 2(x^5)(-x^4) + 2(x^5)(x^3) + 2(x^5)(-x^2) + 2(x^5)(x) + 2(x^5)(-2) + 2(-x^4)(x^3) + 2(-x^4)(-x^2) \\
 &+ 2(-x^4)(x) + 2(-x^4)(-2) + 2(x^3)(-x^2) + 2(x^3)(x) + 2(x^3)(-2) + 2(-x^2)(x) + 2(-x^2)(-2) + 2(x)(-2) \\
 &= x^{10} + x^8 + x^6 + x^4 + x^2 + 4 - 2x^9 + 2x^8 - 2x^7 + 2x^6 - 4x^5 - 2x^7 + 2x^6 - 2x^5 + 4x^4 - 2x^5 + 2x^4 - 4x^3 - 2x^3 + 4x^2 - 4x \\
 &= x^{10} - 2x^9 + 3x^8 - 4x^7 + 5x^6 - 8x^5 + 7x^4 - 6x^3 + 5x^2 - 4x + 4
 \end{aligned}$$

## EJERCICIO 209

- $$\begin{aligned}
 x^2 + x + 1 &= x^6 + x^3 + 1 + 3(x^2)^2(x) + 3(x^2)^2(1) + 3(x^2)(x^2) + 3(x^2)(1) + 3(x^2) + 3(x) + 6(x^2)(x)(1) \\
 &= x^6 + x^3 + 1 + 3x^5 + 3x^4 + 3x^4 + 3x^2 + 3x^2 + 3x + 6x^3 = x^6 + 3x^5 + 6x^4 + 7x^3 + 6x^2 + 3x + 1
 \end{aligned}$$
- $$\begin{aligned}
 2x^2 - x - 1 &= 8x^6 - x^3 - 1 + 3(2x^2)^2(-x) + 3(2x^2)^2(-1) + 3(-x)^2(-1) + 3(-x)^2(2x^2) + 3(-1)^2(2x^2) + 3(-1)^2(-x) \\
 &+ 6(2x^2)(-x)(-1) \\
 &= 8x^6 - x^3 - 1 - 12x^5 - 12x^4 - 3x^2 + 6x^4 + 6x^2 - 3x + 12x^3 = 8x^6 - 12x^5 - 6x^4 + 11x^3 + 3x^2 - 3x - 1
 \end{aligned}$$
- $$\begin{aligned}
 1 - 3x + 2x^2 & \\
 &= 1 - 27x^3 + 8x^6 + 3(1)^2(-3x) + 3(1)^2(2x^2) + 3(-3x)^2(1) + 3(-3x)^2(2x^2) + 3(2x^2)^2(1) + 3(2x^2)^2(-3x) \\
 &+ 6(1)(-3x)(2x^2) \\
 &= 1 - 27x^3 + 8x^6 - 9x + 6x^2 + 27x^2 + 54x^4 + 12x^4 - 36x^5 - 36x^3 = 1 - 9x + 33x^2 - 63x^3 + 66x^4 - 36x^5 + 8x^6
 \end{aligned}$$
- $$\begin{aligned}
 2 - 3x + x^2 & \\
 &= 8 - 27x^3 + x^6 + 3(2)^2(-3x) + 3(2)^2(x^2) + 3(-3x)^2(2) + 3(-3x)^2(x^2) + 3(x^2)^2(2) + 3(x^2)^2(-3x) + 6(2)(-3x)(x^2) \\
 &= 8 - 27x^3 + x^6 - 36x + 12x^2 + 54x^2 + 27x^4 + 6x^4 - 9x^5 - 36x^3 = x^6 - 9x^5 + 33x^4 - 63x^3 + 66x^2 - 36x + 8
 \end{aligned}$$
- $$\begin{aligned}
 x^3 - 2x^2 - 4 & \\
 &= x^9 - 8x^6 - 64 + 3(x^3)^2(-2x^2) + 3(x^3)^2(-4) + 3(-2x^2)^2(x^3) + 3(-2x^2)^2(-4) + 3(-4)^2(x^3) + 3(-4)^2(-2x^2) \\
 &+ 6(x^3)(-2x^2)(-4) \\
 &= x^9 - 8x^6 - 64 - 6x^8 - 12x^6 + 12x^7 - 48x^4 + 48x^3 - 96x^2 + 48x^5 \\
 &= x^9 - 6x^8 + 12x^7 - 20x^6 + 48x^5 - 48x^4 + 48x^3 - 96x^2 - 64
 \end{aligned}$$
- $$\begin{aligned}
 x^4 - x^2 - 2 & \\
 &= x^{12} - x^6 - 8 + 3(x^4)^2(-x^2) + 3(x^4)^2(-2) + 3(-x^2)^2(x^4) + 3(-x^2)^2(-2) + 3(-2)^2(x^4) + 3(-2)^2(-x^2) \\
 &+ 6(x^4)(-x^2)(-2) \\
 &= x^{12} - x^6 - 8 - 3x^{10} - 6x^8 + 3x^8 - 6x^4 + 12x^4 - 12x^2 + 12x^6 = x^{12} - 3x^{10} - 3x^8 + 11x^6 + 6x^4 - 12x^2 - 8
 \end{aligned}$$

$$\begin{aligned}
7. a^3 + \frac{a^2}{2} - \frac{a}{3} &= a^9 + \frac{a^6}{8} - \frac{a^3}{27} + 3(a^3)^2 \left(\frac{a^2}{2}\right) + 3(a^3)^2 \left(-\frac{a}{3}\right) + 3\left(\frac{a^2}{2}\right)^2 (a^3) + 3\left(\frac{a^2}{2}\right)^2 \left(-\frac{a}{3}\right) + 3\left(-\frac{a}{3}\right)^2 (a^3) \\
&+ 3\left(-\frac{a}{3}\right)^2 \left(\frac{a^2}{2}\right) + 6a^3 \left(\frac{a^2}{2}\right) \left(-\frac{a}{3}\right) \\
&= a^9 + \frac{a^6}{8} - \frac{a^3}{27} + \frac{3a^8}{2} - a^7 + \frac{3a^7}{4} - \frac{a^5}{4} + \frac{a^5}{3} + \frac{a^4}{6} - a^6 = a^9 + \frac{3a^8}{2} - \frac{a^7}{4} - \frac{7a^6}{8} + \frac{a^5}{12} + \frac{a^4}{6} - \frac{a^3}{27}
\end{aligned}$$

$$\begin{aligned}
8. \frac{x^2}{2} - \frac{x}{3} + 2 &= \frac{x^6}{8} - \frac{x^3}{27} + 8 + 3\left(\frac{x^2}{2}\right)^2 \left(-\frac{x}{3}\right) + 3(x^2)^2 (2) + 3\left(-\frac{x}{3}\right)^2 \left(\frac{x^2}{2}\right) + 3\left(-\frac{x}{3}\right)^2 (2) + 3(2)^2 \left(\frac{x^2}{2}\right) \\
&+ 3(2)^2 \left(-\frac{x}{3}\right) + 6\left(\frac{x^2}{2}\right) \left(-\frac{x}{3}\right) (2) \\
&= \frac{x^6}{8} - \frac{x^3}{27} + 8 - \frac{x^5}{4} + \frac{3x^4}{2} + \frac{x^4}{6} + \frac{2x^2}{3} + 6x^2 - 4x - 2x^3 = \frac{x^6}{8} - \frac{x^5}{4} + \frac{5x^4}{3} - \frac{55x^3}{27} + \frac{20x^2}{3} - 4x + 8
\end{aligned}$$

$$\begin{aligned}
9. a^3 - a^2 + a - 1 &= a^9 - a^6 + a^3 - 1 + 3(a^3)^2 (-a^2) + 3(a^3)^2 (a) + 3(a^3)^2 (-1) + 3(-a^2)^2 (a^3) + 3(-a^2)^2 (a) \\
&+ 3(-a^2)^2 (-1) + 3a^2 (a^3) + 3a^2 (-a^2) + 3a^2 (-1) + 3(-1)^2 (a^3) + 3(-1)^2 (-a^2) + 3(-1)^2 (a) \\
&+ 6(a^3)(-a^2)(a) + 6(a^3)(-a^2)(-1) + 6(a^3)(a)(-1) + 6(-a^2)(a)(-1) \\
&= a^9 - a^6 + a^3 - 1 - 3a^8 + 3a^7 - 3a^6 + 3a^7 + 3a^5 - 3a^4 + 3a^5 - 3a^4 - 3a^2 + 3a^3 - 3a^2 + 3a - 6a^6 + 6a^5 - 6a^4 + 6a^3 \\
&= a^9 - 3a^8 + 6a^7 - 10a^6 + 12a^5 - 12a^4 + 10a^3 - 6a^2 + 3a - 1
\end{aligned}$$

$$\begin{aligned}
10. x^3 - 2x^2 + x - 3 &= x^9 - 8x^6 + x^3 - 27 + 3(x^3)^2 (-2x^2) + 3(x^3)^2 (x) + 3(x^3)^2 (-3) + 3(-2x^2)^2 (x^3) + 3(-2x^2)^2 (x) \\
&+ 3(-2x^2)^2 (-3) + 3x^2 (x^3) + 3x^2 (-2x^2) + 3x^2 (-3) + 6(x^3)(-2x^2)(x) + 6(x^3)(-2x^2)(-3) \\
&+ 6(x^3)(x)(-3) + 6(-2x^2)(x)(-3) + 3(-3)^2 (x^3) + 3(-3)^2 (-2x^2) + 3(-3)^2 x \\
&= x^9 - 8x^6 + x^3 - 27 - 6x^8 + 3x^7 - 9x^6 + 12x^7 + 12x^5 - 36x^4 + 3x^5 - 6x^4 - 9x^2 - 12x^6 + 36x^5 \\
&- 18x^4 + 36x^3 + 27x^3 - 54x^2 + 27x \\
&= x^9 - 6x^8 + 15x^7 - 29x^6 + 51x^5 - 60x^4 + 64x^3 - 63x^2 + 27x - 27
\end{aligned}$$

$$\begin{aligned}
11. x^3 - 4x^2 + 2x - 3 &= x^9 - 64x^6 + 8x^3 - 27 + 3(x^3)^2 (-4x^2) + 3(x^3)^2 (2x) + 3(x^3)^2 (-3) + 3(-4x^2)^2 (x^3) + 3(-4x^2)^2 (2x) \\
&+ 3(-4x^2)^2 (-3) + 3(2x)^2 (x^3) + 3(2x)^2 (-4x^2) + 3(2x)^2 (-3) + 3(-3)^2 (x^3) + 3(-3)^2 (-4x^2) \\
&+ 3(-3)^2 (2x) + 6(x^3)(-4x^2)(2x) + 6(x^3)(-4x^2)(-3) + 6(x^3)(2x)(-3) + 6(-4x^2)(2x)(-3) \\
&= x^9 - 64x^6 + 8x^3 - 27 - 12x^8 + 6x^7 - 9x^6 + 48x^7 + 96x^5 - 144x^4 + 12x^5 - 48x^4 - 36x^2 + 27x^3 - 108x^2 \\
&+ 54x - 48x^6 + 72x^5 - 36x^4 + 144x^3 \\
&= x^9 - 12x^8 + 54x^7 - 121x^6 + 180x^5 - 228x^4 + 179x^3 - 144x^2 + 54x - 27
\end{aligned}$$

$$\begin{aligned}
12. 1 - x^2 + 2x^4 - x^6 &= 1 - x^6 + 8x^{12} - x^{18} + 3(-x^2) + 3(2x^4) + 3(-x^6) + 3(-x^2)^2 + 3(-x^2)^2 (2x^4) + 3(-x^2)^2 (-x^6) \\
&+ 3(2x^4)^2 + 3(2x^4)^2 (-x^2) + 3(2x^4)^2 (-x^6) + 3(-x^6)^2 + 3(-x^6)^2 (-x^2) + 3(-x^6)^2 (2x^4) \\
&+ 6(-x^2)(2x^4) + 6(2x^4)(-x^6) + 6(-x^2)(-x^6) + 6(-x^2)(2x^4)(-x^6) \\
&= 1 - x^6 + 8x^{12} - x^{18} - 3x^2 + 6x^4 - 3x^6 + 3x^4 + 6x^8 - 3x^{10} + 12x^8 - 12x^{10} - 12x^{14} + 3x^{12} \\
&- 3x^{14} + 6x^{16} - 12x^6 - 12x^{10} + 6x^8 + 12x^{12} \\
&= 1 - 3x^2 + 9x^4 - 16x^6 + 24x^8 - 27x^{10} + 23x^{12} - 15x^{14} + 6x^{16} - x^{18}
\end{aligned}$$

## EJERCICIO 210

1.  $(x-2)^4 = x^4 - 4x^3(2) + \frac{4 \cdot 3}{2}x^2(2)^2 - \frac{6 \cdot 2}{3}x(2)^3 + (2)^4 = x^4 - 8x^3 + 24x^2 - 32x + 16$
2.  $(a+3)^4 = a^4 + 4a^3(3) + \frac{4 \cdot 3}{2}a^2(3)^2 + \frac{6 \cdot 2}{3}a(3)^3 + (3)^4 = a^4 + 12a^3 + 54a^2 + 108a + 81$
3.  $(2-x)^5 = (2)^5 - 5(2)^4x + \frac{5 \cdot 4}{2}(2)^3x^2 - \frac{10 \cdot 3}{3}(2)^2x^3 + \frac{10 \cdot 2}{4}(2)x^4 - x^5 = 32 - 80x + 80x^2 - 40x^3 + 10x^4 - x^5$
4.  $(2x+5y)^4$   
 $= (2x)^4 + 4(2x)^3(5y) + \frac{4 \cdot 3}{2}(2x)^2(5y)^2 + \frac{6 \cdot 2}{3}(2x)(5y)^3 + (5y)^4 = 16x^4 + 160x^3y + 600x^2y^2 + 1.000xy^3 + 625y^4$
5.  $(a-3)^6 = a^6 - 6a^5(3) + \frac{6 \cdot 5}{2}a^4(3)^2 - \frac{15 \cdot 4}{3}a^3(3)^3 + \frac{20 \cdot 3}{4}a^2(3)^4 - \frac{15 \cdot 2}{5}a(3)^5 + (3)^6$   
 $= a^6 - 18a^5 + 135a^4 - 540a^3 + 1.215a^2 - 1.458a + 729$
6.  $(2a-b)^6 = (2a)^6 - 6(2a)^5b + \frac{6 \cdot 5}{2}(2a)^4b^2 - \frac{15 \cdot 4}{3}(2a)^3b^3 + \frac{20 \cdot 3}{4}(2a)^2b^4 - \frac{15 \cdot 2}{5}(2a)b^5 + b^6$   
 $= 64a^6 - 192a^5b + 240a^4b^2 - 160a^3b^3 + 60a^2b^4 - 12ab^5 + b^6$
7.  $(x^2+2y^3)^5 = (x^2)^5 + 5(x^2)^4(2y^3) + \frac{5 \cdot 4}{2}(x^2)^3(2y^3)^2 + \frac{10 \cdot 3}{3}(x^2)^2(2y^3)^3 + \frac{10 \cdot 2}{4}(x^2)(2y^3)^4 + (2y^3)^5$   
 $= x^{10} + 10x^8y^3 + 40x^6y^6 + 80x^4y^9 + 80x^2y^{12} + 32y^{15}$
8.  $(x^3+1)^6 = (x^3)^6 + 6(x^3)^5(1) + \frac{6 \cdot 5}{2}(x^3)^4(1)^2 + \frac{15 \cdot 4}{3}(x^3)^3(1)^3 + \frac{20 \cdot 3}{4}(x^3)^2(1)^4 + \frac{15 \cdot 2}{5}(x^3)(1)^5 + (1)^6$   
 $= x^{18} + 6x^{15} + 15x^{12} + 20x^9 + 15x^6 + 6x^3 + 1$
9.  $(2a-3b)^5 = (2a)^5 - 5(2a)^4(3b) + \frac{5 \cdot 4}{2}(2a)^3(3b)^2 - \frac{10 \cdot 3}{3}(2a)^2(3b)^3 + \frac{10 \cdot 2}{4}(2a)(3b)^4 - (3b)^5$   
 $= 32a^5 - 240a^4b + 720a^3b^2 - 1.080a^2b^3 + 810ab^4 - 243b^5$
10.  $(x^4-5y^3)^6$   
 $= (x^4)^6 - 6(x^4)^5(5y^3) + \frac{6 \cdot 5}{2}(x^4)^4(5y^3)^2 - \frac{15 \cdot 4}{3}(x^4)^3(5y^3)^3 + \frac{20 \cdot 3}{4}(x^4)^2(5y^3)^4 - \frac{15 \cdot 2}{5}(x^4)(5y^3)^5 + (5y^3)^6$   
 $= x^{24} - 30x^{20}y^3 + 375x^{16}y^6 - 2.500x^{12}y^9 + 9.375x^8y^{12} - 18.750x^4y^{15} + 15.625y^{18}$
11.  $\left(2x - \frac{y}{2}\right)^6$   
 $= (2x)^6 - 6(2x)^5\left(\frac{y}{2}\right) + \frac{6 \cdot 5}{2}(2x)^4\left(\frac{y}{2}\right)^2 - \frac{15 \cdot 4}{3}(2x)^3\left(\frac{y}{2}\right)^3 + \frac{20 \cdot 3}{4}(2x)^2\left(\frac{y}{2}\right)^4 - \frac{15 \cdot 2}{5}(2x)\left(\frac{y}{2}\right)^5 + \left(\frac{y}{2}\right)^6$   
 $= 64x^6 - 96x^5y + 60x^4y^2 - 20x^3y^3 + \frac{15}{4}x^2y^4 - \frac{3}{8}xy^5 + \frac{y^6}{64}$
12.  $\left(3 - \frac{x^2}{3}\right)^5 = (3)^5 - 5(3)^4\left(\frac{x^2}{3}\right) + \frac{5 \cdot 4}{2}(3)^3\left(\frac{x^2}{3}\right)^2 - \frac{10 \cdot 3}{3}(3)^2\left(\frac{x^2}{3}\right)^3 + \frac{10 \cdot 2}{4}(3)\left(\frac{x^2}{3}\right)^4 - \left(\frac{x^2}{3}\right)^5$   
 $= 243 - 135x^2 + 30x^4 - \frac{10}{3}x^6 + \frac{5}{27}x^8 - \frac{x^{10}}{243}$
13.  $(2m^3-3n^4)^6 = (2m^3)^6 - 6(2m^3)^5(3n^4) + \frac{6 \cdot 5}{2}(2m^3)^4(3n^4)^2 - \frac{15 \cdot 4}{3}(2m^3)^3(3n^4)^3 + \frac{20 \cdot 3}{4}(2m^3)^2(3n^4)^4$   
 $- \frac{15 \cdot 2}{5}(2m^3)(3n^4)^5 + (3n^4)^6$   
 $= 64m^{18} - 576m^{15}n^4 + 2.160m^{12}n^8 - 4.320m^9n^{12} + 4.860m^6n^{16} - 2.916m^3n^{20} + 729n^{24}$

14.  $(x^2 - 3)^7$   
 $= (x^2)^7 - 7(x^2)^6(3) + \frac{7 \cdot 6}{2}(x^2)^5(3)^2 - \frac{21 \cdot 5}{3}(x^2)^4(3)^3 + \frac{35 \cdot 4}{4}(x^2)^3(3)^4 - \frac{35 \cdot 3}{5}(x^2)^2(3)^5 + \frac{21 \cdot 2}{6}(x^2)(3)^6 - (3)^7$   
 $= x^{14} - 21x^{12} + 189x^{10} - 945x^8 + 2.835x^6 - 5.103x^4 + 5.103x^2 - 2.187$
15.  $\left(3a - \frac{b^2}{3}\right)^5 = (3a)^5 - 5(3a)^4\left(\frac{b^2}{3}\right) + \frac{5 \cdot 4}{2}(3a)^3\left(\frac{b^2}{3}\right)^2 - \frac{10 \cdot 3}{3}(3a)^2\left(\frac{b^2}{3}\right)^3 + \frac{10 \cdot 2}{4}(3a)\left(\frac{b^2}{3}\right)^4 - \left(\frac{b^2}{3}\right)^5$   
 $= 243a^5 - 135a^4b^2 + 30a^3b^4 - \frac{10}{3}a^2b^6 + \frac{5}{27}ab^8 - \frac{b^{10}}{243}$
16.  $(x^2 + 2y^2)^7 = (x^2)^7 + 7(x^2)^6(2y^2) + \frac{7 \cdot 6}{2}(x^2)^5(2y^2)^2 + \frac{21 \cdot 5}{3}(x^2)^4(2y^2)^3 + \frac{35 \cdot 4}{4}(x^2)^3(2y^2)^4$   
 $+ \frac{35 \cdot 3}{5}(x^2)^2(2y^2)^5 + \frac{21 \cdot 2}{6}(x^2)(2y^2)^6 + (2y^2)^7$   
 $= x^{14} + 14x^{12}y^2 + 84x^{10}y^4 + 280x^8y^6 + 560x^6y^8 + 672x^4y^{10} + 448x^2y^{12} + 128y^{14}$
17.  $(x^3 - 1)^8 = (x^3)^8 - 8(x^3)^7(1) + \frac{8 \cdot 7}{2}(x^3)^6(1)^2 - \frac{28 \cdot 6}{3}(x^3)^5(1)^3 + \frac{56 \cdot 5}{4}(x^3)^4(1)^4 - \frac{70 \cdot 4}{5}(x^3)^3(1)^5$   
 $+ \frac{56 \cdot 3}{6}(x^3)^2(1)^6 - \frac{28 \cdot 2}{7}(x^3)(1)^7 + (1)^8$   
 $= x^{24} - 8x^{21} + 28x^{18} - 56x^{15} + 70x^{12} - 56x^9 + 28x^6 - 8x^3 + 1$
18.  $\left(x^2 - \frac{y}{2}\right)^9 = (x^2)^9 - 9(x^2)^8\left(\frac{y}{2}\right) + \frac{9 \cdot 8}{2}(x^2)^7\left(\frac{y}{2}\right)^2 - \frac{36 \cdot 7}{3}(x^2)^6\left(\frac{y}{2}\right)^3 + \frac{84 \cdot 6}{4}(x^2)^5\left(\frac{y}{2}\right)^4 - \frac{126 \cdot 5}{5}(x^2)^4\left(\frac{y}{2}\right)^5$   
 $+ \frac{126 \cdot 4}{6}(x^2)^3\left(\frac{y}{2}\right)^6 - \frac{84 \cdot 3}{7}(x^2)^2\left(\frac{y}{2}\right)^7 + \frac{36 \cdot 2}{8}(x^2)\left(\frac{y}{2}\right)^8 - \left(\frac{y}{2}\right)^9$   
 $= x^{18} - \frac{9}{2}x^{16}y + 9x^{14}y^2 - \frac{21}{2}x^{12}y^3 + \frac{63}{8}x^{10}y^4 - \frac{63}{16}x^8y^5 + \frac{21}{16}x^6y^6 - \frac{9}{32}x^4y^7 + \frac{9}{256}x^2y^8 - \frac{y^9}{512}$
19.  $(2m^3 - n^4)^7 = (2m^3)^7 - 7(2m^3)^6(n^4) + \frac{7 \cdot 6}{2}(2m^3)^5(n^4)^2 - \frac{21 \cdot 5}{3}(2m^3)^4(n^4)^3 + \frac{35 \cdot 4}{4}(2m^3)^3(n^4)^4$   
 $- \frac{35 \cdot 3}{5}(2m^3)^2(n^4)^5 + \frac{21 \cdot 2}{6}(2m^3)(n^4)^6 - (n^4)^7$   
 $= 128m^{21} - 448m^{18}n^4 + 672m^{15}n^8 - 560m^{12}n^{12} + 280m^9n^{16} - 84m^6n^{20} + 14m^3n^{24} - n^{28}$
20.  $\left(\frac{x^2}{2} + \frac{2y^2}{3}\right)^5$   
 $= \left(\frac{x^2}{2}\right)^5 + 5\left(\frac{x^2}{2}\right)^4\left(\frac{2y^2}{3}\right) + \frac{5 \cdot 4}{2}\left(\frac{x^2}{2}\right)^3\left(\frac{2y^2}{3}\right)^2 + \frac{10 \cdot 3}{3}\left(\frac{x^2}{2}\right)^2\left(\frac{2y^2}{3}\right)^3 + \frac{10 \cdot 2}{4}\left(\frac{x^2}{2}\right)\left(\frac{2y^2}{3}\right)^4 + \left(\frac{2y^2}{3}\right)^5$   
 $= \frac{x^{10}}{32} + \frac{5x^8y^2}{24} + \frac{5x^6y^4}{9} + \frac{20x^4y^6}{27} + \frac{40x^2y^8}{81} + \frac{32y^{10}}{243}$
21.  $\left(\frac{1}{5} - \frac{5a}{2}\right)^6 = \left(\frac{1}{5}\right)^6 - 6\left(\frac{1}{5}\right)^5\left(\frac{5a}{2}\right) + \frac{6 \cdot 5}{2}\left(\frac{1}{5}\right)^4\left(\frac{5a}{2}\right)^2 - \frac{15 \cdot 4}{3}\left(\frac{1}{5}\right)^3\left(\frac{5a}{2}\right)^3 + \frac{20 \cdot 3}{4}\left(\frac{1}{5}\right)^2\left(\frac{5a}{2}\right)^4$   
 $- \frac{15 \cdot 2}{5}\left(\frac{1}{5}\right)\left(\frac{5a}{2}\right)^5 + \left(\frac{5a}{2}\right)^6$   
 $= \frac{1}{15.625} - \frac{3a}{625} + \frac{3a^2}{20} - \frac{5a^3}{2} + \frac{375a^4}{16} - \frac{1.875a^5}{16} + \frac{15.625a^6}{64}$





$$\begin{aligned}
9. \left(\frac{2}{3x} - \frac{3}{2y}\right)^7 &= \left(\frac{2}{3x}\right)^7 - 7\left(\frac{2}{3x}\right)^6\left(\frac{3}{2y}\right) + 21\left(\frac{2}{3x}\right)^5\left(\frac{3}{2y}\right)^2 - 35\left(\frac{2}{3x}\right)^4\left(\frac{3}{2y}\right)^3 + 35\left(\frac{2}{3x}\right)^3\left(\frac{3}{2y}\right)^4 \\
&\quad - 21\left(\frac{2}{3x}\right)^2\left(\frac{3}{2y}\right)^5 + 7\left(\frac{2}{3x}\right)\left(\frac{3}{2y}\right)^6 - \left(\frac{3}{2y}\right)^7 \\
&= \frac{128}{2.187x^7} - \frac{224}{243x^6y} + \frac{56}{9x^5y^2} - \frac{70}{3x^4y^3} + \frac{105}{2x^3y^4} - \frac{567}{8x^2y^5} + \frac{1.701}{32xy^6} - \frac{2.187}{128y^7}
\end{aligned}$$

$$\begin{aligned}
10. \left(\frac{2}{m} - \frac{m^2}{2}\right)^7 &= \left(\frac{2}{m}\right)^7 - 7\left(\frac{2}{m}\right)^6\left(\frac{m^2}{2}\right) + 21\left(\frac{2}{m}\right)^5\left(\frac{m^2}{2}\right)^2 - 35\left(\frac{2}{m}\right)^4\left(\frac{m^2}{2}\right)^3 + 35\left(\frac{2}{m}\right)^3\left(\frac{m^2}{2}\right)^4 \\
&\quad - 21\left(\frac{2}{m}\right)^2\left(\frac{m^2}{2}\right)^5 + 7\left(\frac{2}{m}\right)\left(\frac{m^2}{2}\right)^6 - \left(\frac{m^2}{2}\right)^7 \\
&= \frac{128}{m^7} - \frac{224}{m^4} + \frac{168}{m} - 70m^2 + \frac{35m^5}{2} - \frac{21m^8}{8} + \frac{7m^{11}}{32} - \frac{m^{14}}{128}
\end{aligned}$$

$$\begin{aligned}
11. (x^3 + mn)^8 &= (x^3)^8 + 8(x^3)^7 mn + 28(x^3)^6 (mn)^2 + 56(x^3)^5 (mn)^3 + 70(x^3)^4 (mn)^4 + 56(x^3)^3 (mn)^5 \\
&\quad + 28(x^3)^2 (mn)^6 + 8(x^3)(mn)^7 + (mn)^8 \\
&= x^{24} + 8x^{21}mn + 28x^{18}m^2n^2 + 56x^{15}m^3n^3 + 70x^{12}m^4n^4 + 56x^9m^5n^5 + 28x^6m^6n^6 + 8x^3m^7n^7 + m^8n^8
\end{aligned}$$

$$\begin{aligned}
12. \left(3 - \frac{b^2}{3}\right)^9 &= (3)^9 - 9(3)^8\left(\frac{b^2}{3}\right) + 36(3)^7\left(\frac{b^2}{3}\right)^2 - 84(3)^6\left(\frac{b^2}{3}\right)^3 + 126(3)^5\left(\frac{b^2}{3}\right)^4 - 126(3)^4\left(\frac{b^2}{3}\right)^5 \\
&\quad + 84(3)^3\left(\frac{b^2}{3}\right)^6 - 36(3)^2\left(\frac{b^2}{3}\right)^7 + 9(3)\left(\frac{b^2}{3}\right)^8 - \left(\frac{b^2}{3}\right)^9 \\
&= 19.683 - 19.683b^2 + 8.748b^4 - 2.268b^6 + 378b^8 - 42b^{10} + \frac{28b^{12}}{9} - \frac{4b^{14}}{27} + \frac{b^{16}}{243} - \frac{b^{18}}{19.683}
\end{aligned}$$

$$\begin{aligned}
13. \left(1 - \frac{1}{x}\right)^{10} &= (1)^{10} - 10(1)^9\left(\frac{1}{x}\right) + 45(1)^8\left(\frac{1}{x}\right)^2 - 120(1)^7\left(\frac{1}{x}\right)^3 + 210(1)^6\left(\frac{1}{x}\right)^4 - 252(1)^5\left(\frac{1}{x}\right)^5 + 210(1)^4\left(\frac{1}{x}\right)^6 \\
&\quad - 120(1)^3\left(\frac{1}{x}\right)^7 + 45(1)^2\left(\frac{1}{x}\right)^8 - 10(1)\left(\frac{1}{x}\right)^9 + \left(\frac{1}{x}\right)^{10} \\
&= 1 - \frac{10}{x} + \frac{45}{x^2} - \frac{120}{x^3} + \frac{210}{x^4} - \frac{252}{x^5} + \frac{210}{x^6} - \frac{120}{x^7} + \frac{45}{x^8} - \frac{10}{x^9} + \frac{1}{x^{10}}
\end{aligned}$$

$$\begin{aligned}
14. (2m^2 - 5n^5)^6 &= (2m^2)^6 - 6(2m^2)^5(5n^5) + 15(2m^2)^4(5n^5)^2 - 20(2m^2)^3(5n^5)^3 + 15(2m^2)^2(5n^5)^4 \\
&\quad - 6(2m^2)(5n^5)^5 + (5n^5)^6 \\
&= 64m^{12} - 960m^{10}n^5 + 6.000m^8n^{10} - 20.000m^6n^{15} + 37.500m^4n^{20} - 37.500m^2n^{25} + 15.625n^{30}
\end{aligned}$$

$$\begin{aligned}
15. \left(4 - \frac{x^5}{4}\right)^7 &= (4)^7 - 7(4)^6\left(\frac{x^5}{4}\right) + 21(4)^5\left(\frac{x^5}{4}\right)^2 - 35(4)^4\left(\frac{x^5}{4}\right)^3 + 35(4)^3\left(\frac{x^5}{4}\right)^4 - 21(4)^2\left(\frac{x^5}{4}\right)^5 + 7(4)\left(\frac{x^5}{4}\right)^6 - \left(\frac{x^5}{4}\right)^7 \\
&= 16.384 - 7.168x^5 + 1.344x^{10} - 140x^{15} + \frac{35x^{20}}{4} - \frac{21x^{25}}{64} + \frac{7x^{30}}{1.024} - \frac{x^{35}}{16.384}
\end{aligned}$$

## EJERCICIO 212

1.  $(x-y)^5$  donde  $r=3$   

$$= \frac{5 \cdot 4}{1 \cdot 2} (x)^{5-2} (-y)^2 = 10x^3y^2$$
2.  $(a-4b)^7$  donde  $r=4$   

$$= \frac{7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3} (a)^{7-3} (-4b)^{4-1}$$

$$= 35a^4(-64b^3)$$

$$= -2.240a^4b^3$$
3.  $(1+x)^{11}$  donde  $r=5$   

$$= \frac{11 \cdot 10 \cdot 9 \cdot 8}{1 \cdot 2 \cdot 3 \cdot 4} (1)^{11-4} (x)^{5-1}$$

$$= 330x^4$$
4.  $(3x-2y)^6$  donde  $r=4$   

$$= \frac{6 \cdot 5 \cdot 4}{1 \cdot 2 \cdot 3} (3x)^{6-3} (-2y)^{4-1}$$

$$= 20(27x^3)(-8y^3)$$

$$= -4.320x^3y^3$$
5.  $(a^2-2b)^9$  donde  $r=5$   

$$= \frac{9 \cdot 8 \cdot 7 \cdot 6}{1 \cdot 2 \cdot 3 \cdot 4} (a^2)^{9-4} (-2b)^{5-1}$$

$$= 126(a^{10})(16b^4)$$

$$= 2.016a^{10}b^4$$
6.  $\left(2a - \frac{b}{2}\right)^8$  donde  $r=6$   

$$= \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} (2a)^{8-5} \left(-\frac{b}{2}\right)^{6-1}$$

$$= 56(8a^3) \left(-\frac{b^5}{32}\right)$$

$$= -14a^3b^5$$
7.  $(x^2-2y)^{10}$  donde  $r=7$   

$$= \frac{10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6} (x^2)^{10-6} (-2y)^{7-1}$$

$$= 210(x^8)(64y^6)$$

$$= 13.440x^8y^6$$
8.  $(x-y^2)^{11}$  donde  $r=8$   

$$= \frac{11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7} (x)^{11-7} (-y^2)^{8-1}$$

$$= 330x^4(-y^{14})$$

$$= -330x^4y^{14}$$
9.  $(a^2+b)^{15}$  donde  $r=10$   

$$= \frac{15 \cdot 14 \cdot 13 \cdot 12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9} (a^2)^{15-9} (b)^{10-1}$$

$$= 5.005a^{12}b^9$$
10.  $(1-x^2)^{12}$  donde  $r=9$   

$$= \frac{12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8} (1)^{12-8} (-x^2)^{9-1}$$

$$= 495x^{16}$$
11.  $(2a-b^2)^6$  donde  $r=6$   

$$= \frac{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} (2a)^{6-5} (-b^2)^{6-1}$$

$$= 6(2a)(-b^{10})$$

$$= -12ab^{10}$$
12.  $(3x^2-y^2)^8$  donde  $r=5$   

$$= \frac{8 \cdot 7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4} (3x^2)^{8-4} (-y^2)^{5-1}$$

$$= 70(81x^8)(y^8)$$

$$= 5.670x^8y^8$$

## EJERCICIO 213

1.  $\sqrt{4a^2b^4} = \pm 2ab^2$
2.  $\sqrt{25x^6y^8} = \pm 5x^3y^4$
3.  $\sqrt[3]{27a^3b^9} = 3ab^3$
4.  $\sqrt[3]{-8a^3b^6x^{12}} = -2ab^2x^4$
5.  $\sqrt{64x^8y^{10}} = \pm 8x^4y^5$
6.  $\sqrt[4]{16a^8b^{16}} = \pm 2a^2b^4$
7.  $\sqrt[5]{x^{15}y^{20}z^{25}} = x^3y^4z^5$
8.  $\sqrt[3]{-64a^3x^6y^{18}} = -4ax^2y^6$
9.  $\sqrt[5]{-243m^5n^{15}} = -3mn^3$
10.  $\sqrt{81x^6y^8z^{20}} = \pm 9x^3y^4z^{10}$
11.  $\sqrt[3]{1.000x^9y^{18}} = 10x^3y^6$
12.  $\sqrt[4]{81a^{12}b^{24}} = \pm 3a^3b^6$
13.  $\sqrt[6]{64a^{12}b^{18}c^{30}} = \pm 2a^2b^3c^5$
14.  $\sqrt{49a^{2n}b^{4n}} = \pm 7a^n b^{2n}$
15.  $\sqrt[5]{-x^{5n}y^{10x}} = -x^n y^{2x}$
16.  $\sqrt{\frac{9a^2}{25x^4}} = \pm \frac{3a}{5x^2}$
17.  $\sqrt[3]{\frac{27a^3}{64x^9}} = -\frac{3a}{4x^3}$
18.  $\sqrt[5]{\frac{a^5b^{10}}{32x^{15}}} = -\frac{ab^2}{2x^3}$
19.  $\sqrt[4]{\frac{a^8}{81b^4c^{12}}} = \pm \frac{a^2}{3bc^3}$
20.  $\sqrt[7]{\frac{128}{x^{14}}} = \frac{2}{x^2}$
21.  $\sqrt{\frac{x^{2m}}{121y^{4n}}} = \pm \frac{x^m}{11y^{2n}}$
22.  $\sqrt[3]{\frac{125x^9}{216m^{12}}} = -\frac{5x^3}{6m^4}$
23.  $\sqrt[9]{\frac{a^{18}}{b^9c^{27}}} = \frac{a^2}{bc^3}$
24.  $\sqrt[10]{1.024y^{30}} = \pm \frac{x^2}{2y^3}$

## EJERCICIO 214

$$\begin{array}{r|l}
 \sqrt{16x^2 - 24xy^2 + 9y^4} & 4x - 3y^2 \\
 \hline
 -16x^2 & (8x - 3y^2)(-3y^2) \\
 \hline
 -24xy^2 + 9y^4 & = -24xy^2 + 9y^4 \\
 \hline
 24xy^2 - 9y^4 & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{25a^4 - 70a^3x + 49a^2x^2} & 5a^2 - 7ax \\
 \hline
 -25a^4 & (10a^2 - 7ax)(-7ax) \\
 \hline
 -70a^3x + 49a^2x^2 & = -70a^3x + 49a^2x^2 \\
 \hline
 70a^3x - 49a^2x^2 & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{x^4 - 4x^3 + 6x^2 - 4x + 1} & x^2 - 2x + 1 \\
 \hline
 -x^4 & (2x^2 - 2x)(-2x) \\
 \hline
 -4x^3 + 6x^2 & = -4x^3 + 4x^2 \\
 \hline
 4x^3 - 4x^2 & \\
 \hline
 2x^2 - 4x + 1 & (2x^2 - 4x + 1)(1) \\
 \hline
 -2x^2 + 4x - 1 & = 2x^2 - 4x + 1 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{4a^4 + 4a^3 + 5a^2 + 2a + 1} & 2a^2 + a + 1 \\
 \hline
 -4a^4 & (4a^2 + a)(a) \\
 \hline
 4a^3 + 5a^2 & = 4a^3 + a^2 \\
 \hline
 -4a^3 - a^2 & \\
 \hline
 4a^2 + 2a + 1 & (4a^2 + 2a + 1)(1) \\
 \hline
 -4a^2 - 2a - 1 & = 4a^2 + 2a + 1 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{n^4 - 10n^3 + 29n^2 - 20n + 4} & n^2 - 5n + 2 \\
 \hline
 -n^4 & (2n^2 - 5n)(-5n) \\
 \hline
 -10n^3 + 29n^2 & = -10n^3 + 25n^2 \\
 \hline
 10n^3 - 25n^2 & \\
 \hline
 4n^2 - 20n + 4 & (2n^2 - 10n + 2)(2) \\
 \hline
 -4n^2 + 20n - 4 & = 4n^2 - 20n + 4 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{x^6 - 10x^5 + 25x^4 + 12x^3 - 60x^2 + 36} & x^3 - 5x^2 + 6 \\
 \hline
 -x^6 & (2x^3 - 5x^2)(-5x^2) \\
 \hline
 -10x^5 + 25x^4 & = -10x^5 + 25x^4 \\
 10x^5 - 25x^4 & \\
 \hline
 12x^3 - 60x^2 + 36 & (2x^3 - 10x^2 + 6)(6) \\
 -12x^3 + 60x^2 - 36 & = 12x^3 - 60x^2 + 36 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{16a^8 - 24a^6 + 49a^4 - 30a^2 + 25} & 4a^4 - 3a^2 + 5 \\
 \hline
 -16a^8 & (8a^4 - 3a^2)(-3a^2) \\
 \hline
 -24a^6 + 49a^4 & = -24a^6 + 9a^4 \\
 24a^6 - 9a^4 & \\
 \hline
 40a^4 - 30a^2 + 25 & (8a^4 - 6a^2 + 5)(5) \\
 -40a^4 + 30a^2 - 25 & = 40a^4 - 30a^2 + 25 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{x^2 + 4xy - 2xz - 4yz + 4y^2 + z^2} & x + 2y - z \\
 \hline
 -x^2 & (2x + 2y)(2y) \\
 \hline
 4xy - 2xz & + 4y^2 \\
 & = 4xy + 4y^2 \\
 -4xy & - 4y^2 \\
 \hline
 -2xz - 4yz & + z^2 \\
 2xz + 4yz & - z^2 \\
 \hline
 0 & (2x + 4y - z)(-z) \\
 & = -2xz - 4yz + z^2
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{x^{12} + 2x^9 - 5x^6 - 6x^3 + 9} & x^6 + x^3 - 3 \\
 \hline
 -x^{12} & (2x^6 + x^3)(x^3) \\
 \hline
 2x^9 - 5x^6 & = 2x^9 + x^6 \\
 -2x^9 + x^6 & \\
 \hline
 -6x^6 - 6x^3 + 9 & (2x^6 + 2x^3 - 3)(-3) \\
 6x^6 + 6x^3 - 9 & = -6x^6 - 6x^3 + 9 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 \sqrt{25x^8 - 70x^6 + 30x^5 + 49x^4 - 42x^3 + 9x^2} & 5x^4 - 7x^2 + 3x \\
 \hline
 -25x^8 & (10x^4 - 7x^2)(-7x^2) \\
 \hline
 -70x^6 + 30x^5 + 49x^4 & = -70x^6 + 49x^4 \\
 70x^6 & - 49x^4 \\
 \hline
 30x^5 & - 42x^3 + 9x^2 \\
 -30x^5 & + 42x^3 - 9x^2 \\
 \hline
 0 & (10x^4 - 14x^2 + 3x)(3x) \\
 & = 30x^5 - 42x^3 + 9x^2
 \end{array}$$

$$\begin{array}{l|l}
 11. \sqrt{4a^4 + 8a^3b - 8a^2b^2 - 12ab^3 + 9b^4} & 2a^2 + 2ab - 3b^2 \\
 \hline
 -4a^4 & (4a^2 + 2ab)(2ab) \\
 \hline
 8a^3b - 8a^2b^2 & = 8a^3b + 4a^2b^2 \\
 -8a^3b - 4a^2b^2 & \\
 \hline
 -12a^2b^2 - 12ab^3 + 9b^4 & (4a^2 + 4ab - 3b^2)(-3b^2) \\
 12a^2b^2 + 12ab^3 - 9b^4 & = -12a^2b^2 - 12ab^3 + 9b^4 \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{l|l}
 12. \sqrt{x^6 - 2x^5 + 3x^4 - x^2 + 2x + 1} & x^3 - x^2 + x + 1 \\
 \hline
 -x^6 & (2x^3 - x^2)(-x^2) \\
 \hline
 -2x^5 + 3x^4 & = -2x^5 + x^4 \\
 2x^5 - x^4 & \\
 \hline
 2x^4 - x^2 + 2x & (2x^3 - 2x^2 + x)(x) \\
 2x^3 - 2x^4 - x^2 & = 2x^4 - 2x^3 + x^2 \\
 2x^3 - 2x^2 + 2x + 1 & \\
 -2x^3 + 2x^2 - 2x - 1 & (2x^3 - 2x^2 + 2x + 1)(1) \\
 \hline
 0 & = 2x^3 - 2x^2 + 2x + 1
 \end{array}$$

$$\begin{array}{l|l}
 13. \sqrt{x^6 - 6x^5 + 5x^4 + 16x^3 - 8x^2 - 8x + 4} & x^3 - 3x^2 - 2x + 2 \\
 \hline
 -x^6 & (2x^3 - 3x^2)(-3x^2) \\
 \hline
 -6x^5 + 5x^4 & = -6x^5 + 9x^4 \\
 6x^5 - 9x^4 & \\
 \hline
 -4x^4 + 16x^3 - 8x^2 & (2x^3 - 6x^2 - 2x)(-2x) \\
 4x^4 - 12x^3 - 4x^2 & = -4x^4 + 12x^3 + 4x^2 \\
 \hline
 4x^3 - 12x^2 - 8x + 4 & \\
 -4x^3 + 12x^2 + 8x - 4 & (2x^3 - 6x^2 - 4x + 2)(2) \\
 \hline
 0 & = 4x^3 - 12x^2 - 8x + 4
 \end{array}$$

$$\begin{array}{l|l}
 14. \sqrt{x^8 + 6x^6 - 8x^5 + 19x^4 - 24x^3 + 46x^2 - 40x + 25} & x^4 + 3x^2 - 4x + 5 \\
 \hline
 -x^8 & (2x^4 + 3x^2)(3x^2) = 6x^6 + 9x^4 \\
 \hline
 6x^6 - 8x^5 + 19x^4 & (2x^4 + 6x^2 - 4x)(-4x) \\
 -6x^6 - 9x^4 & = -8x^5 - 24x^3 + 16x^2 \\
 \hline
 -8x^5 + 10x^4 - 24x^3 + 46x^2 & \\
 8x^5 + 24x^3 - 16x^2 & \\
 \hline
 10x^4 + 30x^2 - 40x + 25 & (2x^4 + 6x^2 - 8x + 5)(5) \\
 -10x^4 - 30x^2 + 40x - 25 & = 10x^4 + 30x^2 - 40x + 25 \\
 \hline
 0 & 
 \end{array}$$

<p><b>15.</b> <math>\sqrt{x^8 - 8x^7 + 16x^6 + 4x^5 - 22x^4 + 24x^3 + 4x^2 - 12x + 9}</math></p> $\begin{array}{r} -x^8 \\ \hline -8x^7 + 16x^6 \\ 8x^7 - 16x^6 \\ \hline 4x^5 - 22x^4 + 24x^3 + 4x^2 \\ -4x^5 + 16x^4 \qquad -4x^2 \\ \hline -6x^4 + 24x^3 \qquad -12x + 9 \\ 6x^4 - 24x^3 \qquad +12x - 9 \\ \hline 0 \end{array}$	$x^4 - 4x^3 + 2x - 3$ $(2x^4 - 4x^3)(-4x^3) = -8x^7 + 16x^6$ $(2x^4 - 8x^3 + 2x)(2x) = 4x^5 - 16x^4 + 4x^2$ $(2x^4 - 8x^3 + 4x - 3)(-3) = -6x^4 + 24x^3 - 12x + 9$
<p><b>16.</b> <math>\sqrt{9 - 36a + 42a^2 - 18a^3 + 13a^4 - 2a^5 + a^6}</math></p> $\begin{array}{r} -9 \\ \hline -36a + 42a^2 \\ 36a - 36a^2 \\ \hline 6a^2 - 18a^3 + 13a^4 \\ -6a^2 + 12a^3 - a^4 \\ \hline -6a^3 + 12a^4 - 2a^5 + a^6 \\ 6a^3 - 12a^4 + 2a^5 - a^6 \\ \hline 0 \end{array}$	$3 - 6a + a^2 - a^3$ $(6 - 6a)(-6a) = -36a + 36a^2$ $(6 - 12a + a^2)(a^2) = 6a^2 - 12a^3 + a^4$ $(6 - 12a + 2a^2 - a^3)(-a^3) = -6a^3 + 12a^4 - 2a^5 + a^6$
<p><b>17.</b> <math>\sqrt{9x^6 - 24x^5 + 28x^4 - 22x^3 + 12x^2 - 4x + 1}</math></p> $\begin{array}{r} -9x^6 \\ \hline -24x^5 + 28x^4 \\ 24x^5 - 16x^4 \\ \hline 12x^4 - 22x^3 + 12x^2 \\ -12x^4 + 16x^3 - 4x^2 \\ \hline -6x^3 + 8x^2 - 4x + 1 \\ 6x^3 - 8x^2 + 4x - 1 \\ \hline 0 \end{array}$	$3x^3 - 4x^2 + 2x - 1$ $(6x^3 - 4x^2)(-4x^2) = -24x^5 + 16x^4$ $(6x^3 - 8x^2 + 2x)(2x) = 12x^4 - 16x^3 + 4x^2$ $(6x^3 - 8x^2 + 4x - 1)(-1) = -6x^3 + 8x^2 - 4x + 1$
<p><b>18.</b> <math>\sqrt{16x^6 - 40x^5 + 73x^4 - 84x^3 + 66x^2 - 36x + 9}</math></p> $\begin{array}{r} -16x^6 \\ \hline -40x^5 + 73x^4 \\ 40x^5 - 25x^4 \\ \hline 48x^4 - 84x^3 + 66x^2 \\ -48x^4 + 60x^3 - 36x^2 \\ \hline -24x^3 + 30x^2 - 36x + 9 \\ 24x^3 - 30x^2 + 36x - 9 \\ \hline 0 \end{array}$	$4x^3 - 5x^2 + 6x - 3$ $(8x^3 - 5x^2)(-5x^2) = -40x^5 + 25x^4$ $(8x^3 - 10x^2 + 6x)(6x) = 48x^4 - 60x^3 + 36x^2$ $(8x^3 - 10x^2 + 12x - 3)(-3) = -24x^3 + 30x^2 - 36x + 9$

$$\begin{array}{l|l}
 19. \sqrt{m^6 - 4m^5n + 4m^4n^2 + 4m^3n^4 - 8m^2n^5 + 4n^8} & m^3 - 2m^2n + 2n^4 \\
 \hline
 -m^6 & (2m^3 - 2m^2n)(-2m^2n) \\
 \hline
 -4m^5n + 4m^4n^2 & = -4m^5n + 4m^4n^2 \\
 \hline
 4m^5n - 4m^4n^2 & \\
 \hline
 & 4m^3n^4 - 8m^2n^5 + 4n^8 \\
 & (2m^3 - 4m^2n + 2n^4)(2n^4) \\
 & = 4m^3n^4 - 8m^2n^5 + 4n^8 \\
 & \hline
 & -4m^3n^4 + 8m^2n^5 - 4n^8 \\
 & \hline
 & 0
 \end{array}$$

$$\begin{array}{l|l}
 20. \sqrt{9x^6 - 6x^5y + 13x^4y^2 - 16x^3y^3 + 8x^2y^4 - 8xy^5 + 4y^6} & 3x^3 - x^2y + 2xy^2 - 2y^3 \\
 \hline
 -9x^6 & (6x^3 - x^2y)(-x^2y) = -6x^5y + x^4y^2 \\
 \hline
 -6x^5y + 13x^4y^2 & \\
 \hline
 6x^5y - x^4y^2 & (6x^3 - 2x^2y + 2xy^2)(2xy^2) \\
 \hline
 12x^4y^2 - 16x^3y^3 + 8x^2y^4 & = 12x^4y^2 - 4x^3y^3 + 4x^2y^4 \\
 \hline
 -12x^4y^2 + 4x^3y^3 - 4x^2y^4 & \\
 \hline
 -12x^3y^3 + 4x^2y^4 - 8xy^5 + 4y^6 & (6x^3 - 2x^2y + 4xy^2 - 2y^3)(-2y^3) \\
 \hline
 12x^3y^3 - 4x^2y^4 + 8xy^5 - 4y^6 & = -12x^3y^3 + 4x^2y^4 - 8xy^5 + 4y^6 \\
 \hline
 & 0
 \end{array}$$

$$\begin{array}{l|l}
 21. \sqrt{16a^6 - 24a^5b + 25a^4b^2 - 20a^3b^3 + 10a^2b^4 - 4ab^5 + b^6} & 4a^3 - 3a^2b + 2ab^2 - b^3 \\
 \hline
 -16a^6 & (8a^3 - 3a^2b)(-3a^2b) = -24a^5b + 9a^4b^2 \\
 \hline
 -24a^5b + 25a^4b^2 & \\
 \hline
 24a^5b - 9a^4b^2 & (8a^3 - 6a^2b + 2ab^2)(2ab^2) \\
 \hline
 16a^4b^2 - 20a^3b^3 + 10a^2b^4 & = 16a^4b^2 - 12a^3b^3 + 4a^2b^4 \\
 \hline
 -16a^4b^2 + 12a^3b^3 - 4a^2b^4 & \\
 \hline
 -8a^3b^3 + 6a^2b^4 - 4ab^5 + b^6 & (8a^3 - 6a^2b + 4ab^2 - b^3)(-b^3) \\
 \hline
 8a^3b^3 - 6a^2b^4 + 4ab^5 - b^6 & = -8a^3b^3 + 6a^2b^4 - 4ab^5 + b^6 \\
 \hline
 & 0
 \end{array}$$

$$\begin{array}{l|l}
 22. \sqrt{36x^8 - 36x^6y^2 + 48x^5y^3 - 15x^4y^4 - 24x^3y^5 + 28x^2y^6 - 16xy^7 + 4y^8} & 6x^4 - 3x^2y^2 + 4xy^3 - 2y^4 \\
 \hline
 -36x^8 & (12x^4 - 3x^2y^2)(-3x^2y^2) = -36x^6y^2 + 9x^4y^4 \\
 \hline
 -36x^6y^2 + 48x^5y^3 - 15x^4y^4 & \\
 \hline
 36x^6y^2 - 9x^4y^4 & (12x^4 - 6x^2y^2 + 4xy^3)(4xy^3) \\
 \hline
 48x^5y^3 - 24x^4y^4 - 24x^3y^5 + 28x^2y^6 & = 48x^5y^3 - 24x^3y^5 + 16x^2y^6 \\
 \hline
 -48x^5y^3 + 24x^3y^5 - 16x^2y^6 & (12x^4 - 6x^2y^2 + 8xy^3 - 2y^4)(-2y^4) \\
 \hline
 -24x^4y^4 + 12x^2y^6 - 16xy^7 + 4y^8 & = -24x^4y^4 + 12x^2y^6 - 16xy^7 + 4y^8 \\
 \hline
 24x^4y^4 - 12x^2y^6 + 16xy^7 - 4y^8 & \\
 \hline
 & 0
 \end{array}$$



$  \begin{array}{r}  \sqrt{25a^6 - 40a^5x + 26a^4x^2 - 28a^3x^3 + 17a^2x^4 - 4ax^5 + 4x^6} \\  - 25a^6 \\  \hline  -40a^5x + 26a^4x^2 \\  40a^5x - 16a^4x^2 \\  \hline  10a^4x^2 - 28a^3x^3 + 17a^2x^4 \\  -10a^4x^2 + 8a^3x^3 - a^2x^4 \\  \hline  -20a^3x^3 + 16a^2x^4 - 4ax^5 + 4x^6 \\  20a^3x^3 - 16a^2x^4 + 4ax^5 - 4x^6 \\  \hline  0  \end{array}  $	$  \begin{array}{r}  \sqrt{a^3 - 4a^2x + ax^2 - 2x^3} \\  (10a^3 - 4a^2x)(-4a^2x) = -40a^5x + 16a^4x^2 \\  (10a^3 - 8a^2x + ax^2)(ax^2) = 10a^4x^2 - 8a^3x^3 + a^2x^4 \\  (10a^3 - 8a^2x + 2ax^2 - 2x^3)(-2x^3) \\  = -20a^3x^3 + 16a^2x^4 - 4ax^5 + 4x^6  \end{array}  $
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$  \begin{array}{r}  \sqrt{4a^8 - 12a^7 + 17a^6 - 16a^5 + 14a^4 - 10a^3 + 5a^2 - 2a + 1} \\  - 4a^8 \\  \hline  -12a^7 + 17a^6 \\  12a^7 - 9a^6 \\  \hline  8a^6 - 16a^5 + 14a^4 \\  -8a^6 + 12a^5 - 4a^4 \\  \hline  -4a^5 + 10a^4 - 10a^3 + 5a^2 \\  4a^5 - 6a^4 + 4a^3 - a^2 \\  \hline  4a^4 - 6a^3 + 4a^2 - 2a + 1 \\  -4a^4 + 6a^3 - 4a^2 + 2a - 1 \\  \hline  0  \end{array}  $	$  \begin{array}{r}  \sqrt{2a^4 - 3a^3 + 2a^2 - a + 1} \\  (4a^4 - 3a^3)(-3a^3) = -12a^7 + 9a^6 \\  (4a^4 - 6a^3 + 2a^2)(2a^2) \\  = 8a^6 - 12a^5 + 4a^4 \\  (4a^4 - 6a^3 + 4a^2 - a)(-a) \\  = -4a^5 + 6a^4 - 4a^3 + a^2 \\  (4a^4 - 6a^3 + 4a^2 - 2a + 1)(1) \\  = 4a^4 - 6a^3 + 4a^2 - 2a + 1  \end{array}  $
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$  \begin{array}{r}  \sqrt{x^{10} - 2x^9 + 3x^8 - 4x^7 + 5x^6 - 8x^5 + 7x^4 - 6x^3 + 5x^2 - 4x + 4} \\  - x^{10} \\  \hline  -2x^9 + 3x^8 \\  2x^9 - x^8 \\  \hline  2x^8 - 4x^7 + 5x^6 \\  -2x^8 + 2x^7 - x^6 \\  \hline  -2x^7 + 4x^6 - 8x^5 + 7x^4 \\  2x^7 - 2x^6 + 2x^5 - x^4 \\  \hline  2x^6 - 6x^5 + 6x^4 - 6x^3 + 5x^2 \\  -2x^6 + 2x^5 - 2x^4 + 2x^3 - x^2 \\  \hline  -4x^5 + 4x^4 - 4x^3 + 4x^2 - 4x + 4 \\  4x^5 - 4x^4 + 4x^3 - 4x^2 + 4x - 4 \\  \hline  0  \end{array}  $	$  \begin{array}{r}  \sqrt{x^5 - x^4 + x^3 - x^2 + x - 2} \\  (2x^5 - x^4)(-x^4) = -2x^9 + x^8 \\  (2x^5 - 2x^4 + x^3)(x^3) = 2x^8 - 2x^7 + x^6 \\  (2x^5 - 2x^4 + 2x^3 - x^2)(-x^2) \\  = -2x^7 + 2x^6 - 2x^5 + x^4 \\  (2x^5 - 2x^4 + 2x^3 - 2x^2 + x)(x) \\  = 2x^6 - 2x^5 + 2x^4 - 2x^3 + x^2 \\  (2x^5 - 2x^4 + 2x^3 - 2x^2 + 2x - 2)(-2) \\  = -4x^5 + 4x^4 - 4x^3 + 4x^2 - 4x + 4  \end{array}  $
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## EJERCICIO 215

$$\begin{array}{r|l}
 1. \sqrt{\frac{x^4}{4} - x^3 + \frac{5x^2}{3} - \frac{4x}{3} + \frac{4}{9}} & \frac{x^2}{2} - x + \frac{2}{3} \\
 \hline
 -\frac{x^4}{4} & \\
 \hline
 -x^3 + \frac{5x^2}{3} & (x^2 - x)(-x) = -x^3 + x^2 \\
 \hline
 x^3 - x^2 & \left(x^2 - 2x + \frac{2}{3}\right)\left(\frac{2}{3}\right) = \frac{2x^2}{3} - \frac{4x}{3} + \frac{4}{9} \\
 \hline
 \frac{2x^2}{3} - \frac{4x}{3} + \frac{4}{9} & \\
 \hline
 -\frac{2x^2}{3} + \frac{4x}{3} - \frac{4}{9} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 2. \sqrt{\frac{a^2}{x^2} - \frac{2a}{3x} + \frac{19}{9} - \frac{2x}{3a} + \frac{x^2}{a^2}} & \frac{a}{x} - \frac{1}{3} + \frac{x}{a} \\
 \hline
 -\frac{a^2}{x^2} & \left(\frac{2a}{x} - \frac{1}{3}\right)\left(-\frac{1}{3}\right) = -\frac{2a}{3x} + \frac{1}{9} \\
 \hline
 -\frac{2a}{3x} + \frac{19}{9} & \\
 \hline
 \frac{2a}{3x} - \frac{1}{9} & \left(\frac{2a}{x} - \frac{2}{3} + \frac{x}{a}\right)\left(\frac{x}{a}\right) = 2 - \frac{2x}{3a} + \frac{x^2}{a^2} \\
 \hline
 2 - \frac{2x}{3a} + \frac{x^2}{a^2} & \\
 \hline
 -2 + \frac{2x}{3a} - \frac{x^2}{a^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 3. \sqrt{\frac{a^2}{4} - ab + b^2 + \frac{ac}{4} - \frac{bc}{2} + \frac{c^2}{16}} & \frac{a}{2} - b + \frac{c}{4} \\
 \hline
 -\frac{a^2}{4} & (a-b)(-b) = -ab + b^2 \\
 \hline
 -ab + b^2 & \\
 \hline
 ab - b^2 & \left(a - 2b + \frac{c}{4}\right)\left(\frac{c}{4}\right) = \frac{ac}{4} - \frac{bc}{2} + \frac{c^2}{16} \\
 \hline
 \frac{ac}{4} - \frac{bc}{2} + \frac{c^2}{16} & \\
 \hline
 -\frac{ac}{4} + \frac{bc}{2} - \frac{c^2}{16} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 4. \sqrt{\frac{9a^4}{16} - \frac{3a^3}{4} + \frac{29a^2}{20} - \frac{4a}{5} + \frac{16}{25}} & \frac{3a^2}{4} - \frac{a}{2} + \frac{4}{5} \\
 \hline
 -\frac{9a^4}{16} & \left(\frac{3a^2}{2} - \frac{a}{2}\right)\left(-\frac{a}{2}\right) = -\frac{3a^3}{4} + \frac{a^2}{4} \\
 \hline
 -\frac{3a^3}{4} + \frac{29a^2}{20} & \\
 \hline
 \frac{3a^3}{4} - \frac{a^2}{4} & \left(\frac{3a^2}{2} - a + \frac{4}{5}\right)\left(\frac{4}{5}\right) = \frac{6a^2}{5} - \frac{4a}{5} + \frac{16}{25} \\
 \hline
 \frac{6a^2}{5} - \frac{4a}{5} + \frac{16}{25} & \\
 \hline
 -\frac{6a^2}{5} + \frac{4a}{5} - \frac{16}{25} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 5. \sqrt{\frac{a^4}{16} + \frac{a^3b}{2} + \frac{3a^2b^2}{4} - ab^3 + \frac{b^4}{4}} & \frac{a^2}{4} + ab - \frac{b^2}{2} \\
 \hline
 -\frac{a^4}{16} & \left(\frac{a^2}{2} + ab\right)(ab) = \frac{a^3b}{2} + a^2b^2 \\
 \hline
 \frac{a^3b}{2} + \frac{3a^2b^2}{4} & \\
 \hline
 -\frac{a^3b}{2} - a^2b^2 & \left(\frac{a^2}{2} + 2ab - \frac{b^2}{2}\right)\left(-\frac{b^2}{2}\right) = -\frac{a^2b^2}{4} - ab^3 + \frac{b^4}{4} \\
 \hline
 -\frac{a^2b^2}{4} - ab^3 + \frac{b^4}{4} & \\
 \hline
 \frac{a^2b^2}{4} + ab^3 - \frac{b^4}{4} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 6. \sqrt{\frac{x^2}{25} + \frac{2x}{3} - 2xy + \frac{25}{9} - \frac{50y}{3} + 25y^2} & \frac{x}{5} + \frac{5}{3} - 5y \\
 \hline
 -\frac{x^2}{25} & \left(\frac{2x}{5} + \frac{5}{3}\right)\left(\frac{5}{3}\right) = \frac{2x}{3} + \frac{25}{9} \\
 \hline
 \frac{2x}{3} - 2xy + \frac{25}{9} & \\
 \hline
 -\frac{2x}{3} - \frac{25}{9} & \left(\frac{2x}{5} + \frac{10}{3} - 5y\right)(-5y) = -2xy - \frac{50y}{3} + 25y^2 \\
 \hline
 -2xy - \frac{50y}{3} + 25y^2 & \\
 \hline
 2xy + \frac{50y}{3} - 25y^2 & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 7. \sqrt{\frac{x^4}{9} - \frac{4x^3y}{3} + \frac{62x^2y^2}{15} - \frac{4xy^3}{5} + \frac{y^4}{25}} & \frac{x^2}{3} - 2xy + \frac{y^2}{5} \\
 \hline
 -\frac{x^4}{9} & \left(\frac{2x^2}{3} - 2xy\right)(-2xy) = -\frac{4x^3y}{3} + 4x^2y^2 \\
 \hline
 -\frac{4x^3y}{3} + \frac{62x^2y^2}{15} - \frac{4xy^3}{5} & \\
 \hline
 \frac{4x^3y}{3} - 4x^2y^2 & \left(\frac{2x^2}{3} - 4xy + \frac{y^2}{5}\right)\left(\frac{y^2}{5}\right) = \frac{2x^2y^2}{15} - \frac{4xy^3}{5} + \frac{y^4}{25} \\
 \hline
 \frac{2x^2y^2}{15} - \frac{4xy^3}{5} + \frac{y^4}{25} & \\
 \hline
 -\frac{2x^2y^2}{15} + \frac{4xy^3}{5} - \frac{y^4}{25} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 8. \sqrt{\frac{a^4}{16} - \frac{3a^2}{10} + \frac{9}{25} + \frac{a^2b^2}{18} - \frac{2b^2}{15} + \frac{b^4}{81}} & \frac{a^2}{4} - \frac{3}{5} + \frac{b^2}{9} \\
 \hline
 -\frac{a^4}{16} & \left(\frac{a^2}{2} - \frac{3}{5}\right)\left(-\frac{3}{5}\right) = -\frac{3a^2}{10} + \frac{9}{25} \\
 \hline
 -\frac{3a^2}{10} + \frac{9}{25} & \\
 \hline
 \frac{3a^2}{10} - \frac{9}{25} & \left(\frac{a^2}{2} - \frac{6}{5} + \frac{b^2}{9}\right)\left(\frac{b^2}{9}\right) = \frac{a^2b^2}{18} - \frac{2b^2}{15} + \frac{b^4}{81} \\
 \hline
 \frac{a^2b^2}{18} - \frac{2b^2}{15} + \frac{b^4}{81} & \\
 \hline
 -\frac{a^2b^2}{18} + \frac{2b^2}{15} - \frac{b^4}{81} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 9. \sqrt{x^2 + 4x + 2 - \frac{4}{y} + \frac{1}{x^2}} & x + 2 - \frac{1}{x} \\
 \hline
 -x^2 & (2x+2)(2) = 4x+4 \\
 \hline
 4x+2 & \\
 \hline
 -4x-4 & \left(2x+4 - \frac{1}{x}\right)\left(-\frac{1}{x}\right) = -2 - \frac{4}{x} + \frac{1}{x^2} \\
 \hline
 -2 - \frac{4}{y} + \frac{1}{x^2} & \\
 \hline
 2 + \frac{4}{y} - \frac{1}{x^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{l|l}
 \sqrt{\frac{x^2}{9} - \frac{10x}{3} + \frac{79}{3} - \frac{20}{x} + \frac{4}{x^2}} & \frac{x}{3} - 5 + \frac{2}{x} \\
 \hline
 -\frac{x^2}{9} & \left(\frac{2x}{3} - 5\right)(-5) = -\frac{10x}{3} + 25 \\
 \hline
 -\frac{10x}{3} + \frac{79}{3} & \\
 \hline
 \frac{10x}{3} - 25 & \left(\frac{2x}{3} - 10 + \frac{2}{x}\right)\left(\frac{2}{x}\right) = \frac{4}{3} - \frac{20}{x} + \frac{4}{x^2} \\
 \hline
 \frac{4}{3} - \frac{20}{x} + \frac{4}{x^2} & \\
 \hline
 -\frac{4}{3} + \frac{20}{x} - \frac{4}{x^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{l|l}
 \sqrt{\frac{a^4}{4} - 5a^2 + 28 - \frac{30}{a^2} + \frac{9}{a^4}} & \frac{a^2}{2} - 5 + \frac{3}{a^2} \\
 \hline
 -\frac{a^4}{4} & (a^2 - 5)(-5) = -5a^2 + 25 \\
 \hline
 -5a^2 + 28 & \\
 \hline
 5a^2 - 25 & \left(a^2 - 10 + \frac{3}{a^2}\right)\left(\frac{3}{a^2}\right) = 3 - \frac{30}{a^2} + \frac{9}{a^4} \\
 \hline
 3 - \frac{30}{a^2} + \frac{9}{a^4} & \\
 \hline
 -3 + \frac{30}{a^2} - \frac{9}{a^4} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{l|l}
 \sqrt{\frac{a^4}{9} + \frac{2a^3}{3x} + \frac{a^2}{x^2} - \frac{2ax}{3} - 2 + \frac{x^2}{a^2}} & \frac{a^2}{3} + \frac{a}{x} - \frac{x}{a} \\
 \hline
 -\frac{a^4}{9} & \left(\frac{2a^2}{3} + \frac{a}{x}\right)\left(\frac{a}{x}\right) = \frac{2a^3}{3x} + \frac{a^2}{x^2} \\
 \hline
 \frac{2a^3}{3x} + \frac{a^2}{x^2} & \\
 \hline
 -\frac{2a^3}{3x} - \frac{a^2}{x^2} & \left(\frac{2a^2}{3} + \frac{2a}{x} - \frac{x}{a}\right)\left(-\frac{x}{a}\right) = -\frac{2ax}{3} - 2 + \frac{x^2}{a^2} \\
 \hline
 -\frac{2ax}{3} - 2 + \frac{x^2}{a^2} & \\
 \hline
 \frac{2ax}{3} + 2 - \frac{x^2}{a^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 13. \sqrt{\frac{9a^2}{x^2} - \frac{3a}{2x} + \frac{65}{16} - \frac{x}{3a} + \frac{4x^2}{9a^2}} & \frac{3a}{x} - \frac{1}{4} + \frac{2x}{3a} \\
 \hline
 -\frac{9a^2}{x^2} & \left(\frac{6a}{x} - \frac{1}{4}\right)\left(-\frac{1}{4}\right) = -\frac{3a}{2x} + \frac{1}{16} \\
 \hline
 -\frac{3a}{2x} + \frac{65}{16} & \\
 \hline
 \frac{3a}{2x} - \frac{1}{16} & \left(\frac{6a}{x} - \frac{1}{2} + \frac{2x}{3a}\right)\left(\frac{2x}{3a}\right) = 4 - \frac{x}{3a} + \frac{4x^2}{9a^2} \\
 \hline
 4 - \frac{x}{3a} + \frac{4x^2}{9a^2} & \\
 \hline
 -4 + \frac{x}{3a} - \frac{4x^2}{9a^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 14. \sqrt{9x^4 + 30x^2 + 55 + \frac{50}{x^2} + \frac{25}{x^4}} & 3x^2 + 5 + \frac{5}{x^2} \\
 \hline
 -9x^4 & (6x^2 + 5)(5) = 30x^2 + 25 \\
 \hline
 30x^2 + 55 & \\
 \hline
 -30x^2 - 25 & \left(6x^2 + 10 + \frac{5}{x^2}\right)\left(\frac{5}{x^2}\right) = 30 + \frac{50}{x^2} + \frac{25}{x^4} \\
 \hline
 30 + \frac{50}{x^2} + \frac{25}{x^4} & \\
 \hline
 -30 - \frac{50}{x^2} - \frac{25}{x^4} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{r|l}
 15. \sqrt{\frac{4a^2}{25x^2} - \frac{2a}{5x} + \frac{19}{12} - \frac{5x}{3a} + \frac{25x^2}{9a^2}} & \frac{2a}{5x} - \frac{1}{2} + \frac{5x}{3a} \\
 \hline
 -\frac{4a^2}{25x^2} & \left(\frac{4a}{5x} - \frac{1}{2}\right)\left(-\frac{1}{2}\right) = -\frac{2a}{5x} + \frac{1}{4} \\
 \hline
 -\frac{2a}{5x} + \frac{19}{12} & \\
 \hline
 \frac{2a}{5x} - \frac{1}{4} & \left(\frac{4a}{5x} - 1 + \frac{5x}{3a}\right)\left(\frac{5x}{3a}\right) = \frac{4}{3} - \frac{5x}{3a} + \frac{25x^2}{9a^2} \\
 \hline
 \frac{4}{3} - \frac{5x}{3a} + \frac{25x^2}{9a^2} & \\
 \hline
 -\frac{4}{3} + \frac{5x}{3a} - \frac{25x^2}{9a^2} & \\
 \hline
 0 & 
 \end{array}$$

$$\begin{array}{l}
 16. \sqrt{\frac{x^4}{16} - \frac{x^3y}{4} + \frac{3x^2y^2}{20} + \frac{xy^3}{5} + \frac{y^4}{25}} \quad \frac{x^2}{4} - \frac{xy}{2} - \frac{y^2}{5} \\
 \hline
 -\frac{x^4}{16} \\
 \hline
 -\frac{x^3y}{4} + \frac{3x^2y^2}{20} \\
 \frac{x^3y}{4} - \frac{x^2y^2}{4} \\
 \hline
 -\frac{x^2y^2}{10} + \frac{xy^3}{5} + \frac{y^4}{25} \\
 \frac{x^2y^2}{10} - \frac{xy^3}{5} - \frac{y^4}{25} \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{l}
 \left(\frac{x^2}{2} - \frac{xy}{2}\right)\left(-\frac{xy}{2}\right) = -\frac{x^3y}{4} + \frac{x^2y^2}{4} \\
 \\
 \left(\frac{x^2}{2} - xy - \frac{y^2}{5}\right)\left(-\frac{y^2}{5}\right) = -\frac{x^2y^2}{10} + \frac{xy^3}{5} + \frac{y^4}{25}
 \end{array}$$

$$\begin{array}{l}
 17. \sqrt{\frac{4a^2b^2}{49x^2y^2} - \frac{2ab}{7xy} + \frac{21}{20} - \frac{7xy}{5ab} + \frac{49x^2y^2}{25a^2b^2}} \quad \frac{2ab}{7xy} - \frac{1}{2} + \frac{7xy}{5ab} \\
 \hline
 -\frac{4a^2b^2}{49x^2y^2} \\
 \hline
 -\frac{2ab}{7xy} + \frac{21}{20} \\
 \frac{2ab}{7xy} - \frac{1}{4} \\
 \hline
 \frac{4}{5} - \frac{7xy}{5ab} + \frac{49x^2y^2}{25a^2b^2} \\
 -\frac{4}{5} + \frac{7xy}{5ab} - \frac{49x^2y^2}{25a^2b^2} \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{l}
 \left(\frac{4ab}{7xy} - \frac{1}{2}\right)\left(-\frac{1}{2}\right) = -\frac{2ab}{7xy} + \frac{1}{4} \\
 \\
 \left(\frac{4ab}{7xy} - 1 + \frac{7xy}{5ab}\right)\left(\frac{7xy}{5ab}\right) \\
 = \frac{4}{5} - \frac{7xy}{5ab} + \frac{49x^2y^2}{25a^2b^2}
 \end{array}$$

$$\begin{array}{l}
 18. \sqrt{\frac{9a^2x^2}{25m^2n^2} - \frac{6ax}{25mn} + \frac{23}{75} - \frac{4mn}{45ax} + \frac{4m^2n^2}{81a^2x^2}} \quad \frac{3ax}{5mn} - \frac{1}{5} + \frac{10mn}{45ax} \\
 \hline
 -\frac{9a^2x^2}{25m^2n^2} \\
 \hline
 -\frac{6ax}{25mn} + \frac{23}{75} \\
 \frac{6ax}{25mn} - \frac{1}{25} \\
 \hline
 \frac{20}{75} - \frac{4mn}{45ax} + \frac{4m^2n^2}{81a^2x^2} \\
 -\frac{20}{75} + \frac{4mn}{45ax} - \frac{4m^2n^2}{81a^2x^2} \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{l}
 \left(\frac{6ax}{5mn} - \frac{1}{5}\right)\left(-\frac{1}{5}\right) = -\frac{6ax}{25mn} + \frac{1}{25} \\
 \\
 \left(\frac{6ax}{5mn} - \frac{2}{5} + \frac{10mn}{45ax}\right)\left(\frac{10mn}{45ax}\right) \\
 = \frac{20}{75} - \frac{4mn}{45ax} + \frac{4m^2n^2}{81a^2x^2}
 \end{array}$$

$19. \sqrt{\frac{x^6}{4} - x^5 + \frac{5x^4}{3} + \frac{2x^3}{3} - \frac{32x^2}{9} + \frac{8x}{3} + 4}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{x^6}{4}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-x^5 + \frac{5x^4}{3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $x^5 - x^4$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{2x^4}{3} + \frac{2x^3}{3} - \frac{32x^2}{9}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{2x^4}{3} + \frac{4x^3}{3} - \frac{4x^2}{9}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $2x^3 - 4x^2 + \frac{8x}{3} + 4$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-2x^3 + 4x^2 - \frac{8x}{3} - 4$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $0$	$\frac{x^3}{2} - x^2 + \frac{2x}{3} + 2$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $(x^3 - x^2)(-x^2) = -x^5 + x^4$ $\left(x^3 - 2x^2 + \frac{2x}{3}\right)\left(\frac{2x}{3}\right) = \frac{2x^4}{3} - \frac{4x^3}{3} + \frac{4x^2}{9}$ $\left(x^3 - 2x^2 + \frac{4x}{3} + 2\right)(2) = 2x^3 - 4x^2 + \frac{8x}{3} + 4$
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$20. \sqrt{\frac{1}{4} - \frac{3a}{4} + \frac{59a^2}{48} - \frac{3a^3}{2} + \frac{43a^4}{36} - \frac{2a^5}{3} + \frac{1a^6}{4}}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{1}{4}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{3a}{4} + \frac{59a^2}{48}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{3a}{4} - \frac{9a^2}{16}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{2a^2}{3} - \frac{3a^3}{2} + \frac{43a^4}{36}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{2a^2}{3} + a^3 - \frac{4a^4}{9}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{a^3}{2} + \frac{3a^4}{4} - \frac{2a^5}{3} + \frac{a^6}{4}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{a^3}{2} - \frac{3a^4}{4} + \frac{2a^5}{3} - \frac{a^6}{4}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $0$	$\frac{1}{2} - \frac{3a}{4} + \frac{2a^2}{3} - \frac{a^3}{2}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\left(1 - \frac{3a}{4}\right)\left(-\frac{3a}{4}\right) = -\frac{3a}{4} + \frac{9a^2}{16}$ $\left(1 - \frac{3a}{2} + \frac{2a^2}{3}\right)\left(\frac{2a^2}{3}\right) = \frac{2a^2}{3} - a^3 + \frac{4a^4}{9}$ $\left(1 - \frac{3a}{2} + \frac{4a^2}{3} - \frac{a^3}{2}\right)\left(-\frac{a^3}{2}\right)$ $= -\frac{a^3}{2} + \frac{3a^4}{4} - \frac{2a^5}{3} + \frac{a^6}{4}$
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### EJERCICIO 216

$1. \sqrt[3]{8 - 36y + 54y^2 - 27y^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-8$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-36y + 54y^2 - 27y^3$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $36y - 54y^2 + 27y^3$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $0$	$2 - 3y$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $3(2)^2 = 12$ $3(2)^2(-3y) = -36y$ $3(2)(-3y)^2 = 54y^2$ $(-3y)^3 = -27y^3$
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$$\begin{array}{l|l}
2. \sqrt[3]{64a^6 + 240a^4b^2 + 300a^2b^4 + 125b^6} & 4a^2 + 5b^2 \\
\hline
-64a^6 & 3(4a^2)^2 = 48a^4 \\
\hline
240a^4b^2 + 300a^2b^4 + 125b^6 & 3(4a^2)^2(5b^2) = 240a^4b^2 \\
-240a^4b^2 - 300a^2b^4 - 125b^6 & 3(4a^2)(5b^2)^2 = 300a^2b^4 \\
\hline
0 & (5b^2)^3 = 125b^6
\end{array}$$

$$\begin{array}{l|l}
3. \sqrt[3]{x^6 + 3x^5 + 6x^4 + 7x^3 + 6x^2 + 3x + 1} & x^2 + x + 1 \\
\hline
-x^6 & 3(x^2)^2 = 3x^4 \\
\hline
3x^5 + 6x^4 + 7x^3 & 3(x^2)^2(x) = 3x^5 \\
-3x^5 - 3x^4 - x^3 & 3(x^2)(x^2) = 3x^4 \\
\hline
3x^4 + 6x^3 + 6x^2 + 3x + 1 & x^3 = x^3 \\
-3x^4 - 6x^3 - 6x^2 - 3x - 1 & 3(x^2 + x)^2 = 3x^4 + 6x^3 + 3x^2 \\
\hline
0 & 3(x^2 + x)^2(1) = 3x^4 + 6x^3 + 3x^2 \\
& 3(x^2 + x)(1)^2 = 3x^2 + 3x \\
& (1)^3 = 1
\end{array}$$

$$\begin{array}{l|l}
4. \sqrt[3]{8x^6 - 12x^5 - 6x^4 + 11x^3 + 3x^2 - 3x - 1} & 2x^2 - x - 1 \\
\hline
-8x^6 & 3(2x^2)^2 = 12x^4 \\
\hline
-12x^5 - 6x^4 + 11x^3 & 3(2x^2)^2(-x) = -12x^5 \\
12x^5 - 6x^4 + x^3 & 3(2x^2)(-x)^2 = 6x^4 \\
\hline
-12x^4 + 12x^3 + 3x^2 - 3x - 1 & (-x)^3 = -x^3 \\
12x^4 - 12x^3 - 3x^2 + 3x + 1 & \\
\hline
0 & 3(2x^2 - x)^2 = 12x^4 - 12x^3 + 3x^2 \\
& 3(2x^2 - x)^2(-1) = -12x^4 + 12x^3 - 3x^2 \\
& 3(2x^2 - x)(-1)^2 = 6x^2 - 3x \\
& (-1)^3 = -1
\end{array}$$

$$\begin{array}{l|l}
5. \sqrt[3]{1 - 9x + 33x^2 - 63x^3 + 66x^4 - 36x^5 + 8x^6} & 1 - 3x + 2x^2 \\
\hline
-1 & 3(1)^2 = 3 \\
\hline
-9x + 33x^2 - 63x^3 & 3(1)^2(-3x) = -9x \\
9x - 27x^2 + 27x^3 & 3(1)(-3x)^2 = 27x^2 \\
\hline
6x^2 - 36x^3 + 66x^4 - 36x^5 + 8x^6 & (-3x)^3 = -27x^3 \\
-6x^2 + 36x^3 - 66x^4 + 36x^5 - 8x^6 & \\
\hline
0 & 3(1 - 3x)^2 = 3 - 18x + 27x^2 \\
& 3(1 - 3x)^2(2x^2) = 6x^2 - 36x^3 + 54x^4 \\
& 3(1 - 3x)(2x^2)^2 = 12x^4 - 36x^5 \\
& (2x^2)^3 = 8x^6
\end{array}$$

$\begin{array}{r} \sqrt[3]{x^6 - 9x^5 + 33x^4 - 63x^3 + 66x^2 - 36x + 8} \\ - x^6 \\ \hline -9x^5 + 33x^4 - 63x^3 \\ 9x^5 - 27x^4 + 27x^3 \\ \hline 6x^4 - 36x^3 + 66x^2 - 36x + 8 \\ -6x^4 + 36x^3 - 66x^2 + 36x - 8 \\ \hline 0 \end{array}$	$x^2 - 3x + 2$ <hr/> $3(x^2)^2 = 3x^4$ $3(x^2)^2(-3x) = -9x^5$ $3(x^2)(-3x)^2 = 27x^4$ $(-3x)^3 = -27x^3$  $3(x^2 - 3x)^2 = 3x^4 - 18x^3 + 27x^2$ $3(x^2 - 3x)^2(2) = 6x^4 - 36x^3 + 54x^2$ $3(x^2 - 3x)(2)^2 = 12x^2 - 36x$ $(2)^3 = 8$
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$\begin{array}{r} \sqrt[3]{x^9 - 6x^8 + 12x^7 - 20x^6 + 48x^5 - 48x^4 + 48x^3 - 96x^2 - 64} \\ - x^9 \\ \hline -6x^8 + 12x^7 - 20x^6 \\ 6x^8 - 12x^7 + 8x^6 \\ \hline -12x^6 + 48x^5 - 48x^4 + 48x^3 - 96x^2 - 64 \\ 12x^6 - 48x^5 + 48x^4 - 48x^3 + 96x^2 + 64 \\ \hline 0 \end{array}$	$x^3 - 2x^2 - 4$ <hr/> $3(x^3)^2 = 3x^6$ $3(x^3)^2(-2x^2) = -6x^8$ $3(x^3)^3(-2x^2)^2 = 12x^7$ $(-2x^2)^3 = -8x^6$  $3(x^3 - 2x^2)^2 = 3x^6 - 12x^5 + 12x^4$ $3(x^3 - 2x^2)^2(-4) = -12x^6 + 48x^5 - 48x^4$ $3(x^3 - 2x^2)(-4)^2 = 48x^3 - 96x^2$ $(-4)^3 = -64$
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$\begin{array}{r} \sqrt[3]{x^{12} - 3x^{10} - 3x^8 + 11x^6 + 6x^4 - 12x^2 - 8} \\ - x^{12} \\ \hline -3x^{10} - 3x^8 + 11x^6 \\ 3x^{10} - 3x^8 + x^6 \\ \hline -6x^8 + 12x^6 + 6x^4 - 12x^2 - 8 \\ 6x^8 - 12x^6 - 6x^4 + 12x^2 + 8 \\ \hline 0 \end{array}$	$x^4 - x^2 - 2$ <hr/> $3(x^4)^2 = 3x^8$ $3(x^4)^2(-x^2) = -3x^{10}$ $3(x^4)(-x^2)^2 = 3x^8$ $(-x^2)^3 = -x^6$  $3(x^4 - x^2)^2 = 3x^8 - 6x^6 + 3x^4$ $3(x^4 - x^2)^2(-2) = -6x^8 + 12x^6 - 6x^4$ $3(x^4 - x^2)(-2)^2 = 12x^4 - 12x^2$ $(-2)^3 = -8$
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$\begin{array}{r} \sqrt[3]{8x^6 - 36x^5 + 66x^4 - 63x^3 + 33x^2 - 9x + 1} \\ - 8x^6 \\ \hline - 36x^5 + 66x^4 - 63x^3 \\ 36x^5 - 54x^4 + 27x^3 \\ \hline 12x^4 - 36x^3 + 33x^2 - 9x + 1 \\ - 12x^4 + 36x^3 - 33x^2 + 9x - 1 \\ \hline 0 \end{array}$	$\begin{array}{l} 2x^2 - 3x + 1 \\ \hline 3(2x^2)^2 = 12x^4 \\ 3(2x^2)^2(-3x) = -36x^5 \\ 3(2x^2)(-3x)^2 = 54x^4 \\ (-3x)^3 = -27x^3 \\ \hline 3(2x^2 - 3x)^2 = 12x^4 - 36x^3 + 27x^2 \\ 3(2x^2 - 3x)^2(1) = 12x^4 - 36x^3 + 27x^2 \\ 3(2x^2 - 3x)(1)^2 = 6x^2 - 9x \\ (1)^3 = 1 \end{array}$
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$\begin{array}{r} \sqrt{27a^6 - 135a^5 + 117a^4 + 235a^3 - 156a^2 - 240a - 64} \\ - 27a^6 \\ \hline - 135a^5 + 117a^4 + 235a^3 \\ 135a^5 - 225a^4 + 125a^3 \\ \hline - 108a^4 + 360a^3 - 156a^2 - 240a - 64 \\ 108a^4 - 360a^3 + 156a^2 + 240a + 64 \\ \hline 0 \end{array}$	$\begin{array}{l} 3a^2 - 5a - 4 \\ \hline 3(3a^2)^2 = 27a^4 \\ 3(3a^2)^2(-5a) = -135a^5 \\ 3(3a^2)(-5a)^2 = 225a^4 \\ (-5a)^3 = -125a^3 \\ \hline 3(3a^2 - 5a)^2 = 27a^4 - 90a^3 + 75a^2 \\ 3(3a^2 - 5a)^2(-4) = -108a^4 + 360a^3 - 300a^2 \\ 3(3a^2 - 5a)(-4)^2 = 144a^2 - 240a \\ (-4)^3 = -64 \end{array}$
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$\begin{array}{r} \sqrt[3]{a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6} \\ - a^6 \\ \hline - 6a^5b + 15a^4b^2 - 20a^3b^3 \\ 6a^5b - 12a^4b^2 + 8a^3b^3 \\ \hline 3a^4b^2 - 12a^3b^3 + 15a^2b^4 - 6ab^5 + b^6 \\ - 3a^4b^2 + 12a^3b^3 - 15a^2b^4 + 6ab^5 - b^6 \\ \hline 0 \end{array}$	$\begin{array}{l} a^2 - 2ab + b^2 \\ \hline 3(a^2)^2 = 3a^4 \\ 3(a^2)^2(-2ab) = -6a^5b \\ 3(a^2)(-2ab)^2 = 12a^4b^2 \\ (-2ab)^3 = -8a^3b^3 \\ \hline 3(a^2 - 2ab)^2 = 3a^4 - 12a^3b + 12a^2b^2 \\ 3(a^2 - 2ab)^2(b^2) = 3a^4b^2 - 12a^3b^3 + 12a^2b^4 \\ 3(a^2 - 2ab)(b^2)^2 = 3a^2b^4 - 6ab^5 \\ (b^2)^3 = b^6 \end{array}$
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$  \begin{array}{r}  \sqrt[3]{x^6 - 9x^5y + 42x^4y^2 - 117x^3y^3 + 210x^2y^4 - 225xy^5 + 125y^6} \\  \hline  -x^6 \\  \hline  -9x^5y + 42x^4y^2 - 117x^3y^3 \\  \hline  9x^5y - 27x^4y^2 + 27x^3y^3 \\  \hline  15x^4y^2 - 80x^3y^3 + 210x^2y^4 - 225xy^5 + 125y^6 \\  \hline  -15x^4y^2 + 80x^3y^3 - 210x^2y^4 + 225xy^5 - 125y^6 \\  \hline  0  \end{array}  $	$  \begin{array}{l}  x^2 - 3xy + 5y^2 \\  \hline  3(x^2)^2 = 3x^4 \\  3(x^2)^2(-3xy) = -9x^5y \\  3(x^2)(-3xy)^2 = 27x^4y^2 \\  (-3xy)^3 = -27x^3y^3 \\  \\  3(x^2 - 3xy)^2 = 3x^4 - 18x^3y + 27x^2y^2 \\  3(x^2 - 3xy)^2(5y^2) = 15x^4y^2 - 80x^3y^3 + 135x^2y^4 \\  3(x^2 - 3xy)(5y^2)^2 = 75x^2y^4 - 225xy^5 \\  (5y^2)^3 = 125y^6  \end{array}  $
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$  \begin{array}{r}  \sqrt{a^{12} - 3a^{10} + 15a^8 - 25a^6 + 60a^4 - 48a^2 + 64} \\  \hline  -a^{12} \\  \hline  -3a^{10} + 15a^8 - 25a^6 \\  \hline  3a^{10} - 3a^8 + a^6 \\  \hline  12a^8 - 24a^6 + 60a^4 - 48a^2 + 64 \\  \hline  -12a^8 + 24a^6 - 60a^4 + 48a^2 - 64 \\  \hline  0  \end{array}  $	$  \begin{array}{l}  a^4 - a^2 + 4 \\  \hline  3(a^4)^2 = 3a^8 \\  3(a^4)^2(-a^2) = -3a^{10} \\  3(a^4)(-a^2)^2 = 3a^8 \\  (-a^2)^3 = -a^6 \\  \\  3(a^4 - a^2)^2 = 3a^8 - 6a^6 + 3a^4 \\  3(a^4 - a^2)^2(4) = 12a^8 - 24a^6 + 12a^4 \\  3(a^4 - a^2)(4)^2 = 48a^4 - 48a^2 \\  (4)^3 = 64  \end{array}  $
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$  \begin{array}{r}  \sqrt[3]{a^9 - 9a^8x + 27a^7x^2 - 21a^6x^3 - 36a^5x^4 + 54a^4x^5 + 12a^3x^6 - 36a^2x^7 + 8x^9} \\  \hline  -a^9 \\  \hline  -9a^8x + 27a^7x^2 - 21a^6x^3 \\  \hline  9a^8x - 27a^7x^2 + 27a^6x^3 \\  \hline  6a^6x^3 - 36a^5x^4 + 54a^4x^5 + 12a^3x^6 - 36a^2x^7 + 8x^9 \\  \hline  -6a^6x^3 + 36a^5x^4 - 54a^4x^5 - 12a^3x^6 + 36a^2x^7 - 8x^9 \\  \hline  0  \end{array}  $	$  \begin{array}{l}  a^3 - 3a^2x + 2x^3 \\  \hline  3(a^3)^2 = 3a^6 \\  3(a^3)^2(-3a^2x) = -9a^8x \\  3(a^3)(-3a^2x)^2 = 27a^7x^2 \\  (-3a^2x)^3 = -27a^6x^3 \\  \\  3(a^3 - 3a^2x)^2 = 3a^6 - 18a^5x + 27a^4x^2 \\  3(a^3 - 3a^2x)^2(2x^3) = 6a^6x^3 - 36a^5x^4 + 54a^4x^5 \\  3(a^3 - 3a^2x)(2x^3)^2 = 12a^3x^6 - 36a^2x^7 \\  (2x^3)^3 = 8x^9  \end{array}  $
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$$15. \sqrt[3]{a^9 - 3a^8 + 6a^7 - 10a^6 + 12a^5 - 12a^4 + 10a^3 - 6a^2 + 3a - 1}$$

$$-a^9$$

$$-3a^8 + 6a^7 - 10a^6$$

$$3a^8 - 3a^7 + a^6$$

$$3a^7 - 9a^6 + 12a^5 - 12a^4 + 10a^3$$

$$-3a^7 + 6a^6 - 6a^5 + 3a^4 - a^3$$

$$-3a^6 + 6a^5 - 9a^4 + 9a^3 - 6a^2 + 3a - 1$$

$$3a^6 - 6a^5 + 9a^4 - 9a^3 + 6a^2 - 3a + 1$$

$$0$$

$$a^3 - a^2 + a - 1$$

$$3(a^3)^2 = 3a^6$$

$$3(a^3)^2(-a^2) = -3a^8$$

$$3(a^3)(-a^2)^2 = 3a^7$$

$$(-a^2)^3 = -a^6$$

$$3(a^3 - a^2)^2 = 3a^6 - 6a^5 + 3a^4$$

$$3(a^3 - a^2)^2(a) = 3a^7 - 6a^6 + 3a^5$$

$$3(a^3 - a^2)(a^2) = 3a^5 - 3a^4$$

$$(a^3)^3 = a^9$$

$$3(a^3 - a^2 + a)^2 = 3a^6 + 3a^4 + 3a^2 - 6a^5 + 6a^4 - 6a^3$$

$$3(a^3 - a^2 + a)^2(-1) = -3a^6 + 6a^5 - 9a^4 + 6a^3 - 3a^2$$

$$3(a^3 - a^2 + a)(-1)^2 = 3a^3 - 3a^2 + 3a$$

$$(-1)^3 = -1$$

$$16. \sqrt[3]{x^9 - 12x^8 + 54x^7 - 121x^6 + 180x^5 - 228x^4 + 179x^3 - 144x^2 + 54x - 27}$$

$$-x^9$$

$$-12x^8 + 54x^7 - 121x^6$$

$$12x^8 - 48x^7 + 64x^6$$

$$6x^7 - 57x^6 + 180x^5 - 228x^4 + 179x^3$$

$$-6x^7 + 48x^6 - 108x^5 + 48x^4 - 8x^3$$

$$-9x^6 + 72x^5 - 180x^4 + 171x^3 - 144x^2 + 54x - 27$$

$$9x^6 - 72x^5 + 180x^4 - 171x^3 + 144x^2 - 54x + 27$$

$$0$$

$$x^3 - 4x^2 + 2x - 3$$

$$3(x^3)^2 = 3x^6 \quad 3(x^3)^2(-4x^2) = -12x^8$$

$$3(x^3)(-4x^2)^2 = 48x^7 \quad (-4x^2)^3 = -64x^6$$

$$3(x^3 - 4x^2)^2 = 3x^6 - 24x^5 + 48x^4$$

$$3(x^3 - 4x^2)^2(2x) = 6x^7 - 48x^6 + 96x^5$$

$$3(x^3 - 4x^2)(2x)^2 = 12x^5 - 48x^4$$

$$(2x)^3 = 8x^3$$

$$3(x^3 - 4x^2 + 2x)^2 = 3x^6 + 48x^4 + 12x^2 - 24x^5 + 12x^4 - 48x^3$$

$$3(x^3 - 4x^2 + 2x)^2(-3) = -9x^6 - 144x^4 - 36x^2 + 72x^5 - 36x^4 + 144x^3$$

$$3(x^3 - 4x^2 + 2x)(-3)^2 = 27x^3 - 108x^2 + 54x$$

$$(-3)^3 = -27$$

## EJERCICIO 217

$1. \sqrt[3]{\frac{x^6}{8} - \frac{x^5}{4} + \frac{5x^4}{3} - \frac{55x^3}{27} + \frac{20x^2}{3} - 4x + 8}$ <hr style="border: 0.5px solid black;"/> $-\frac{x^6}{8}$ <hr style="border: 0.5px solid black;"/> $-\frac{x^5}{4} + \frac{5x^4}{3} - \frac{55x^3}{27}$ <hr style="border: 0.5px solid black;"/> $\frac{x^5}{4} - \frac{x^4}{6} + \frac{x^3}{27}$ <hr style="border: 0.5px solid black;"/> $\frac{3x^4}{2} - 2x^3 + \frac{20x^2}{3} - 4x + 8$ <hr style="border: 0.5px solid black;"/> $-\frac{3x^4}{2} + 2x^3 - \frac{20x^2}{3} + 4x - 8$ <hr style="border: 0.5px solid black;"/> $0$	$\frac{x^2}{2} - \frac{x}{3} + 2$ <hr style="border: 0.5px solid black;"/> $3\left(\frac{x^2}{2}\right)^2 = \frac{3x^4}{4}$ $3\left(\frac{x^2}{2}\right)^2\left(-\frac{x}{3}\right) = -\frac{x^5}{4}$ $3\left(\frac{x^2}{2}\right)\left(-\frac{x}{3}\right)^2 = \frac{x^4}{6}$ $\left(-\frac{x}{3}\right)^3 = -\frac{x^3}{27}$ $3\left(\frac{x^2}{2} - \frac{x}{3}\right)^2 = \frac{3x^4}{4} - x^3 + \frac{x^2}{3}$ $3\left(\frac{x^2}{2} - \frac{x}{3}\right)^2(2) = \frac{3x^4}{2} - 2x^3 + \frac{2x^2}{3}$ $3\left(\frac{x^2}{2} - \frac{x}{3}\right)^2(2)^2 = 6x^2 - 4x$ $(2)^3 = 8$
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$2. \sqrt[3]{a^9 + \frac{3a^8}{2} - \frac{a^7}{4} - \frac{7a^6}{8} + \frac{a^5}{12} + \frac{a^4}{6} - \frac{a^3}{27}}$ <hr style="border: 0.5px solid black;"/> $-a^9$ <hr style="border: 0.5px solid black;"/> $\frac{3a^8}{2} - \frac{a^7}{4} - \frac{7a^6}{8}$ <hr style="border: 0.5px solid black;"/> $-\frac{3a^8}{2} + \frac{3a^7}{4} - \frac{a^6}{8}$ <hr style="border: 0.5px solid black;"/> $-a^7 - a^6 + \frac{a^5}{12} + \frac{a^4}{6} - \frac{a^3}{27}$ <hr style="border: 0.5px solid black;"/> $a^7 + a^6 - \frac{a^5}{12} - \frac{a^4}{6} + \frac{a^3}{27}$ <hr style="border: 0.5px solid black;"/> $0$	$a^3 + \frac{a^2}{2} - \frac{a}{3}$ <hr style="border: 0.5px solid black;"/> $3(a^3)^2 = 3a^6$ $3(a^3)^2\left(\frac{a^2}{2}\right) = \frac{3a^8}{2}$ $3(a^3)\left(\frac{a^2}{2}\right)^2 = \frac{3a^7}{4}$ $\left(\frac{a^2}{2}\right)^3 = \frac{a^6}{8}$ $3\left(a^3 + \frac{a^2}{2}\right)^2 = 3a^6 + 3a^5 + \frac{3a^4}{4}$ $3\left(a^3 + \frac{a^2}{2}\right)^2\left(-\frac{a}{3}\right) = -a^7 - a^6 - \frac{a^5}{4}$ $3\left(a^3 + \frac{a^2}{2}\right)\left(-\frac{a}{3}\right)^2 = \frac{a^5}{3} + \frac{a^4}{6}$ $\left(-\frac{a}{3}\right)^3 = -\frac{a^3}{27}$
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$3. \sqrt[3]{\frac{x^3}{8} - \frac{9x^2}{4} + 15x - 45 + \frac{60}{x} - \frac{36}{x^2} + \frac{8}{x^3}}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{x^3}{8}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{9x^2}{4} + 15x - 45$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{9x^2}{4} - \frac{27x}{2} + 27$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{3x}{2} - 18 + \frac{60}{x} - \frac{36}{x^2} + \frac{8}{x^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{3x}{2} + 18 - \frac{60}{x} + \frac{36}{x^2} - \frac{8}{x^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $0$	$\frac{x}{2} - 3 + \frac{2}{x}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $3\left(\frac{x}{2}\right)^2 = \frac{3x^2}{4}$ $3\left(\frac{x}{2}\right)^2(-3) = -\frac{9x^2}{4}$ $3\left(\frac{x}{2}\right)(-3)^2 = \frac{27x}{2}$ $(-3)^3 = -27$ $3\left(\frac{x}{2} - 3\right)^2 = \frac{3x^2}{4} - 9x + 27$ $3\left(\frac{x}{2} - 3\right)\left(\frac{2}{x}\right) = \frac{3x}{2} - 18 + \frac{54}{x}$ $3\left(\frac{x}{2} - 3\right)\left(\frac{2}{x}\right)^2 = \frac{6}{x} - \frac{36}{x^2}$ $\left(\frac{2}{x}\right)^3 = \frac{8}{x^3}$
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$4. \sqrt[3]{\frac{a^3}{8b^3} - \frac{3a^2}{4b^2} + \frac{15a}{8b} - \frac{5}{2} + \frac{15b}{8a} - \frac{3b^2}{4a^2} + \frac{b^3}{8a^3}}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{a^3}{8b^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{3a^2}{4b^2} + \frac{15a}{8b} - \frac{5}{2}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{3a^2}{4b^2} - \frac{3a}{2b} + 1$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $\frac{3a}{8b} - \frac{3}{2} + \frac{15b}{8a} - \frac{3b^2}{4a^2} + \frac{b^3}{8a^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $-\frac{3a}{8b} + \frac{3}{2} - \frac{15b}{8a} + \frac{3b^2}{4a^2} - \frac{b^3}{8a^3}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $0$	$\frac{a}{2b} - 1 + \frac{b}{2a}$ <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> $3\left(\frac{a}{2b}\right)^2 = \frac{3a^2}{4b^2}$ $3\left(\frac{a}{2b}\right)^2(-1) = -\frac{3a^2}{4b^2}$ $3\left(\frac{a}{2b}\right)(-1)^2 = \frac{3a}{2b}$ $(-1)^3 = -1$  $3\left(\frac{a}{2b} - 1\right)^2 = \frac{3a^2}{4b^2} - \frac{3a}{b} + 3$ $3\left(\frac{a}{2b} - 1\right)\left(\frac{b}{2a}\right) = \frac{3a}{8b} - \frac{3}{2} + \frac{3b}{2a}$ $3\left(\frac{a}{2b} - 1\right)\left(\frac{b}{2a}\right)^2 = \frac{3b}{8a} - \frac{3b^2}{4a^2}$ $\left(\frac{b}{2a}\right)^3 = \frac{b^3}{8a^3}$
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$$5. \sqrt[3]{\frac{8a^3}{27x^3} - \frac{2a^2}{3x^2} + \frac{a}{18x} + \frac{13}{24} - \frac{x}{36a} - \frac{x^2}{6a^2} - \frac{x^3}{27a^3}}$$

$$-\frac{8a^3}{27x^3}$$

$$-\frac{2a^2}{3x^2} + \frac{a}{18x} + \frac{13}{24}$$

$$\frac{2a^2}{3x^2} - \frac{a}{2x} + \frac{1}{8}$$

$$-\frac{4a}{9x} + \frac{2}{3} - \frac{x}{36a} - \frac{x^2}{6a^2} - \frac{x^3}{27a^3}$$

$$\frac{4a}{9x} - \frac{2}{3} + \frac{x}{36a} + \frac{x^2}{6a^2} + \frac{x^3}{27a^3}$$

0

$$\frac{2a}{3x} - \frac{1}{2} - \frac{x}{3a}$$

$$3\left(\frac{2a}{3x}\right)^2 = \frac{4a^2}{3x^2}$$

$$3\left(\frac{2a}{3x}\right)^2\left(-\frac{1}{2}\right) = -\frac{2a^2}{3x^2}$$

$$3\left(\frac{2a}{3x}\right)\left(-\frac{1}{2}\right)^2 = \frac{a}{2x}$$

$$\left(-\frac{1}{2}\right)^3 = -\frac{1}{8}$$

$$3\left(\frac{2a}{3x} - \frac{1}{2}\right)^2 = \frac{4a^2}{3x^2} - \frac{2a}{x} + \frac{3}{4}$$

$$3\left(\frac{2a}{3x} - \frac{1}{2}\right)^2\left(-\frac{x}{3a}\right) = -\frac{4a}{9x} + \frac{2}{3} - \frac{x}{4a}$$

$$3\left(\frac{2a}{3x} - \frac{1}{2}\right)\left(-\frac{x}{3a}\right)^2 = \frac{2x}{9a} - \frac{x^2}{6a^2}$$

$$\left(-\frac{x}{3a}\right)^3 = -\frac{x^3}{27a^3}$$

$$6. \sqrt[3]{\frac{8a^3}{27b^3} + \frac{4a^2}{3b^2} + \frac{3a}{b} + 4 + \frac{27b}{8a} + \frac{27b^2}{16a^2} + \frac{27b^3}{64a^3}}$$

$$-\frac{8a^3}{27b^3}$$

$$\frac{4a^2}{3b^2} + \frac{3a}{b} + 4$$

$$-\frac{4a^2}{3b^2} - \frac{2a}{b} - 1$$

$$\frac{a}{b} + 3 + \frac{27b}{8a} + \frac{27b^2}{16a^2} + \frac{27b^3}{64a^3}$$

$$-\frac{a}{b} - 3 - \frac{27b}{8a} - \frac{27b^2}{16a^2} - \frac{27b^3}{64a^3}$$

0

$$\frac{2a}{3b} + 1 + \frac{3b}{4a}$$

$$3\left(\frac{2a}{3b}\right)^2 = \frac{4a^2}{3b^2}$$

$$3\left(\frac{2a}{3b}\right)^2(1) = \frac{4a^2}{3b^2}$$

$$3\left(\frac{2a}{3b}\right)(1)^2 = \frac{2a}{b}$$

$$(1)^3 = 1$$

$$3\left(\frac{2a}{3b} + 1\right)^2 = \frac{4a^2}{3b^2} + \frac{4a}{b} + 3$$

$$3\left(\frac{2a}{3b} + 1\right)^2\left(\frac{3b}{4a}\right) = \frac{a}{b} + 3 + \frac{9b}{4a}$$

$$3\left(\frac{2a}{3b} + 1\right)\left(\frac{3b}{4a}\right)^2 = \frac{9b}{8a} + \frac{27b^2}{16a^2}$$

$$\left(\frac{3b}{4a}\right)^3 = \frac{27b^3}{64a^3}$$



## EJERCICIO 218

$$1. x^{\frac{1}{3}} = \sqrt[3]{x}$$

$$2. m^{\frac{3}{5}} = \sqrt[5]{m^3}$$

$$3. 4a^4 = 4\sqrt[4]{a^3}$$

$$4. xy^{\frac{1}{2}} = x\sqrt{y}$$

$$5. a^{\frac{4}{5}}b^{\frac{3}{2}} = \sqrt[5]{a^4} \sqrt[2]{b^3}$$

$$= \sqrt[5]{a^4} \sqrt[2]{b^2 b}$$

$$= b\sqrt[5]{a^4} \sqrt{b}$$

$$6. x^{\frac{3}{2}}y^{\frac{1}{4}}z^{\frac{1}{5}} = \sqrt{x^3} \sqrt[4]{y} \sqrt[5]{z}$$

$$= \sqrt{x^2 x} \sqrt[4]{y} \sqrt[5]{z}$$

$$= x\sqrt{x} \sqrt[4]{y} \sqrt[5]{z}$$

$$7. 2a^{\frac{4}{5}}b^{\frac{5}{2}} = 2\sqrt[5]{a^4} \sqrt[2]{b^5}$$

$$= 2\sqrt[5]{a^4} \sqrt[2]{b^2 b^2 b}$$

$$= 2b^2 \sqrt[5]{a^4} \sqrt{b}$$

$$8. 3x^{\frac{2}{7}}y^{\frac{4}{5}}z^{\frac{2}{7}} = 3\sqrt[7]{x^2} \sqrt[5]{y^4} \sqrt[7]{z^2}$$

$$9. a^{\frac{1}{4}}b^{\frac{5}{4}}c^{\frac{7}{4}} = \sqrt[4]{ab^5c^7}$$

$$= \sqrt[4]{ab^4bc^4c^3}$$

$$= bc\sqrt[4]{abc^3}$$

$$10. 8mn^{\frac{8}{3}} = 8m\sqrt[3]{n^8}$$

$$= 8m\sqrt[3]{n^3n^3n^2}$$

$$= 8mn^2 \sqrt[3]{n^2}$$

$$11. 4a^2b^{\frac{7}{3}}c^{\frac{5}{6}} = 4a^2\sqrt[3]{b^7} \sqrt[6]{c^5}$$

$$= 4a^2\sqrt[3]{b^3b^3b} \sqrt[6]{c^5}$$

$$= 4a^2b^2 \sqrt[3]{b} \sqrt[6]{c^5}$$

$$12. 5m^{\frac{2}{5}}n^{\frac{3}{5}}x^{\frac{4}{5}} = 5\sqrt[5]{m^2n^3x^4}$$

$$13. \sqrt{a^5} = a^2 \sqrt{a}$$

$$14. \sqrt[3]{x^7} = x^2 \sqrt[3]{x}$$

$$15. \sqrt{x} = x^{\frac{1}{2}}$$

$$16. \sqrt[3]{m} = m^{\frac{1}{3}}$$

$$17. 2\sqrt[4]{x^5} = 2x^{\frac{5}{4}}$$

$$18. \sqrt{a^3} \sqrt[3]{b^5} = a^{\frac{3}{2}}b^{\frac{5}{3}}$$

$$19. 3\sqrt{x^7} \sqrt[5]{y^6} = 3x^{\frac{7}{2}}y^{\frac{6}{5}}$$

$$20. 2\sqrt[4]{ab^3c^5} = 2a^{\frac{1}{4}}b^{\frac{3}{4}}c^{\frac{5}{4}}$$

$$21. 5a\sqrt{x^2y^3z^9} = 5ax^{\frac{2}{2}}y^{\frac{3}{2}}z^{\frac{9}{2}}$$

$$22. 3\sqrt[6]{m^7} \sqrt[5]{n^8} = 3m^{\frac{7}{6}}n^{\frac{8}{5}}$$

$$23. 3\sqrt{a^m} \sqrt[3]{b^n} = 3a^{\frac{m}{2}}b^{\frac{n}{3}}$$

$$24. \sqrt[m]{a} \sqrt[n]{b^3} \sqrt[r]{c^x} = a^{\frac{1}{m}}b^{\frac{3}{n}}c^{\frac{x}{r}}$$

## EJERCICIO 219

$$1. a^2b^{-3} = \frac{a^2}{b^3}$$

$$2. 3x^{-5} = \frac{3}{x^5}$$

$$3. a^{-4}b^{\frac{1}{2}} = \frac{1}{a^4b^{\frac{1}{2}}} = \frac{1}{a^4\sqrt{b}}$$

$$4. 3x^{-2}y^{-\frac{1}{3}} = \frac{3}{x^2y^{\frac{1}{3}}} = \frac{3}{x^2\sqrt[3]{y}}$$

$$5. m^{-\frac{1}{2}}n^{-5} = \frac{1}{m^{\frac{1}{2}}n^5}$$

$$6. a^2b^{-1}c = \frac{a^2c}{b}$$

$$7. 4x^2y^{\frac{3}{5}} = \frac{4x^2}{y^{\frac{5}{3}}}$$

$$8. 5a^{-\frac{1}{3}}b^{-\frac{3}{4}}c^{-1} = \frac{5}{a^{\frac{1}{3}}b^{\frac{3}{4}}c}$$

$$9. \frac{1}{2x^{-2}} = \frac{x^2}{2}$$

$$10. \frac{3}{x^{-1}y^{-5}} = 3xy^5$$

$$11. \frac{2a^{-2}b^{-3}}{a^{-4}c^{-1}} = \frac{2a^4c}{a^2b^3} = \frac{2a^2c}{b^3}$$

$$12. \frac{x^{-1}y^{-2}z^{-3}}{a^{-2}b^{-5}c^{-8}} = \frac{a^2b^5c^8}{xy^2z^3}$$

$$13. \frac{3m^{-4}n^{-\frac{1}{2}}}{8m^{-3}n^{-4}} = \frac{3m^3n^{-\frac{1}{2}}n^4}{8m^4} = \frac{3n^{\frac{7}{2}}}{8m}$$

$$14. \frac{4a^{\frac{1}{2}}}{7a^{-4}b^2c^{-\frac{2}{3}}} = \frac{4a^{\frac{1}{2}}a^4c^{\frac{2}{3}}}{7b^2}$$

$$= \frac{4a^{\frac{9}{2}}c^{\frac{2}{3}}}{7b^2}$$

$$15. \frac{2m^{-5}n^{-7}}{a^2m^3n^{-4}} = \frac{2}{a^2m^3m^5n^{-4}n^7}$$

$$= \frac{2}{a^2m^8n^3}$$

$$16. \frac{a^{-\frac{1}{2}}x^{-2}}{3a^3x^2y^{-1}} = \frac{y}{3a^{\frac{1}{2}}a^2x^2} = \frac{y}{3a^{\frac{5}{2}}x^4}$$

$$17. \frac{c^2}{4b^{-\frac{1}{2}}x^3} = \frac{b^{\frac{1}{2}}c^2}{4x^3}$$

$$18. \frac{1}{3a^{-\frac{3}{4}}b^{-\frac{2}{5}}c^4} = \frac{a^{\frac{3}{4}}b^{\frac{2}{5}}}{3c^4}$$

$$19. \frac{3a^2mn}{a^{-3}m^{-\frac{1}{2}}n^{-\frac{3}{4}}} = 3a^2a^{\frac{1}{2}}m^{\frac{3}{2}}n^{\frac{3}{4}}$$

$$= 3a^{\frac{5}{2}}m^{\frac{3}{2}}n^{\frac{3}{4}}$$

$$20. \frac{x^{-\frac{2}{3}}y^{-\frac{1}{4}}}{x^2yz^{-\frac{1}{2}}} = \frac{\frac{1}{z^{\frac{1}{2}}}}{x^{\frac{8}{3}}x^{\frac{3}{4}}yy^4} = \frac{1}{x^{\frac{35}{4}}y^{\frac{15}{4}}z^{\frac{1}{2}}}$$

## EJERCICIO 220

1.  $\frac{a^2}{b^2} = \frac{1}{a^{-2}b^2}$
2.  $\frac{3x^{-1}}{y^2} = \frac{3}{xy^2}$
3.  $\frac{4mr^2}{x^3} = \frac{4}{m^{-1}n^{-2}x^3}$
4.  $\frac{a^{-1}b^{-3}}{3} = \frac{1}{3ab^3}$
5.  $\frac{3c^{-\frac{2}{3}}}{7} = \frac{3}{7c^{\frac{2}{3}}}$
6.  $\frac{2x^{\frac{1}{4}}}{5y^2} = \frac{2}{5x^{-\frac{1}{4}}y^2}$
7.  $\frac{m^{-3}}{5} = \frac{1}{5m^3}$
8.  $\frac{3a^{-2}b^3}{c^4} = \frac{3}{a^2c^4b^{-3}}$
9.  $x^{-\frac{1}{2}}y^2 = \frac{1}{x^{\frac{1}{2}}y^{-2}}$
10.  $a^{-\frac{2}{3}}b^3c^{-2} = \frac{1}{a^{\frac{2}{3}}c^2b^{-3}}$
11.  $\frac{3x^{-1}y^{-\frac{1}{2}}}{y^3} = \frac{3}{xy^3y^{\frac{1}{2}}} = \frac{3}{xy^{\frac{7}{2}}}$
12.  $\frac{2m^{-2}n^2}{9} = \frac{2}{9m^2n^{-\frac{1}{2}}}$
13.  $\frac{2}{a} = 2a^{-1}$
14.  $\frac{3a}{b^2} = 3ab^{-2}$
15.  $\frac{x^2y}{y^{-2}} = x^2yy^2 = x^2y^3$
16.  $\frac{4}{x^{-\frac{1}{2}}y^2} = 4x^{\frac{1}{2}}y^{-2}$
17.  $\frac{3a^5}{7x^{-5}y^{-\frac{3}{4}}} = \frac{3a^5x^5y^{\frac{3}{4}}}{7}$
18.  $\frac{1}{a^{-4}b^{-\frac{1}{3}}} = a^4b^{\frac{1}{3}}$
19.  $\frac{2m^2}{3m^{-3}n^{-\frac{1}{4}}} = \frac{2m^2m^3n^{\frac{1}{4}}}{3} = \frac{2m^5n^{\frac{1}{4}}}{3}$
20.  $\frac{a^3}{x^2y^{-\frac{1}{2}}} = a^3x^{-2}y^{\frac{1}{2}}$
21.  $\frac{3a^2b^3}{a^{-1}x} = 3a^2ab^3x^{-1} = 3a^3b^3x^{-1}$
22.  $\frac{3xy^2z^3}{x^{-1}y^{-2}z^{-3}} = 3xy^2y^2z^3z^3 = 3x^2y^4z^6$
23.  $\frac{m^{-2}n^{-1}x^{-\frac{1}{2}}}{m^{-4}n^{-5}x^{-2}} = m^{-2}m^4n^{-1}n^5x^{-\frac{1}{2}}x^2 = m^2n^4x^{\frac{3}{2}}$

## EJERCICIO 221

1.  $x^{-\frac{1}{2}} = \frac{1}{x^{\frac{1}{2}}} = \frac{1}{\sqrt{x}}$
2.  $\frac{1}{a^{-\frac{1}{2}}b^{\frac{2}{3}}} = \frac{a^{\frac{1}{2}}}{\sqrt[3]{b^2}} = \frac{\sqrt{a}}{\sqrt[3]{b^2}}$
3.  $5a^{\frac{5}{7}}b^{-\frac{1}{3}} = \frac{5\sqrt[7]{a^5}}{b^{\frac{1}{3}}} = \frac{5\sqrt[7]{a^5}}{\sqrt[3]{b}}$
4.  $\frac{3x^{-1}}{x^{-\frac{1}{2}}} = \frac{3}{x^{\frac{1}{2}}x} = \frac{3}{x^{\frac{3}{2}}} = \frac{3}{\sqrt{x}}$
5.  $2m^{-\frac{2}{5}}n^{\frac{3}{4}} = \frac{2\sqrt[5]{n^3}}{m^{\frac{2}{5}}} = \frac{2\sqrt[5]{n^3}}{\sqrt[5]{m^2}}$
6.  $\frac{1}{4x^{\frac{1}{3}}} = \frac{1}{4\sqrt[3]{x}}$
7.  $\frac{x^{\frac{3}{5}}}{y^{-\frac{2}{3}}} = \sqrt[5]{x^3}y^{\frac{2}{3}} = \sqrt[5]{x^3}\sqrt[3]{y^2}$
8.  $\frac{3a^{-\frac{3}{2}}}{x^4} = \frac{3}{a^{\frac{3}{2}}\sqrt[4]{x}} = \frac{3}{\sqrt[2]{a^2a}\sqrt[4]{x}} = \frac{3}{a\sqrt{a}\sqrt[4]{x}}$
9.  $\frac{a^{-\frac{1}{2}}}{4a^2} = \frac{1}{4a^{\frac{1}{2}}a^2} = \frac{1}{4a^{\frac{5}{2}}} = \frac{1}{4\sqrt[2]{a^5}} = \frac{1}{4a^2\sqrt{a}}$
10.  $x^{-\frac{2}{3}}y^{\frac{3}{5}}z^{-\frac{4}{7}} = \frac{\sqrt[5]{y^3}}{x^{\frac{2}{3}}z^{\frac{4}{7}}} = \frac{\sqrt[5]{y^3}}{\sqrt[3]{x^2}\sqrt[7]{z^4}}$
11.  $x^{-2}m^{-3}n^{-\frac{2}{5}} = \frac{1}{x^2m^3n^{\frac{2}{5}}} = \frac{1}{x^2m^3\sqrt[5]{n^2}}$
12.  $\left(a^{-\frac{1}{2}}\right)^3 = \frac{1}{a^{\frac{3}{2}}} = \frac{1}{\sqrt{a^3}} = \frac{1}{a\sqrt{a}}$
13.  $\left(x^{\frac{2}{3}}\right)^{-2} = x^{-\frac{4}{3}} = \frac{1}{x^{\frac{4}{3}}} = \frac{1}{\sqrt[3]{x^4}} = \frac{1}{x\sqrt[3]{x}}$
14.  $\left(\frac{a}{b}\right)^{\frac{3}{2}} = \frac{a^{\frac{3}{2}}}{b^{\frac{3}{2}}} = \frac{b^{\frac{3}{2}}}{a^{\frac{3}{2}}} = \frac{\sqrt{b^2b}}{\sqrt{a^2a}} = \frac{b\sqrt{b}}{a\sqrt{a}}$
15.  $\left(x^{-\frac{1}{2}}\right)^{\frac{1}{3}} = x^{-\frac{1}{6}} = \frac{1}{x^{\frac{1}{6}}} = \frac{1}{\sqrt[6]{x}}$
16.  $\sqrt{a^{-3}} = a^{-\frac{3}{2}} = \frac{1}{a^{\frac{3}{2}}}$
17.  $2\sqrt{x^{-3}y^{-4}} = 2x^{-\frac{3}{2}}y^{-\frac{4}{2}} = \frac{2}{x^{\frac{3}{2}}y^2}$

$$18. \frac{a^{\frac{2}{3}}}{\sqrt{x^{-5}}} = \frac{a^{\frac{2}{3}}}{x^{-\frac{5}{2}}} = a^{\frac{2}{3}} x^{\frac{5}{2}}$$

$$19. \frac{3\sqrt[3]{m^2}}{5\sqrt[4]{n^{-3}}} = \frac{3m^{\frac{2}{3}}}{5n^{-\frac{3}{4}}} = \frac{3m^{\frac{2}{3}}n^{\frac{3}{4}}}{5}$$

$$20. a^{-\frac{3}{5}}\sqrt[4]{b^{-3}} = \frac{b^{-\frac{3}{4}}}{a^{\frac{3}{5}}} = \frac{1}{a^{\frac{3}{5}}b^{\frac{3}{4}}}$$

$$21. x^2\sqrt{x^{-1}} = x^2x^{-\frac{1}{2}} = x^{\frac{3}{2}}$$

$$22. \frac{1}{\sqrt{a^{-7}b^{-6}}} = \frac{1}{a^{-\frac{7}{2}}b^{-\frac{6}{2}}} = a^{\frac{7}{2}}b^3$$

$$23. \frac{3x^{-\frac{2}{3}}}{\sqrt{y^{-4}}} = \frac{3y^{\frac{4}{2}}}{x^{\frac{2}{3}}} = \frac{3y^2}{x^{\frac{2}{3}}}$$

$$24. \sqrt{m^{-1}}\sqrt[3]{n^{-3}} = m^{-\frac{1}{2}}n^{-\frac{3}{3}} = \frac{1}{m^{\frac{1}{2}}n}$$

$$25. 16^{\frac{3}{2}} = \sqrt{(16)^3} \\ = \sqrt{(16)^2(16)} = 16\sqrt{16} = 64$$

$$26. 8^{\frac{2}{3}} = \sqrt[3]{8^2} = \sqrt[3]{64} = 4$$

$$27. 81^{\frac{3}{4}} = 81^{\frac{1}{2}}81^{\frac{1}{4}} \\ = \sqrt{81}\sqrt[4]{81} = 9 \cdot 3 = 27$$

$$28. 9^{\frac{5}{2}} = \frac{1}{9^{\frac{5}{2}}} \\ = \frac{1}{\sqrt{9^5}} \\ = \frac{1}{\sqrt{9^2 \cdot 9^2 \cdot 9}} = \frac{1}{81\sqrt{9}} = \frac{1}{243}$$

$$29. (-27)^{\frac{2}{3}} = \sqrt[3]{(-27)^2} \\ = \sqrt[3]{-27}\sqrt[3]{-27} \\ = -3 \cdot -3 = 9$$

$$30. (-32)^{\frac{2}{5}} = \sqrt[5]{(-32)^2} \\ = \sqrt[5]{-32}\sqrt[5]{-32} \\ = -2 \cdot -2 = 4$$

$$31. 49^{-\frac{3}{2}} = \frac{1}{\sqrt{49^3}} = \frac{1}{\sqrt{49^2}\sqrt{49}} \\ = \frac{1}{49 \cdot 7} = \frac{1}{343}$$

$$32. \left(\frac{4}{9}\right)^{\frac{5}{2}} = \frac{\sqrt{4^5}}{\sqrt{9^5}} \\ = \frac{\sqrt{4^2 \cdot 4^2 \cdot 4}}{\sqrt{9^2 \cdot 9^2 \cdot 9}} \\ = \frac{16\sqrt{4}}{81\sqrt{9}} \\ = \frac{16 \cdot 2}{81 \cdot 3} = \frac{32}{243}$$

$$33. \left(\frac{8}{27}\right)^{\frac{1}{3}} = \frac{27^{\frac{1}{3}}}{8^{\frac{1}{3}}} \\ = \frac{\sqrt[3]{27}}{\sqrt[3]{8}} = \frac{3}{2} = 1\frac{1}{2}$$

$$34. \left(\frac{25}{36}\right)^{-\frac{1}{2}} = \frac{36^{\frac{1}{2}}}{25^{\frac{1}{2}}} \\ = \frac{\sqrt{36}}{\sqrt{25}} = \frac{6}{5} = 1\frac{1}{5}$$

$$35. \left(\frac{32}{243}\right)^{\frac{1}{5}} = \frac{243^{\frac{1}{5}}}{32^{\frac{1}{5}}} \\ = \frac{\sqrt[5]{243}}{\sqrt[5]{32}} = \frac{3}{2} = 1\frac{1}{2}$$

$$36. \left(-\frac{27}{64}\right)^{\frac{2}{3}} = \frac{64^{\frac{2}{3}}}{-27^{\frac{2}{3}}} \\ = \frac{\sqrt[3]{64^2}}{\sqrt[3]{(-27)^2}} \\ = \frac{\sqrt[3]{64}\sqrt[3]{64}}{\sqrt[3]{-27}\sqrt[3]{-27}} \\ = \frac{4 \cdot 4}{-3 \cdot -3} = \frac{16}{9} = 1\frac{7}{9}$$

$$37. \frac{1}{9^{-3}} = 9^3 = 729$$

$$38. \left(\frac{16}{81}\right)^{-\frac{5}{4}} = \frac{81^{\frac{5}{4}}}{16^{\frac{5}{4}}} \\ = \frac{\sqrt[4]{81^4}\sqrt[4]{81}}{\sqrt[4]{16^4}\sqrt[4]{16}} \\ = \frac{81 \cdot 3}{16 \cdot 2} = \frac{243}{32} = 7\frac{19}{32}$$

$$39. \left(-\frac{32}{243}\right)^{-\frac{2}{5}} = \frac{243^{\frac{2}{5}}}{-32^{\frac{2}{5}}} \\ = \frac{\sqrt[5]{243}\sqrt[5]{243}}{\sqrt[5]{-32}\sqrt[5]{-32}} \\ = \frac{3 \cdot 3}{-2 \cdot -2} = \frac{9}{4} = 2\frac{1}{4}$$

$$40. \left(2\frac{1}{9}\right)^{\frac{3}{2}} = \left(\frac{25}{9}\right)^{-\frac{3}{2}} \\ = \frac{9^{\frac{3}{2}}}{25^{\frac{3}{2}}} \\ = \frac{\sqrt{9^2}\sqrt{9}}{\sqrt{25^2}\sqrt{25}} \\ = \frac{9 \cdot 3}{25 \cdot 5} = \frac{27}{125}$$

$$41. \left(5\frac{1}{16}\right)^{\frac{1}{4}} = \left(\frac{81}{16}\right)^{\frac{1}{4}} \\ = \frac{16^{\frac{1}{4}}}{81^{\frac{1}{4}}} = \frac{\sqrt[4]{16}}{\sqrt[4]{81}} = \frac{2}{3}$$

$$42. 8^{\frac{2}{3}} \cdot 4^{\frac{3}{2}} = \sqrt[3]{8}\sqrt[3]{8}\sqrt{4^2}\sqrt{4} \\ = 2 \cdot 2 \cdot 4 \cdot 2 = 32$$

$$43. 9^{\frac{5}{2}} \cdot 27^{-\frac{1}{3}} = \frac{\sqrt{9^5}}{\sqrt[3]{27}} \\ = \frac{\sqrt{9^2}\sqrt{9^2}\sqrt{9}}{3} = 81$$

$$44. 243^{\frac{1}{5}} \cdot 128^{\frac{3}{7}} \\ = \frac{\sqrt[5]{128^3}}{\sqrt[5]{243}} = \frac{\sqrt[5]{128}\sqrt[5]{128}\sqrt[5]{128}}{3} \\ = \frac{2 \cdot 2 \cdot 2}{3} = \frac{8}{3} = 2\frac{2}{3}$$

## EJERCICIO 222

1.  $a^{-2} + a^{-1}b^{\frac{1}{2}} + x^0$  para  $a=3$   $b=4$

$$\begin{aligned} &= 3^{-2} + 3^{-1} \cdot 4^{\frac{1}{2}} + x^0 \\ &= \frac{1}{3^2} + \frac{1\sqrt{4}}{3} + 1 \\ &= \frac{1}{9} + \frac{2}{3} + 1 = \frac{1+6+9}{9} = \frac{16}{9} = 1\frac{7}{9} \end{aligned}$$

2.  $3x^{-\frac{1}{2}} + x^2y^{-3} + x^0y^{\frac{1}{3}}$  para  $x=4$   $y=1$

$$\begin{aligned} &= 3(4)^{\frac{1}{2}} + 4^2(1)^{-3} + 1(1)^{\frac{1}{3}} \\ &= \frac{3}{\sqrt{4}} + 16 + 1 = \frac{3}{2} + 17 = \frac{3+34}{2} = \frac{37}{2} = 18\frac{1}{2} \end{aligned}$$

3.  $2a^{-3}b + \frac{a^{-4}}{b^{-1}} + a^{\frac{1}{2}}b^{-\frac{3}{4}}$  para  $a=4$   $b=16$

$$\begin{aligned} &= 2(4)^{-3} \cdot 16 + \frac{4^{-4}}{16^{-1}} + 4^{\frac{1}{2}} \cdot 16^{-\frac{3}{4}} \\ &= \frac{2}{4^3} \cdot 16 + \frac{16}{4^4} + \frac{\sqrt{4}}{\sqrt[4]{(16)^2 \cdot 16}} \\ &= \frac{1}{2} + \frac{1}{16} + \frac{2}{16^2 \sqrt[4]{16}} = \frac{1}{2} + \frac{1}{16} + \frac{1}{4} = \frac{8+1+4}{16} = \frac{13}{16} \end{aligned}$$

4.  $\frac{x^4}{y^{-2}} + x^{-\frac{1}{2}}y^{-\frac{1}{3}} - x^0y^0 + \frac{x}{y^{\frac{4}{3}}}$  para  $x=16$   $y=8$

$$\begin{aligned} &= \frac{16^4}{8^{-2}} + 16^{-\frac{1}{2}} \cdot 8^{-\frac{1}{3}} - 16^0 \cdot 8^0 + \frac{16}{8^{\frac{4}{3}}} \\ &= \sqrt[4]{16^2} \sqrt[4]{16} \cdot 8^2 + \frac{1}{\sqrt{16} \sqrt[3]{8}} - 1 + \frac{16}{\sqrt[3]{(8^3)8}} \\ &= 4 \cdot 2 \cdot 64 + \frac{1}{4 \cdot 2} - 1 + \frac{16}{8 \sqrt[3]{8}} = 512 + \frac{1}{8} - 1 + 1 \\ &= 512\frac{1}{8} \end{aligned}$$

5.  $\frac{x^0}{x^{-1}} + \frac{y^{-3}}{y^0} + 2x^0 + x^4y^{-2}$  para  $x=81$   $y=3$

$$\begin{aligned} &= \frac{1}{81^{-1}} + \frac{3^{-3}}{1} + 2(1) + 81^4 \cdot 3^{-2} \\ &= 81 + \frac{1}{3^3} + 2 + \frac{\sqrt[4]{81^2} \sqrt[4]{81}}{3^2} \\ &= 83 + \frac{1}{27} + \frac{9 \cdot 3}{9} = 83 + \frac{1}{27} + 3 = 86 + \frac{1}{27} = 86\frac{1}{27} \end{aligned}$$

6.  $a^{\frac{1}{2}}x^{\frac{1}{3}} + a^{-\frac{1}{2}}x^{-\frac{1}{3}} + \frac{1}{a^{-\frac{1}{4}}x^{-1}} + 3x^0$  para  $a=16$   $x=8$

$$\begin{aligned} &= 16^{\frac{1}{2}} \cdot 8^{\frac{1}{3}} + 16^{-\frac{1}{2}} \cdot 8^{-\frac{1}{3}} + \frac{1}{16^{-\frac{1}{4}} \cdot 8^{-1}} + 3(1) \\ &= \sqrt{16} \sqrt[3]{8} + \frac{1}{\sqrt{16} \sqrt[3]{8}} + \sqrt[4]{16} \cdot 8 + 3 \\ &= 8 + \frac{1}{4 \cdot 2} + 16 + 3 = 27 + \frac{1}{8} = 27\frac{1}{8} \end{aligned}$$

7.  $\frac{a^{-2}}{b^{-1}} + 3a^{-1}b^2c^{-3} - \frac{a^{-2}}{b^{\frac{1}{2}}c^{-1}} + b^4 + c^0$

para  $b=16$   $c=2$   $a=3$

$$\begin{aligned} &= \frac{3^{-2}}{16^{-1}} + 3(3)^{-1} \cdot 16^2(2)^{-3} - \frac{3^{-2}}{16^{\frac{1}{2}} \cdot 2^{-1}} + 16^4 + 1 \\ &= \frac{16}{3^2} + \frac{3}{3} \cdot \frac{256}{2^3} - \frac{2}{3^2 \sqrt{16}} + \sqrt[4]{16} + 1 \\ &= \frac{16}{9} + 32 - \frac{1}{18} + 2 + 1 \\ &= \frac{16}{9} + 35 - \frac{1}{18} = \frac{32+630-1}{18} = \frac{661}{18} = 36\frac{13}{18} \end{aligned}$$

8.  $\frac{x^0}{3y^0} + x^{\frac{2}{3}} - y^{\frac{1}{5}} + \frac{x^{-2}}{y^{-1}} + y^0$  para  $x=8$   $y=32$

$$\begin{aligned} &= \frac{1}{3(1)} + 8^{\frac{2}{3}} - 32^{\frac{1}{5}} + \frac{8^{-2}}{32^{-1}} + 1 \\ &= \frac{1}{3} + \sqrt[3]{(2^3)^2} - \sqrt[5]{32} + \frac{32}{8^2} + 1 \\ &= \frac{1}{3} + 2^2 - 2 + \frac{1}{2} + 1 = \frac{1}{3} + 3 + \frac{1}{2} = \frac{2+18+3}{6} = \frac{23}{6} = 3\frac{5}{6} \end{aligned}$$

9.  $a^{-\frac{1}{3}} - \frac{1}{b^{-\frac{4}{5}}} + a^0b - \sqrt[3]{ab^{\frac{2}{5}}} - \frac{1}{a^{-\frac{2}{3}}}$  para  $a=27$   $b=243$

$$\begin{aligned} &= 27^{-\frac{1}{3}} - \frac{1}{243^{-\frac{4}{5}}} + (1)243 - \sqrt[3]{27 \cdot 243^{\frac{2}{5}}} - \frac{1}{27^{-\frac{2}{3}}} \\ &= \frac{1}{\sqrt[3]{27}} - \sqrt[5]{(3^5)^4} + 243 - 3 \sqrt[3]{(3^3)^2} - \sqrt[3]{(3^3)^2} \\ &= \frac{1}{3} - 3^4 + 243 - 3(3)^2 - 3^2 \\ &= \frac{1}{3} + 162 - 27 - 9 = \frac{1}{3} + 126 = 126\frac{1}{3} \end{aligned}$$

## EJERCICIO 223

- $x^2x^{-3} = x^{2+(-3)} = x^{-1}$
- $a^{-2}a^{-3} = a^{-2-3} = a^{-5}$
- $x^3x^{-3} = x^{3-3} = x^0 = 1$
- $a^{\frac{1}{2}}a = a^{\frac{1}{2}+1} = a^{\frac{3}{2}}$
- $x^{\frac{1}{2}}x^{\frac{1}{4}} = x^{\frac{1}{2}+\frac{1}{4}} = x^{\frac{3}{4}}$
- $a^{\frac{3}{4}}a^{\frac{1}{4}} = a^{\frac{3}{4}+\frac{1}{4}} = a^1 = a$
- $3m^{\frac{2}{5}}m^{-\frac{3}{5}} = 3m^{\frac{2}{5}-\frac{3}{5}} = 3m^{-\frac{1}{5}}$
- $2a^{\frac{3}{4}}a^{-\frac{1}{2}} = 2a^{\frac{3}{4}-\frac{1}{2}} = 2a^{\frac{1}{4}}$
- $x^{-2}x^{-\frac{1}{3}} = x^{-2-\frac{1}{3}} = x^{-\frac{7}{3}}$
- $3rn^{\frac{2}{3}}n^{-\frac{2}{3}} = 3n^{\frac{2}{3}-\frac{2}{3}} = 3n^0 = 3$
- $4a^{-2}a^{-\frac{1}{2}} = 4a^{-2-\frac{1}{2}} = 4a^{-\frac{5}{2}}$
- $a^{-1}b^{-2}ab^2 = a^{-1+1}b^{-2+2} = a^0b^0 = 1$
- $x^{-3}y^{\frac{1}{2}}x^{-2}y^{-\frac{1}{2}} = x^{-3-2}y^{\frac{1}{2}-\frac{1}{2}} = x^{-5}y^0 = x^{-5}$
- $3a^{\frac{1}{2}}b^{\frac{1}{2}}2a^{-2}b^{-\frac{1}{2}} = 3 \cdot 2a^{\frac{1}{2}-2}b^{\frac{1}{2}-\frac{1}{2}} = 6a^{-\frac{3}{2}}b^0 = 6a^{-\frac{3}{2}}$
- $a^3b^{-1}a^{-2}b^{-2} = a^{3-2}b^{-1-2} = ab^{-3}$
- $a^{-\frac{1}{2}}b^{\frac{3}{4}}a^{\frac{1}{2}}b^{\frac{1}{4}} = a^{-\frac{1}{2}+\frac{1}{2}}b^{\frac{3}{4}+\frac{1}{4}} = a^0b^1 = b$
- $m^{-\frac{2}{3}}n^{\frac{1}{3}}m^{-\frac{1}{3}}n^{\frac{2}{3}} = m^{-\frac{2}{3}-\frac{1}{3}}n^{\frac{1}{3}+\frac{2}{3}} = m^{-1}n^1 = m^{-1}n$
- $2a^{-1}b^{\frac{3}{4}}ab^{-2} = 2a^{-1+1}b^{\frac{3}{4}-2} = 2a^0b^{-\frac{5}{4}} = 2b^{-\frac{5}{4}}$

## EJERCICIO 224

- $$\begin{array}{r} a^{-4} + 3a^{-2} + 2 \\ \hline a^{-4} - a^{-2} + 1 \\ \hline a^{-8} + 3a^{-6} + 2a^{-4} \\ - a^{-6} - 3a^{-4} - 2a^{-2} \\ \hline a^{-4} + 3a^{-2} + 2 \\ \hline a^{-8} + 2a^{-6} \quad + a^{-2} + 2 \end{array}$$
- $$\begin{array}{r} x^2 - 1 + x^{-2} \\ \hline x^2 + 2 - x^{-2} \\ \hline x^4 - x^2 + 1 \\ 2x^2 - 2 + 2x^{-2} \\ -1 + x^{-2} - x^{-4} \\ \hline x^4 + x^2 - 2 + 3x^{-2} - x^{-4} \end{array}$$
- $$\begin{array}{r} x + 2x^{\frac{2}{3}} + x^{\frac{1}{3}} \\ \hline x^3 - 2 + x^{-\frac{1}{3}} \\ \hline \frac{4}{x^3} + 2x + x^{\frac{2}{3}} \\ -2x - 4x^{\frac{2}{3}} - 2x^{\frac{1}{3}} \\ \hline x^{\frac{2}{3}} + 2x^{\frac{1}{3}} + 1 \\ \hline x^{\frac{4}{3}} - 2x^{\frac{2}{3}} + 1 \end{array}$$
- $$\begin{array}{r} 2a^{\frac{3}{4}} - a^{\frac{1}{2}} + 2a^{\frac{1}{4}} \\ \hline a^{\frac{1}{4}} + 1 - a^{-\frac{1}{4}} \\ \hline 2a - a^{\frac{3}{4}} + 2a^{\frac{1}{2}} \\ 2a^{\frac{3}{4}} - a^{\frac{1}{2}} + 2a^{\frac{1}{4}} \\ -2a^{\frac{1}{2}} + a^{\frac{1}{4}} - 2 \\ \hline 2a + a^{\frac{3}{4}} - a^{\frac{1}{2}} + 3a^{\frac{1}{4}} - 2 \end{array}$$
- $$\begin{array}{r} a^{\frac{2}{3}} - 2 + 2a^{-\frac{2}{3}} \\ \hline 3 + a^{-\frac{2}{3}} - 4a^{-\frac{4}{3}} \\ \hline 3a^{\frac{2}{3}} - 6 + 6a^{-\frac{2}{3}} \\ + 1 - 2a^{-\frac{2}{3}} + 2a^{-\frac{4}{3}} \\ -4a^{-\frac{2}{3}} + 8a^{-\frac{4}{3}} - 8a^{-2} \\ \hline 3a^{\frac{2}{3}} - 5 + 10a^{-\frac{4}{3}} - 8a^{-2} \end{array}$$
- $$\begin{array}{r} x^{\frac{3}{4}} + 2x^{\frac{1}{4}} - x^{-\frac{1}{4}} \\ \hline x^2 - 2 + x^{-\frac{1}{2}} \\ \hline x^4 + 2x^4 - x^4 \\ -2x^4 - 4x^{\frac{1}{4}} + 2x^{-\frac{1}{4}} \\ \hline x^4 + 2x^{-\frac{1}{4}} - x^{-\frac{3}{4}} \\ \hline x^{\frac{5}{4}} - 4x^{\frac{1}{4}} + 4x^{-\frac{1}{4}} - x^{-\frac{3}{4}} \end{array}$$
- $$\begin{array}{r} a^2b^{-1} + a + b \\ \hline a^{-2}b^{-2} - a^{-3}b^{-1} + a^{-4} \\ \hline b^{-3} + a^{-1}b^{-2} + a^{-2}b^{-1} \\ - a^{-1}b^{-2} - a^{-2}b^{-1} - a^{-3} \\ \hline a^{-2}b^{-1} + a^{-3} + a^{-4}b \\ \hline b^{-3} + a^{-2}b^{-1} + a^{-4}b \end{array}$$
- $$\begin{array}{r} x^{-1}y^{-1} + x^{-3}y^{-3} + x^{-5}y^{-5} \\ \hline x^{-3}y^{-2} - x^{-5}y^{-4} + x^{-7}y^{-6} \\ \hline x^{-4}y^{-3} + x^{-6}y^{-5} + x^{-8}y^{-7} \\ - x^{-6}y^{-5} - x^{-8}y^{-7} - x^{-10}y^{-9} \\ + x^{-8}y^{-7} + x^{-10}y^{-9} + x^{-12}y^{-11} \\ \hline x^{-4}y^{-3} + x^{-8}y^{-7} + x^{-12}y^{-11} \end{array}$$

$$9. \frac{a^{\frac{3}{4}}b^{-3} + a^{\frac{1}{4}}b^{-2} - a^{-\frac{1}{4}}b^{-1}}{a^{\frac{1}{2}}b^{-1} - 2 + 3a^{-\frac{1}{2}}b}$$

$$\frac{a^{\frac{5}{4}}b^{-4} + a^{\frac{3}{4}}b^{-3} - a^{\frac{1}{4}}b^{-2} - 2a^{\frac{3}{4}}b^{-3} - 2a^{\frac{1}{4}}b^{-2} + 2a^{-\frac{1}{4}}b^{-1}}{3a^{\frac{1}{4}}b^{-2} + 3a^{-\frac{1}{4}}b^{-1} - 3a^{-\frac{3}{4}}}$$

$$\frac{a^{\frac{5}{4}}b^{-4} - a^{\frac{3}{4}}b^{-3} + 5a^{-\frac{1}{4}}b^{-1} - 3a^{-\frac{3}{4}}}{}$$

$$10. a^{-1} + 2a^{-\frac{1}{2}}b^{-\frac{1}{2}} + 2b^{-1}$$

$$\frac{a^{-1} - a^{-\frac{1}{2}}b^{-\frac{1}{2}} + b^{-1}}{a^{-2} + 2a^{-\frac{3}{2}}b^{-\frac{1}{2}} + 2a^{-1}b^{-1} - a^{-\frac{3}{2}}b^{-\frac{1}{2}} - 2a^{-1}b^{-1} - 2a^{-\frac{1}{2}}b^{-\frac{3}{2}} + a^{-1}b^{-1} + 2a^{-\frac{1}{2}}b^{-\frac{3}{2}} + 2b^{-2}}$$

$$\frac{a^{-2} + a^{-\frac{3}{2}}b^{-\frac{1}{2}} + a^{-1}b^{-1} + 2b^{-2}}{}$$

$$11. 4x^2 - x^2y^2 + xy - x^2y^2$$

$$\frac{x^2 + y^2}{4x^2 - x^2y^2 + x^2y - xy^2 - 4x^2y^2 - x^2y + xy^2 - x^2y^2}$$

$$\frac{4x^2 + 3x^2y^2 - x^2y^2}{}$$

$$12. x - 2a^{\frac{1}{3}}x^{\frac{2}{3}} + a^{\frac{2}{3}}x^{\frac{1}{3}} - 3a$$

$$\frac{x^{\frac{4}{3}} + 3a^{\frac{2}{3}}x^{\frac{2}{3}} + 2a^{\frac{1}{3}}x}{x^{\frac{7}{3}} - 2a^{\frac{1}{3}}x^2 + a^{\frac{2}{3}}x^{\frac{5}{3}} - 3ax^{\frac{4}{3}} + 3a^{\frac{2}{3}}x^{\frac{5}{3}} - 6ax^{\frac{4}{3}} + 3a^{\frac{4}{3}}x - 9a^{\frac{5}{3}}x^{\frac{2}{3}} + 2a^{\frac{1}{3}}x^2 - 4a^{\frac{2}{3}}x^{\frac{5}{3}} + 2ax^{\frac{4}{3}} - 6a^{\frac{4}{3}}x}$$

$$\frac{x^{\frac{7}{3}} - 7ax^{\frac{4}{3}} - 3a^{\frac{4}{3}}x - 9a^{\frac{5}{3}}x^{\frac{2}{3}}}{}$$

$$13. 5a^2 - 3a + 4 - 2a^{-1}$$

$$\frac{3a + 2 - 5a^{-1}}{15a^3 - 9a^2 + 12a - 6}$$

$$\frac{10a^2 - 6a + 8 - 4a^{-1} - 25a + 15 - 20a^{-1} + 10a^{-2}}{15a^3 + a^2 - 19a + 17 - 24a^{-1} + 10a^{-2}}$$

$$14. 2x - 3 + x^{-1} + 4x^{-2}$$

$$\frac{x^{-1} - 2x^{-2} + x^{-3}}{2 - 3x^{-1} + x^{-2} + 4x^{-3} - 4x^{-1} + 6x^{-2} - 2x^{-3} - 8x^{-4} + 2x^{-2} - 3x^{-3} + x^{-4} + 4x^{-5}}$$

$$\frac{2 - 7x^{-1} + 9x^{-2} - x^{-3} - 7x^{-4} + 4x^{-5}}{}$$

$$15. m - m^{\frac{1}{2}}n^2 + n - m^{-\frac{1}{2}}n^{\frac{3}{2}}$$

$$\frac{m^{\frac{1}{2}} + n^{\frac{1}{2}} + m^{-\frac{1}{2}}n}{m^2 - mn^2 + m^2n - n^2 + mn^2 - m^2n + n^2 - m^{-\frac{1}{2}}n^2 + m^{\frac{1}{2}}n - n^2 + m^{-\frac{1}{2}}n^2 - m^{-1}n^{\frac{5}{2}}}$$

$$\frac{m^{\frac{3}{2}} + m^{\frac{1}{2}}n - n^{\frac{3}{2}} - m^{-1}n^{\frac{5}{2}}}{}$$

$$16. a^{\frac{3}{5}} + 2a^{\frac{1}{5}} - a^{-\frac{1}{5}}$$

$$\frac{-2 + a^{\frac{2}{5}} - a^{-\frac{2}{5}}}{-2a^{\frac{3}{5}} - 4a^{\frac{1}{5}} + 2a^{-\frac{1}{5}} + 2a^{\frac{3}{5}} - a^{\frac{1}{5}} + a - a^{\frac{1}{5}} - 2a^{-\frac{1}{5}} + a^{-\frac{3}{5}} - 6a^{\frac{1}{5}} + a + a^{-\frac{3}{5}}}$$

$$17. m + 3m^{\frac{2}{3}} + 2m^{\frac{1}{3}}$$

$$\frac{2 - 2m^{\frac{1}{3}} + 2m^{-\frac{2}{3}}}{2m + 6m^{\frac{2}{3}} + 4m^{\frac{1}{3}} - 2m^{\frac{2}{3}} - 6m^{\frac{1}{3}} - 4 + 2m^{\frac{1}{3}} + 6 + 4m^{-\frac{1}{3}}}$$

$$\frac{2m + 4m^{\frac{2}{3}} + 2 + 4m^{-\frac{1}{3}}}{}$$

$$18. x^{\frac{3}{4}}y^2 + 3x^{\frac{1}{4}}y - x^{\frac{1}{4}}y^2$$

$$\frac{x^{\frac{5}{4}}y^2 - 3x^{\frac{3}{4}}y - x^{\frac{1}{4}}y^{\frac{1}{2}}}{x^{-2}y^2 + 3x^{-\frac{3}{2}}y^{\frac{3}{2}} - x^{-1}y - 3x^{\frac{3}{2}}y^{\frac{3}{2}} - 9x^{-1}y + 3x^{-\frac{1}{2}}y^{\frac{1}{2}} - x^{-1}y - 3x^{-\frac{1}{2}}y^{\frac{1}{2}} + 1}$$

$$\frac{x^{-2}y^2 - 11x^{-1}y + 1}{}$$

$$\begin{array}{r}
 19. \quad x^2y^{-1} + 5x^3y^{-3} + 2x^4y^{-5} \\
 \frac{x^{-3}y^3 - x^{-2}y + 3x^{-1}y^{-1}}{x^{-1}y^2 + 5 + 2xy^{-2}} \\
 \frac{-1 - 5xy^{-2} - 2x^2y^{-4}}{+ 3xy^{-2} + 15x^2y^{-4} + 6x^3y^{-6}} \\
 \hline
 x^{-1}y^2 + 4 \qquad + 13x^2y^{-4} + 6x^3y^{-6}
 \end{array}$$

$$\begin{array}{r}
 20. \quad a^{-\frac{2}{3}}b^{\frac{1}{2}} + 2a^{-\frac{4}{3}}b - a^{-2}b^{\frac{3}{2}} \\
 \frac{3a^{\frac{2}{3}}b^{-\frac{1}{2}} + 1 + a^{-\frac{2}{3}}b^{\frac{1}{2}}}{3 + 6a^{-\frac{2}{3}}b^{\frac{1}{2}} - 3a^{-\frac{4}{3}}b} \\
 + a^{-\frac{2}{3}}b^{\frac{1}{2}} + 2a^{-\frac{4}{3}}b - a^{-2}b^{\frac{3}{2}} \\
 \hline
 \frac{a^{-\frac{4}{3}}b + 2a^{-2}b^{\frac{3}{2}} - a^{-\frac{8}{3}}b^2}{3 + 7a^{-\frac{2}{3}}b^{\frac{1}{2}} \qquad + a^{-2}b^{\frac{3}{2}} - a^{-\frac{8}{3}}b^2}
 \end{array}$$

### EJERCICIO 225

$$1. a^2 \div a^{-2} = a^{2-(-2)} = a^{2+2} = a^4$$

$$2. x^{-3} \div x^2 = x^{-3-2} = x^{-5}$$

$$3. m^{\frac{1}{2}} \div m^{-\frac{1}{4}} = m^{\frac{1}{2}-(-\frac{1}{4})} = m^{\frac{1}{2}+\frac{1}{4}} = m^{\frac{3}{4}}$$

$$4. a^2 \div a^5 = a^{2-5} = a^{-3}$$

$$5. x^{-3} \div x^{-7} = x^{-3-(-7)} = x^{-3+7} = x^4$$

$$6. a^{\frac{1}{2}} \div a = a^{\frac{1}{2}-1} = a^{-\frac{1}{2}}$$

$$7. x^{-\frac{2}{3}} \div x^{-\frac{1}{3}} = x^{-\frac{2}{3}-(-\frac{1}{3})} = x^{-\frac{2}{3}+\frac{1}{3}} = x^{-\frac{1}{3}}$$

$$8. a^{\frac{2}{5}} \div a^{-\frac{1}{5}} = a^{\frac{2}{5}-(-\frac{1}{5})} = a^{\frac{2}{5}+\frac{1}{5}} = a^{\frac{3}{5}}$$

$$9. m^{-\frac{3}{4}} \div m^2 = m^{-\frac{3}{4}-2} = m^{-\frac{5}{4}}$$

$$10. a^{\frac{1}{3}} \div a = a^{\frac{1}{3}-1} = a^{-\frac{2}{3}}$$

$$11. 4x^{\frac{2}{5}} \div 2x^{-\frac{1}{5}} = \frac{4}{2}x^{\frac{2}{5}-(-\frac{1}{5})} = 2x^{\frac{2}{5}+\frac{1}{5}} = 2x^{\frac{3}{5}}$$

$$12. a^{-3} \div a^{-\frac{7}{4}} = a^{-3-(-\frac{7}{4})} = a^{-3+\frac{7}{4}} = a^{-\frac{5}{4}}$$

$$13. x^{-2}y^{-1} \div x^{-3}y^{-2} = x^{-2+3}y^{-1+2} = xy$$

$$14. a^{\frac{1}{2}}b^{\frac{1}{3}} \div ab = a^{\frac{1}{2}-1}b^{\frac{1}{3}-1} = a^{-\frac{1}{2}}b^{-\frac{2}{3}}$$

$$15. a^2b^{-3} \div a^{-1}b = a^{2+1}b^{-3-1} = a^3b^{-4}$$

$$16. x^{-\frac{1}{2}}y^{\frac{2}{3}} \div x^{-\frac{1}{2}}y^{-1} = x^{-\frac{1}{2}+\frac{1}{2}}y^{\frac{2}{3}+1} = x^0y^{\frac{5}{3}} = y^{\frac{5}{3}}$$

$$17. m^{\frac{3}{4}}n^{-\frac{3}{4}} \div m^{-\frac{1}{2}}n^4 = m^{\frac{3}{4}+\frac{1}{2}}n^{-\frac{3}{4}-4} = m^{\frac{5}{4}}n^{-\frac{3}{2}}$$

$$18. 8x^{-2}y^{\frac{2}{5}} \div 4xy^{-\frac{1}{5}} = \frac{8}{4}x^{-2-1}y^{\frac{2}{5}-\frac{1}{5}} = 2x^{-3}y^{\frac{1}{5}}$$

$$19. a^{\frac{1}{3}}b \div a^{-\frac{1}{4}}b^{-3} = a^{\frac{1}{3}+\frac{1}{4}}b^{1+3} = a^{\frac{7}{12}}b^4$$

$$20. x^{-4}y^{-5} \div x^2y^{-1} = x^{-4-2}y^{-5+1} = x^{-6}y^{-4}$$

### EJERCICIO 226

$$\begin{array}{r}
 1. \quad x^{-8} + 2x^{-6} \quad + \quad x^{-2} + 2 \left| \frac{x^{-4} - x^{-2} + 1}{x^{-4} + 3x^{-2} + 2} \right. \\
 \frac{-x^{-8} + x^{-6} - x^{-4}}{3x^{-6} - x^{-4} + x^{-2}} \\
 \frac{-3x^{-6} + 3x^{-4} - 3x^{-2}}{2x^{-4} - 2x^{-2} + 2} \\
 \frac{-2x^{-4} + 2x^{-2} - 2}{\phantom{0}}
 \end{array}$$

$$\begin{array}{r}
 2. \quad a^{\frac{4}{3}} - 2a^{\frac{2}{3}} \quad + 1 \left| \frac{a + 2a^{\frac{2}{3}} + a^{\frac{1}{3}}}{a^{\frac{1}{3}} - 2 + a^{-\frac{1}{3}}} \right. \\
 \frac{-a^{\frac{4}{3}} - 2a - a^{\frac{2}{3}}}{-2a - 3a^{\frac{2}{3}}} \\
 \frac{+ 2a + 4a^{\frac{2}{3}} + 2a^{\frac{1}{3}}}{a^{\frac{2}{3}} + 2a^{\frac{1}{3}} + 1} \\
 \frac{-a^{\frac{2}{3}} - 2a^{\frac{1}{3}} - 1}{\phantom{0}}
 \end{array}$$

$$\begin{array}{r}
 3. \quad m^4 + m^2 - 2 + 3m^{-2} - m^{-4} \quad \left| \begin{array}{l} m^2 - 1 + m^{-2} \\ m^2 + 2 - m^{-2} \end{array} \right. \\
 \hline
 -m^4 + m^2 - 1 \\
 2m^2 - 3 + 3m^{-2} \\
 \hline
 -2m^2 + 2 - 2m^{-2} \\
 -1 + m^{-2} - m^{-4} \\
 \hline
 +1 - m^{-2} + m^{-4}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 2x + x^{\frac{3}{4}} - x^{\frac{1}{2}} + 3x^{\frac{1}{4}} - 2 \quad \left| \begin{array}{l} x^{\frac{1}{4}} + 1 - x^{-\frac{1}{4}} \\ 2x^{\frac{3}{4}} - x^{\frac{1}{2}} + 2x^{\frac{1}{4}} \end{array} \right. \\
 \hline
 -2x - 2x^{\frac{3}{4}} + 2x^{\frac{1}{2}} \\
 -x^{\frac{3}{4}} + x^{\frac{1}{2}} + 3x^{\frac{1}{4}} \\
 \hline
 +x^{\frac{3}{4}} + x^{\frac{1}{2}} - x^{\frac{1}{4}} \\
 2x^{\frac{1}{2}} + 2x^{\frac{1}{4}} - 2 \\
 \hline
 -2x^{\frac{1}{2}} - 2x^{\frac{1}{4}} + 2
 \end{array}$$

$$\begin{array}{r}
 5. \quad 3m^{\frac{2}{3}} - 5 + 10m^{\frac{4}{3}} - 8m^{-2} \quad \left| \begin{array}{l} 3 + m^{-\frac{2}{3}} - 4m^{-\frac{4}{3}} \\ m^{\frac{2}{3}} - 2 + 2m^{-\frac{2}{3}} \end{array} \right. \\
 \hline
 -3m^{\frac{2}{3}} - 1 + 4m^{-\frac{2}{3}} \\
 -6 + 4m^{-\frac{2}{3}} + 10m^{-\frac{4}{3}} \\
 \hline
 +6 + 2m^{-\frac{2}{3}} - 8m^{-\frac{4}{3}} \\
 6m^{-\frac{2}{3}} + 2m^{-\frac{4}{3}} - 8m^{-2} \\
 \hline
 -6m^{-\frac{2}{3}} - 2m^{-\frac{4}{3}} + 8m^{-2}
 \end{array}$$

$$\begin{array}{r}
 6. \quad a^{\frac{5}{4}} - 4a^{\frac{1}{4}} + 4a^{-\frac{1}{4}} - a^{-\frac{3}{4}} \quad \left| \begin{array}{l} a^{\frac{1}{2}} - 2 + a^{-\frac{1}{2}} \\ a^{\frac{3}{4}} + 2a^{\frac{1}{4}} - a^{-\frac{1}{4}} \end{array} \right. \\
 \hline
 -a^{\frac{5}{4}} + 2a^{\frac{3}{4}} - a^{\frac{1}{4}} \\
 2a^{\frac{3}{4}} - 5a^{\frac{1}{4}} + 4a^{-\frac{1}{4}} \\
 \hline
 -2a^{\frac{3}{4}} + 4a^{\frac{1}{4}} - 2a^{-\frac{1}{4}} \\
 -a^{\frac{1}{4}} + 2a^{-\frac{1}{4}} - a^{-\frac{3}{4}} \\
 \hline
 +a^{\frac{1}{4}} - 2a^{-\frac{1}{4}} + a^{-\frac{3}{4}}
 \end{array}$$

$$\begin{array}{r}
 7. \quad 4x^{-5} - 7x^{-4} - x^{-3} + 9x^{-2} - 7x^{-1} + 2 \quad \left| \begin{array}{l} 4x^{-2} + x^{-1} - 3 + 2x \\ x^{-3} - 2x^{-2} + x^{-1} \end{array} \right. \\
 \hline
 -4x^{-5} - x^{-4} + 3x^{-3} - 2x^{-2} \\
 -8x^{-4} + 2x^{-3} + 7x^{-2} - 7x^{-1} \\
 \hline
 8x^{-4} + 2x^{-3} - 6x^{-2} + 4x^{-1} \\
 4x^{-3} + x^{-2} - 3x^{-1} + 2 \\
 \hline
 -4x^{-3} - x^{-2} + 3x^{-1} - 2
 \end{array}$$

$$\begin{array}{r}
 8. \quad a^{-12}b^{-11} + a^{-8}b^{-7} + a^{-4}b^{-3} \quad \left| \begin{array}{l} a^{-7}b^{-6} - a^{-5}b^{-4} + a^{-3}b^{-2} \\ a^{-5}b^{-5} + a^{-3}b^{-3} + a^{-1}b^{-1} \end{array} \right. \\
 \hline
 -a^{-12}b^{-11} + a^{-10}b^{-9} - a^{-8}b^{-7} \\
 a^{-10}b^{-9} \\
 \hline
 -a^{-10}b^{-9} + a^{-8}b^{-7} - a^{-6}b^{-5} \\
 a^{-8}b^{-7} - a^{-6}b^{-5} + a^{-4}b^{-3} \\
 \hline
 -a^{-8}b^{-7} + a^{-6}b^{-5} - a^{-4}b^{-3}
 \end{array}$$



$$\begin{array}{r}
 9. \quad \frac{m^{-4}n + m^{-2}n^{-1}}{-m^{-4}n + m^{-3} - m^{-2}n^{-1}} + n^{-3} \left| \frac{m^{-4} - m^{-3}n^{-1} + m^{-2}n^{-2}}{n + m + m^2n^{-1}} \right. \\
 \hline
 m^{-3} \\
 \frac{-m^{-3} + m^{-2}n^{-1} - m^{-1}n^{-2}}{m^{-2}n^{-1} - m^{-1}n^{-2} + n^{-3}} \\
 \hline
 \frac{-m^{-2}n^{-1} + m^{-1}n^{-2} - n^{-3}}{\phantom{-m^{-2}n^{-1} + m^{-1}n^{-2} - n^{-3}}}
 \end{array}$$

$$\begin{array}{r}
 10. \quad \frac{15a^3 + a^2 - 19a + 17 - 24a^{-1} + 10a^{-2}}{-15a^3 - 10a^2 + 25a} \left| \frac{3a + 2 - 5a^{-1}}{5a^2 - 3a + 4 - 2a^{-1}} \right. \\
 \hline
 -9a^2 + 6a + 17 \\
 + 9a^2 + 6a - 15 \\
 \hline
 12a + 2 - 24a^{-1} \\
 \hline
 -12a - 8 + 20a^{-1} \\
 \hline
 -6 - 4a^{-1} + 10a^{-2} \\
 \hline
 + 6 + 4a^{-1} - 10a^{-2}
 \end{array}$$

$$\begin{array}{r}
 11. \quad \frac{a^{\frac{5}{4}}b^{-4} - a^{\frac{3}{4}}b^{-3}}{-a^{\frac{5}{4}}b^{-4} + 2a^{\frac{3}{4}}b^{-3} - 3a^{\frac{1}{4}}b^{-2}} + 5a^{\frac{1}{4}}b^{-1} - 3a^{-\frac{3}{4}} \left| \frac{a^{\frac{1}{2}}b^{-1} - 2 + 3a^{\frac{1}{2}}b}{a^{\frac{3}{4}}b^{-3} + a^{\frac{1}{4}}b^{-2} - a^{-\frac{1}{4}}b^{-1}} \right. \\
 \hline
 a^{\frac{3}{4}}b^{-3} - 3a^{\frac{1}{4}}b^{-2} + 5a^{-\frac{1}{4}}b^{-1} \\
 \hline
 -a^{\frac{3}{4}}b^{-3} + 2a^{\frac{1}{4}}b^{-2} - 3a^{-\frac{1}{4}}b^{-1} \\
 \hline
 -a^{\frac{1}{4}}b^{-2} + 2a^{-\frac{1}{4}}b^{-1} - 3a^{-\frac{3}{4}} \\
 \hline
 + a^{\frac{1}{4}}b^{-2} - 2a^{-\frac{1}{4}}b^{-1} + 3a^{-\frac{3}{4}}
 \end{array}$$

$$\begin{array}{r}
 12. \quad \frac{x^{-2} + x^{\frac{3}{2}}y^{\frac{1}{2}} + x^{-1}y^{-1}}{-x^{-2} + x^{\frac{3}{2}}y^{\frac{1}{2}} - x^{-1}y^{-1}} + 2y^{-2} \left| \frac{x^{-1} - x^{-\frac{1}{2}}y^{-\frac{1}{2}} + y^{-1}}{x^{-1} + 2x^{\frac{1}{2}}y^{-\frac{1}{2}} + 2y^{-1}} \right. \\
 \hline
 2x^{\frac{3}{2}}y^{\frac{1}{2}} \\
 \hline
 -2x^{\frac{3}{2}}y^{\frac{1}{2}} + 2x^{-1}y^{-1} - 2x^{-\frac{1}{2}}y^{-\frac{3}{2}} \\
 \hline
 2x^{-1}y^{-1} - 2x^{-\frac{1}{2}}y^{-\frac{3}{2}} + 2y^{-2} \\
 \hline
 -2x^{-1}y^{-1} + 2x^{-\frac{1}{2}}y^{-\frac{3}{2}} - 2y^{-2}
 \end{array}$$

$$\begin{array}{l}
 \text{13. } m - 6m^{\frac{1}{5}} + m^{-\frac{3}{5}} \left| \begin{array}{l} m^{\frac{3}{5}} + 2m^{\frac{1}{5}} - m^{-\frac{1}{5}} \\ m^{\frac{2}{5}} - 2 - m^{-\frac{2}{5}} \end{array} \right. \\
 \hline
 -m - 2m^{\frac{3}{5}} + m^{\frac{1}{5}} \\
 -2m^{\frac{3}{5}} - 5m^{\frac{1}{5}} \\
 \hline
 2m^{\frac{3}{5}} + 4m^{\frac{1}{5}} - 2m^{-\frac{1}{5}} \\
 -m^{\frac{1}{5}} - 2m^{-\frac{1}{5}} + m^{-\frac{3}{5}} \\
 \hline
 +m^{\frac{1}{5}} + 2m^{-\frac{1}{5}} - m^{-\frac{3}{5}}
 \end{array}
 \qquad
 \begin{array}{l}
 \text{14. } 2x + 4x^{\frac{2}{3}} + 2 + 4x^{-\frac{1}{3}} \left| \begin{array}{l} x + 3x^{\frac{2}{3}} + 2x^{\frac{1}{3}} \\ 2 - 2x^{-\frac{1}{3}} + 2x^{\frac{2}{3}} \end{array} \right. \\
 \hline
 -2x - 6x^{\frac{2}{3}} - 4x^{\frac{1}{3}} \\
 -2x^{\frac{2}{3}} - 4x^{\frac{1}{3}} + 2 \\
 \hline
 +2x^{\frac{2}{3}} + 6x^{\frac{1}{3}} + 4 \\
 2x^{\frac{1}{3}} + 6 + 4x^{-\frac{1}{3}} \\
 \hline
 -2x^{\frac{1}{3}} - 6 - 4x^{-\frac{1}{3}}
 \end{array}$$

$$\begin{array}{l}
 \text{15. } 4x^{\frac{5}{2}} + 3x^2y^{\frac{1}{2}} - x^{\frac{1}{2}}y^2 \left| \begin{array}{l} x^{\frac{1}{2}} + y^{\frac{1}{2}} \\ 4x^2 - x^{\frac{3}{2}}y^{\frac{1}{2}} - xy - x^{\frac{1}{2}}y^{\frac{3}{2}} \end{array} \right. \\
 \hline
 -4x^{\frac{5}{2}} - 4x^2y^{\frac{1}{2}} \\
 -x^{\frac{1}{2}}y^2 \\
 \hline
 +x^{\frac{1}{2}}y^{\frac{1}{2}} - x^{\frac{3}{2}}y \\
 -x^{\frac{3}{2}}y \\
 \hline
 +x^{\frac{3}{2}}y - xy^{\frac{3}{2}} \\
 -xy^{\frac{3}{2}} - x^{\frac{1}{2}}y^2 \\
 \hline
 +xy^{\frac{3}{2}} + x^{\frac{1}{2}}y^2
 \end{array}$$

$$\begin{array}{l}
 \text{16. } x^{\frac{7}{3}} - 7ax^{\frac{4}{3}} - 3a^{\frac{4}{3}}x - 9a^{\frac{5}{3}}x^{\frac{2}{3}} \left| \begin{array}{l} x^{\frac{4}{3}} + 2a^{\frac{1}{3}}x + 3a^{\frac{2}{3}}x^{\frac{2}{3}} \\ x - 2a^{\frac{1}{3}}x^{\frac{2}{3}} + a^{\frac{2}{3}}x^{\frac{1}{3}} - 3a \end{array} \right. \\
 \hline
 -x^{\frac{7}{3}} - 2a^{\frac{1}{3}}x^2 - 3a^{\frac{2}{3}}x^{\frac{5}{3}} \\
 -2a^{\frac{1}{3}}x^2 - 3a^{\frac{2}{3}}x^{\frac{5}{3}} - 7ax^{\frac{4}{3}} \\
 \hline
 +2a^{\frac{1}{3}}x^2 + 4a^{\frac{2}{3}}x^{\frac{5}{3}} + 6ax^{\frac{4}{3}} \\
 a^{\frac{2}{3}}x^{\frac{5}{3}} - ax^{\frac{4}{3}} - 3a^{\frac{4}{3}}x \\
 \hline
 -a^{\frac{2}{3}}x^{\frac{5}{3}} - 2ax^{\frac{4}{3}} - 3a^{\frac{4}{3}}x \\
 -3ax^{\frac{4}{3}} - 6a^{\frac{4}{3}}x - 9a^{\frac{5}{3}}x^{\frac{2}{3}} \\
 \hline
 +3ax^{\frac{4}{3}} + 6a^{\frac{4}{3}}x + 9a^{\frac{5}{3}}x^{\frac{2}{3}}
 \end{array}$$

$$\begin{array}{l}
 17. \quad \frac{a^{\frac{3}{2}}}{a^2} + a^{\frac{1}{2}}b - b^{\frac{3}{2}} \quad -a^{-1}b^{\frac{5}{2}} \left| \frac{a^{\frac{1}{2}} + b^{\frac{1}{2}} + a^{-\frac{1}{2}}b}{a - a^{\frac{1}{2}}b^{\frac{1}{2}} + b - a^{-\frac{1}{2}}b^{\frac{3}{2}}} \right. \\
 \hline
 -a^{\frac{3}{2}} - ab^{\frac{1}{2}} - a^{\frac{1}{2}}b \\
 \hline
 -ab^{\frac{1}{2}} \quad -b^{\frac{3}{2}} \\
 +ab^{\frac{1}{2}} + a^{\frac{1}{2}}b + b^{\frac{3}{2}} \\
 \hline
 a^{\frac{1}{2}}b \\
 -a^{\frac{1}{2}}b - b^{\frac{3}{2}} - a^{-\frac{1}{2}}b^2 \\
 \hline
 -b^{\frac{3}{2}} - a^{-\frac{1}{2}}b^2 - a^{-1}b^{\frac{5}{2}} \\
 +b^{\frac{3}{2}} + a^{-\frac{1}{2}}b^2 + a^{-1}b^{\frac{5}{2}} \\
 \hline
 \end{array}$$

$$\begin{array}{l}
 18. \quad m^{-2}n^2 \quad -11m^{-1}n \quad +1 \left| \frac{m^{-\frac{3}{4}}n^{\frac{3}{2}} + 3m^{-\frac{1}{4}}n - m^{\frac{1}{2}}n^{\frac{1}{2}}}{m^{-\frac{5}{4}}n^{\frac{1}{2}} - 3m^{-\frac{3}{4}} - m^{-\frac{1}{4}}n^{-\frac{1}{2}}} \right. \\
 \hline
 -m^{-2}n^2 - 3m^{-\frac{3}{2}}n^{\frac{3}{2}} + m^{-1}n \\
 \hline
 -3m^{-\frac{3}{2}}n^{\frac{3}{2}} - 10m^{-1}n \\
 +3m^{-\frac{3}{2}}n^{\frac{3}{2}} + 9m^{-1}n - 3m^{-\frac{1}{2}}n^{\frac{1}{2}} \\
 \hline
 -m^{-1}n - 3m^{-\frac{1}{2}}n^{\frac{1}{2}} + 1 \\
 +m^{-1}n + 3m^{-\frac{1}{2}}n^{\frac{1}{2}} - 1 \\
 \hline
 \end{array}$$

$$\begin{array}{l}
 19. \quad x^{-1}y^2 + 4 \quad +13x^2y^{-4} + 6x^3y^{-6} \left| \frac{x^{-3}y^3 - x^{-2}y + 3x^{-1}y^{-1}}{x^2y^{-1} + 5x^3y^{-3} + 2x^4y^{-5}} \right. \\
 \hline
 -x^{-1}y^2 + 1 - 3xy^{-2} \\
 \hline
 5 - 3xy^{-2} + 13x^2y^{-4} \\
 -5 + 5xy^{-2} - 15x^2y^{-4} \\
 \hline
 2xy^{-2} - 2x^2y^{-4} + 6x^3y^{-6} \\
 -2xy^{-2} + 2x^2y^{-4} - 6x^3y^{-6} \\
 \hline
 \end{array}$$

$$\begin{array}{l}
 20. \quad 3 + 7a^{-\frac{2}{3}}b^{\frac{1}{2}} \quad +a^{-2}b^{\frac{3}{2}} - a^{-\frac{8}{3}}b^2 \left| \frac{3a^{\frac{2}{3}}b^{-\frac{1}{2}} + 1 + a^{-\frac{2}{3}}b^{\frac{1}{2}}}{a^{-\frac{2}{3}}b^{\frac{1}{2}} + 2a^{-\frac{4}{3}}b - a^{-2}b^{\frac{3}{2}}} \right. \\
 \hline
 -3 - a^{-\frac{2}{3}}b^{\frac{1}{2}} - a^{-\frac{4}{3}}b \\
 \hline
 6a^{-\frac{2}{3}}b^{\frac{1}{2}} - a^{-\frac{4}{3}}b + a^{-2}b^{\frac{3}{2}} \\
 -6a^{-\frac{2}{3}}b^{\frac{1}{2}} - 2a^{-\frac{4}{3}}b - 2a^{-2}b^{\frac{3}{2}} \\
 \hline
 -3a^{-\frac{4}{3}}b - a^{-2}b^{\frac{3}{2}} - a^{-\frac{8}{3}}b^2 \\
 +3a^{-\frac{4}{3}}b + a^{-2}b^{\frac{3}{2}} + a^{-\frac{8}{3}}b^2 \\
 \hline
 \end{array}$$

## EJERCICIO 227

1.  $(a^{-1})^2 = a^{-1 \cdot 2} = a^{-2}$
2.  $(a^{-2}b^{-1})^3 = a^{-2 \cdot 3} b^{-1 \cdot 3} = a^{-6}b^{-3}$
3.  $\left(a^{\frac{3}{2}}\right)^2 = a^{\frac{3}{2} \cdot 2} = a^3$
4.  $\left(x^{\frac{3}{4}}\right)^3 = x^{\frac{3}{4} \cdot 3} = x^{\frac{9}{4}}$
5.  $\left(m^{\frac{3}{4}}\right)^2 = m^{\frac{3}{4} \cdot 2} = m^{\frac{6}{4}} = m^{\frac{3}{2}}$
6.  $\left(a^{-\frac{2}{3}}\right)^3 = a^{-\frac{2}{3} \cdot 3} = a^{-2}$
7.  $\left(x^{-4}y^{\frac{1}{4}}\right)^2 = x^{-4 \cdot 2} y^{\frac{1}{4} \cdot 2} = x^{-8} y^{\frac{1}{2}} = x^{-8} y^{\frac{1}{2}}$
8.  $\left(2a^{\frac{1}{2}}b^{\frac{1}{3}}\right)^2 = 2^2 a^{\frac{1}{2} \cdot 2} b^{\frac{1}{3} \cdot 2} = 4a^1 b^{\frac{2}{3}} = 4ab^{\frac{2}{3}}$
9.  $(a^{-3}b^{-1})^4 = a^{-3 \cdot 4} b^{-1 \cdot 4} = a^{-12} b^{-4}$
10.  $\left(x^{\frac{2}{3}}y^{-\frac{1}{2}}\right)^6 = x^{\frac{2}{3} \cdot 6} y^{-\frac{1}{2} \cdot 6} = x^4 y^{-3} = x^4 y^{-3}$
11.  $\left(3a^{\frac{2}{5}}b^{-3}\right)^5 = 3^5 a^{\frac{2}{5} \cdot 5} b^{-3 \cdot 5} = 243a^2 b^{-15} = 243a^2 b^{-15}$
12.  $\left(2m^{-\frac{1}{2}}n^{-\frac{1}{3}}\right)^3 = 2^3 m^{-\frac{1}{2} \cdot 3} n^{-\frac{1}{3} \cdot 3} = 8m^{-\frac{3}{2}} n^{-1} = 8m^{-\frac{3}{2}} n^{-1}$

## EJERCICIO 228

1.  $\left(a^{\frac{1}{2}} + b^{\frac{1}{2}}\right)^2 = \left(a^{\frac{1}{2}}\right)^2 + 2\left(a^{\frac{1}{2}}\right)\left(b^{\frac{1}{2}}\right) + \left(b^{\frac{1}{2}}\right)^2$   
 $= a + 2a^{\frac{1}{2}}b^{\frac{1}{2}} + b$
2.  $\left(x^{\frac{3}{4}} - y^{\frac{1}{3}}\right)^2 = \left(x^{\frac{3}{4}}\right)^2 - 2\left(x^{\frac{3}{4}}\right)\left(y^{\frac{1}{3}}\right) + \left(y^{\frac{1}{3}}\right)^2$   
 $= x^{\frac{3}{2}} - 2x^{\frac{3}{4}}y^{\frac{1}{3}} + y^{\frac{2}{3}}$
3.  $\left(m^{-\frac{1}{2}} + 2m\right)^2 = \left(m^{-\frac{1}{2}}\right)^2 + 2(2m)\left(m^{-\frac{1}{2}}\right) + (2m)^2$   
 $= m^{-1} + 4m^{1-\frac{1}{2}} + 4m^2 = m^{-1} + 4m^{\frac{1}{2}} + 4m^2$
4.  $(a^{-2}b^3 - a^3b^{-2})^2$   
 $= (a^{-2}b^3)^2 - 2(a^{-2}b^3)(a^3b^{-2}) + (a^3b^{-2})^2$   
 $= a^{-4}b^6 - 2a^{-2+3}b^{3-2} + a^6b^{-4}$   
 $= a^{-4}b^6 - 2ab + a^6b^{-4}$
5.  $\left(a^{-1} - 3b^{-\frac{3}{4}}\right)^2 = (a^{-1})^2 - 2(a^{-1})\left(3b^{-\frac{3}{4}}\right) + \left(3b^{-\frac{3}{4}}\right)^2$   
 $= a^{-2} - 6a^{-1}b^{-\frac{3}{4}} + 9b^{-\frac{3}{2}}$
6.  $(a^{-2} + \sqrt{b})^2 = (a^{-2})^2 + 2(a^{-2})\left(b^{\frac{1}{2}}\right) + \left(b^{\frac{1}{2}}\right)^2$   
 $= a^{-4} + 2a^{-2}b^{\frac{1}{2}} + b$
7.  $\left(\sqrt[4]{x^3} - y^{-\frac{1}{2}}\right)^2 = \left(x^{\frac{3}{4}}\right)^2 - 2\left(x^{\frac{3}{4}}\right)\left(y^{-\frac{1}{2}}\right) + \left(y^{-\frac{1}{2}}\right)^2$   
 $= x^{\frac{3}{2}} - 2x^{\frac{3}{4}}y^{-\frac{1}{2}} + y^{-1}$
8.  $\left(m^{-2}n^{\frac{1}{4}} - m^{\frac{1}{2}}n^{-1}\right)^2$   
 $= \left(m^{-2}n^{\frac{1}{4}}\right)^2 - 2\left(m^{-2}n^{\frac{1}{4}}\right)\left(m^{\frac{1}{2}}n^{-1}\right) + \left(m^{\frac{1}{2}}n^{-1}\right)^2$   
 $= m^{-4}n^{\frac{1}{2}} - 2m^{-2+\frac{1}{2}}n^{\frac{1}{4}-1} + mn^{-2}$   
 $= m^{-4}n^{\frac{1}{2}} - 2m^{-\frac{3}{2}}n^{-\frac{3}{4}} + mn^{-2}$
9.  $\left(a^{\frac{1}{3}} + b^{\frac{1}{3}}\right)^3$   
 $= \left(a^{\frac{1}{3}}\right)^3 + 3\left(a^{\frac{1}{3}}\right)^2\left(b^{\frac{1}{3}}\right) + 3\left(a^{\frac{1}{3}}\right)\left(b^{\frac{1}{3}}\right)^2 + \left(b^{\frac{1}{3}}\right)^3$   
 $= a + 3a^{\frac{2}{3}}b^{\frac{1}{3}} + 3a^{\frac{1}{3}}b^{\frac{2}{3}} + b$
10.  $\left(\sqrt[3]{x^2} - 3y^{-1}\right)^3$   
 $= \left(x^{\frac{2}{3}}\right)^3 - 3\left(x^{\frac{2}{3}}\right)^2\left(3y^{-1}\right) + 3\left(x^{\frac{2}{3}}\right)\left(3y^{-1}\right)^2 - \left(3y^{-1}\right)^3$   
 $= x^2 - 9x^{\frac{4}{3}}y^{-1} + 27x^{\frac{2}{3}}y^{-2} - 27y^{-3}$

$$11. \left(m^{\frac{2}{3}} + 4n^{-\frac{3}{2}}\right)^3 = \left(m^{\frac{2}{3}}\right)^3 + 3\left(m^{\frac{2}{3}}\right)^2\left(4n^{-\frac{3}{2}}\right) + 3\left(m^{\frac{2}{3}}\right)\left(4n^{-\frac{3}{2}}\right)^2 + \left(4n^{-\frac{3}{2}}\right)^3 = m^2 + 12m^{\frac{4}{3}}n^{-\frac{3}{2}} + 48m^{\frac{2}{3}}n^{-3} + 64n^{-\frac{9}{2}}$$

$$12. \left(2a^{-4} - 3b^{-\frac{1}{2}}\right)^3 = (2a^{-4})^3 - 3(2a^{-4})^2\left(3b^{-\frac{1}{2}}\right) + 3(2a^{-4})\left(3b^{-\frac{1}{2}}\right)^2 - \left(3b^{-\frac{1}{2}}\right)^3 = 8a^{-12} - 36a^{-8}b^{-\frac{1}{2}} + 54a^{-4}b^{-1} - 27b^{-\frac{3}{2}}$$

$$13. \left(\sqrt{x} - \sqrt[3]{y}\right)^3 = \left(x^{\frac{1}{2}}\right)^3 - 3\left(x^{\frac{1}{2}}\right)^2\left(y^{\frac{1}{3}}\right) + 3\left(x^{\frac{1}{2}}\right)\left(y^{\frac{1}{3}}\right)^2 - \left(y^{\frac{1}{3}}\right)^3 = x^{\frac{3}{2}} - 3xy^{\frac{1}{3}} + 3x^{\frac{1}{2}}y^{\frac{2}{3}} - y$$

$$14. \left(a^{\frac{1}{2}} + b^{\frac{2}{3}}\right)^4 = \left(a^{\frac{1}{2}}\right)^4 + 4\left(a^{\frac{1}{2}}\right)^3\left(b^{\frac{2}{3}}\right) + 6\left(a^{\frac{1}{2}}\right)^2\left(b^{\frac{2}{3}}\right)^2 + 4\left(a^{\frac{1}{2}}\right)\left(b^{\frac{2}{3}}\right)^3 + \left(b^{\frac{2}{3}}\right)^4 = a^2 + 4a^{\frac{3}{2}}b^{\frac{2}{3}} + 6ab^{\frac{4}{3}} + 4a^{\frac{1}{2}}b^2 + b^{\frac{8}{3}}$$

$$15. \left(x^{-2} - y^{-\frac{1}{3}}\right)^4 = (x^{-2})^4 - 4(x^{-2})^3\left(y^{-\frac{1}{3}}\right) + 6(x^{-2})^2\left(y^{-\frac{1}{3}}\right)^2 - 4(x^{-2})\left(y^{-\frac{1}{3}}\right)^3 + \left(y^{-\frac{1}{3}}\right)^4 \\ = x^{-8} - 4x^{-6}y^{-\frac{1}{3}} + 6x^{-4}y^{-\frac{2}{3}} - 4x^{-2}y^{-1} + y^{-\frac{4}{3}}$$

$$16. \left(x^{\frac{1}{3}} + y^{\frac{3}{4}}\right)^5 = \left(x^{\frac{1}{3}}\right)^5 + 5\left(x^{\frac{1}{3}}\right)^4\left(y^{\frac{3}{4}}\right) + 10\left(x^{\frac{1}{3}}\right)^3\left(y^{\frac{3}{4}}\right)^2 + 10\left(x^{\frac{1}{3}}\right)^2\left(y^{\frac{3}{4}}\right)^3 + 5\left(x^{\frac{1}{3}}\right)\left(y^{\frac{3}{4}}\right)^4 + \left(y^{\frac{3}{4}}\right)^5 \\ = x^{\frac{5}{3}} + 5x^{\frac{4}{3}}y^{\frac{3}{4}} + 10xy^{\frac{3}{2}} + 10x^{\frac{2}{3}}y^{\frac{9}{4}} + 5x^{\frac{1}{3}}y^{-3} + y^{-\frac{15}{4}}$$

$$17. \left(\sqrt{m} - \sqrt[3]{n}\right)^5 = \left(m^{\frac{1}{2}}\right)^5 - 5\left(m^{\frac{1}{2}}\right)^4\left(n^{\frac{1}{3}}\right) + 10\left(m^{\frac{1}{2}}\right)^3\left(n^{\frac{1}{3}}\right)^2 - 10\left(m^{\frac{1}{2}}\right)^2\left(n^{\frac{1}{3}}\right)^3 + 5\left(m^{\frac{1}{2}}\right)\left(n^{\frac{1}{3}}\right)^4 - \left(n^{\frac{1}{3}}\right)^5 \\ = m^{\frac{5}{2}} - 5m^2n^{\frac{1}{3}} + 10m^{\frac{3}{2}}n^{\frac{2}{3}} - 10mn + 5m^{\frac{1}{2}}n^{\frac{4}{3}} - n^{\frac{5}{3}}$$

$$18. \left(a^2 - 2\sqrt{m}\right)^6 \\ = (a^2)^6 - 6(a^2)^5\left(2m^{\frac{1}{2}}\right) + 15(a^2)^4\left(2m^{\frac{1}{2}}\right)^2 - 20(a^2)^3\left(2m^{\frac{1}{2}}\right)^3 + 15(a^2)^2\left(2m^{\frac{1}{2}}\right)^4 - 6(a^2)\left(2m^{\frac{1}{2}}\right)^5 + \left(2m^{\frac{1}{2}}\right)^6 \\ = a^{12} - 12a^{10}m^{\frac{1}{2}} + 60a^8m - 160a^6m^{\frac{3}{2}} + 240a^4m^2 - 192a^2m^{\frac{5}{2}} + 64m^3$$

$$19. \left(x^{-3} + \sqrt[4]{y}\right)^5 = (x^{-3})^5 + 5(x^{-3})^4\left(y^{\frac{1}{4}}\right) + 10(x^{-3})^3\left(y^{\frac{1}{4}}\right)^2 + 10(x^{-3})^2\left(y^{\frac{1}{4}}\right)^3 + 5(x^{-3})\left(y^{\frac{1}{4}}\right)^4 + \left(y^{\frac{1}{4}}\right)^5 \\ = x^{-15} + 5x^{-12}y^{\frac{1}{4}} + 10x^{-9}y^{\frac{1}{2}} + 10x^{-6}y^{\frac{3}{4}} + 5x^{-3}y + y^{\frac{5}{4}}$$

$$20. \left(a^{-2} + 3a^{-1} + 2\right)^2 = (a^{-2})^2 + (3a^{-1})^2 + (2)^2 + 2(a^{-2})(3a^{-1}) + 2(a^{-2})(2) + 2(3a^{-1})(2) \\ = a^{-4} + 9a^{-2} + 4 + 6a^{-3} + 4a^{-2} + 12a^{-1} = a^{-4} + 6a^{-3} + 13a^{-2} + 12a^{-1} + 4$$

$$21. \left(x^{\frac{1}{2}} - x^{\frac{1}{4}} + 2x^{-\frac{1}{4}}\right)^2 = \left(x^{\frac{1}{2}}\right)^2 + \left(-x^{\frac{1}{4}}\right)^2 + \left(2x^{-\frac{1}{4}}\right)^2 + 2\left(x^{\frac{1}{2}}\right)\left(-x^{\frac{1}{4}}\right) + 2\left(x^{\frac{1}{2}}\right)\left(2x^{-\frac{1}{4}}\right) + 2\left(-x^{\frac{1}{4}}\right)\left(2x^{-\frac{1}{4}}\right) \\ = x + x^{\frac{1}{2}} + 4x^{-\frac{1}{2}} - 2x^{\frac{3}{4}} + 4x^{\frac{1}{4}} - 4 = x - 2x^{\frac{3}{4}} + x^{\frac{1}{2}} + 4x^{\frac{1}{4}} - 4 + 4x^{-\frac{1}{2}}$$

$$22. \left(a^{-\frac{1}{2}} + 3 + a^{\frac{1}{2}}\right)^2 = \left(a^{-\frac{1}{2}}\right)^2 + (3)^2 + \left(a^{\frac{1}{2}}\right)^2 + 2\left(a^{-\frac{1}{2}}\right)(3) + 2\left(a^{-\frac{1}{2}}\right)\left(a^{\frac{1}{2}}\right) + 2(3)\left(a^{\frac{1}{2}}\right) \\ = a^{-1} + 9 + a + 6a^{-\frac{1}{2}} + 2 + 6a^{\frac{1}{2}} = a + 6a^{\frac{1}{2}} + 11 + 6a^{-\frac{1}{2}} + a^{-1}$$



$$\begin{array}{l}
 \sqrt{m+6m^{\frac{1}{2}}+11+6m^{-\frac{1}{2}}+m^{-1}} \\
 \hline
 -m \\
 \hline
 6m^{\frac{1}{2}}+11 \\
 -6m^{\frac{1}{2}}-9 \\
 \hline
 2+6m^{-\frac{1}{2}}+m^{-1} \\
 -2-6m^{-\frac{1}{2}}-m^{-1} \\
 \hline
 \end{array}
 \quad
 \begin{array}{l}
 m^{\frac{1}{2}}+3+m^{-\frac{1}{2}} \\
 \hline
 (2m^{\frac{1}{2}}+3)(3)=6m^{\frac{1}{2}}+9 \\
 \\
 (2m^{\frac{1}{2}}+6+m^{-\frac{1}{2}})\left(m^{-\frac{1}{2}}\right) \\
 =2+6m^{-\frac{1}{2}}+m^{-1}
 \end{array}$$

$$\begin{array}{l}
 \sqrt{9a^{\frac{4}{3}}-6a+25a^{\frac{2}{3}}-8a^{\frac{1}{3}}+16} \\
 \hline
 -9a^{\frac{4}{3}} \\
 \hline
 -6a+25a^{\frac{2}{3}} \\
 +6a-a^{\frac{2}{3}} \\
 \hline
 24a^{\frac{2}{3}}-8a^{\frac{1}{3}}+16 \\
 -24a^{\frac{2}{3}}+8a^{\frac{1}{3}}-16 \\
 \hline
 \end{array}
 \quad
 \begin{array}{l}
 3a^{\frac{2}{3}}-a^{\frac{1}{3}}+4 \\
 \hline
 (6a^{\frac{2}{3}}-a^{\frac{1}{3}})\left(-a^{\frac{1}{3}}\right) \\
 =-6a+a^{\frac{2}{3}} \\
 \\
 (6a^{\frac{2}{3}}-2a^{\frac{1}{3}}+4)(4) \\
 =24a^{\frac{2}{3}}-8a^{\frac{1}{3}}+16
 \end{array}$$

$$\begin{array}{l}
 \sqrt{a^2+4a^{\frac{7}{4}}-2a^{\frac{3}{2}}-12a^{\frac{5}{4}}+9a} \\
 \hline
 -a^2 \\
 \hline
 +4a^{\frac{7}{4}}-2a^{\frac{3}{2}} \\
 -4a^{\frac{7}{4}}-4a^{\frac{3}{2}} \\
 \hline
 -6a^{\frac{3}{2}}-12a^{\frac{5}{4}}+9a \\
 +6a^{\frac{3}{2}}+12a^{\frac{5}{4}}-9a \\
 \hline
 \end{array}
 \quad
 \begin{array}{l}
 a+2a^{\frac{3}{4}}-3a^{\frac{1}{2}} \\
 \hline
 (2a+2a^{\frac{3}{4}})\left(2a^{\frac{3}{4}}\right) \\
 =4a^{\frac{7}{4}}+4a^{\frac{3}{2}} \\
 \\
 (2a+4a^{\frac{3}{4}}-3a^{\frac{1}{2}})\left(-3a^{\frac{1}{2}}\right) \\
 =-6a^{\frac{3}{2}}-12a^{\frac{5}{4}}+9a
 \end{array}$$

$$\begin{array}{l|l}
 5. \sqrt{mn^{-\frac{2}{3}} - 4m^{\frac{1}{2}}n^{-\frac{1}{3}} + 6 - 4m^{-\frac{1}{2}}n^{\frac{1}{3}} + m^{-1}n^{\frac{2}{3}}} & m^{\frac{1}{2}}n^{-\frac{1}{3}} - 2 + m^{-\frac{1}{2}}n^{\frac{1}{3}} \\
 \hline
 -mn^{-\frac{2}{3}} & \left(2m^{\frac{1}{2}}n^{-\frac{1}{3}} - 2\right)(-2) \\
 \hline
 -4m^{\frac{1}{2}}n^{-\frac{1}{3}} + 6 & = -4m^{\frac{1}{2}}n^{-\frac{1}{3}} + 4 \\
 \hline
 +4m^{\frac{1}{2}}n^{-\frac{1}{3}} - 4 & \\
 \hline
 2 - 4m^{-\frac{1}{2}}n^{\frac{1}{3}} + m^{-1}n^{\frac{2}{3}} & \left(2m^{\frac{1}{2}}n^{-\frac{1}{3}} - 4 + m^{-\frac{1}{2}}n^{\frac{1}{3}}\right)\left(m^{-\frac{1}{2}}n^{\frac{1}{3}}\right) \\
 \hline
 -2 + 4m^{-\frac{1}{2}}n^{\frac{1}{3}} - m^{-1}n^{\frac{2}{3}} & = 2 - 4m^{-\frac{1}{2}}n^{\frac{1}{3}} + m^{-1}n^{\frac{2}{3}}
 \end{array}$$

$$\begin{array}{l|l}
 6. \sqrt{a^{\frac{4}{5}} - 8a^{\frac{3}{5}} + 10a^{\frac{2}{5}} + 24a^{\frac{1}{5}} + 9} & a^{\frac{2}{5}} - 4a^{\frac{1}{5}} - 3 \\
 \hline
 -a^{\frac{4}{5}} & \left(2a^{\frac{2}{5}} - 4a^{\frac{1}{5}}\right)\left(-4a^{\frac{1}{5}}\right) \\
 \hline
 -8a^{\frac{3}{5}} + 10a^{\frac{2}{5}} & = -8a^{\frac{3}{5}} + 16a^{\frac{2}{5}} \\
 \hline
 +8a^{\frac{3}{5}} - 16a^{\frac{2}{5}} & \\
 \hline
 -6a^{\frac{2}{5}} + 24a^{\frac{1}{5}} + 9 & \left(2a^{\frac{2}{5}} - 8a^{\frac{1}{5}} - 3\right)(-3) \\
 \hline
 +6a^{\frac{2}{5}} - 24a^{\frac{1}{5}} - 9 & = -6a^{\frac{2}{5}} + 24a^{\frac{1}{5}} + 9
 \end{array}$$

$$\begin{array}{l|l}
 7. \sqrt[3]{a^{-3} - 6a^{-\frac{5}{2}} + 21a^{-2} - 44a^{-\frac{3}{2}} + 63a^{-1} - 54a^{-\frac{1}{2}} + 27} & a^{-1} - 2a^{-\frac{1}{2}} + 3 \\
 \hline
 -a^{-3} & 3(a^{-1})^2 = 3a^{-2} \\
 \hline
 -6a^{-\frac{5}{2}} + 21a^{-2} - 44a^{-\frac{3}{2}} & 3(a^{-1})^2\left(-2a^{-\frac{1}{2}}\right) = -6a^{-\frac{5}{2}} \\
 \hline
 +6a^{-\frac{5}{2}} - 12a^{-2} + 8a^{-\frac{3}{2}} & 3(a^{-1})\left(-2a^{-\frac{1}{2}}\right)^2 = 12a^{-2} \\
 \hline
 9a^{-2} - 36a^{-\frac{3}{2}} + 63a^{-1} - 54a^{-\frac{1}{2}} + 27 & \left(-2a^{-\frac{1}{2}}\right)^3 = -8a^{-\frac{3}{2}} \\
 \hline
 -9a^{-2} + 36a^{-\frac{3}{2}} - 63a^{-1} + 54a^{-\frac{1}{2}} - 27 & \\
 \hline
 & 3\left(a^{-1} - 2a^{-\frac{1}{2}}\right)^2 = 3a^{-2} - 12a^{-\frac{3}{2}} + 12a^{-1} \\
 & 3\left(a^{-1} - 2a^{-\frac{1}{2}}\right)^2(3) = 9a^{-2} - 36a^{-\frac{3}{2}} + 36a^{-1} \\
 & 3\left(a^{-1} - 2a^{-\frac{1}{2}}\right)(3)^2 = 27a^{-1} - 54a^{-\frac{1}{2}} \\
 & (3)^3 = 27
 \end{array}$$



$8. \sqrt[3]{x^2 - 6x^{\frac{4}{3}} + 15x^{\frac{2}{3}} - 20 + 15x^{-\frac{2}{3}} - 6x^{-\frac{4}{3}} + x^{-2}}$ <hr style="border: 0.5px solid black;"/> $-x^2$ <hr style="border: 0.5px solid black;"/> $-6x^{\frac{4}{3}} + 15x^{\frac{2}{3}} - 20$ <hr style="border: 0.5px solid black;"/> $+6x^{\frac{4}{3}} - 12x^{\frac{2}{3}} + 8$ <hr style="border: 0.5px solid black;"/> $3x^{\frac{2}{3}} - 12 + 15x^{-\frac{2}{3}} - 6x^{-\frac{4}{3}} + x^{-2}$ <hr style="border: 0.5px solid black;"/> $-3x^{\frac{2}{3}} + 12 - 15x^{-\frac{2}{3}} + 6x^{-\frac{4}{3}} - x^{-2}$ <hr style="border: 0.5px solid black;"/>	$x^{\frac{2}{3}} - 2 + x^{-\frac{2}{3}}$ <hr style="border: 0.5px solid black;"/> $3\left(x^{\frac{2}{3}}\right)^2 = 3x^{\frac{4}{3}}$ $3\left(x^{\frac{2}{3}}\right)^2(-2) = -6x^{\frac{4}{3}}$ $3\left(x^{\frac{2}{3}}\right)^2(-2)^2 = 12x^{\frac{4}{3}}$ $(-2)^3 = -8$ $3\left(x^{\frac{2}{3}} - 2\right)^2 = 3x^{\frac{4}{3}} - 12x^{\frac{2}{3}} + 12$ $3\left(x^{\frac{2}{3}} - 2\right)^2\left(x^{-\frac{2}{3}}\right) = 3x^{\frac{2}{3}} - 12 + 12x^{-\frac{2}{3}}$ $3\left(x^{\frac{2}{3}} - 2\right)\left(x^{-\frac{2}{3}}\right)^2 = 3x^{-\frac{2}{3}} - 6x^{-\frac{4}{3}}$ $\left(x^{-\frac{2}{3}}\right)^3 = x^{-2}$
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$9. \sqrt[3]{a^{\frac{3}{2}} + 3a^{\frac{5}{4}} - 5a^{\frac{3}{4}} + 3a^{\frac{1}{4}} - 1}$ <hr style="border: 0.5px solid black;"/> $-a^{\frac{3}{2}}$ <hr style="border: 0.5px solid black;"/> $+3a^{\frac{5}{4}} - 5a^{\frac{3}{4}} + 3a^{\frac{1}{4}}$ <hr style="border: 0.5px solid black;"/> $-3a^{\frac{5}{4}} - 3a - a^{\frac{3}{2}}$ <hr style="border: 0.5px solid black;"/> $-3a - 6a^{\frac{3}{4}} + 3a^{\frac{1}{4}} - 1$ <hr style="border: 0.5px solid black;"/> $+3a + 6a^{\frac{3}{4}} - 3a^{\frac{1}{4}} + 1$ <hr style="border: 0.5px solid black;"/>	$a^{\frac{1}{2}} + a^{\frac{1}{4}} - 1$ <hr style="border: 0.5px solid black;"/> $3\left(a^{\frac{1}{2}}\right)^2 = 3a$ $3\left(a^{\frac{1}{2}}\right)^2\left(a^{\frac{1}{4}}\right) = 3a^{\frac{5}{4}}$ $3\left(a^{\frac{1}{2}}\right)\left(a^{\frac{1}{4}}\right)^2 = 3a$ $\left(a^{\frac{1}{4}}\right)^3 = a^{\frac{3}{4}}$ $3\left(a^{\frac{1}{2}} + a^{\frac{1}{4}}\right)^2 = 3a + 6a^{\frac{3}{4}} + 3a^{\frac{1}{2}}$ $3\left(a^{\frac{1}{2}} + a^{\frac{1}{4}}\right)^2(-1) = -3a - 6a^{\frac{3}{4}} - 3a^{\frac{1}{2}}$ $3\left(a^{\frac{1}{2}} + a^{\frac{1}{4}}\right)(-1)^2 = 3a^{\frac{1}{2}} + 3a^{\frac{1}{4}}$ $(-1)^3 = -1$
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## EJERCICIO 230

$$\begin{array}{l|l}
 1. \sqrt{a^2x^{-2} - \frac{2ax^{-1}}{3} + \frac{19}{9} - \frac{2xa^{-1}}{3} + x^2a^{-2}} & ax^{-1} - \frac{1}{3} + a^{-1}x \\
 \hline
 -a^2x^{-2} & \left(2ax^{-1} - \frac{1}{3}\right)\left(-\frac{1}{3}\right) \\
 \hline
 -\frac{2ax^{-1}}{3} + \frac{19}{9} & = -\frac{2ax^{-1}}{3} + \frac{1}{9} \\
 +\frac{2ax^{-1}}{3} - \frac{1}{9} & \\
 \hline
 2 - \frac{2a^{-1}x}{3} + x^2a^{-2} & \left(2ax^{-1} - \frac{2}{3} + a^{-1}x\right)(a^{-1}x) \\
 -2 + \frac{2a^{-1}x}{3} - a^{-2}x^2 & = 2 - \frac{2a^{-1}x}{3} + a^{-2}x^2 \\
 \hline
 \end{array}$$

$$\begin{array}{l|l}
 2. \sqrt{x^2 - 4 + 2x^{-1} + 4x^{-2} - 4x^{-3} + x^{-4}} & x - 2x^{-1} + x^{-2} \\
 \hline
 -x^2 & (2x - 2x^{-1})(-2x^{-1}) = -4 + 4x^{-2} \\
 \hline
 -4 + 2x^{-1} + 4x^{-2} & \\
 +4 - 4x^{-2} & (2x - 4x^{-1} + x^{-2})(x^{-2}) \\
 \hline
 2x^{-1} - 4x^{-3} + x^{-4} & = 2x^{-1} - 4x^{-3} + x^{-4} \\
 -2x^{-1} + 4x^{-3} - x^{-4} & \\
 \hline
 \end{array}$$

$$\begin{array}{l|l}
 3. \sqrt{a^4 - 10a + 4 + 25a^{-2} - 20a^{-3} + 4a^{-4}} & a^2 - 5a^{-1} + 2a^{-2} \\
 \hline
 -a^4 & (2a^2 - 5a^{-1})(-5a^{-1}) \\
 \hline
 -10a + 4 + 25a^{-2} & = -10a + 25a^{-2} \\
 +10a - 25a^{-2} & \\
 \hline
 +4 - 20a^{-3} + 4a^{-4} & (2a^2 - 10a^{-1} + 2a^{-2})(2a^{-2}) \\
 -4 + 20a^{-3} - 4a^{-4} & = 4 - 20a^{-3} + 4a^{-4} \\
 \hline
 \end{array}$$

$$\begin{array}{l|l}
 4. \sqrt{\frac{m^4}{4} - 5m^2 + 28 - 30m^{-2} + 9m^{-4}} & \frac{m^2}{2} - 5 + 3m^{-2} \\
 \hline
 -\frac{m^4}{4} & (m^2 - 5)(-5) = -5m^2 + 25 \\
 \hline
 -5m^2 + 28 & (m^2 - 10 + 3m^{-2})(3m^{-2}) \\
 +5m^2 - 25 & = 3 - 30m^{-2} + 9m^{-4} \\
 \hline
 3 - 30m^{-2} + 9m^{-4} & \\
 -3 + 30m^{-2} - 9m^{-4} & \\
 \hline
 \end{array}$$

$$\begin{array}{l}
 \sqrt{\frac{4x^2y^{-2}}{25} - \frac{2xy^{-1}}{5} + \frac{19}{12} - \frac{5x^{-1}y}{3} + \frac{25x^{-2}y^2}{9}} \\
 \hline
 - \frac{4x^2y^{-2}}{25} \\
 \hline
 - \frac{2xy^{-1}}{5} + \frac{19}{12} \\
 + \frac{2xy^{-1}}{5} - \frac{1}{4} \\
 \hline
 \frac{4}{3} - \frac{5x^{-1}y}{3} + \frac{25x^{-2}y^2}{9} \\
 - \frac{4}{3} + \frac{5x^{-1}y}{3} - \frac{25x^{-2}y^2}{9} \\
 \hline
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 \frac{2xy^{-1}}{5} - \frac{1}{2} + \frac{5x^{-1}y}{3} \\
 \hline
 \left(\frac{4xy^{-1}}{5} - \frac{1}{2}\right)\left(-\frac{1}{2}\right) = -\frac{2xy^{-1}}{5} + \frac{1}{4} \\
 \\
 \left(\frac{4xy^{-1}}{5} - 1 + \frac{5x^{-1}y}{3}\right)\left(\frac{5x^{-1}y}{3}\right) \\
 = \frac{4}{3} - \frac{5x^{-1}y}{3} + \frac{25x^{-2}y^2}{9}
 \end{array}$$

$$\begin{array}{l}
 \sqrt{\frac{a^4}{9} + \frac{2a^3x^{-1}}{3} + a^2x^{-2} - \frac{2ax}{3} - 2 + a^{-2}x^2} \\
 \hline
 - \frac{a^4}{9} \\
 \hline
 \frac{2a^3x^{-1}}{3} + a^2x^{-2} \\
 - \frac{2a^3x^{-1}}{3} - a^2x^{-2} \\
 \hline
 - \frac{2ax}{3} - 2 + a^{-2}x^2 \\
 + \frac{2ax}{3} + 2 - a^{-2}x^2 \\
 \hline
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 \frac{a^2}{3} + ax^{-1} - a^{-1}x \\
 \hline
 \left(\frac{2a^2}{3} + ax^{-1}\right)(ax^{-1}) = \frac{2a^3x^{-1}}{3} + a^2x^{-2} \\
 \\
 \left(\frac{2a^2}{3} + 2ax^{-1} - a^{-1}x\right)(-a^{-1}x) \\
 = -\frac{2ax}{3} - 2 + a^{-2}x^2
 \end{array}$$

$$\begin{array}{l}
 \sqrt{9m^4 + 30m^2 + 55 + 50m^{-2} + 25m^{-4}} \\
 \hline
 - 9m^4 \\
 \hline
 + 30m^2 + 55 \\
 - 30m^2 - 25 \\
 \hline
 30 + 50m^{-2} + 25m^{-4} \\
 - 30 - 50m^{-2} - 25m^{-4} \\
 \hline
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 3m^2 + 5 + 5m^{-2} \\
 \\
 (6m^2 + 5)(5) = 30m^2 + 25 \\
 \\
 (6m^2 + 10 + 5m^{-2})(5m^{-2}) \\
 = 30 + 50m^{-2} + 25m^{-4}
 \end{array}$$

$$\begin{array}{l}
 \sqrt{\frac{4a^2b^2x^{-2}y^{-2}}{49} - \frac{2abx^{-1}y^{-1}}{7} + \frac{21}{20} - \frac{7xya^{-1}b^{-1}}{5} + \frac{49x^2y^2a^{-2}b^{-2}}{25}} \\
 \hline
 - \frac{4a^2b^2x^{-2}y^{-2}}{49} \\
 \hline
 - \frac{2abx^{-1}y^{-1}}{7} + \frac{21}{20} \\
 \frac{2abx^{-1}y^{-1}}{7} - \frac{1}{4} \\
 \hline
 \frac{4}{5} - \frac{7xya^{-1}b^{-1}}{5} + \frac{49x^2y^2a^{-2}b^{-2}}{25} \\
 - \frac{4}{5} + \frac{7xya^{-1}b^{-1}}{5} - \frac{49x^2y^2a^{-2}b^{-2}}{25} \\
 \hline
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 \frac{2abx^{-1}y^{-1}}{7} - \frac{1}{2} + \frac{7a^{-1}b^{-1}xy}{5} \\
 \hline
 \left(\frac{4abx^{-1}y^{-1}}{7} - \frac{1}{2}\right)\left(-\frac{1}{2}\right) \\
 = -\frac{2abx^{-1}y^{-1}}{7} + \frac{1}{4} \\
 \\
 \left(\frac{4abx^{-1}y^{-1}}{7} - 1 + \frac{7a^{-1}b^{-1}xy}{5}\right)\left(\frac{7a^{-1}b^{-1}xy}{5}\right) \\
 = \frac{4}{5} - \frac{7a^{-1}b^{-1}xy}{5} + \frac{49a^{-2}b^{-2}x^2y^2}{25}
 \end{array}$$

$$\begin{array}{l|l}
 9. \sqrt{ab^{\frac{2}{3}} - 4a^{\frac{1}{2}}b^{\frac{1}{3}} + 6 - 4b^{\frac{1}{3}}a^{\frac{1}{2}} + a^{-1}b^{\frac{2}{3}}} & a^{\frac{1}{2}}b^{-\frac{1}{3}} - 2 + a^{-\frac{1}{2}}b^{\frac{1}{3}} \\
 \hline
 -ab^{\frac{2}{3}} & \left(2a^{\frac{1}{2}}b^{-\frac{1}{3}} - 2\right)(-2) = -4a^{\frac{1}{2}}b^{-\frac{1}{3}} + 4 \\
 \hline
 -4a^{\frac{1}{2}}b^{-\frac{1}{3}} + 6 & \\
 \hline
 +4a^{\frac{1}{2}}b^{-\frac{1}{3}} - 4 & \left(2a^{\frac{1}{2}}b^{-\frac{1}{3}} - 4 + a^{-\frac{1}{2}}b^{\frac{1}{3}}\right)\left(a^{-\frac{1}{2}}b^{\frac{1}{3}}\right) \\
 \hline
 2 - 4a^{-\frac{1}{2}}b^{\frac{1}{3}} + a^{-1}b^{\frac{2}{3}} & = 2 - 4a^{-\frac{1}{2}}b^{\frac{1}{3}} + a^{-1}b^{\frac{2}{3}} \\
 \hline
 -2 + 4a^{-\frac{1}{2}}b^{\frac{1}{3}} - a^{-1}b^{\frac{2}{3}} & 
 \end{array}$$

$$\begin{array}{l|l}
 10. \sqrt{a^4b^4 + 6a^2b^2 + 7 - 6a^{-2}b^{-2} + a^{-4}b^{-4}} & a^2b^2 + 3 - a^{-2}b^{-2} \\
 \hline
 -a^4b^4 & (2a^2b^2 + 3)(3) = 6a^2b^2 + 9 \\
 \hline
 +6a^2b^2 + 7 & \\
 \hline
 -6a^2b^2 - 9 & (2a^2b^2 + 6 - a^{-2}b^{-2})(-a^{-2}b^{-2}) \\
 \hline
 -2 - 6a^{-2}b^{-2} + a^{-4}b^{-4} & = -2 - 6a^{-2}b^{-2} + a^{-4}b^{-4} \\
 \hline
 +2 + 6a^{-2}b^{-2} - a^{-4}b^{-4} & 
 \end{array}$$

$$\begin{array}{l|l}
 11. \sqrt{xy^{\frac{2}{3}} - 8x^{\frac{1}{2}}y^{\frac{1}{3}} + 18 - 8x^{-\frac{1}{2}}y^{-\frac{1}{3}} + x^{-1}y^{-\frac{2}{3}}} & x^{\frac{1}{2}}y^{\frac{1}{3}} - 4 + x^{-\frac{1}{2}}y^{-\frac{1}{3}} \\
 \hline
 -xy^{\frac{2}{3}} & \left(2x^{\frac{1}{2}}y^{\frac{1}{3}} - 4\right)(-4) = -8x^{\frac{1}{2}}y^{\frac{1}{3}} + 16 \\
 \hline
 -8x^{\frac{1}{2}}y^{\frac{1}{3}} + 18 & \\
 \hline
 +8x^{\frac{1}{2}}y^{\frac{1}{3}} - 16 & \left(2x^{\frac{1}{2}}y^{\frac{1}{3}} - 8 + x^{-\frac{1}{2}}y^{-\frac{1}{3}}\right)\left(x^{-\frac{1}{2}}y^{-\frac{1}{3}}\right) \\
 \hline
 2 - 8x^{-\frac{1}{2}}y^{-\frac{1}{3}} + x^{-1}y^{-\frac{2}{3}} & = 2 - 8x^{-\frac{1}{2}}y^{-\frac{1}{3}} + x^{-1}y^{-\frac{2}{3}} \\
 \hline
 -2 + 8x^{-\frac{1}{2}}y^{-\frac{1}{3}} - x^{-1}y^{-\frac{2}{3}} & 
 \end{array}$$

### EJERCICIO 231

$$1. \sqrt{18} = \sqrt{2 \cdot 3^2} = 3\sqrt{2}$$

$$2. 3\sqrt{48} = 3\sqrt{3 \cdot 2^4} = 3 \cdot 2^2 \sqrt{3} = 12\sqrt{3}$$

$$3. \sqrt[3]{16} = \sqrt[3]{2 \cdot 2^3} = 2\sqrt[3]{2}$$

$$4. \frac{1}{2}\sqrt[3]{128} = \frac{1}{2}\sqrt[3]{2^6 \cdot 2} = \frac{1}{2} \cdot 2^2 \sqrt[3]{2} = 2\sqrt[3]{2}$$

$$5. 2^4\sqrt[4]{243} = 2^4\sqrt[4]{3^4 \cdot 3} = 2 \cdot 3 \sqrt[4]{3} = 6\sqrt[4]{3}$$

$$6. \sqrt{50a^2b} = \sqrt{2 \cdot 5^2 a^2 b} = 5a\sqrt{2b}$$

$$7. 3\sqrt{81x^3y^4} = 3\sqrt{9^2 \cdot x^2 xy^4} = 3 \cdot 9xy^2 \sqrt{x} = 27xy^2 \sqrt{x}$$

$$\begin{aligned}
 8. \frac{1}{2}\sqrt{108a^5b^7} &= \frac{1}{2}\sqrt{2^2 \cdot 3^2 \cdot 3 \cdot a^4 ab^6 b} \\
 &= \frac{2}{2} \cdot 3a^2 b^3 \sqrt{3ab} = 3a^2 b^3 \sqrt{3ab}
 \end{aligned}$$

$$9. \frac{3}{5}\sqrt{125mn^6} = \frac{3}{5}\sqrt{5^2 \cdot 5mn^6} = \frac{3 \cdot 5}{5} n^3 \sqrt{5m} = 3n^3 \sqrt{5m}$$

$$\begin{aligned}
 10. 2a\sqrt{44a^3b^7c^9} &= 2a\sqrt{2^2 \cdot 11a^2 ab^6 bc^8 c} \\
 &= 2 \cdot 2a \cdot ab^3 c^4 \sqrt{11abc} = 4a^2 b^3 c^4 = \sqrt{11abc}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & 2\sqrt[3]{16x^2y^7} \\
 & = 2\sqrt[3]{2^3 \cdot 2x^2y^6y} = 2 \cdot 2y^2 \sqrt[3]{2x^2y} = 4y^2 \sqrt[3]{2x^2y} \\
 12. \quad & \frac{2}{3}\sqrt[3]{27m^2n^8} \\
 & = \frac{2}{3}\sqrt[3]{3^3 m^2 n^6 n^2} = \frac{2 \cdot 3}{3} n^2 \sqrt[3]{m^2 n^2} = 2n^2 \sqrt[3]{m^2 n^2} \\
 13. \quad & 5a\sqrt[3]{160x^7y^9z^{13}} \\
 & = 5a\sqrt[3]{2^3 \cdot 20x^6xy^9z^{12}z} \\
 & = 5 \cdot 2ax^2y^3z^4 \sqrt[3]{20xz} = 10ax^2y^3z^4 \sqrt[3]{20xz} \\
 14. \quad & \sqrt[4]{80a^4b^5c^{12}} = \sqrt[4]{2^4 \cdot 5a^4b^4bc^{12}} = 2abc^3 \sqrt[4]{5b} \\
 15. \quad & 3\sqrt[4]{5x^8y^{14}z^{16}} = 3\sqrt[4]{5x^8y^{12}y^2z^{16}} = 3x^2y^3z^4 \sqrt[4]{5y^2} \\
 16. \quad & \frac{2}{5}\sqrt[5]{32x^2y^{11}} \\
 & = \frac{2}{5}\sqrt[5]{2^5 x^2y^{10}y} = \frac{2 \cdot 2}{5} y^2 \sqrt[5]{x^2y} = \frac{4y^2}{5} \sqrt[5]{x^2y} \\
 17. \quad & 2xy\sqrt[3]{128x^2y^8} \\
 & = 2xy\sqrt[3]{2^6 \cdot 2x^2y^6y^2} \\
 & = 2 \cdot 2^2 xy^2 \sqrt[3]{2x^2y^2} = 8xy^2 \sqrt[3]{2x^2y^2} \\
 18. \quad & \frac{1}{3a}\sqrt{27a^3m^7} \\
 & = \frac{1}{3a}\sqrt{3^2 \cdot 3a^2am^6m} = \frac{3am^3}{3a}\sqrt{3am} = m^3\sqrt{3am}
 \end{aligned}$$

### EJERCICIO 232

$$\begin{aligned}
 1. \quad & \sqrt{\frac{1}{5}} = \frac{\sqrt{1 \cdot 5}}{\sqrt{5 \cdot 5}} = \frac{\sqrt{5}}{5} = \frac{1}{5}\sqrt{5} \\
 2. \quad & \sqrt{\frac{3}{8}} = \sqrt{\frac{3 \cdot 2}{8 \cdot 2}} = \sqrt{\frac{6}{2^4}} = \frac{1}{2^2}\sqrt{6} = \frac{1}{4}\sqrt{6} \\
 3. \quad & 2\sqrt{\frac{1}{2}} = 2\sqrt{\frac{2 \cdot 1}{2 \cdot 2}} = 2\sqrt{\frac{2}{2^2}} = \frac{2}{2}\sqrt{2} = \sqrt{2} \\
 4. \quad & 3\sqrt{\frac{1}{6}} = 3\sqrt{\frac{1 \cdot 6}{6 \cdot 6}} = 3\sqrt{\frac{6}{6^2}} = \frac{3}{6}\sqrt{6} = \frac{1}{2}\sqrt{6} \\
 5. \quad & \frac{1}{2}\sqrt{\frac{2}{3}} = \frac{1}{2}\sqrt{\frac{2 \cdot 3}{3 \cdot 3}} = \frac{1}{2}\sqrt{\frac{6}{3^2}} = \frac{1}{2 \cdot 3}\sqrt{6} = \frac{1}{6}\sqrt{6} \\
 6. \quad & \sqrt{\frac{a^2}{8x}} = \sqrt{\frac{a^2x}{2^2 \cdot 2x^2}} = \frac{a}{2x}\sqrt{\frac{x}{2}} = \frac{a}{2x}\sqrt{\frac{2x}{2^2}} = \frac{a}{4x}\sqrt{2x}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & \frac{3}{5x}\sqrt[3]{375a^9b} \\
 & = \frac{3}{5x}\sqrt[3]{5^3 \cdot 3a^6a^2b} = \frac{3 \cdot 5a^2}{5x}\sqrt[3]{3a^2b} = \frac{3a^2}{x}\sqrt[3]{3a^2b} \\
 20. \quad & \frac{1}{3}\sqrt[4]{81a^4b} = \frac{1}{3}\sqrt[4]{3^4a^4b} = \frac{3}{3}a\sqrt[4]{b} = a\sqrt[4]{b} \\
 21. \quad & \sqrt{9a+18b} = \sqrt{9(a+2b)} = \sqrt{3^2(a+2b)} = 3\sqrt{a+2b} \\
 22. \quad & \sqrt{3a^3b^2 - 3a^2b^2} \\
 & = \sqrt{3a^2b^2(a-1)} = ab\sqrt{3(a-1)} = ab\sqrt{3a-3} \\
 23. \quad & \sqrt{8x^2y^4 + 16xy^4} \\
 & = \sqrt{2^2 \cdot 2xy^4(x+2)} = 2y^2\sqrt{2x(x+2)} = 2y^2\sqrt{2x^2+4x} \\
 24. \quad & \sqrt{2x^2 - 4xy + 2y^2} \\
 & = \sqrt{2(x^2 - 2xy + y^2)} = \sqrt{2(x-y)^2} = (x-y)\sqrt{2} \\
 25. \quad & \sqrt{(a-b)(a^2-b^2)} \\
 & = \sqrt{(a-b)(a-b)(a+b)} \\
 & = \sqrt{(a-b)^2(a+b)} = (a-b)\sqrt{a+b} \\
 26. \quad & \sqrt{2am^2 + 4amn + 2an^2} \\
 & = \sqrt{2a(m^2 + 2mn + n^2)} = \sqrt{2a(m+n)^2} = (m+n)\sqrt{2a} \\
 27. \quad & \sqrt{9a^3 - 36a^2 + 36a} \\
 & = \sqrt{3^2a(a^2 - 2a + 4)} \\
 & = 3\sqrt{a(a-2)^2} = 3(a-2)\sqrt{a} = (3a-6)\sqrt{a}
 \end{aligned}$$

$$\begin{aligned}
 7. \quad & \frac{3}{2}\sqrt{\frac{4a^2}{27y^3}} = \frac{3}{2}\sqrt{\frac{3 \cdot 2^2 a^2 y}{3^4 y^4}} = \frac{3 \cdot 2a}{2 \cdot 3^2 y^2}\sqrt{3y} = \frac{a}{3y^2}\sqrt{3y} \\
 8. \quad & 5\sqrt{\frac{9n}{5m^3}} = 5\sqrt{\frac{3^2 \cdot 5mn}{5^2 m^4}} = \frac{5 \cdot 3}{5m^2}\sqrt{5mn} = \frac{3}{m^2}\sqrt{5mn} \\
 9. \quad & 6\sqrt{\frac{5a^3}{24x^2}} = 6\sqrt{\frac{5 \cdot 6a^3}{2^4 \cdot 3^2 x^2}} = \frac{6}{2^2 \cdot 3x}\sqrt{30a^2a} = \frac{a}{2x}\sqrt{30a} \\
 10. \quad & \sqrt[3]{\frac{2}{3}} = \sqrt[3]{\frac{2 \cdot 3^2}{3^3}} = \frac{1}{3}\sqrt[3]{18} \\
 11. \quad & 5\sqrt[3]{\frac{1}{5}} = 5\sqrt[3]{\frac{5^2}{5^3}} = \frac{5}{5}\sqrt[3]{5^2} = \sqrt[3]{25} \\
 12. \quad & \sqrt[3]{\frac{8}{9x^2}} = \sqrt[3]{\frac{2^3 \cdot 3x}{3^2 x^3}} = \frac{2}{3x}\sqrt[3]{3x}
 \end{aligned}$$

$$13. 2b^2 \sqrt[3]{\frac{125}{4b^5}} = 2b^2 \sqrt[3]{\frac{5^3 \cdot 2b}{2^3 b^6}} = \frac{2 \cdot 5b^2}{2b^2} \sqrt[3]{2b} = 5 \sqrt[3]{2b}$$

$$14. \frac{2}{3} \sqrt[3]{\frac{27x^2}{16a^2b^4}} = \frac{2}{3} \sqrt[3]{\frac{3^3 \cdot 4ab^2x^2}{2^6 a^3 b^6}} = \frac{2 \cdot 3}{3 \cdot 2^2 ab^2} \sqrt[3]{4ab^2x^2} = \frac{1}{2ab^2} \sqrt[3]{4ab^2x^2}$$

$$15. 2xy \sqrt[4]{\frac{81a^2}{4x^3y}} = 2xy \sqrt[4]{\frac{3^4 \cdot 2^2 a^2 xy^3}{2^4 x^3 y^4}} = \frac{2 \cdot 3xy}{2xy} \sqrt[4]{4a^2 xy^3} = 3 \sqrt[4]{4a^2 xy^3}$$

### EJERCICIO 233

$$1. \sqrt[4]{9} = \sqrt[4]{3^2} = 3^{\frac{2}{4}} = 3^{\frac{1}{2}} = \sqrt{3}$$

$$2. \sqrt[6]{4} = \sqrt[6]{2^2} = 2^{\frac{2}{6}} = 2^{\frac{1}{3}} = \sqrt[3]{2}$$

$$3. \sqrt[9]{27} = \sqrt[9]{3^3} = 3^{\frac{3}{9}} = 3^{\frac{1}{3}} = \sqrt[3]{3}$$

$$4. \sqrt[8]{16} = \sqrt[8]{2^4} = 2^{\frac{4}{8}} = 2^{\frac{1}{2}} = \sqrt{2}$$

$$5. 3 \sqrt[12]{64} = 3 \sqrt[12]{2^6} = 3 \cdot 2^{\frac{6}{12}} = 3 \cdot 2^{\frac{1}{2}} = 3\sqrt{2}$$

$$6. \sqrt[4]{25a^2b^2} = \sqrt[4]{5^2 a^2 b^2} = 5^{\frac{2}{4}} a^{\frac{2}{4}} b^{\frac{2}{4}} = 5^{\frac{1}{2}} a^{\frac{1}{2}} b^{\frac{1}{2}} = \sqrt{5ab}$$

$$7. 5 \sqrt[6]{49a^2b^4} = 5 \sqrt[6]{7^2 a^2 b^4} = 5 \cdot 7^{\frac{2}{6}} a^{\frac{2}{6}} b^{\frac{4}{6}} = 5 \sqrt[3]{7ab^2}$$

$$8. \sqrt[8]{81x^4y^8} = \sqrt[8]{3^4 x^4 y^8} = 3^{\frac{4}{8}} x^{\frac{4}{8}} y^{\frac{8}{8}} = 3^{\frac{1}{2}} x^{\frac{1}{2}} y = y\sqrt{3x}$$

$$9. \sqrt[10]{32x^{10}y^{15}} = \sqrt[10]{2^5 x^{10} y^{15}} = 2^{\frac{5}{10}} x^{\frac{10}{10}} y^{\frac{15}{10}} = 2^{\frac{1}{2}} x y^{\frac{3}{2}} = x\sqrt{2y^3} = x\sqrt{2y^2y} = xy\sqrt{2y}$$

$$10. \sqrt[12]{64m^6n^{18}} = \sqrt[12]{2^6 m^6 n^{18}} = 2^{\frac{6}{12}} m^{\frac{6}{12}} n^{\frac{18}{12}} = \sqrt{2mn^3} = \sqrt{2mn^2n} = n\sqrt{2mn}$$

$$11. \sqrt[6]{343a^9x^{12}} = \sqrt[6]{7^3 a^9 x^{12}} = 7^{\frac{3}{6}} a^{\frac{9}{6}} x^{\frac{12}{6}} = 7^{\frac{1}{2}} a^{\frac{3}{2}} x^2 = x^2 \sqrt{7a^3} = ax^2 \sqrt{7a}$$

$$12. \sqrt[15]{m^{10}n^{15}x^{20}} = m^{\frac{10}{15}} n^{\frac{15}{15}} x^{\frac{20}{15}} = m^{\frac{2}{3}} nx^{\frac{4}{3}} = n \sqrt[3]{m^2 x^4} = n \sqrt[3]{m^2 x^3 x} = nx \sqrt[3]{m^2 x}$$

### EJERCICIO 234

$$1. 2\sqrt{3} = \sqrt{2^2 \cdot 3} = \sqrt{12}$$

$$2. 3\sqrt{5} = \sqrt{3^2 \cdot 5} = \sqrt{45}$$

$$3. 5a\sqrt{b} = \sqrt{(5a)^2 b} = \sqrt{25a^2 b}$$

$$4. \frac{1}{2}\sqrt{2} = \sqrt{\left(\frac{1}{2}\right)^2 \cdot 2} = \sqrt{\frac{1}{4} \cdot 2} = \sqrt{\frac{1}{2}}$$

$$5. 3a\sqrt{2a^2} = \sqrt{(3a)^2 \cdot 2a^2} = \sqrt{9a^2(2a^2)} = \sqrt{18a^4}$$

$$6. 5x^2y\sqrt{3} = \sqrt{(5x^2y)^2 \cdot 3} = \sqrt{25x^4y^2 \cdot 3} = \sqrt{75x^4y^2}$$

$$7. ab^2 \sqrt[3]{a^2b} = \sqrt[3]{(ab^2)^3 (a^2b)} = \sqrt[3]{(a^3b^6)(a^2b)} = \sqrt[3]{a^5b^7}$$

$$8. 4m \sqrt[3]{2m^2} = \sqrt[3]{(4m)^3 (2m^2)} = \sqrt[3]{(64m^3)(2m^2)} = \sqrt[3]{128m^5}$$

$$9. 2a \sqrt[4]{8ab^3} = \sqrt[4]{(2a)^4 (8ab^3)} = \sqrt[4]{(16a^4)(8ab^3)} = \sqrt[4]{128a^5b^3}$$

$$10. (a+b) \sqrt{\frac{a}{a+b}} = \sqrt{\frac{(a+b)^2 (a)}{a+b}} = \sqrt{(a+b)(a)} = \sqrt{a^2 + ab}$$

$$11. (x+1) \sqrt{\frac{2x}{x+1}} = \sqrt{\frac{(x+1)^2 2x}{x+1}} = \sqrt{(x+1)2x} = \sqrt{2x^2 + 2x}$$

$$12. (x-1) \sqrt{\frac{x-2}{x-1}} = \sqrt{\frac{(x-1)^2 (x-2)}{x-1}} = \sqrt{(x-1)(x-2)} = \sqrt{x^2 - 3x + 2}$$

### EJERCICIO 235

$$1. \sqrt{5} = \sqrt[6]{5^3} = \sqrt[6]{125}$$

$$\sqrt[3]{2} = \sqrt[6]{2^2} = \sqrt[6]{4}$$

$$2. \sqrt{2} = \sqrt[4]{2^2} = \sqrt[4]{4}$$

$$\sqrt[3]{3} = \sqrt[6]{3^2} = \sqrt[6]{9}$$

$$3. \sqrt{3} = \sqrt[12]{3^6} = \sqrt[12]{729}$$

$$\sqrt[3]{4} = \sqrt[12]{4^4} = \sqrt[12]{256}$$

$$\sqrt[4]{8} = \sqrt[12]{8^3} = \sqrt[12]{512}$$

$$4. \sqrt{2} = \sqrt[12]{2^6} = \sqrt[12]{64}$$

$$\sqrt[3]{3} = \sqrt[12]{3^4} = \sqrt[12]{81}$$

$$\sqrt[4]{5} = \sqrt[12]{5^3} = \sqrt[12]{125}$$

$$\sqrt[6]{7} = \sqrt[12]{7^2} = \sqrt[12]{49}$$

$$5. \sqrt{5x} = \sqrt[6]{(5x)^3} = \sqrt[6]{125x^3}$$

$$\sqrt[3]{4x^2y} = \sqrt[6]{(4x^2y)^2} = \sqrt[6]{16x^4y^2}$$

$$\sqrt[6]{7a^3b} = \sqrt[6]{7a^3b}$$

$$6. \sqrt[3]{2ab} = \sqrt[15]{(2ab)^5} = \sqrt[15]{32a^5b^5}$$

$$\sqrt[5]{3a^2x} = \sqrt[15]{(3a^2x)^3} = \sqrt[15]{27a^6x^3}$$

$$\sqrt[15]{5a^3x^2} = \sqrt[15]{5a^3x^2}$$

$$7. \sqrt[4]{8a^2x^3} = \sqrt[12]{(8a^2x^3)^3} = \sqrt[12]{512a^6x^9}$$

$$\sqrt[6]{3a^5m^4} = \sqrt[12]{(3a^5m^4)^2} = \sqrt[12]{9a^{10}m^8}$$

$$8. \sqrt[3]{x^2} = \sqrt[18]{(x^2)^6} = \sqrt[18]{x^{12}}$$

$$\sqrt[6]{2y^3} = \sqrt[18]{(2y^3)^3} = \sqrt[18]{8y^9}$$

$$\sqrt[9]{5m^7} = \sqrt[18]{(5m^7)^2} = \sqrt[18]{25m^{14}}$$

$$9. \sqrt[4]{3a} = \sqrt[20]{(3a)^5} = \sqrt[20]{243a^5}$$

$$\sqrt[5]{2b^2} = \sqrt[20]{(2b^2)^4} = \sqrt[20]{16b^8}$$

$$\sqrt[10]{7x^3} = \sqrt[20]{(7x^3)^2} = \sqrt[20]{49x^6}$$

$$10. 2\sqrt[3]{a} = 2\sqrt[12]{a^4} = 2\sqrt[12]{a^4}$$

$$3\sqrt{2b} = 3\sqrt[12]{(2b)^6} = 3\sqrt[12]{64b^6}$$

$$4\sqrt[4]{5x^2} = 4\sqrt[12]{(5x^2)^3} = 4\sqrt[12]{125x^6}$$

$$11. 3\sqrt[3]{a^2} = 3\sqrt[18]{(a^2)^6} = 3\sqrt[18]{a^{12}}$$

$$\frac{1}{2}\sqrt[6]{b^3} = \frac{1}{2}\sqrt[18]{(b^3)^3} = \frac{1}{2}\sqrt[18]{b^9}$$

$$4\sqrt[9]{x^5} = 4\sqrt[18]{(x^5)^2} = 4\sqrt[18]{x^{10}}$$

$$12. \sqrt{2m} = \sqrt[10]{(2m)^5} = \sqrt[10]{32m^5}$$

$$3\sqrt[5]{a^3x^4} = 3\sqrt[10]{(a^3x^4)^2} = 3\sqrt[10]{a^6x^8}$$

$$2\sqrt[10]{x^7y^2} = 2\sqrt[10]{x^7y^2}$$

### EJERCICIO 236

$$1. \sqrt{5} = \sqrt[6]{5^3} = \sqrt[6]{125}$$

$$\sqrt[3]{2} = \sqrt[6]{2^2} = \sqrt[6]{4}$$

Luego el orden es:  $\sqrt{5}$ ,  $\sqrt[3]{2}$

$$2. \sqrt[6]{15} = \sqrt[12]{(15)^2} = \sqrt[12]{225}$$

$$\sqrt[4]{7} = \sqrt[12]{7^3} = \sqrt[12]{343}$$

Luego el orden es:  $\sqrt[4]{7}$ ,  $\sqrt[6]{15}$

$$3. \sqrt{11} = \sqrt[6]{(11)^3} = \sqrt[6]{1.331}$$

$$\sqrt[3]{43} = \sqrt[6]{(43)^2} = \sqrt[6]{1.849}$$

Luego el orden es:  $\sqrt[3]{43}$ ,  $\sqrt{11}$

$$4. \sqrt{3} = \sqrt[6]{3^3} = \sqrt[6]{27}$$

$$\sqrt[3]{5} = \sqrt[6]{5^2} = \sqrt[6]{25}$$

$$\sqrt[6]{32} = \sqrt[6]{32}$$

Luego el orden es:  $\sqrt[6]{32}$ ,  $\sqrt{3}$ ,  $\sqrt[3]{5}$

$$5. \sqrt[4]{3} = \sqrt[20]{3^5} = \sqrt[20]{243}$$

$$\sqrt[5]{4} = \sqrt[20]{4^4} = \sqrt[20]{256}$$

$$\sqrt[10]{15} = \sqrt[20]{15^2} = \sqrt[20]{225}$$

Luego el orden es:  $\sqrt[5]{4}$ ,  $\sqrt[4]{3}$ ,  $\sqrt[10]{15}$

$$6. \sqrt[3]{2} = \sqrt[18]{2^6} = \sqrt[18]{64}$$

$$\sqrt[6]{3} = \sqrt[18]{3^3} = \sqrt[18]{27}$$

$$\sqrt[9]{9} = \sqrt[18]{9^2} = \sqrt[18]{81}$$

Luego el orden es:  $\sqrt[9]{9}$ ,  $\sqrt[3]{2}$ ,  $\sqrt[6]{3}$

### EJERCICIO 237

$$1. 7\sqrt{2} - 15\sqrt{2} = (7-15)\sqrt{2} = -8\sqrt{2}$$

$$3. \sqrt{5} - 22\sqrt{5} - 8\sqrt{5} = (1-22-8)\sqrt{5} = -29\sqrt{5}$$

$$2. 4\sqrt{3} - 20\sqrt{3} + 19\sqrt{3} = (4-20+19)\sqrt{3} = 3\sqrt{3}$$

$$4. \sqrt{2} - 9\sqrt{2} + 30\sqrt{2} - 40\sqrt{2} = (1-9+30-40)\sqrt{2} = -18\sqrt{2}$$

$$5. \frac{3}{4}\sqrt{2} - \frac{1}{2}\sqrt{2} = \left(\frac{3}{4} - \frac{1}{2}\right)\sqrt{2} = \left(\frac{3-2}{4}\right)\sqrt{2} = \frac{1}{4}\sqrt{2}$$

$$6. \frac{3}{5}\sqrt{3} - \sqrt{3} = \left(\frac{3}{5} - 1\right)\sqrt{3} = \left(\frac{3-5}{5}\right)\sqrt{3} = -\frac{2}{5}\sqrt{3}$$

$$7. 2\sqrt{5} - \frac{1}{2}\sqrt{5} + \frac{3}{4}\sqrt{5} \\ = \left(2 - \frac{1}{2} + \frac{3}{4}\right)\sqrt{5} = \left(\frac{8-2+3}{4}\right)\sqrt{5} = \frac{9}{4}\sqrt{5}$$

$$8. \frac{1}{4}\sqrt{3} + 5\sqrt{3} - \frac{1}{8}\sqrt{3} \\ = \left(\frac{1}{4} + 5 - \frac{1}{8}\right)\sqrt{3} = \left(\frac{2+40-1}{8}\right)\sqrt{3} = \frac{41}{8}\sqrt{3}$$

$$9. a\sqrt{b} - 3a\sqrt{b} + 7a\sqrt{b} = (a - 3a + 7a)\sqrt{b} = 5a\sqrt{b}$$

$$10. 3x\sqrt{y} + (a-x)\sqrt{y} - 2x\sqrt{y} \\ = (3x + a - x - 2x)\sqrt{y} = a\sqrt{y}$$

$$11. (x-1)\sqrt{3} + (x-3)\sqrt{3} + 4\sqrt{3} \\ = (x-1+x-3+4)\sqrt{3} = 2x\sqrt{3}$$

$$12. \frac{1}{3}\sqrt[3]{2} - \frac{2}{3}\sqrt[3]{2} + 2\sqrt[3]{2} \\ = \left(\frac{1}{3} - \frac{2}{3} + 2\right)\sqrt[3]{2} = \left(\frac{1-2+6}{3}\right)\sqrt[3]{2} = \frac{5}{3}\sqrt[3]{2}$$

$$13. \frac{3}{5}\sqrt[3]{2} - \frac{1}{4}\sqrt[3]{2} + \frac{1}{6}\sqrt[3]{2} = \left(\frac{36-15+10}{60}\right)\sqrt[3]{2} = \frac{31}{60}\sqrt[3]{2}$$

$$14. x\sqrt[3]{a^2} - (a-2x)\sqrt[3]{a^2} + (2a-3x)\sqrt[3]{a^2} \\ = (x-a+2x+2a-3x)\sqrt[3]{a^2} = a\sqrt[3]{a^2}$$

### EJERCICIO 238

$$1. \sqrt{45} = \sqrt{3^2 \cdot 5} = 3\sqrt{5} \\ -\sqrt{27} = -\sqrt{3^2 \cdot 3} = -3\sqrt{3} \\ -\sqrt{20} = -\sqrt{2^2 \cdot 5} = -2\sqrt{5} \\ \text{Entonces:} \\ = 3\sqrt{5} - 3\sqrt{3} - 2\sqrt{5} \\ = (3-2)\sqrt{5} - 3\sqrt{3} = \sqrt{5} - 3\sqrt{3}$$

$$2. \sqrt{175} = \sqrt{5^2 \cdot 7} = 5\sqrt{7} \\ \sqrt{243} = \sqrt{3^4 \cdot 3} = 9\sqrt{3} \\ -\sqrt{63} = -\sqrt{3^2 \cdot 7} = -3\sqrt{7} \\ -2\sqrt{75} = -2\sqrt{5^2 \cdot 3} = -10\sqrt{3} \\ \text{Entonces:} \\ = 5\sqrt{7} + 9\sqrt{3} - 3\sqrt{7} - 10\sqrt{3} \\ = (5-3)\sqrt{7} + (9-10)\sqrt{3} = 2\sqrt{7} - \sqrt{3}$$

$$3. \sqrt{80} = \sqrt{2^4 \cdot 5} = 2^2\sqrt{5} = 4\sqrt{5} \\ -2\sqrt{252} = -2\sqrt{2^2 \cdot 3^2 \cdot 7} = -2 \cdot 2 \cdot 3\sqrt{7} = -12\sqrt{7} \\ 3\sqrt{405} = 3\sqrt{3^4 \cdot 5} = 3 \cdot 3^2\sqrt{5} = 27\sqrt{5} \\ -3\sqrt{500} = -3\sqrt{2^2 \cdot 5^2 \cdot 5} = -3 \cdot 2 \cdot 5\sqrt{5} = -30\sqrt{5} \\ \text{Entonces:} \\ = 4\sqrt{5} + 27\sqrt{5} - 30\sqrt{5} - 12\sqrt{7} \\ = (4+27-30)\sqrt{5} - 12\sqrt{7} = \sqrt{5} - 12\sqrt{7}$$

$$4. 7\sqrt{450} = 7\sqrt{3^2 \cdot 5^2 \cdot 2} = 7 \cdot 3 \cdot 5\sqrt{2} = 105\sqrt{2} \\ -4\sqrt{320} = -4\sqrt{2^6 \cdot 5} = -4 \cdot 2^3\sqrt{5} = -32\sqrt{5} \\ 3\sqrt{80} = 3\sqrt{2^4 \cdot 5} = 3 \cdot 2^2\sqrt{5} = 12\sqrt{5} \\ -5\sqrt{800} = -5\sqrt{2^4 \cdot 2 \cdot 5^2} = -5 \cdot 2^2 \cdot 5\sqrt{2} = -100\sqrt{2} \\ \text{Entonces:} \\ = 105\sqrt{2} - 100\sqrt{2} - 32\sqrt{5} + 12\sqrt{5} \\ = (105-100)\sqrt{2} + (-32+12)\sqrt{5} = 5\sqrt{2} - 20\sqrt{5}$$

$$5. \frac{1}{2}\sqrt{12} = \frac{1}{2}\sqrt{2^2 \cdot 3} = \sqrt{3} \\ -\frac{1}{3}\sqrt{18} = -\frac{1}{3}\sqrt{3^2 \cdot 2} = -\sqrt{2} \\ \frac{3}{4}\sqrt{48} = \frac{3}{4}\sqrt{2^4 \cdot 3} = 3\sqrt{3} \\ \frac{1}{6}\sqrt{72} = \frac{1}{6}\sqrt{2^2 \cdot 2 \cdot 3^2} = \sqrt{2} \\ \text{Entonces:} \\ = \sqrt{3} + 3\sqrt{3} - \sqrt{2} + \sqrt{2} = (1+3)\sqrt{3} = 4\sqrt{3}$$

$$6. \frac{3}{4}\sqrt{176} = \frac{3}{4}\sqrt{2^4 \cdot 11} = \frac{2^2 \cdot 3}{4}\sqrt{11} = 3\sqrt{11} \\ -\frac{2}{3}\sqrt{45} = -\frac{2}{3}\sqrt{3^2 \cdot 5} = -\frac{2 \cdot 3}{3}\sqrt{5} = -2\sqrt{5} \\ \frac{1}{8}\sqrt{320} = \frac{1}{8}\sqrt{2^6 \cdot 5} = \frac{2^3}{8}\sqrt{5} = \sqrt{5} \\ \frac{1}{5}\sqrt{275} = \frac{1}{5}\sqrt{5^2 \cdot 11} = \frac{5}{5}\sqrt{11} = \sqrt{11} \\ \text{Entonces:} \\ = 3\sqrt{11} + \sqrt{11} - 2\sqrt{5} + \sqrt{5} \\ = (3+1)\sqrt{11} - (2+1)\sqrt{5} = 4\sqrt{11} - \sqrt{5}$$



$$\begin{aligned}
 7. \quad \frac{1}{7}\sqrt{147} &= \frac{1}{7}\sqrt{3 \cdot 7^2} = \sqrt{3} \\
 -\frac{1}{5}\sqrt{700} &= -\frac{1}{5}\sqrt{2^2 \cdot 5^2 \cdot 7} = -2\sqrt{7} \\
 \frac{1}{10}\sqrt{28} &= \frac{1}{10}\sqrt{2^2 \cdot 7} = \frac{1}{5}\sqrt{7} \\
 \frac{1}{3}\sqrt{2 \cdot 187} &= \frac{1}{3}\sqrt{3^6 \cdot 3} = 9\sqrt{3}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= \sqrt{3} + 9\sqrt{3} - 2\sqrt{7} + \frac{1}{5}\sqrt{7} \\
 &= (1+9)\sqrt{3} + \left(-2 + \frac{1}{5}\right)\sqrt{7} \\
 &= 10\sqrt{3} - \frac{9}{5}\sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad \sqrt{\frac{1}{3}} &= \sqrt{\frac{3}{3^2}} = \frac{1}{3}\sqrt{3} \\
 -\sqrt{\frac{1}{2}} &= -\sqrt{\frac{2}{2^2}} = -\frac{1}{2}\sqrt{2} \\
 \sqrt{\frac{3}{4}} &= \sqrt{\frac{3}{2^2}} = \frac{1}{2}\sqrt{3}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= \frac{1}{3}\sqrt{3} + \frac{1}{2}\sqrt{3} - \frac{1}{2}\sqrt{2} \\
 &= \left(\frac{1}{3} + \frac{1}{2}\right)\sqrt{3} - \frac{1}{2}\sqrt{2} \\
 &= \frac{5}{6}\sqrt{3} - \frac{1}{2}\sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad \sqrt{\frac{9}{5}} &= \sqrt{\frac{3^2 \cdot 5}{5^2}} = \frac{3}{5}\sqrt{5} \\
 -\sqrt{\frac{1}{6}} &= -\sqrt{-\frac{6}{6^2}} = -\frac{1}{6}\sqrt{6} \\
 -\sqrt{\frac{1}{20}} &= -\sqrt{\frac{5}{2^2 \cdot 5^2}} = -\frac{1}{10}\sqrt{5} \\
 &\quad \sqrt{6} = \sqrt{6}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= \frac{3}{5}\sqrt{5} - \frac{1}{10}\sqrt{5} - \frac{1}{6}\sqrt{6} + \sqrt{6} \\
 &= \left(\frac{3}{5} - \frac{1}{10}\right)\sqrt{5} + \left(-\frac{1}{6} + 1\right)\sqrt{6} \\
 &= \frac{1}{2}\sqrt{5} + \frac{5}{6}\sqrt{6}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad \frac{5}{3}\sqrt{\frac{3}{5}} &= \frac{5}{3}\sqrt{\frac{15}{5^2}} = \frac{1}{3}\sqrt{15} \\
 -\frac{1}{2}\sqrt{\frac{3}{4}} &= -\frac{1}{2}\sqrt{\frac{3}{2^2}} = -\frac{1}{4}\sqrt{3} \\
 -5\sqrt{\frac{1}{15}} &= -5\sqrt{\frac{15}{3^2 \cdot 5^2}} = -\frac{1}{3}\sqrt{15} \\
 3\sqrt{\frac{1}{12}} &= 3\sqrt{\frac{3}{2^2 \cdot 3^2}} = \frac{1}{2}\sqrt{3}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= \frac{1}{3}\sqrt{15} - \frac{1}{3}\sqrt{15} - \frac{1}{4}\sqrt{3} + \frac{1}{2}\sqrt{3} \\
 &= \left(-\frac{1}{4} + \frac{1}{2}\right)\sqrt{3} = \frac{1}{4}\sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad 5\sqrt{128} &= 5\sqrt{2^6 \cdot 2} = 40\sqrt{2} \\
 -\frac{1}{3}\sqrt{\frac{1}{3}} &= -\frac{1}{3}\sqrt{\frac{3}{3^2}} = -\frac{1}{9}\sqrt{3} \\
 -5\sqrt{98} &= -5\sqrt{7^2 \cdot 2} = -35\sqrt{2}
 \end{aligned}$$

$$\sqrt{\frac{1}{27}} = \sqrt{\frac{3}{3^4}} = \frac{1}{9}\sqrt{3}$$

Entonces:

$$\begin{aligned}
 &= 40\sqrt{2} - 35\sqrt{2} - \frac{1}{9}\sqrt{3} + \frac{1}{9}\sqrt{3} \\
 &= (40-35)\sqrt{2} = 5\sqrt{2}
 \end{aligned}$$

$$12. \quad 2\sqrt{700} = 2\sqrt{2^2 \cdot 5^2 \cdot 7} = 20\sqrt{7}$$

$$-15\sqrt{\frac{1}{45}} = -15\sqrt{\frac{5}{3^2 \cdot 5^2}} = -\sqrt{5}$$

$$4\sqrt{\frac{5}{16}} = 4\sqrt{\frac{5}{2^4}} = \sqrt{5}$$

$$-56\sqrt{\frac{1}{7}} = -56\sqrt{\frac{7}{7^2}} = -8\sqrt{7}$$

Entonces:

$$\begin{aligned}
 &= 20\sqrt{7} - 8\sqrt{7} - \sqrt{5} + \sqrt{5} \\
 &= (20-8)\sqrt{7} = 12\sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad \sqrt{25ax^2} &= \sqrt{5^2 ax^2} = 5x\sqrt{a} \\
 \sqrt{49b} &= \sqrt{7^2 b} = 7\sqrt{b} \\
 -\sqrt{9ax^2} &= -\sqrt{3^2 ax^2} = -3x\sqrt{a} \\
 \text{entonces:} & \\
 &= 5x\sqrt{a} - 3x\sqrt{a} + 7\sqrt{b} \\
 &= (5x-3x)\sqrt{a} + 7\sqrt{b} \\
 &= 2x\sqrt{a} + 7\sqrt{b}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad 2\sqrt{m^2 n} &= 2m\sqrt{n} \\
 -\sqrt{9m^2 n} &= -\sqrt{3^2 m^2 n} = -3m\sqrt{n} \\
 \sqrt{16mn^2} &= \sqrt{2^4 mn^2} = 4n\sqrt{m} \\
 -\sqrt{4mn^2} &= -\sqrt{2^2 mn^2} = -2n\sqrt{m}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= 2m\sqrt{n} - 3m\sqrt{n} + 4n\sqrt{m} - 2n\sqrt{m} \\
 &= (2m-3m)\sqrt{n} + (4n-2n)\sqrt{m} \\
 &= -m\sqrt{n} + 2n\sqrt{m}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad a\sqrt{320x} &= a\sqrt{2^6 \cdot 5x} = 8a\sqrt{5x} \\
 -7\sqrt{5a^2 x} &= -7a\sqrt{5x} \\
 &\quad -(a-4b)\sqrt{5x}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= 8a\sqrt{5x} - 7a\sqrt{5x} - (a-4b)\sqrt{5x} \\
 &= (8a-7a-a+4b)\sqrt{5x} = 4b\sqrt{5x}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad \sqrt{9x-9} &= \sqrt{3^2(x-1)} = 3\sqrt{x-1} \\
 \sqrt{4x-4} &= \sqrt{2^2(x-1)} = 2\sqrt{x-1} \\
 &\quad -5\sqrt{x-1}
 \end{aligned}$$

Entonces:

$$\begin{aligned}
 &= 3\sqrt{x-1} + 2\sqrt{x-1} - 5\sqrt{x-1} \\
 &= (3+2-5)\sqrt{x-1} = 0
 \end{aligned}$$

$$17. \quad 2\sqrt{a^4x+3a^4y} = 2\sqrt{a^4(x+3y)} = 2a^2\sqrt{x+3y}$$

$$-a^2\sqrt{9x+27y} = -a^2\sqrt{3^2(x+3y)} = -3a^2\sqrt{x+3y}$$

$$\sqrt{25a^4x+75a^4y} = \sqrt{5^2a^4(x+3y)} = 5a^2\sqrt{x+3y}$$

Entonces:

$$= 2a^2\sqrt{x+3y} - 3a^2\sqrt{x+3y} + 5a^2\sqrt{x+3y}$$

$$= (2a^2 - 3a^2 + 5a^2)\sqrt{x+3y} = 4a^2\sqrt{x+3y}$$

$$18. \quad 3a\sqrt{\frac{a+1}{a^2}} = \frac{3a}{a}\sqrt{a+1} = 3\sqrt{a+1}$$

$$-\sqrt{4a+4} = -\sqrt{2^2(a+1)} = -2\sqrt{a+1}$$

$$(a+1)\sqrt{\frac{1}{a+1}} = (a+1)\sqrt{\frac{a+1}{(a+1)^2}} = \sqrt{a+1}$$

Entonces:

$$= 3\sqrt{a+1} - 2\sqrt{a+1} + \sqrt{a+1} = (3-2+1)\sqrt{a+1} = 2\sqrt{a+1}$$

$$19. \quad (a-b)\sqrt{\frac{a+b}{a-b}} = (a-b)\sqrt{\frac{a^2-b^2}{(a-b)^2}} = \sqrt{a^2-b^2}$$

$$-(a+b)\sqrt{\frac{a-b}{a+b}} = -(a+b)\sqrt{\frac{a^2-b^2}{(a+b)^2}} = -\sqrt{a^2-b^2}$$

$$(2a-2b)\sqrt{\frac{1}{a-b}} = 2(a-b)\sqrt{\frac{a-b}{(a-b)^2}} = 2\sqrt{a-b}$$

entonces:

$$= \sqrt{a^2-b^2} - \sqrt{a^2-b^2} + 2\sqrt{a-b} = 2\sqrt{a-b}$$

$$4. \quad 5\sqrt[3]{48} = 5\sqrt[3]{2^3 \cdot 6} = 10\sqrt[3]{6}$$

$$-3\sqrt[3]{3 \cdot 645} = -3\sqrt[3]{3^6 \cdot 5} = -27\sqrt[3]{5}$$

$$-2\sqrt[3]{384} = -2\sqrt[3]{2^6 \cdot 6} = -8\sqrt[3]{6}$$

$$4\sqrt[3]{1 \cdot 715} = 4\sqrt[3]{7^3 \cdot 5} = 28\sqrt[3]{5}$$

Entonces:

$$= 10\sqrt[3]{6} - 8\sqrt[3]{6} - 27\sqrt[3]{5} + 28\sqrt[3]{5}$$

$$= (10-8)\sqrt[3]{6} + (-27+28)\sqrt[3]{5} = 2\sqrt[3]{6} + \sqrt[3]{5}$$

$$6. \quad \frac{1}{2}\sqrt[3]{24} = \frac{1}{2}\sqrt[3]{2^3 \cdot 3} = \sqrt[3]{3}$$

$$-\frac{2}{3}\sqrt[3]{54} = -\frac{2}{3}\sqrt[3]{3^3 \cdot 2} = -2\sqrt[3]{2}$$

$$\frac{3}{5}\sqrt[3]{375} = \frac{3}{5}\sqrt[3]{5^3 \cdot 3} = 3\sqrt[3]{3}$$

$$-\frac{1}{4}\sqrt[3]{128} = -\frac{1}{4}\sqrt[3]{2^6 \cdot 2} = -\sqrt[3]{2}$$

Entonces:

$$= \sqrt[3]{3} + 3\sqrt[3]{3} - 2\sqrt[3]{2} - \sqrt[3]{2}$$

$$= (1+3)\sqrt[3]{3} + (-2-1)\sqrt[3]{2} = 4\sqrt[3]{3} - 3\sqrt[3]{2}$$

## EJERCICIO 239

$$1. \quad \sqrt[3]{54} = \sqrt[3]{3^3 \cdot 2} = \sqrt[3]{2}$$

$$-\sqrt[3]{24} = -\sqrt[3]{2^3 \cdot 3} = -2\sqrt[3]{3}$$

$$-\sqrt[3]{16} = -\sqrt[3]{2^3 \cdot 2} = -2\sqrt[3]{2}$$

Entonces:

$$= 3\sqrt[3]{2} - 2\sqrt[3]{2} - 2\sqrt[3]{3} = \sqrt[3]{2} - 2\sqrt[3]{3}$$

$$2. \quad \sqrt[3]{40} = \sqrt[3]{2^3 \cdot 5} = 2\sqrt[3]{5}$$

$$\sqrt[3]{1.029} = \sqrt[3]{7^3 \cdot 3} = 7\sqrt[3]{3}$$

$$-\sqrt[3]{625} = -\sqrt[3]{5^3 \cdot 5} = -5\sqrt[3]{5}$$

Entonces:

$$= 2\sqrt[3]{5} - 5\sqrt[3]{5} + 7\sqrt[3]{3}$$

$$= (2-5)\sqrt[3]{5} + 7\sqrt[3]{3} = 7\sqrt[3]{3} - 3\sqrt[3]{5}$$

$$3. \quad 2\sqrt[3]{250} = 2\sqrt[3]{5^3 \cdot 2} = 10\sqrt[3]{2}$$

$$-4\sqrt[3]{24} = -4\sqrt[3]{2^3 \cdot 3} = -8\sqrt[3]{3}$$

$$-6\sqrt[3]{16} = -6\sqrt[3]{2^3 \cdot 2} = -12\sqrt[3]{2}$$

$$\sqrt[3]{2.187} = \sqrt[3]{3^6 \cdot 3} = 9\sqrt[3]{3}$$

Entonces:

$$= 10\sqrt[3]{2} - 12\sqrt[3]{2} + 9\sqrt[3]{3} - 8\sqrt[3]{3}$$

$$= (10-12)\sqrt[3]{2} + (9-8)\sqrt[3]{3} = \sqrt[3]{3} - 2\sqrt[3]{2}$$

$$5. \quad \sqrt[3]{81} = \sqrt[3]{3^3 \cdot 3} = 3\sqrt[3]{3}$$

$$-3\sqrt[3]{375} = -3\sqrt[3]{5^3 \cdot 3} = -15\sqrt[3]{3}$$

$$\sqrt[3]{686} = \sqrt[3]{7^3 \cdot 2} = 7\sqrt[3]{2}$$

$$2\sqrt[3]{648} = 2\sqrt[3]{2^3 \cdot 3^3 \cdot 3} = 12\sqrt[3]{3}$$

Entonces:

$$= 3\sqrt[3]{3} + 12\sqrt[3]{3} - 15\sqrt[3]{3} + 7\sqrt[3]{2} = 7\sqrt[3]{2}$$

$$7. \quad \frac{3}{5}\sqrt[3]{625} = \frac{3}{5}\sqrt[3]{5^3 \cdot 5} = 3\sqrt[3]{5}$$

$$-\frac{3}{2}\sqrt[3]{192} = -\frac{3}{2}\sqrt[3]{2^6 \cdot 3} = -6\sqrt[3]{3}$$

$$\frac{1}{7}\sqrt[3]{1.715} = \frac{1}{7}\sqrt[3]{7^3 \cdot 5} = \sqrt[3]{5}$$

$$-\frac{3}{8}\sqrt[3]{1.536} = -\frac{3}{8}\sqrt[3]{2^9 \cdot 3} = -3\sqrt[3]{3}$$

Entonces:

$$= 3\sqrt[3]{5} + \sqrt[3]{5} - 6\sqrt[3]{3} - 3\sqrt[3]{3}$$

$$= (3+1)\sqrt[3]{5} + (-6-3)\sqrt[3]{3} = 4\sqrt[3]{5} - 9\sqrt[3]{3}$$

$$8. \quad \sqrt[3]{\frac{1}{4}} = \sqrt[3]{\frac{2}{2^3}} = \frac{1}{2}\sqrt[3]{2}$$

$$\sqrt[3]{\frac{1}{3}} = \sqrt[3]{\frac{9}{3^3}} = \frac{1}{3}\sqrt[3]{9}$$

$$-2\sqrt[3]{\frac{2}{27}} = -2\sqrt[3]{\frac{2}{3^3}} = -\frac{2}{3}\sqrt[3]{2}$$

Entonces:

$$= \frac{1}{2}\sqrt[3]{2} - \frac{1}{3}\sqrt[3]{2} + \frac{1}{3}\sqrt[3]{9}$$

$$= \left(\frac{1}{2} - \frac{1}{3}\right)\sqrt[3]{2} + \frac{1}{3}\sqrt[3]{9} = \frac{1}{6}\sqrt[3]{2} + \frac{1}{3}\sqrt[3]{9}$$

$$9. \quad 6\sqrt[3]{\frac{1}{24}} = 6\sqrt[3]{\frac{9}{2^3 \cdot 3^3}} = \sqrt[3]{9}$$

$$\sqrt[3]{\frac{1}{25}} = \sqrt[3]{\frac{5}{5^3}} = \frac{1}{5}\sqrt[3]{5}$$

$$-2\sqrt[3]{\frac{5}{64}} = -2\sqrt[3]{\frac{5}{2^3 \cdot 2^3}} = -\frac{1}{2}\sqrt[3]{5}$$

Entonces:

$$= \frac{1}{5}\sqrt[3]{2} - \frac{1}{2}\sqrt[3]{5} + \sqrt[3]{9}$$

$$= \left(\frac{1}{5} - \frac{1}{2}\right)\sqrt[3]{5} + \sqrt[3]{9} = -\frac{3}{10}\sqrt[3]{5} + \sqrt[3]{9}$$

$$10. \quad 7\sqrt[3]{\frac{1}{49}} = 7\sqrt[3]{\frac{7}{7^3}} = \sqrt[3]{7}$$

$$\sqrt[3]{\frac{1}{16}} = \sqrt[3]{\frac{4}{2^6}} = \frac{1}{4}\sqrt[3]{4}$$

$$\sqrt[3]{\frac{1}{2}} = \sqrt[3]{\frac{4}{2^3}} = \frac{1}{2}\sqrt[3]{4}$$

$$-2\sqrt[3]{\frac{7}{8}} = -2\sqrt[3]{\frac{7}{2^3}} = -\sqrt[3]{7}$$

Entonces:

$$= \frac{1}{4}\sqrt[3]{4} + \frac{1}{2}\sqrt[3]{4} + \sqrt[3]{7} - \sqrt[3]{7} = \left(\frac{1}{4} + \frac{1}{2}\right)\sqrt[3]{4} = \frac{3}{4}\sqrt[3]{4}$$

$$11. \quad \frac{2}{3}\sqrt[3]{135} = \frac{2}{3}\sqrt[3]{3^3 \cdot 5} = 2\sqrt[3]{5}$$

$$\frac{1}{2}\sqrt[3]{\frac{1}{32}} = \frac{1}{2}\sqrt[3]{\frac{2}{2^6}} = \frac{1}{8}\sqrt[3]{2}$$

$$\frac{7}{4}\sqrt[3]{\frac{1}{4}} = \frac{7}{4}\sqrt[3]{\frac{2}{2^3}} = \frac{7}{8}\sqrt[3]{2}$$

$$-20\sqrt[3]{\frac{1}{200}} = -20\sqrt[3]{\frac{5}{2^3 \cdot 5^3}} = -2\sqrt[3]{5}$$

Entonces:

$$= 2\sqrt[3]{5} - 2\sqrt[3]{5} + \frac{1}{8}\sqrt[3]{2} + \frac{7}{8}\sqrt[3]{2} = \left(\frac{1}{8} + \frac{7}{8}\right)\sqrt[3]{2} = \sqrt[3]{2}$$

$$12. \quad 3\sqrt[3]{-24} = 3\sqrt[3]{(-2)^3 \cdot 3} = -6\sqrt[3]{3}$$

$$-4\sqrt[3]{-81} = -4\sqrt[3]{(-3)^3 \cdot 3} = 12\sqrt[3]{3}$$

$$-\sqrt[3]{-375} = -\sqrt[3]{(-5)^3 \cdot 3} = 5\sqrt[3]{3}$$

Entonces:

$$= -6\sqrt[3]{3} + 12\sqrt[3]{3} + 5\sqrt[3]{3}$$

$$= (-6 + 12 + 5)\sqrt[3]{3} = 11\sqrt[3]{3}$$

$$13. \quad 4\sqrt[3]{-320} = 4\sqrt[3]{(2)^6(-5)} = 16\sqrt[3]{-5}$$

$$-10\sqrt[3]{-40} = -10\sqrt[3]{(2)^3(-5)} = -20\sqrt[3]{-5}$$

$$-2\sqrt[3]{-54} = -2\sqrt[3]{(3)^3(-2)} = -6\sqrt[3]{-2}$$

$$3\sqrt[3]{-1.024} = 3\sqrt[3]{(2)^9(-2)} = 24\sqrt[3]{-2}$$

Entonces:

$$= 16\sqrt[3]{-5} - 20\sqrt[3]{-5} - 6\sqrt[3]{-2} + 24\sqrt[3]{-2}$$

$$= (16 - 20)\sqrt[3]{-5} + (-6 + 24)\sqrt[3]{-2}$$

$$= -4\sqrt[3]{-5} + 18\sqrt[3]{-2}$$

$$14. \quad 3\sqrt[3]{2a^3} = 3a\sqrt[3]{2}$$

$$-b\sqrt[3]{128} = -b\sqrt[3]{2^6 \cdot 2} = -4b\sqrt[3]{2}$$

$$(4b - 3a)\sqrt[3]{2}$$

Entonces:

$$= 3a\sqrt[3]{2} - 4b\sqrt[3]{2} + (4b - 3a)\sqrt[3]{2}$$

$$= (3a - 4b + 4b - 3a)\sqrt[3]{2} = 0$$

$$15. \quad a\sqrt[3]{250b} = a\sqrt[3]{5^3 \cdot 2b} = 5a\sqrt[3]{2b}$$

$$-\sqrt[3]{3ab^3} = -b\sqrt[3]{3a}$$

$$-5\sqrt[3]{2a^3b} = -5a\sqrt[3]{2b}$$

$$3b\sqrt[3]{3a}$$

Entonces:

$$5a\sqrt[3]{2b} - 5a\sqrt[3]{2b} - b\sqrt[3]{3a} + 3b\sqrt[3]{3a}$$

$$= (-b + 3b)\sqrt[3]{3a} = 2b\sqrt[3]{3a}$$

## EJERCICIO 240

- $\sqrt{3} \cdot \sqrt{6} = \sqrt{18} = \sqrt{3^2 \cdot 2} = 3\sqrt{2}$
- $5\sqrt{21} \cdot 2\sqrt{3} = 10\sqrt{63} = 10\sqrt{3^2 \cdot 7} = 30\sqrt{7}$
- $\frac{1}{2}\sqrt{14} \cdot \frac{2}{7}\sqrt{21} = \frac{1}{7}\sqrt{294} = \frac{1}{7}\sqrt{7^2 \cdot 6} = \sqrt{6}$
- $\sqrt[3]{12} \cdot \sqrt[3]{9} = \sqrt[3]{108} = \sqrt[3]{3^3 \cdot 4} = 3\sqrt[3]{4}$
- $\frac{5}{6}\sqrt[3]{15} \cdot 12\sqrt[3]{50} = 10\sqrt[3]{750} = 10\sqrt[3]{2^3 \cdot 3^2 \cdot 5^2} = 50\sqrt[3]{6}$
- $x\sqrt{2a} \cdot \frac{1}{a}\sqrt{5a} = \frac{x}{a}\sqrt{10a^2} = x\sqrt{10}$
- $5\sqrt{12} \cdot 3\sqrt{75} = 15\sqrt{900} = 15\sqrt{2^2 \cdot 3^2 \cdot 5^2} = 450$
- $\frac{3}{4}\sqrt[3]{9a^2} \cdot 8\sqrt[3]{3ab} = 6\sqrt[3]{27a^3b} = 6a\sqrt[3]{3^3b} = 18a\sqrt[3]{b}$
- $3\sqrt{6} \cdot \sqrt{14} \cdot 2\sqrt{35} = 6\sqrt{2 \cdot 940} = 6\sqrt{2^2 \cdot 7^2 \cdot 15} = 84\sqrt{15}$
- $\frac{1}{2}\sqrt{21} \cdot \frac{2}{3}\sqrt{42} \cdot \frac{3}{7}\sqrt{22} = \frac{1}{7}\sqrt{19 \cdot 404} = \frac{1}{7}\sqrt{2^2 \cdot 7^2 \cdot 3^2 \cdot 11} = 6\sqrt{11}$
- $3\sqrt[3]{45} \cdot \frac{1}{6}\sqrt[3]{15} \cdot 4\sqrt[3]{20} = 2\sqrt[3]{13 \cdot 500} = 2\sqrt[3]{5^3 \cdot 3^2 \cdot 4} = 30\sqrt[3]{4}$
- $\frac{5}{6}\sqrt{\frac{7}{8}} \cdot \frac{3}{5}\sqrt{\frac{4}{7}} = \frac{1}{2}\sqrt{\frac{1}{2}} = \frac{1}{2}\sqrt{\frac{2}{2^2}} = \frac{1}{4}\sqrt{2}$
- $\frac{2}{x}\sqrt{a^2x} \cdot \frac{3}{2}\sqrt{\frac{1}{a^3}} = \frac{3}{x}\sqrt{\frac{x}{a}} = \frac{3}{x}\sqrt{\frac{ax}{a^2}} = \frac{3}{ax}\sqrt{ax}$
- $\frac{1}{3}\sqrt{\frac{x}{y^2}} \cdot 6\sqrt{\frac{2}{y}} = 2\sqrt{\frac{2x}{y^3}} = 2\sqrt{\frac{2xy}{y^4}} = \frac{2}{y^2}\sqrt{2xy}$

## EJERCICIO 241

- $$\frac{\sqrt{2} - \sqrt{3}}{\sqrt{2}} = \frac{\sqrt{4} - \sqrt{6}}{\sqrt{2}} = 2 - \sqrt{6}$$
- $$\frac{7\sqrt{5} + 5\sqrt{3}}{2\sqrt{3}} = \frac{14\sqrt{15} + 10\sqrt{9}}{14\sqrt{15} + 30} = \frac{14\sqrt{15} + 30}{14\sqrt{15} + 30}$$
- $$\frac{2\sqrt{3} + \sqrt{5} - 5\sqrt{2}}{4\sqrt{15}} = \frac{8\sqrt{45} + 4\sqrt{75} - 20\sqrt{30}}{4(2\sqrt{3^2 \cdot 5} + \sqrt{5^2 \cdot 3} - 5\sqrt{30})} = \frac{4(6\sqrt{5} + 5\sqrt{3} - 5\sqrt{30})}{4(6\sqrt{5} + 5\sqrt{3} - 5\sqrt{30})}$$
- $$\frac{\sqrt{2} - \sqrt{3}}{\sqrt{2} + 2\sqrt{3}} = \frac{\sqrt{4} - \sqrt{6}}{\sqrt{4} + \sqrt{6}} + \frac{2\sqrt{6} - 2\sqrt{9}}{\sqrt{4} + \sqrt{6}} = \frac{\sqrt{4} + \sqrt{6}}{\sqrt{4} + \sqrt{6}} - 2\sqrt{9} = 2 + \sqrt{6} - 6 = \sqrt{6} - 4$$
- $$\frac{\sqrt{5} + 5\sqrt{3}}{2\sqrt{5} + 3\sqrt{3}} = \frac{2\sqrt{25} + 10\sqrt{15}}{2\sqrt{25} + 10\sqrt{15}} + \frac{3\sqrt{15} + 15\sqrt{9}}{2\sqrt{25} + 10\sqrt{15}} = \frac{2\sqrt{25} + 13\sqrt{15} + 15\sqrt{9}}{2\sqrt{25} + 10\sqrt{15}} = \frac{10 + 13\sqrt{15} + 45}{55 + 13\sqrt{15}}$$
- $$\frac{3\sqrt{7} - 2\sqrt{3}}{5\sqrt{3} + 4\sqrt{7}} = \frac{15\sqrt{21} - 10\sqrt{9}}{-8\sqrt{21} + 12\sqrt{49}} = \frac{7\sqrt{21} - 10\sqrt{9} + 12\sqrt{49}}{7\sqrt{21} - 30 + 84} = \frac{7\sqrt{21} + 54}{7\sqrt{21} + 54}$$
- $$\frac{\sqrt{a} - 2\sqrt{x}}{3\sqrt{a} + \sqrt{x}} = \frac{3\sqrt{a^2} - 6\sqrt{ax}}{3\sqrt{a^2} - 6\sqrt{ax}} + \frac{\sqrt{ax} - 2\sqrt{x^2}}{3\sqrt{a^2} - 6\sqrt{ax}} = \frac{3\sqrt{a^2} - 5\sqrt{ax} - 2\sqrt{x^2}}{3a - 5\sqrt{ax} - 2x}$$
- $$\frac{7\sqrt{5} - 11\sqrt{7}}{5\sqrt{5} - 8\sqrt{7}} = \frac{35\sqrt{25} - 55\sqrt{35}}{35\sqrt{25} - 55\sqrt{35}} + \frac{-56\sqrt{35} + 88\sqrt{49}}{35\sqrt{25} - 55\sqrt{35}} = \frac{35\sqrt{25} - 111\sqrt{35} + 88\sqrt{49}}{35\sqrt{25} - 55\sqrt{35}} = \frac{175 - 111\sqrt{35} + 616}{791 - 111\sqrt{35}}$$
- $$\frac{\sqrt{2} + \sqrt{3} + \sqrt{5}}{\sqrt{2} - \sqrt{3}} = \frac{\sqrt{4} + \sqrt{6} + \sqrt{10}}{-\sqrt{6} - \sqrt{9} - \sqrt{15}} = \frac{\sqrt{4} + \sqrt{10} - \sqrt{9} - \sqrt{15}}{2 + \sqrt{10} - 3 - \sqrt{15}} = \frac{\sqrt{10} - \sqrt{15} - 1}{2 - \sqrt{6} - \sqrt{15}}$$
- $$\frac{\sqrt{2} - 3\sqrt{3} + \sqrt{5}}{\sqrt{2} + 2\sqrt{3} - \sqrt{5}} = \frac{\sqrt{4} - 3\sqrt{6} + \sqrt{10}}{+2\sqrt{6} - 6\sqrt{9} + 2\sqrt{15}} = \frac{\sqrt{4} - \sqrt{6}}{-\sqrt{10} + 3\sqrt{15} - \sqrt{25}} = \frac{2 - \sqrt{6}}{-18 + 5\sqrt{15} - 5} = \frac{5\sqrt{15} - \sqrt{6} - 21}{-18 + 5\sqrt{15} - 5}$$

$$\begin{aligned}
 11. \quad & \frac{2\sqrt{3}-\sqrt{6}+\sqrt{5}}{\sqrt{3}+\sqrt{6}+3\sqrt{5}} \\
 & \frac{2\sqrt{9}-\sqrt{18}+\sqrt{15}}{2\sqrt{18}-\sqrt{36}+\sqrt{30}} \\
 & \frac{2\sqrt{18}-\sqrt{36}+\sqrt{30}}{6\sqrt{15}-3\sqrt{30}+3\sqrt{25}} \\
 & = \frac{2\sqrt{9}+\sqrt{3^2 \cdot 2}+7\sqrt{15}-\sqrt{36}-2\sqrt{30}+3\sqrt{25}}{6+3\sqrt{2}+7\sqrt{15}-6-2\sqrt{30}+15} \\
 & = \frac{7\sqrt{15}+3\sqrt{2}-2\sqrt{30}+15}{15}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & \frac{\sqrt{a}+\sqrt{a+1}}{\sqrt{a}+2\sqrt{a+1}} \\
 & \frac{\sqrt{a^2}+\sqrt{a^2+a}}{2\sqrt{a^2+a}+2\sqrt{(a+1)^2}} \\
 & = \frac{\sqrt{a^2}+3\sqrt{a^2+a}+2\sqrt{(a+1)^2}}{a+3\sqrt{a^2+a}+2a+2} \\
 & = \frac{3a+3\sqrt{a^2+a}+2}{a+3\sqrt{a^2+a}+2a+2}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad & \frac{2\sqrt{a}-3\sqrt{a-b}}{3\sqrt{a}+\sqrt{a-b}} \\
 & \frac{6\sqrt{a^2}-9\sqrt{a^2-ab}}{2\sqrt{a^2-ab}-3\sqrt{(a-b)^2}} \\
 & = \frac{6\sqrt{a^2}-7\sqrt{a^2-ab}-3\sqrt{(a-b)^2}}{6a-7\sqrt{a^2-ab}-3a+3b} \\
 & = \frac{3a+3b-7\sqrt{a^2-ab}}{6a-7\sqrt{a^2-ab}-3a+3b}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \frac{\sqrt{1-x^2}+x}{2x+\sqrt{1-x^2}} \\
 & \frac{2x\sqrt{1-x^2}+2x^2}{x\sqrt{1-x^2}+\sqrt{(1-x^2)^2}} \\
 & = \frac{3x\sqrt{1-x^2}+2x^2}{x\sqrt{1-x^2}+1-x^2} \\
 & = \frac{3x\sqrt{1-x^2}+x^2+1-x^2}{x\sqrt{1-x^2}+1-x^2}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \frac{\sqrt{a+1}+\sqrt{a-1}}{\sqrt{a+1}+2\sqrt{a-1}} \\
 & \frac{\sqrt{(a+1)^2}+\sqrt{a^2-1}}{2\sqrt{a^2-1}+2\sqrt{(a-1)^2}} \\
 & = \frac{a+1+\sqrt{a^2-1}+2a-2}{2\sqrt{a^2-1}+2a-2} \\
 & = \frac{3a+3\sqrt{a^2-1}-1}{2\sqrt{a^2-1}+2a-2}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & \frac{2\sqrt{x+2}-2}{\sqrt{x+2}-3} \\
 & \frac{2\sqrt{(x+2)^2}-2\sqrt{x+2}}{-6\sqrt{x+2}+6} \\
 & = \frac{2\sqrt{(x+2)^2}-8\sqrt{x+2}+6}{-6\sqrt{x+2}+6} \\
 & = \frac{2x+4-8\sqrt{x+2}+6}{-6\sqrt{x+2}+6} \\
 & = \frac{2x+10-8\sqrt{x+2}}{-6\sqrt{x+2}+6}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \frac{3\sqrt{a}-2\sqrt{a+x}}{2\sqrt{a}+3\sqrt{a+x}} \\
 & \frac{6\sqrt{a^2}-4\sqrt{a^2+ax}}{9\sqrt{a^2+ax}-6\sqrt{(a+x)^2}} \\
 & = \frac{6\sqrt{a^2}+5\sqrt{a^2+ax}-6\sqrt{(a+x)^2}}{9\sqrt{a^2+ax}-6a-6x} \\
 & = \frac{5\sqrt{a^2+ax}-6x}{9\sqrt{a^2+ax}-6a-6x}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \frac{\sqrt{a+x}-\sqrt{a-x}}{\sqrt{a+x}-2\sqrt{a-x}} \\
 & \frac{\sqrt{(a+x)^2}-\sqrt{a^2-x^2}}{-2\sqrt{a^2-x^2}+2\sqrt{(a-x)^2}} \\
 & = \frac{\sqrt{(a+x)^2}-3\sqrt{a^2-x^2}+2\sqrt{(a-x)^2}}{-2\sqrt{a^2-x^2}+2a-2x} \\
 & = \frac{3a-x-3\sqrt{a^2-x^2}}{-2\sqrt{a^2-x^2}+2a-2x}
 \end{aligned}$$

## EJERCICIO 242

1.  $\sqrt{x} = \sqrt[6]{x^3}$

$$\sqrt[3]{2x^2} = \sqrt[6]{(2x^2)^2} = \sqrt[6]{4x^4}$$

$$\begin{aligned} \sqrt[6]{x^3} \cdot \sqrt[6]{4x^4} &= \sqrt[6]{4x^7} \\ &= \sqrt[6]{4x^6 x} \\ &= x \sqrt[6]{4x} \end{aligned}$$

2.  $3\sqrt{2ab} = 3\sqrt[4]{(2ab)^2} = 3\sqrt[4]{4a^2b^2}$

$$\begin{aligned} 3\sqrt[4]{4a^2b^2} \cdot 4\sqrt[4]{8a^3} &= 12\sqrt[4]{32a^5b^2} \\ &= 12\sqrt[4]{2^4 \cdot 2a^4ab^2} \\ &= 24a\sqrt[4]{2ab^2} \end{aligned}$$

3.  $\sqrt[3]{9x^2y} = \sqrt[6]{(9x^2y)^2}$

$$\begin{aligned} &= \sqrt[6]{81x^4y^2} \\ \sqrt[6]{81x^4y^2} \cdot \sqrt[6]{81x^5} &= \sqrt[6]{6.561x^9y^2} \\ &= \sqrt[6]{3^6 \cdot 3^2 x^6 x^3 y^2} \\ &= 3x \sqrt[6]{9x^3y^2} \end{aligned}$$

4.  $\sqrt[3]{a^2b^2} = \sqrt[12]{(a^2b^2)^4}$

$$\begin{aligned} &= \sqrt[12]{8a^8b^8} \\ 2\sqrt[4]{3a^3b} &= 2\sqrt[12]{(3a^3b)^3} \\ &= 2\sqrt[12]{27a^9b^3} \\ \sqrt[12]{8a^8b^8} \cdot 2\sqrt[12]{27a^9b^3} &= 2\sqrt[12]{27a^{17}b^{11}} \\ &= 2\sqrt[12]{27a^{12}a^5b^{11}} \\ &= 2a\sqrt[12]{27a^5b^{11}} \end{aligned}$$

5.  $\sqrt[4]{25x^2y^3} = \sqrt[12]{(25x^2y^3)^3}$

$$\begin{aligned} &= \sqrt[12]{15.625x^6y^9} \\ \sqrt[6]{125x^2} &= \sqrt[12]{(125x^2)^2} \\ &= \sqrt[12]{15.625x^4} \\ \sqrt[12]{15.625x^6y^9} \cdot \sqrt[12]{15.625x^4} &= \sqrt[12]{244.140.625x^{10}y^9} \end{aligned}$$

$$\begin{aligned} &= \sqrt[12]{5^{12}x^{10}y^9} = 5\sqrt[12]{x^{10}y^9} \\ 6. \frac{2}{3}\sqrt[3]{4m^2} &= \frac{2}{3}\sqrt[15]{(4m^2)^5} \end{aligned}$$

$$\begin{aligned} &= \frac{2}{3}\sqrt[15]{4^5m^{10}} \\ \frac{3}{4}\sqrt[3]{16m^4n} &= \frac{3}{4}\sqrt[15]{(4^2m^4n)^3} \end{aligned}$$

$$\begin{aligned} &= \frac{3}{4}\sqrt[15]{4^6m^{12}n^3} \\ \frac{2}{3}\sqrt[15]{4^5m^{10}} \cdot \frac{3}{4}\sqrt[15]{4^6m^{12}n^3} &= \frac{1}{2}\sqrt[15]{4^{11}m^{22}n^3} \end{aligned}$$

$$\begin{aligned} &= \frac{1}{2}\sqrt[15]{2^{22}m^{22}n^3} \\ \frac{1}{2}\sqrt[15]{2^{22}m^{22}n^3} &= \frac{1}{2}\sqrt[15]{2^{15} \cdot 2^7 m^{15} m^7 n^3} \end{aligned}$$

$$\begin{aligned} &= m\sqrt[15]{2^7 m^7 n^3} = m\sqrt[15]{128m^7n^3} \\ 7. \sqrt{\frac{1}{2x}} &= \sqrt[6]{\left(\frac{1}{2x}\right)^3} = \sqrt[6]{\frac{1}{8x^3}} \end{aligned}$$

$$\sqrt[3]{2} = \sqrt[6]{(x^2)^2} = \sqrt[6]{x^4}$$

$$\begin{aligned} \sqrt[6]{\frac{x^{-3}}{8}} \cdot \sqrt[6]{x^4} &= \sqrt[6]{\frac{x}{8}} = \sqrt[6]{\frac{8x}{2^6}} \\ &= \frac{1}{2}\sqrt[6]{8x} \end{aligned}$$

8.  $\sqrt{2x} = \sqrt[10]{(2x)^5} = \sqrt[10]{2^5x^5}$

$$\sqrt[5]{4x} = \sqrt[10]{(2x)^2} = \sqrt[10]{2^4x^2}$$

$$\sqrt[10]{2^5x^5} \cdot \sqrt[10]{2^4x^2} = \sqrt[10]{\frac{1}{16x^2}}$$

$$\begin{aligned} &= \sqrt[10]{\frac{2^5 \cdot 2^4 x^2 x^5}{2^4 x^2}} \\ &= \sqrt[10]{2^5 x^5} = (2x)^{\frac{5}{10}} = (2x)^{\frac{1}{2}} = \sqrt{2x} \end{aligned}$$

9.  $\frac{2}{3}\sqrt{\frac{2b}{a}} = \frac{2}{3}\sqrt[6]{\left(\frac{2b}{a}\right)^3} = \frac{2}{3}\sqrt[6]{\frac{8b^3}{a^3}}$

$$\frac{3}{8}\sqrt[3]{\frac{a^2}{4b^2}} = \frac{3}{8}\sqrt[6]{\left(\frac{a^2}{2^2b^2}\right)^2} = \frac{3}{8}\sqrt[6]{\frac{a^4}{2^4b^4}}$$

$$\begin{aligned} \frac{2}{3}\sqrt[6]{\frac{2^3b^3}{a^3}} \cdot \frac{3}{8}\sqrt[6]{\frac{a^4}{2^4b^4}} &= \frac{1}{4}\sqrt[6]{\frac{a}{2b}} = \frac{1}{4}\sqrt[6]{\frac{2^5ab^5}{2^6b^6}} = \frac{1}{8b}\sqrt{32ab^5} \end{aligned}$$

10.  $\frac{1}{2}\sqrt{\frac{1}{3}} = \frac{1}{2}\sqrt[6]{\left(\frac{1}{3}\right)^3} = \frac{1}{2}\sqrt[6]{\frac{1}{3^3}}$

$$\frac{3}{2}\sqrt[3]{\frac{1}{9}} = \frac{3}{2}\sqrt[6]{\left(\frac{1}{9}\right)^2} = \frac{3}{2}\sqrt[6]{\frac{1}{3^4}}$$

$$\frac{1}{2}\sqrt[6]{\frac{1}{3^3}} \cdot \frac{3}{2}\sqrt[6]{\frac{1}{3^4}} = \sqrt[6]{243}$$

$$= \frac{3}{4}\sqrt[6]{\frac{3^5}{3^7}}$$

$$= \frac{3}{4}\sqrt[6]{\frac{1}{9}}$$

$$= \frac{3}{4}\sqrt[6]{\frac{3^4}{3^6}}$$

$$= \frac{1}{4}(3)^{\frac{4}{6}} = \frac{1}{4}(3)^{\frac{2}{3}} = \frac{1}{4}\sqrt[3]{3^2} = \frac{1}{4}\sqrt[3]{9}$$

## EJERCICIO 243

1.  $\frac{4\sqrt{6}}{2\sqrt{3}} = 2\sqrt{\frac{6}{3}} = 2\sqrt{2}$

2.  $\frac{2\sqrt{3a}}{10\sqrt{a}} = \frac{1}{5}\sqrt{\frac{3a}{a}} = \frac{1}{5}\sqrt{3}$

3.  $\frac{1}{2}\sqrt{\frac{3xy}{x}} = \frac{4}{3}\sqrt{\frac{3xy}{x}} = \frac{2}{3}\sqrt{3y}$

4.  $\frac{\sqrt{75x^2y^3}}{5\sqrt{3xy}} = \frac{1}{5}\sqrt{\frac{75x^2y^3}{3xy}} = \frac{1}{5}\sqrt{25xy^2} = \frac{1}{5}\sqrt{5^2xy^2} = y\sqrt{x}$

5.  $\frac{3\sqrt[3]{16a^5}}{4\sqrt[3]{2a^2}} = \frac{3}{4}\sqrt[3]{\frac{16a^5}{2a^2}} = \frac{3}{4}\sqrt[3]{8a^3} = \frac{3}{4}\sqrt[3]{2^3a^3} = \frac{3}{2}a$

6.  $\frac{5}{10}\sqrt{\frac{1}{2}} = \frac{15}{60}\sqrt{\frac{1}{2}} = \frac{1}{4}\sqrt{\frac{3}{4}} = \frac{1}{4}\sqrt{\frac{3}{2^2}} = \frac{1}{8}\sqrt{3}$

7.  $\frac{4x\sqrt{a^3x^2}}{2\sqrt{a^2x^3}} = 2x\sqrt{\frac{a^3x^2}{a^2x^3}} = 2x\sqrt{\frac{a}{x}} = 2x\sqrt{\frac{ax}{x^2}} = 2\sqrt{ax}$



$$8. (\sqrt[6]{18})^3 = \sqrt[6]{18^3} = (18)^{\frac{3}{6}} = (18)^{\frac{1}{2}} = \sqrt{18} = \sqrt{3^2 \cdot 2} = 3\sqrt{2}$$

$$9. (4a\sqrt{2x})^2 = (4a)^2 \sqrt{(2x)^2} = 16a^2(2x) = 32a^2x$$

$$10. (2\sqrt{x+1})^2 = 2^2 \sqrt{(x+1)^2} = 4(x+1) = 4x+4$$

$$11. (3\sqrt{x-a})^2 = 3^2 \sqrt{(x-a)^2} = 9(x-a) = 9x-9a$$

$$12. (4\sqrt[6]{9a^3b^4})^3 \\ = 4^3 \sqrt[6]{(3^2 a^3 b^4)^3} \\ = 64 \sqrt[6]{3^6 a^6 a^3 b^6 b^6} \\ = 192ab^2 \sqrt[6]{a^3} \\ = 192ab^2 (a)^{\frac{3}{6}} = 192ab^2 (a)^{\frac{1}{2}} = 192ab^2 \sqrt{a}$$

$$13. (\sqrt{2}-\sqrt{3})^2 = \sqrt{2}^2 - 2\sqrt{2}\sqrt{3} + \sqrt{3}^2 \\ = 2 - 2\sqrt{6} + 3 = 5 - 2\sqrt{6}$$

$$14. (4\sqrt{2}+\sqrt{3})^2 = 4^2 \sqrt{2}^2 + 2 \cdot 4\sqrt{2}\sqrt{3} + \sqrt{3}^2 \\ = 32 + 8\sqrt{6} + 3 = 35 + 8\sqrt{6}$$

$$15. (\sqrt{5}-\sqrt{7})^2 = \sqrt{5}^2 - 2\sqrt{5}\sqrt{7} + \sqrt{7}^2 \\ = 5 - 2\sqrt{35} + 7 = 12 - 2\sqrt{35}$$

### EJERCICIO 246

$$1. \sqrt[3]{\sqrt{a^2}} = \sqrt[6]{a^2} = (a)^{\frac{2}{6}} = a^{\frac{1}{3}} = \sqrt[3]{a}$$

$$2. \sqrt[3]{\sqrt{8}} = \sqrt[6]{8} = (2)^{\frac{3}{6}} = (2)^{\frac{1}{2}} = \sqrt{2}$$

$$3. \sqrt[4]{\sqrt{81}} = \sqrt[8]{3^4} = (3)^{\frac{4}{8}} = (3)^{\frac{1}{2}} = \sqrt{3}$$

$$4. \sqrt{\sqrt{3a}} = \sqrt[4]{3a}$$

$$5. \sqrt[3]{\sqrt{4a^2}} = \sqrt[6]{2^2 a^2} = (2a)^{\frac{2}{6}} = (2a)^{\frac{1}{3}} = \sqrt[3]{2a}$$

$$6. \sqrt[3]{2\sqrt{2}} = \sqrt[6]{2^2 \cdot 2} = \sqrt[6]{2^3} = (2)^{\frac{3}{6}} = (2)^{\frac{1}{2}} = \sqrt{2}$$

$$7. \sqrt[4]{\sqrt{25a^2}} = \sqrt[8]{5^2 a^2} = (5a)^{\frac{2}{8}} = (5a)^{\frac{1}{4}} = \sqrt[4]{5a}$$

### EJERCICIO 247

$$1. \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{\sqrt{3^2}} = \frac{\sqrt{3}}{3}$$

$$3. \frac{3}{4\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{4\sqrt{5^2}} = \frac{3\sqrt{5}}{4 \cdot 5} = \frac{3\sqrt{5}}{20}$$

$$2. \frac{5}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{5\sqrt{2}}{\sqrt{2^2}} = \frac{5\sqrt{2}}{2}$$

$$4. \frac{2a}{\sqrt{2ax}} \cdot \frac{\sqrt{2ax}}{\sqrt{2ax}} = \frac{2a\sqrt{2ax}}{\sqrt{2^2 a^2 x^2}} = \frac{2a\sqrt{2ax}}{2ax} = \frac{\sqrt{2ax}}{x}$$

$$5. \frac{5}{\sqrt[3]{4a^2}} \cdot \frac{\sqrt[3]{2a}}{\sqrt[3]{2a}} = \frac{5\sqrt[3]{2a}}{\sqrt[3]{2^3 a^3}} = \frac{5\sqrt[3]{2a}}{2a}$$

$$6. \frac{1}{\sqrt[3]{9x}} \cdot \frac{\sqrt[3]{3x^2}}{\sqrt[3]{3x^2}} = \frac{\sqrt[3]{3x^2}}{\sqrt[3]{3^3 x^3}} = \frac{\sqrt[3]{3x^2}}{3x}$$

$$16. (5\sqrt{7}-6)^2 = 5^2 \sqrt{7}^2 - 2 \cdot 5 \cdot 6\sqrt{7} + 6^2 \\ = 175 - 60\sqrt{7} + 36 = 211 - 60\sqrt{7}$$

$$17. (\sqrt{x}+\sqrt{x-1})^2 = \sqrt{x}^2 + 2\sqrt{x}\sqrt{x-1} + \sqrt{(x-1)^2} \\ = x + 2\sqrt{x^2-x} + x-1 \\ = 2x + 2\sqrt{x^2-x} - 1$$

$$18. (\sqrt{x+1}-4\sqrt{x})^2 \\ = \sqrt{(x+1)^2} - 2 \cdot 4\sqrt{x+1}\sqrt{x} + 4^2 \sqrt{x}^2 \\ = x+1 - 8\sqrt{x^2+x} + 16x = 17x+1 - 8\sqrt{x^2+x}$$

$$19. (\sqrt{a+1}-\sqrt{a-1})^2 \\ = \sqrt{(a+1)^2} - 2\sqrt{a+1}\sqrt{a-1} + \sqrt{(a-1)^2} \\ = a+1 - 2\sqrt{a^2-1} + a-1 = 2a - 2\sqrt{a^2-1}$$

$$20. (2\sqrt{2x-1}+\sqrt{2x+1})^2 \\ = 2^2 \sqrt{(2x-1)^2} + 2 \cdot 2\sqrt{2x-1}\sqrt{2x+1} + \sqrt{(2x+1)^2} \\ = 4(2x-1) + 4\sqrt{4x^2-1} + 2x+1 \\ = 8x-4 + 4\sqrt{4x^2-1} + 2x+1 \\ = 10x-3 + 4\sqrt{4x^2-1}$$

$$8. \sqrt[3]{\sqrt[4]{27a^3}} = \sqrt[12]{3^3 a^3} = (3a)^{\frac{3}{12}} = (3a)^{\frac{1}{4}} = \sqrt[4]{3a}$$

$$9. \sqrt{3\sqrt[3]{3}} = \sqrt{\sqrt[3]{3^5 \cdot 3}} = \sqrt[6]{3^6} = (3)^{\frac{6}{6}} = (3)^1 = 3$$

$$10. \sqrt[4]{\sqrt{a^4 b^6}} = \sqrt[8]{a^4 b^4 b^2} = (ab)^{\frac{4}{8}} (b)^{\frac{2}{8}} = (ab)^{\frac{1}{2}} (b)^{\frac{1}{4}} \\ = \sqrt{ab} \cdot \sqrt[4]{b} \\ \Rightarrow \sqrt{ab} = \sqrt[4]{(ab)^2} = \sqrt[4]{a^2 b^2} \\ = \sqrt[4]{a^2 b^2} \sqrt[4]{b} = \sqrt[4]{a^2 b^3}$$

$$11. \sqrt[5]{\sqrt[3]{x^{10}}} = \sqrt[15]{x^{10}} = x^{\frac{10}{15}} = x^{\frac{2}{3}} = \sqrt[3]{x^2}$$

$$12. \sqrt[3]{\sqrt{(a+b)^2}} = \sqrt[6]{(a+b)^2} = (a+b)^{\frac{2}{6}} = (a+b)^{\frac{1}{3}} = \sqrt[3]{a+b}$$



$$7. \frac{3}{\sqrt[4]{9a}} \cdot \frac{\sqrt[4]{3^2 a^3}}{\sqrt[4]{3^2 a^3}} = \frac{3\sqrt[4]{3^2 a^3}}{\sqrt[4]{3^4 a^4}} = \frac{3\sqrt[4]{9a^3}}{3a} = \frac{\sqrt[4]{9a^3}}{a}$$

$$10. \frac{1}{\sqrt[5]{8a^4}} \cdot \frac{\sqrt[5]{2^2 a}}{\sqrt[5]{2^2 a}} = \frac{\sqrt[5]{4a}}{\sqrt[5]{2^5 a^5}} = \frac{\sqrt[5]{4a}}{2a}$$

$$8. \frac{6}{5\sqrt[3]{3x}} \cdot \frac{\sqrt[3]{3^2 x^2}}{\sqrt[3]{3^2 x^2}} = \frac{6\sqrt[3]{3^2 x^2}}{5\sqrt[3]{3^3 x^3}} = \frac{6\sqrt[3]{9x^2}}{15x} = \frac{2\sqrt[3]{9x^2}}{5x}$$

$$11. \frac{5n^2}{3\sqrt{mn}} \cdot \frac{\sqrt{mn}}{\sqrt{mn}} = \frac{5n^2 \sqrt{mn}}{3\sqrt{m^2 n^2}} = \frac{5n^2 \sqrt{mn}}{3mn} = \frac{5n\sqrt{mn}}{3m}$$

$$9. \frac{x}{\sqrt[4]{27x^2}} \cdot \frac{\sqrt[4]{3x^2}}{\sqrt[4]{3x^2}} = \frac{x\sqrt[4]{3x^2}}{\sqrt[4]{3^4 x^4}} = \frac{x\sqrt[4]{3x^2}}{3x} = \frac{\sqrt[4]{3x^2}}{3}$$

$$12. \frac{1}{5a\sqrt[4]{25x^3}} \cdot \frac{\sqrt[4]{5^2 x}}{\sqrt[4]{5^2 x}} = \frac{\sqrt[4]{25x}}{5a\sqrt[4]{5^4 x^4}} = \frac{\sqrt[4]{25x}}{25ax}$$

## EJERCICIO 248

$$1. \frac{3-\sqrt{2}}{1+\sqrt{2}} \cdot \frac{1-\sqrt{2}}{1-\sqrt{2}} = \frac{3-3\sqrt{2}-\sqrt{2}+\sqrt{2}^2}{1-\sqrt{2}^2} = \frac{3-4\sqrt{2}+2}{1-2} = \frac{5-4\sqrt{2}}{-1} = 4\sqrt{2}-5$$

$$2. \frac{5+2\sqrt{3}}{4-\sqrt{3}} \cdot \frac{4+\sqrt{3}}{4+\sqrt{3}} = \frac{20+5\sqrt{3}+8\sqrt{3}+2\sqrt{3}^2}{4^2-\sqrt{3}^2} = \frac{20+13\sqrt{3}+6}{16-3} = \frac{26+13\sqrt{3}}{13} = 2+\sqrt{3}$$

$$3. \frac{\sqrt{2}-\sqrt{5}}{\sqrt{2}+\sqrt{5}} \cdot \frac{\sqrt{2}-\sqrt{5}}{\sqrt{2}-\sqrt{5}} = \frac{\sqrt{2}^2-2\sqrt{2}\sqrt{5}+\sqrt{5}^2}{\sqrt{2}^2-\sqrt{5}^2} = \frac{2-2\sqrt{10}+5}{2-5} = \frac{7-2\sqrt{10}}{-3} = \frac{2\sqrt{10}-7}{3}$$

$$4. \frac{\sqrt{7}+2\sqrt{5}}{\sqrt{7}-\sqrt{5}} \cdot \frac{\sqrt{7}+\sqrt{5}}{\sqrt{7}+\sqrt{5}} = \frac{\sqrt{7}^2+\sqrt{35}+2\sqrt{35}+2\sqrt{5}^2}{\sqrt{7}^2-\sqrt{5}^2} = \frac{7+3\sqrt{35}+10}{7-5} = \frac{17+3\sqrt{35}}{2}$$

$$5. \frac{\sqrt{2}-3\sqrt{5}}{2\sqrt{2}+\sqrt{5}} \cdot \frac{2\sqrt{2}-\sqrt{5}}{2\sqrt{2}-\sqrt{5}} = \frac{2\sqrt{2}^2-2\sqrt{2}\sqrt{5}-6\sqrt{10}+3\sqrt{5}^2}{2^2\sqrt{2}^2-\sqrt{5}^2} = \frac{4-7\sqrt{10}+15}{8-5} = \frac{19-7\sqrt{10}}{3}$$

$$6. \frac{19}{5\sqrt{2}-4\sqrt{3}} \cdot \frac{5\sqrt{2}+4\sqrt{3}}{5\sqrt{2}+4\sqrt{3}} = \frac{95\sqrt{2}+76\sqrt{3}}{5^2\sqrt{2}^2-4^2\sqrt{3}^2} = \frac{95\sqrt{2}+76\sqrt{3}}{50-48} = \frac{95\sqrt{2}+76\sqrt{3}}{2}$$

$$7. \frac{3\sqrt{2}}{7\sqrt{2}-6\sqrt{3}} \cdot \frac{7\sqrt{2}+6\sqrt{3}}{7\sqrt{2}+6\sqrt{3}} = \frac{21\sqrt{2}^2+18\sqrt{6}}{7^2\sqrt{2}^2-6^2\sqrt{3}^2} = \frac{42+18\sqrt{6}}{98-108} = \frac{42+18\sqrt{6}}{-10} = -\frac{21+9\sqrt{6}}{5}$$

$$8. \frac{4\sqrt{3}-3\sqrt{7}}{2\sqrt{3}+3\sqrt{7}} \cdot \frac{2\sqrt{3}-3\sqrt{7}}{2\sqrt{3}-3\sqrt{7}} = \frac{8\sqrt{3}^2-12\sqrt{21}-6\sqrt{21}+9\sqrt{7}^2}{2^2\sqrt{3}^2-3^2\sqrt{7}^2} = \frac{24-18\sqrt{21}+63}{12-63} = \frac{87-18\sqrt{21}}{-51} = \frac{6\sqrt{21}-29}{17}$$

$$9. \frac{5\sqrt{2}-6\sqrt{3}}{4\sqrt{2}-3\sqrt{3}} \cdot \frac{4\sqrt{2}+3\sqrt{3}}{4\sqrt{2}+3\sqrt{3}} = \frac{20\sqrt{2}^2+15\sqrt{6}-24\sqrt{6}-18\sqrt{3}^2}{4^2\sqrt{2}^2-3^2\sqrt{3}^2} = \frac{40-9\sqrt{6}-54}{32-27} = \frac{-14-9\sqrt{6}}{5} = -\frac{14+9\sqrt{6}}{5}$$

$$10. \frac{\sqrt{7}+3\sqrt{11}}{5\sqrt{7}+4\sqrt{11}} \cdot \frac{5\sqrt{7}-4\sqrt{11}}{5\sqrt{7}-4\sqrt{11}} = \frac{5\sqrt{7}^2-4\sqrt{77}+15\sqrt{77}-12\sqrt{11}^2}{5^2\sqrt{7}^2-4^2\sqrt{11}^2} = \frac{35+11\sqrt{77}-132}{175-176} = \frac{-97+11\sqrt{77}}{-1} = 97-11\sqrt{77}$$

$$11. \frac{\sqrt{5}+\sqrt{2}}{7+2\sqrt{10}} \cdot \frac{7-2\sqrt{10}}{7-2\sqrt{10}} = \frac{7\sqrt{5}-2\sqrt{50}+7\sqrt{2}-2\sqrt{20}}{7^2-2^2\sqrt{10}^2} \\ = \frac{7\sqrt{5}-2\sqrt{5^2 \cdot 2}+7\sqrt{2}-2\sqrt{2^2 \cdot 5}}{49-40} = \frac{7\sqrt{5}-10\sqrt{2}+7\sqrt{2}-4\sqrt{5}}{9} = \frac{3\sqrt{5}-3\sqrt{2}}{9} = \frac{\sqrt{5}-\sqrt{2}}{3}$$

$$12. \frac{9\sqrt{3}-3\sqrt{2}}{6-\sqrt{6}} \cdot \frac{6+\sqrt{6}}{6+\sqrt{6}} = \frac{54\sqrt{3}+9\sqrt{18}-18\sqrt{2}-3\sqrt{12}}{6^2-\sqrt{6}^2} \\ = \frac{54\sqrt{3}+9\sqrt{3^2 \cdot 2}-18\sqrt{2}-3\sqrt{2^2 \cdot 3}}{36-6} = \frac{54\sqrt{3}+27\sqrt{2}-18\sqrt{2}-6\sqrt{3}}{30} = \frac{48\sqrt{3}+9\sqrt{2}}{30} = \frac{16\sqrt{3}+3\sqrt{2}}{10}$$

$$13. \frac{\sqrt{a}+\sqrt{x}}{2\sqrt{a}+\sqrt{x}} \cdot \frac{2\sqrt{a}-\sqrt{x}}{2\sqrt{a}-\sqrt{x}} \\ = \frac{2\sqrt{a^2}-\sqrt{ax}+2\sqrt{ax}-\sqrt{x^2}}{2^2\sqrt{a^2}-\sqrt{x^2}} = \frac{2a+\sqrt{ax}-x}{4a-x}$$

$$14. \frac{\sqrt{x}-\sqrt{x-1}}{\sqrt{x}+\sqrt{x-1}} \cdot \frac{\sqrt{x}-\sqrt{x-1}}{\sqrt{x}-\sqrt{x-1}} \\ = \frac{\sqrt{x^2}-2\sqrt{x}\sqrt{x-1}+\sqrt{(x-1)^2}}{\sqrt{x^2}-\sqrt{(x-1)^2}} \\ = \frac{x-2\sqrt{x^2-x}+x-1}{x-(x-1)} = 2x-1-2\sqrt{x^2-x}$$

$$15. \frac{\sqrt{a}-\sqrt{a+1}}{\sqrt{a}+\sqrt{a+1}} \cdot \frac{\sqrt{a}-\sqrt{a+1}}{\sqrt{a}-\sqrt{a+1}} \\ = \frac{\sqrt{a^2}-2\sqrt{a}\sqrt{a+1}+\sqrt{(a+1)^2}}{\sqrt{a^2}-\sqrt{(a+1)^2}} \\ = \frac{a-2\sqrt{a^2+a}+a+1}{a-(a+1)} \\ = \frac{2a+1-2\sqrt{a^2+a}}{-1} = 2\sqrt{a^2+a}-2a-1$$

$$16. \frac{\sqrt{x+2}+\sqrt{2}}{\sqrt{x+2}-\sqrt{2}} \cdot \frac{\sqrt{x+2}+\sqrt{2}}{\sqrt{x+2}+\sqrt{2}} \\ = \frac{\sqrt{(x+2)^2}+2\sqrt{x+2}\sqrt{2}+\sqrt{2^2}}{\sqrt{(x+2)^2}-\sqrt{2^2}} \\ = \frac{x+2+2\sqrt{2x+4}+2}{x+2-2} = \frac{x+4+2\sqrt{2x+4}}{x}$$

$$17. \frac{\sqrt{a+4}-\sqrt{a}}{\sqrt{a+4}+\sqrt{a}} \cdot \frac{\sqrt{a+4}-\sqrt{a}}{\sqrt{a+4}-\sqrt{a}} \\ = \frac{\sqrt{(a+4)^2}-2\sqrt{a+4}\sqrt{a}+\sqrt{a^2}}{\sqrt{(a+4)^2}-\sqrt{a^2}} \\ = \frac{a+4-2\sqrt{a^2+4a}+a}{a+4-a} = \frac{2a+4-2\sqrt{a^2+4a}}{4} \\ = \frac{a+2-\sqrt{a^2+4a}}{2}$$

$$18. \frac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}+\sqrt{a-b}} \cdot \frac{\sqrt{a+b}-\sqrt{a-b}}{\sqrt{a+b}-\sqrt{a-b}} \\ = \frac{\sqrt{(a+b)^2}-2\sqrt{a+b}\sqrt{a-b}+\sqrt{(a-b)^2}}{\sqrt{(a+b)^2}-\sqrt{(a-b)^2}} \\ = \frac{a+b-2\sqrt{a^2-b^2}+a-b}{a+b-a+b} = \frac{2a-2\sqrt{a^2-b^2}}{2b} = \frac{a-\sqrt{a^2-b^2}}{b}$$

## EJERCICIO 249

$$1. \frac{\sqrt{3}}{\sqrt{2}+\sqrt{3}-\sqrt{5}} \cdot \frac{(\sqrt{2}+\sqrt{3})+\sqrt{5}}{(\sqrt{2}+\sqrt{3})+\sqrt{5}} \\ = \frac{\sqrt{6}+\sqrt{9}+\sqrt{15}}{(\sqrt{2}+\sqrt{3})^2-(\sqrt{5})^2} \\ = \frac{3+\sqrt{6}+\sqrt{15}}{2+2\sqrt{6}+3-5} = \frac{3+\sqrt{6}+\sqrt{15}}{2\sqrt{6}} \cdot \frac{2\sqrt{6}}{2\sqrt{6}} = \frac{6\sqrt{6}+2\sqrt{36}+2\sqrt{90}}{(2\sqrt{6})^2} = \frac{6\sqrt{6}+12+6\sqrt{10}}{24} = \frac{6(\sqrt{6}+2+\sqrt{10})}{24} = \frac{2+\sqrt{6}+\sqrt{10}}{4}$$

$$2. \frac{\sqrt{2}}{\sqrt{2}+\sqrt{3}+\sqrt{6}} \cdot \frac{(\sqrt{2}+\sqrt{3})-\sqrt{6}}{(\sqrt{2}+\sqrt{3})-\sqrt{6}} \\ = \frac{2+\sqrt{6}-\sqrt{12}}{(\sqrt{2}+\sqrt{3})^2-(\sqrt{6})^2} \\ = \frac{2+\sqrt{6}-2\sqrt{3}}{2+2\sqrt{6}+3-6} = \frac{2+\sqrt{6}-2\sqrt{3}}{2\sqrt{6}-1} \cdot \frac{2\sqrt{6}+1}{2\sqrt{6}+1} = \frac{4\sqrt{6}+2+12+\sqrt{6}-4\sqrt{18}-2\sqrt{3}}{(2\sqrt{6})^2-1} = \frac{5\sqrt{6}+14-12\sqrt{2}-2\sqrt{3}}{23}$$

$$\begin{aligned}
 3. \quad & \frac{2-\sqrt{3}}{2+\sqrt{3}+\sqrt{5}} \cdot \frac{(2+\sqrt{3})-\sqrt{5}}{(2+\sqrt{3})-\sqrt{5}} \\
 &= \frac{4-3-2\sqrt{5}+\sqrt{15}}{(2+\sqrt{3})^2-(\sqrt{5})^2} \\
 &= \frac{1-2\sqrt{5}+\sqrt{15}}{4+4\sqrt{3}+3-5} \\
 &= \frac{1-2\sqrt{5}+\sqrt{15}}{2+4\sqrt{3}} \cdot \frac{2-4\sqrt{3}}{2-4\sqrt{3}} \\
 &= \frac{2-4\sqrt{3}-4\sqrt{5}+8\sqrt{15}+2\sqrt{15}-4\sqrt{45}}{2^2-(4\sqrt{3})^2} \\
 &= \frac{2-4\sqrt{3}-4\sqrt{5}+10\sqrt{15}-12\sqrt{5}}{-44} \\
 &= \frac{2(2\sqrt{3}+8\sqrt{5}-5\sqrt{15}-1)}{44} = \frac{2\sqrt{3}+8\sqrt{5}-5\sqrt{15}-1}{22}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{\sqrt{3}+\sqrt{5}}{\sqrt{2}+\sqrt{3}+\sqrt{5}} \cdot \frac{(\sqrt{2}+\sqrt{3})-\sqrt{5}}{(\sqrt{2}+\sqrt{3})-\sqrt{5}} \\
 &= \frac{\sqrt{6}+\sqrt{10}+3-5}{(\sqrt{2}+\sqrt{3})^2-(\sqrt{5})^2} \\
 &= \frac{\sqrt{10}+\sqrt{6}-2}{2+2\sqrt{6}+3-5} \\
 &= \frac{\sqrt{10}+\sqrt{6}-2}{2\sqrt{6}} \cdot \frac{2\sqrt{6}}{2\sqrt{6}} \\
 &= \frac{2\sqrt{60}+2\sqrt{36}-4\sqrt{6}}{(2\sqrt{6})^2} \\
 &= \frac{4\sqrt{15}+12-4\sqrt{6}}{24} \\
 &= \frac{4(\sqrt{15}+3-\sqrt{6})}{24} = \frac{\sqrt{15}+3-\sqrt{6}}{6}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & \frac{\sqrt{6}+\sqrt{3}+\sqrt{2}}{\sqrt{6}+\sqrt{3}-\sqrt{2}} \cdot \frac{(\sqrt{6}+\sqrt{3})+\sqrt{2}}{(\sqrt{6}+\sqrt{3})+\sqrt{2}} \\
 &= \frac{6+3+2+2\sqrt{18}+2\sqrt{12}+2\sqrt{6}}{(\sqrt{6}+\sqrt{3})^2-(\sqrt{2})^2} \\
 &= \frac{11+6\sqrt{2}+4\sqrt{3}+2\sqrt{6}}{6+2\sqrt{18}+3-2} \\
 &= \frac{11+6\sqrt{2}+4\sqrt{3}+2\sqrt{6}}{2\sqrt{18}+7} \cdot \frac{2\sqrt{18}-7}{2\sqrt{18}-7} \\
 &= \frac{22\sqrt{18}-77+12\sqrt{36}-42\sqrt{2}+8\sqrt{54}-28\sqrt{3}+4\sqrt{108}-14\sqrt{6}}{(2\sqrt{18})^2-49} \\
 &= \frac{66\sqrt{2}-77+72-42\sqrt{2}+24\sqrt{6}-28\sqrt{3}+24\sqrt{3}-14\sqrt{6}}{72-49} \\
 &= \frac{24\sqrt{2}-4\sqrt{3}+10\sqrt{6}-5}{23}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & \frac{\sqrt{2}-\sqrt{5}}{\sqrt{2}+\sqrt{5}-\sqrt{10}} \cdot \frac{(\sqrt{2}+\sqrt{5})+\sqrt{10}}{(\sqrt{2}+\sqrt{5})+\sqrt{10}} \\
 &= \frac{2-5+\sqrt{20}-\sqrt{50}}{2+2\sqrt{10}+5-10} \\
 &= \frac{2\sqrt{5}-5\sqrt{2}-3}{2\sqrt{10}-3} \cdot \frac{2\sqrt{10}+3}{2\sqrt{10}+3} \\
 &= \frac{4\sqrt{50}+6\sqrt{5}-10\sqrt{20}-15\sqrt{2}-6\sqrt{10}-9}{40-9} \\
 &= \frac{20\sqrt{2}+6\sqrt{5}-20\sqrt{5}-15\sqrt{2}-6\sqrt{10}-9}{31} \\
 &= \frac{5\sqrt{2}-14\sqrt{5}-6\sqrt{10}-9}{31}
 \end{aligned}$$

## EJERCICIO 250

$$1. \quad \frac{\sqrt{2}}{\sqrt{2}+\sqrt{3}} \cdot \frac{\sqrt{2}-\sqrt{3}}{\sqrt{2}-\sqrt{3}} = \frac{2-\sqrt{6}}{2-3} = \frac{2-\sqrt{6}}{-1} = \sqrt{6}-2$$

$$\begin{aligned}
 2. \quad & \frac{\sqrt{3}}{\sqrt{3}-2\sqrt{5}} \cdot \frac{\sqrt{3}+2\sqrt{5}}{\sqrt{3}+2\sqrt{5}} \\
 &= \frac{3+2\sqrt{15}}{3-20} = \frac{3+2\sqrt{15}}{-17} = -\frac{3+2\sqrt{15}}{17}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{2+\sqrt{5}}{1-\sqrt{5}} \cdot \frac{1+\sqrt{5}}{1+\sqrt{5}} \\
 &= \frac{2+2\sqrt{5}+\sqrt{5}+5}{1-5} = \frac{7+3\sqrt{5}}{-4} = -\frac{7+3\sqrt{5}}{4}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{\sqrt{2}+\sqrt{5}}{\sqrt{2}-\sqrt{5}} \cdot \frac{\sqrt{2}+\sqrt{5}}{\sqrt{2}+\sqrt{5}} \\
 &= \frac{2+2\sqrt{10}+5}{2-5} = \frac{7+2\sqrt{10}}{-3} = -\frac{7+2\sqrt{10}}{3}
 \end{aligned}$$

$$5. \frac{2\sqrt{3}-\sqrt{7}}{\sqrt{3}+\sqrt{7}} \cdot \frac{\sqrt{3}-\sqrt{7}}{\sqrt{3}-\sqrt{7}} = \frac{6-2\sqrt{21}-\sqrt{21}+7}{3-7} = \frac{13-3\sqrt{21}}{-4} = \frac{3\sqrt{21}-13}{4}$$

$$6. \frac{\sqrt{6+2\sqrt{5}}}{2\sqrt{6}-\sqrt{5}} \cdot \frac{2\sqrt{6}+\sqrt{5}}{2\sqrt{6}+\sqrt{5}} = \frac{12+5\sqrt{30}+10}{24-5} = \frac{22+5\sqrt{30}}{19}$$

$$7. \frac{5\sqrt{2}+3\sqrt{3}}{3\sqrt{2}-4\sqrt{3}} \cdot \frac{3\sqrt{2}+4\sqrt{3}}{3\sqrt{2}+4\sqrt{3}} = \frac{30+29\sqrt{6}+36}{18-48} = \frac{66+29\sqrt{6}}{-30} = -\frac{66+29\sqrt{6}}{30}$$

$$8. \frac{\sqrt{7}-2\sqrt{11}}{2\sqrt{7}+\sqrt{11}} \cdot \frac{2\sqrt{7}-\sqrt{11}}{2\sqrt{7}-\sqrt{11}} = \frac{14-5\sqrt{77}+22}{28-11} = \frac{36-5\sqrt{77}}{17}$$

## EJERCICIO 251

$$1. \sqrt{x-8}=2 \\ (\sqrt{x-8})^2=2^2 \\ x-8=4 \\ x=12$$

$$2. 5-\sqrt{3x+1}=0 \\ 5=\sqrt{3x+1} \\ 5^2=(3x+1)^2 \\ 25=3x+1 \\ 24=3x \\ 8=x$$

$$3. 7+\sqrt[3]{5x-2}=9 \\ \sqrt[3]{5x-2}=2 \\ (\sqrt[3]{5x-2})^3=2^3 \\ 5x-2=8 \\ 5x=10 \\ x=2$$

$$4. \sqrt{9x^2-5}-3x=-1 \\ \sqrt{9x^2-5}=3x-1 \\ (\sqrt{9x^2-5})^2=(3x-1)^2 \\ 9x^2-5=9x^2-6x+1 \\ -6=-6x \\ 1=x$$

$$5. \sqrt{x^2-2x+1}=9-x \\ \sqrt{(x-1)^2}=9-x \\ x-1=9-x \\ 2x=10 \\ x=5$$

$$6. 15-\sqrt[3]{7x-1}=12 \\ 3=\sqrt[3]{7x-1} \\ 3^3=(\sqrt[3]{7x-1})^3 \\ 27=7x-1 \\ 28=7x \\ 4=x$$

$$7. \sqrt{x}+\sqrt{x+7}=7 \\ (\sqrt{x+7})^2=(7-\sqrt{x})^2 \\ x+7=49-14\sqrt{x}+x \\ 7=49-14\sqrt{x} \\ 1=7-2\sqrt{x} \\ -6=-2\sqrt{x} \\ 3=\sqrt{x} \\ 3^2=(\sqrt{x})^2 \\ 9=x$$

$$8. \sqrt{3x-5}+\sqrt{3x-14}=9 \\ (\sqrt{3x-5})^2=(9-\sqrt{3x-14})^2 \\ 3x-5=81-18\sqrt{3x-14}+3x-14 \\ -72=-18\sqrt{3x-14} \\ 4^2=(\sqrt{3x-14})^2 \\ 16=3x-14 \\ 30=3x \\ 10=x$$

$$9. \sqrt{x+10}-\sqrt{x+19}=-1 \\ (\sqrt{x+10})^2=(\sqrt{x+19}-1)^2 \\ x+10=x+19-2\sqrt{x+19}+1 \\ -10=-2\sqrt{x+19} \\ 5=\sqrt{x+19} \\ 5^2=(\sqrt{x+19})^2 \\ 25=x+19 \\ 6=x$$

$$10. \sqrt{4x-11}=7\sqrt{2x-29} \\ (\sqrt{4x-11})^2=(7\sqrt{2x-29})^2 \\ 4x-11=49(2x-29) \\ 4x-11=98x-1.421 \\ 1.410=94x \\ 15=x$$

$$11. \sqrt{5x-19}-\sqrt{5x}=-1 \\ (\sqrt{5x-19})^2=(\sqrt{5x}-1)^2 \\ 5x-19=5x-2\sqrt{5x}+1 \\ -20=-2\sqrt{5x} \\ 10=\sqrt{5x} \\ 100=5x \\ 20=x$$

$$12. \sqrt{x-2}+5=\sqrt{x+53} \\ (\sqrt{x-2}+5)^2=(\sqrt{x+53})^2 \\ x-2+10\sqrt{x-2}+25=x+53 \\ 10\sqrt{x-2}=30 \\ \sqrt{x-2}=3 \\ x-2=9 \\ x=11$$

$$\begin{aligned}
 13. \quad & \sqrt{9x-14} = 3\sqrt{x+10} - 4 \\
 & (\sqrt{9x-14})^2 = (3\sqrt{x+10} - 4)^2 \\
 & 9x - 14 = 9(x+10) - 24\sqrt{x+10} + 16 \\
 & -14 = 90 - 24\sqrt{x+10} + 16 \\
 & -120 = -24\sqrt{x+10} \\
 & 5 = \sqrt{x+10} \\
 & 25 = x+10 \\
 & 15 = x
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \sqrt{x-16} - \sqrt{x+8} = -4 \\
 & (\sqrt{x-16})^2 = (\sqrt{x+8} - 4)^2 \\
 & x - 16 = x + 8 - 8\sqrt{x+8} + 16 \\
 & -40 = -8\sqrt{x+8} \\
 & 5 = \sqrt{x+8} \\
 & 25 = x+8 \\
 & 17 = x
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & \sqrt{5x-1} + 3 = \sqrt{5x+26} \\
 & (\sqrt{5x-1} + 3)^2 = (\sqrt{5x+26})^2 \\
 & 5x - 1 + 6\sqrt{5x-1} + 9 = 5x + 26 \\
 & 6\sqrt{5x-1} = 18 \\
 & \sqrt{5x-1} = 3 \\
 & 5x - 1 = 9 \\
 & 5x = 10 \\
 & x = 2
 \end{aligned}$$

$$\begin{aligned}
 16. \quad & 13 - \sqrt{13+4x} = 2\sqrt{x} \\
 & (13 - 2\sqrt{x})^2 = (\sqrt{13+4x})^2 \\
 & 169 - 52\sqrt{x} + 4x = 13 + 4x \\
 & -52\sqrt{x} = -156 \\
 & \sqrt{x} = 3 \\
 & x = 9
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & \sqrt{x-4} + \sqrt{x+4} = 2\sqrt{x-1} \\
 & (\sqrt{x-4} + \sqrt{x+4})^2 = (2\sqrt{x-1})^2 \\
 & x - 4 + 2\sqrt{x^2-16} + x + 4 = 4(x-1) \\
 & 2x + 2\sqrt{x^2-16} = 4x - 4 \\
 & (2\sqrt{x^2-16})^2 = (2x-4)^2 \\
 & 4x^2 - 64 = 4x^2 - 16x + 16 \\
 & -80 = -16x \\
 & 5 = x
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & \sqrt{9x+7} - \sqrt{x} - \sqrt{16x-7} = 0 \\
 & (\sqrt{9x+7} - \sqrt{x})^2 = (\sqrt{16x-7})^2 \\
 & 9x + 7 - 2\sqrt{9x^2+7x} + x = 16x - 7 \\
 & -2\sqrt{9x^2+7x} = 6x - 14 \\
 & (-2\sqrt{9x^2+7x})^2 = (6x-14)^2 \\
 & 4(9x^2+7x) = 36x^2 - 168x + 196 \\
 & 36x^2 + 28x = 36x^2 - 168x + 196 \\
 & 196x = 196 \\
 & x = 1
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & \sqrt{9x+10} - 2\sqrt{x+3} = \sqrt{x-2} \\
 & (\sqrt{9x+10} - 2\sqrt{x+3})^2 = (\sqrt{x-2})^2 \\
 & 9x + 10 - 4\sqrt{9x^2+37x+30} + 4(x+3) = x - 2 \\
 & 13x + 22 - x + 2 = 4\sqrt{9x^2+37x+30} \\
 & 12x + 24 = 4\sqrt{9x^2+37x+30} \\
 & 3x + 6 = \sqrt{9x^2+37x+30} \\
 & (3x+6)^2 = (\sqrt{9x^2+37x+30})^2 \\
 & 9x^2 + 36x + 36 = 9x^2 + 37x + 30 \\
 & 36 - 30 = 37x - 36x \\
 & 6 = x
 \end{aligned}$$

$$\begin{aligned}
 20. \quad & \sqrt{18x-8} - \sqrt{2x-4} - 2\sqrt{2x+1} = 0 \\
 & (\sqrt{18x-8})^2 = (\sqrt{2x-4} + 2\sqrt{2x+1})^2 \\
 & 18x - 8 = 2x - 4 + 4\sqrt{4x^2 - 6x - 4} + 4(2x+1) \\
 & 18x - 8 = 10x + 4\sqrt{4x^2 - 6x - 4} \\
 & 8x - 8 = 4\sqrt{4x^2 - 6x - 4} \\
 & 2x - 2 = \sqrt{4x^2 - 6x - 4} \\
 & (2x-2)^2 = (\sqrt{4x^2 - 6x - 4})^2 \\
 & 4x^2 - 8x + 4 = 4x^2 - 6x - 4 \\
 & -2x = -8 \\
 & x = 4
 \end{aligned}$$

$$\begin{aligned}
21. \quad & \sqrt{8x+9} - \sqrt{18x+34} + \sqrt{2x+7} = 0 \\
& (\sqrt{8x+9} + \sqrt{2x+7})^2 = (\sqrt{18x+34})^2 \\
& 8x+9+2\sqrt{16x^2+74x+63}+2x+7=18x+34 \\
& 10x+16+2\sqrt{16x^2+74x+63}=18x+34 \\
& 2\sqrt{16x^2+74x+63}=8x+18 \\
& \sqrt{16x^2+74x+63}=4x+9 \\
& (\sqrt{16x^2+74x+63})^2=(4x+9)^2 \\
& 16x^2+74x+63=16x^2+72x+81 \\
& 2x=18 \\
& x=9
\end{aligned}$$

$$\begin{aligned}
22. \quad & \sqrt{x-2} - \sqrt{x-5} = \sqrt{4x-23} \\
& (\sqrt{x-2} - \sqrt{x-5})^2 = (\sqrt{4x-23})^2 \\
& x-2-2\sqrt{x^2-7x+10}+x-5=4x-23 \\
& 2x-7-4x+23=2\sqrt{x^2-7x+10} \\
& -2x+16=2\sqrt{x^2-7x+10} \\
& -x+8=\sqrt{x^2-7x+10} \\
& (8-x)^2=(\sqrt{x^2-7x+10})^2 \\
& 64-16x+x^2=x^2-7x+10 \\
& 54=9x \\
& 6=x
\end{aligned}$$

$$\begin{aligned}
23. \quad & \sqrt{x+6} - \sqrt{9x+70} = -2\sqrt{x+9} \\
& (\sqrt{x+6} + 2\sqrt{x+9})^2 = (\sqrt{9x+70})^2 \\
& x+6+4\sqrt{x^2+15x+54}+4(x+9)=9x+70 \\
& 5x+42+4\sqrt{x^2+15x+54}=9x+70 \\
& 4\sqrt{x^2+15x+54}=4x+28 \\
& \sqrt{x^2+15x+54}=x+7 \\
& (\sqrt{x^2+15x+54})^2=(x+7)^2 \\
& x^2+15x+54=x^2+14x+49 \\
& x=-5
\end{aligned}$$

$$\begin{aligned}
24. \quad & \sqrt{x-a} + \sqrt{x+a} = \sqrt{4x-2a} \\
& (\sqrt{x-a} + \sqrt{x+a})^2 = (\sqrt{4x-2a})^2 \\
& x-a+2\sqrt{x^2-a^2}+x+a=4x-2a \\
& 2x+2\sqrt{x^2-a^2}=4x-2a \\
& 2\sqrt{x^2-a^2}=2x-2a \\
& \sqrt{x^2-a^2}=x-a \\
& (\sqrt{x^2-a^2})^2=(x-a)^2 \\
& x^2-a^2=x^2-2ax+a^2 \\
& 2ax=2a^2 \\
& x=a
\end{aligned}$$

$$\begin{aligned}
25. \quad & \sqrt{x-4ab} = -2b + \sqrt{x} \\
& (\sqrt{x-4ab})^2 = (\sqrt{x} + 2b)^2 \\
& x-4ab = x-4b\sqrt{x}+4b^2 \\
& 4b\sqrt{x} = 4b^2 + 4ab \\
& \sqrt{x} = b+a \\
& (\sqrt{x})^2 = (a+b)^2 \\
& x = (a+b)^2
\end{aligned}$$

$$\begin{aligned}
26. \quad & \sqrt{x+4a} - \sqrt{x+2a-1} = 1 \\
& (\sqrt{x+4a} - 1)^2 = (\sqrt{x+2a-1})^2 \\
& x+4a-2\sqrt{x+4a}+1=x+2a-1 \\
& 2a+2=2\sqrt{x+4a} \\
& a+1=\sqrt{x+4a} \\
& (a+1)^2=(\sqrt{x+4a})^2 \\
& a^2+2a+1=x+4a \\
& a^2-2a+1=x \\
& (a-1)^2=x
\end{aligned}$$

## EJERCICIO 252

$$1. \quad \sqrt{x} + \sqrt{x+5} = \frac{10}{\sqrt{x}}$$

$$\sqrt{x^2} + \sqrt{x^2+5x} = 10$$

$$\left(\sqrt{x^2+5x}\right)^2 = \left(10 - \sqrt{x^2}\right)^2$$

$$x^2 + 5x = 100 - 20x + x^2$$

$$25x = 100$$

$$x = 4$$

$$2. \quad \sqrt{4x-11} + 2\sqrt{x} = \frac{55}{\sqrt{4x-11}}$$

$$\sqrt{(4x-11)^2} + 2\sqrt{x(4x-11)} = 55$$

$$4x-11 + 2\sqrt{4x^2-11x} = 55$$

$$2\sqrt{4x^2-11x} = 66 - 4x$$

$$\sqrt{4x^2-11x} = 33 - 2x$$

$$\left(\sqrt{4x^2-11x}\right)^2 = (33-2x)^2$$

$$4x^2 - 11x = 1.089 - 132x + 4x^2$$

$$121x = 1.089$$

$$x = 9$$

$$3. \quad \sqrt{x} - \sqrt{x-7} = \frac{4}{\sqrt{x}}$$

$$\sqrt{x^2} - \sqrt{x^2-7x} = 4$$

$$(x-4)^2 = \left(\sqrt{x^2-7x}\right)^2$$

$$x^2 - 8x + 16 = x^2 - 7x$$

$$16 = x$$

$$4. \quad \frac{\sqrt{x}-2}{\sqrt{x}+4} = \frac{\sqrt{x}+1}{\sqrt{x}+13}$$

$$(\sqrt{x}-2)(\sqrt{x}+13) = (\sqrt{x}+1)(\sqrt{x}+4)$$

$$\sqrt{x^2} + 11\sqrt{x} - 26 = \sqrt{x^2} + 5\sqrt{x} + 4$$

$$6\sqrt{x} = 30$$

$$\sqrt{x} = 5$$

$$(\sqrt{x})^2 = 5^2$$

$$x = 25$$

$$5. \quad \frac{6}{\sqrt{x+8}} = \sqrt{x+8} - \sqrt{x}$$

$$6 = \sqrt{(x+8)^2} - \sqrt{x(x+8)}$$

$$6 = x+8 - \sqrt{x^2+8x}$$

$$\sqrt{x^2+8x} = x+2$$

$$\left(\sqrt{x^2+8x}\right)^2 = (x+2)^2$$

$$x^2 + 8x = x^2 + 4x + 4$$

$$4x = 4$$

$$x = 1$$

$$6. \quad \sqrt{x-3} + \frac{8}{\sqrt{x+9}} = \sqrt{x+9}$$

$$\sqrt{(x-3)(x+9)} + 8 = \sqrt{(x+9)^2}$$

$$\sqrt{x^2+6x-27} + 8 = x+9$$

$$\left(\sqrt{x^2+6x-27}\right)^2 = (x+1)^2$$

$$x^2 + 6x - 27 = x^2 + 2x + 1$$

$$4x = 28$$

$$x = 7$$

$$7. \quad \frac{\sqrt{x}+4}{\sqrt{x}-2} = \frac{\sqrt{x}+11}{\sqrt{x}-1}$$

$$(\sqrt{x}+4)(\sqrt{x}-1) = (\sqrt{x}+11)(\sqrt{x}-2)$$

$$\sqrt{x^2} + 3\sqrt{x} - 4 = \sqrt{x^2} + 9\sqrt{x} - 22$$

$$18 = 6\sqrt{x}$$

$$3 = \sqrt{x}$$

$$(3)^2 = (\sqrt{x})^2$$

$$9 = x$$

$$8. \quad 2\sqrt{x+6} - \sqrt{4x-3} = \frac{9}{\sqrt{4x-3}}$$

$$2\sqrt{(x+6)(4x-3)} - \sqrt{(4x-3)^2} = 9$$

$$2\sqrt{4x^2+21x-18} - (4x-3) = 9$$

$$2\sqrt{4x^2+21x-18} - 4x + 3 = 9$$

$$\left(2\sqrt{4x^2+21x-18}\right)^2 = (4x+6)^2$$

$$4(4x^2+21x-18) = 16x^2 + 48x + 36$$

$$16x^2 + 84x - 72 = 16x^2 + 48x + 36$$

$$36x = 108$$

$$x = 3$$

9. 
$$\frac{\sqrt{x}-2}{\sqrt{x}+2} = \frac{2\sqrt{x}-5}{2\sqrt{x}-1}$$

$$(\sqrt{x}-2)(2\sqrt{x}-1) = (2\sqrt{x}-5)(\sqrt{x}+2)$$

$$2\sqrt{x^2}-5\sqrt{x}+2 = 2\sqrt{x^2}-\sqrt{x}-10$$

$$12 = 4\sqrt{x}$$

$$3 = \sqrt{x}$$

$$(3)^2 = (\sqrt{x})^2$$

$$9 = x$$

10. 
$$\sqrt{x+14} - \sqrt{x-7} = \frac{6}{\sqrt{x-7}}$$

$$\sqrt{(x+14)(x-7)} - \sqrt{(x-7)^2} = 6$$

$$\sqrt{x^2+7x-98} - (x-7) = 6$$

$$\sqrt{x^2+7x-98} - x + 7 = 6$$

$$(\sqrt{x^2+7x-98})^2 = (x-1)^2$$

$$x^2+7x-98 = x^2-2x+1$$

$$9x = 99$$

$$x = 11$$

### EJERCICIO 253

1.  $\sqrt{-a^2} = \sqrt{a^2(-1)} = a\sqrt{-1} = ai$

2.  $\sqrt{-2} = \sqrt{2(-1)} = \sqrt{2}\sqrt{-1} = \sqrt{2}i$

3.  $2\sqrt{-9} = 2\sqrt{3^2(-1)} = 6\sqrt{-1} = 6i$

4.  $\sqrt{-81} = \sqrt{9^2(-1)} = 9\sqrt{-1} = 9i$

5.  $\sqrt{-6} = \sqrt{6(-1)} = \sqrt{6}\sqrt{-1} = \sqrt{6}i$

6.  $3\sqrt{-b^4} = 3\sqrt{b^2b^2(-1)} = 3b^2\sqrt{-1} = 3b^2i$

7.  $\sqrt{-12} = \sqrt{2^2 \cdot 3(-1)} = 2\sqrt{3}\sqrt{-1} = 2i\sqrt{3}$

8.  $\sqrt{-7} = \sqrt{7(-1)} = \sqrt{7}\sqrt{-1} = \sqrt{7}i$

9.  $\sqrt{-27} = \sqrt{3^2 \cdot 3(-1)} = 3\sqrt{3}\sqrt{-1} = 3i\sqrt{3}$

10.  $\sqrt{-4m^4} = \sqrt{2^2 m^2 m^2 (-1)} = 2m^2\sqrt{-1} = 2im^2$

11.  $\sqrt{-\frac{1}{16}} = \sqrt{\frac{1}{4^2}(-1)} = \frac{1}{4}\sqrt{-1} = \frac{1}{4}i$

12.  $\sqrt{-a^2-b^2} = \sqrt{-1(a^2+b^2)} = \sqrt{-1}\sqrt{a^2+b^2} = i\sqrt{a^2+b^2}$

### EJERCICIO 254

1.  $\sqrt{-4} = \sqrt{2^2(-1)} = 2i$   
 $\sqrt{-16} = \sqrt{4^2(-1)} = 4i$   
 $= 2i + 4i = 6i$

2.  $\sqrt{-25} = \sqrt{5^2(-1)} = 5i$   
 $\sqrt{-81} = \sqrt{9^2(-1)} = 9i$   
 $-\sqrt{-49} = -\sqrt{7^2(-1)} = -7i$   
 $= 5i + 9i - 7i = 7i$

3.  $2\sqrt{-9} = 2\sqrt{3^2(-1)} = 6i$   
 $3\sqrt{-100} = 3\sqrt{10^2(-1)} = 30i$   
 $= 6i + 30i = 36i$

4.  $3\sqrt{-64} = 3\sqrt{8^2(-1)} = 24i$   
 $-5\sqrt{-49} = -5\sqrt{7^2(-1)} = -35i$   
 $3\sqrt{-121} = 3\sqrt{11^2(-1)} = 33i$   
 $= 24i - 35i + 33i = 22i$

5.  $2\sqrt{-a^2} = 2\sqrt{a^2(-1)} = 2ai$   
 $\sqrt{-a^4} = \sqrt{a^2a^2(-1)} = a^2i$   
 $\sqrt{-a^6} = \sqrt{a^4a^2(-1)} = a^3i$   
 $= 2ai + a^2i + a^3i = i(2a + a^2 + a^3)$

6.  $\sqrt{-18} = \sqrt{3^2 \cdot 2(-1)} = 3\sqrt{2}i$   
 $\sqrt{-8} = \sqrt{2^2 \cdot 2(-1)} = 2\sqrt{2}i$   
 $2\sqrt{-50} = 2\sqrt{5^2 \cdot 2(-1)} = 10\sqrt{2}i$   
 $= 3\sqrt{2}i + 2\sqrt{2}i + 10\sqrt{2}i = 15\sqrt{2}i$

7.  $3\sqrt{-20} = 3\sqrt{2^2 \cdot 5(-1)} = 6\sqrt{5}i$   
 $-2\sqrt{-45} = -2\sqrt{3^2 \cdot 5(-1)} = -6\sqrt{5}i$   
 $3\sqrt{-125} = 3\sqrt{5^2 \cdot 5(-1)} = 15\sqrt{5}i$   
 $= 6\sqrt{5}i - 6\sqrt{5}i + 15\sqrt{5}i = 15\sqrt{5}i$

8.  $\sqrt{-a^4} = \sqrt{a^4(-1)} = a^2i$   
 $4\sqrt{-9a^4} = 4\sqrt{3^2 a^4(-1)} = 12a^2i$   
 $-3\sqrt{-4a^4} = -3\sqrt{2^2 a^4(-1)} = -6a^2i$   
 $= a^2i + 12a^2i - 6a^2i = 7a^2i$



## EJERCICIO 255

$$\begin{aligned} 1. \sqrt{-16} \cdot \sqrt{-25} &= 4\sqrt{-1} \cdot 5\sqrt{-1} \\ &= 20(\sqrt{-1})^2 \\ &= 20(-1) \\ &= -20 \end{aligned}$$

$$\begin{aligned} 2. \sqrt{-81} \cdot \sqrt{-49} &= 9\sqrt{-1} \cdot 7\sqrt{-1} \\ &= 63(\sqrt{-1})^2 \\ &= 63(-1) \\ &= -63 \end{aligned}$$

$$\begin{aligned} 3. 5\sqrt{-36} \cdot 4\sqrt{-64} &= 5 \cdot 6\sqrt{-1} \cdot 4 \cdot 8\sqrt{-1} \\ &= 30\sqrt{-1} \cdot 32\sqrt{-1} \\ &= 960(\sqrt{-1})^2 \\ &= 960(-1) \\ &= -960 \end{aligned}$$

$$\begin{aligned} 4. \sqrt{-3} \cdot \sqrt{-2} &= \sqrt{3}\sqrt{-1} \cdot \sqrt{2}\sqrt{-1} \\ &= \sqrt{6}(\sqrt{-1})^2 \\ &= \sqrt{6}(-1) \\ &= -\sqrt{6} \end{aligned}$$

$$\begin{aligned} 13. \frac{\sqrt{-2} + 3\sqrt{-5}}{2\sqrt{-2} - 6\sqrt{-5}} &= \frac{2\sqrt{4}(\sqrt{-1})^2 + 6\sqrt{10}(\sqrt{-1})^2}{4(-1) - 90(-1)} \\ &= \frac{-6\sqrt{10}(\sqrt{-1})^2 - 18\sqrt{25}(\sqrt{-1})^2}{-4 + 90} \\ &= \frac{-6\sqrt{10} - 18 \cdot 5}{86} \\ &= \frac{-6\sqrt{10} - 90}{86} \end{aligned}$$

$$\begin{aligned} 5. 2\sqrt{-5} \cdot 3\sqrt{-7} &= 2\sqrt{5}\sqrt{-1} \cdot 3\sqrt{7}\sqrt{-1} \\ &= 6\sqrt{35}(\sqrt{-1})^2 \\ &= 6\sqrt{35}(-1) \\ &= -6\sqrt{35} \end{aligned}$$

$$\begin{aligned} 6. \sqrt{-3} \cdot \sqrt{-75} &= \sqrt{3}\sqrt{-1} \cdot \sqrt{25}\sqrt{3}\sqrt{-1} \\ &= 5\sqrt{3^2}(\sqrt{-1})^2 \\ &= 15(-1) \\ &= -15 \end{aligned}$$

$$\begin{aligned} 7. 2\sqrt{-7} \cdot 3\sqrt{-28} &= 2\sqrt{7}\sqrt{-1} \cdot 3\sqrt{4}\sqrt{7}\sqrt{-1} \\ &= 6\sqrt{4}\sqrt{7^2}(\sqrt{-1})^2 \\ &= 12 \cdot 7(-1) \\ &= -84 \end{aligned}$$

$$\begin{aligned} 8. \sqrt{-49} \cdot \sqrt{-4} \cdot \sqrt{-9} &= 7\sqrt{-1} \cdot 2\sqrt{-1} \cdot 3\sqrt{-1} \\ &= 42\sqrt{-1}^3 \\ &= 42\mathbf{e}\sqrt{-1} \mathbf{j} \\ &= -42\sqrt{-1} \\ &= -42i \end{aligned}$$

$$\begin{aligned} 9. \sqrt{-2} \cdot 3\sqrt{-5} \cdot \sqrt{-10} &= \sqrt{2}\sqrt{-1} \cdot 3\sqrt{5}\sqrt{-1} \cdot \sqrt{10}\sqrt{-1} \\ &= 3\sqrt{2 \cdot 5 \cdot 10}(\sqrt{-1})^3 \\ &= 3\sqrt{100}(-\sqrt{-1}) \\ &= -30\sqrt{-1} \\ &= -30i \end{aligned}$$

$$\begin{aligned} 10. \sqrt{-12} \cdot \sqrt{-27} \cdot \sqrt{-8} \cdot \sqrt{-50} &= 2\sqrt{3}\sqrt{-1} \cdot 3\sqrt{3}\sqrt{-1} \cdot 2\sqrt{2}\sqrt{-1} \cdot 5\sqrt{2}\sqrt{-1} \\ &= 60\sqrt{9}\sqrt{4}(\sqrt{-1})^4 \\ &= 60 \cdot 3 \cdot 2(1) \\ &= 360 \end{aligned}$$

$$\begin{aligned} 11. -5\sqrt{-x} \cdot 3\sqrt{-y} &= -5\sqrt{x}\sqrt{-1} \cdot 3\sqrt{y}\sqrt{-1} \\ &= -15\sqrt{xy}(\sqrt{-1})^2 \\ &= -15\sqrt{xy}(-1) \\ &= 15\sqrt{xy} \end{aligned}$$

$$\begin{aligned} 12. \frac{\sqrt{-4} + \sqrt{-9}}{\sqrt{-25} - \sqrt{-16}} &= \frac{10(\sqrt{-1})^2 + 15(\sqrt{-1})^2}{10(-1) + 7(-1) - 12(-1)} \\ &= \frac{-8(\sqrt{-1})^2 - 12(\sqrt{-1})^2}{-10 - 7 + 12} = -5 \end{aligned}$$

$$\begin{aligned} 14. \frac{2\sqrt{-2} + 5\sqrt{-3}}{\sqrt{-2} - 4\sqrt{-3}} &= \frac{2\sqrt{4}(\sqrt{-1})^2 + 5\sqrt{6}(\sqrt{-1})^2}{4(-1) - 3\sqrt{6}(-1) - 60(-1)} \\ &= \frac{-8\sqrt{6}(\sqrt{-1})^2 - 20\sqrt{9}(\sqrt{-1})^2}{-4 + 3\sqrt{6} + 60} \\ &= \frac{-8\sqrt{6} - 20 \cdot 3}{56 + 3\sqrt{6}} \end{aligned}$$

## EJERCICIO 256

$$1. \frac{\sqrt{-16}}{\sqrt{-4}} = \frac{4\sqrt{-1}}{2\sqrt{-1}} = 2 \quad 2. \frac{\sqrt{-10}}{\sqrt{-2}} = \frac{\sqrt{10}\sqrt{-1}}{\sqrt{2}\sqrt{-1}} = \sqrt{\frac{10}{2}} = \sqrt{5} \quad 3. \frac{\sqrt{-81}}{\sqrt{-3}} = \frac{9\sqrt{-1}}{\sqrt{3}\sqrt{-1}} = \frac{9}{\sqrt{3}} = \frac{9\sqrt{3}}{\sqrt{9}} = \frac{9\sqrt{3}}{3} = 3\sqrt{3}$$

$$4. \frac{\sqrt{-90}}{\sqrt{-5}} = \frac{3\sqrt{10}\sqrt{-1}}{\sqrt{5}\sqrt{-1}} = 3\sqrt{\frac{10}{5}} = 3\sqrt{2}$$

$$5. \frac{\sqrt{-150}}{\sqrt{-3}} = \frac{5\sqrt{6}\sqrt{-1}}{\sqrt{3}\sqrt{-1}} = 5\sqrt{\frac{6}{3}} = 5\sqrt{2}$$

$$6. \frac{10\sqrt{-36}}{5\sqrt{-4}} = \frac{60\sqrt{-1}}{10\sqrt{-1}} = 6$$

$$7. \frac{2\sqrt{-18}}{\sqrt{-6}} = \frac{6\sqrt{2}\sqrt{-1}}{\sqrt{6}\sqrt{-1}} = \frac{6\sqrt{2}}{\sqrt{6}} = \frac{6\sqrt{12}}{\sqrt{36}} = \frac{6\sqrt{2^2 \cdot 3}}{6} = 2\sqrt{3}$$

$$8. \frac{\sqrt{-315}}{\sqrt{-7}} = \frac{3\sqrt{35}\sqrt{-1}}{\sqrt{7}\sqrt{-1}} = 3\sqrt{\frac{35}{7}} = 3\sqrt{5}$$

$$9. \frac{\sqrt[4]{-27}}{\sqrt[4]{-3}} = \frac{\sqrt[4]{27}\sqrt{-1}}{\sqrt[4]{3}\sqrt{-1}} = \sqrt[4]{\frac{27}{3}} = \sqrt[4]{9} = \sqrt[4]{3^2} = 3^{\frac{2}{4}} = 3^{\frac{1}{2}} = \sqrt{3}$$

$$10. \frac{\sqrt[4]{-300}}{\sqrt[4]{-12}} = \frac{\sqrt[4]{300}\sqrt{-1}}{\sqrt[4]{12}\sqrt{-1}} = \sqrt[4]{\frac{300}{12}} = \sqrt[4]{25} = \sqrt[4]{5^2} = 5^{\frac{2}{4}} = 5^{\frac{1}{2}} = \sqrt{5}$$

### EJERCICIO 257

1. $\frac{2+3\sqrt{-1}}{5-2\sqrt{-1}}$	4. $\frac{5+\sqrt{-1}}{7+2\sqrt{-1}}$	7. $\frac{2+\sqrt{-2}}{4-\sqrt{-3}}$
$\frac{7+\sqrt{-1}}{7+i}$	$\frac{9+7\sqrt{-1}}{21+10\sqrt{-1}}$	$\frac{6+(\sqrt{2}\sqrt{-1}-\sqrt{3}\sqrt{-1})}{6+(\sqrt{2}i-\sqrt{3}i)}$
2. $\frac{-4-5\sqrt{-1}}{-2+8\sqrt{-1}}$	5. $\frac{3-2i}{5-8i}$	$\frac{6+(\sqrt{2}-\sqrt{3})i}{6+(\sqrt{2}-\sqrt{3})i}$
$\frac{-6+3\sqrt{-1}}{-6+3i}$	$\frac{-10+13i}{-2+3i}$	8. $\frac{7+\sqrt{-5}}{\sqrt{2}-\sqrt{-9}}$
3. $\frac{12-11\sqrt{-1}}{8+7\sqrt{-1}}$	6. $\frac{1-i}{4+3i}$	$\frac{-4+\sqrt{-16}}{(3+\sqrt{2})+(\sqrt{5}\sqrt{-1}-\sqrt{9}\sqrt{-1}+\sqrt{16}\sqrt{-1})}$
$\frac{20-4\sqrt{-1}}{20-4i}$	$\frac{\sqrt{2}+5i}{5+\sqrt{2}+7i}$	$\frac{(3+\sqrt{2})+(\sqrt{5}i-3i+4i)}{(3+\sqrt{2})+(\sqrt{5}i+i)}$
		$\frac{(3+\sqrt{2})+(\sqrt{5}+1)i}{(3+\sqrt{2})+(\sqrt{5}+1)i}$

### EJERCICIO 258

1. $(7-2\sqrt{-1})+(7+2\sqrt{-1})$	3. $(9+i\sqrt{3})+(9-i\sqrt{3})$	5. $(8-3\sqrt{-2})+(8+3\sqrt{-2})$
$= (7+7)+(-2+2)\sqrt{-1}$	$= (9+9)+(i-i)\sqrt{3}$	$= (8+8)+(-3+3)\sqrt{2}\sqrt{-1}$
$= 7 \cdot 2$	$= 9 \cdot 2$	$= 8 \cdot 2$
$= 14$	$= 18$	$= 16$
2. $(-5-3\sqrt{-1})+(-5+3\sqrt{-1})$	4. $(-7-5\sqrt{-1})+(-7+5\sqrt{-1})$	6. $(\sqrt{2}+i\sqrt{3})+(\sqrt{2}-i\sqrt{3})$
$= (-5-5)+(-3+3)\sqrt{-1}$	$= (-7-7)+(-5+5)\sqrt{-1}$	$= (\sqrt{2}+\sqrt{2})+(i-i)\sqrt{3}$
$= -5 \cdot 2$	$= -7 \cdot 2$	$= 2\sqrt{2}$
$= -10$	$= -14$	

## EJERCICIO 259

$$\begin{aligned} 1. & (3-2\sqrt{-1})-(5+3\sqrt{-1}) \\ & \frac{3-2\sqrt{-1}}{-5-3\sqrt{-1}} \\ & \frac{-2-5\sqrt{-1}}{-2-5i} \end{aligned}$$

$$\begin{aligned} 2. & (8+4\sqrt{-1})-(3-10\sqrt{-1}) \\ & \frac{8+4\sqrt{-1}}{-3+10\sqrt{-1}} \\ & \frac{5+14\sqrt{-1}}{5+14i} \end{aligned}$$

$$\begin{aligned} 3. & (-1-\sqrt{-1})-(-7-8\sqrt{-1}) \\ & \frac{-1-\sqrt{-1}}{+7+8\sqrt{-1}} \\ & \frac{6+7\sqrt{-1}}{6+7i} \end{aligned}$$

$$\begin{aligned} 4. & (4-7\sqrt{-1})-(5-3\sqrt{-1}) \\ & \frac{4-7\sqrt{-1}}{-5+3\sqrt{-1}} \\ & \frac{-1-4\sqrt{-1}}{-1-4i} \end{aligned}$$

$$\begin{aligned} 5. & (15-4\sqrt{-1})-(8-7\sqrt{-1}) \\ & \frac{15-4\sqrt{-1}}{-8+7\sqrt{-1}} \\ & \frac{7+3\sqrt{-1}}{7+3i} \end{aligned}$$

$$\begin{aligned} 6. & (11+80\sqrt{-1})-(3-50\sqrt{-1}) \\ & \frac{11+80\sqrt{-1}}{-3+50\sqrt{-1}} \\ & \frac{8+130\sqrt{-1}}{8+130i} \end{aligned}$$

$$\begin{aligned} 7. & (5-\sqrt{-25})-(3+6i) \\ & \frac{5-\sqrt{-25}}{-3-6i} \\ & \frac{2+(-\sqrt{25}\sqrt{-1}-6i)}{2+(-5i-6i)} \\ & \frac{2+(-11i)}{2-11i} \end{aligned}$$

$$\begin{aligned} 8. & (4+\sqrt{-5})-(2+\sqrt{-3}) \\ & \frac{4+\sqrt{-5}}{-2-\sqrt{-3}} \\ & \frac{2+\sqrt{5}\sqrt{-1}-\sqrt{3}\sqrt{-1}}{2+(\sqrt{5}i-\sqrt{3}i)} \\ & \frac{2+(\sqrt{5}-\sqrt{3})i}{2+(\sqrt{5}-\sqrt{3})i} \end{aligned}$$

$$\begin{aligned} 9. & (\sqrt{2}-5\sqrt{-1})-(\sqrt{3}+6\sqrt{-1}) \\ & \frac{\sqrt{2}-5i}{-\sqrt{3}-6i} \\ & \frac{(\sqrt{2}-\sqrt{3})+(-5i-6i)}{(\sqrt{2}-\sqrt{3})+(-11i)} \\ & \frac{(\sqrt{2}-\sqrt{3})-11i}{(\sqrt{2}-\sqrt{3})-11i} \end{aligned}$$

$$\begin{aligned} 10. & (8-\sqrt{-7})-(-7+\sqrt{-3}) \\ & \frac{8-\sqrt{-7}}{7-\sqrt{-3}} \\ & \frac{15+(-\sqrt{7}\sqrt{-1}-\sqrt{3}\sqrt{-1})}{15+(-\sqrt{7}i-\sqrt{3}i)} \\ & \frac{15-(\sqrt{7}+\sqrt{3})i}{15-(\sqrt{7}+\sqrt{3})i} \end{aligned}$$

## EJERCICIO 260

$$\begin{aligned} 1. & (2-\sqrt{-1})-(2+\sqrt{-1}) \\ & \frac{2-\sqrt{-1}-2-\sqrt{-1}}{=} \\ & =(-2-2)+(-1-1)\sqrt{-1} \\ & =-2\sqrt{-1} \\ & =-2i \end{aligned}$$

$$\begin{aligned} 2. & (7+3\sqrt{-1})-(7-3\sqrt{-1}) \\ & \frac{7+3\sqrt{-1}-7+3\sqrt{-1}}{=} \\ & =(7-7)+(3+3)\sqrt{-1} \\ & =6\sqrt{-1} \\ & =6i \end{aligned}$$

$$\begin{aligned} 3. & (-3-7\sqrt{-1})-(-3+7\sqrt{-1}) \\ & \frac{-3-7\sqrt{-1}+3-7\sqrt{-1}}{=} \\ & =(-3+3)+(-7-7)\sqrt{-1} \\ & =-7\cdot 2\sqrt{-1} \\ & =-14i \end{aligned}$$

$$\begin{aligned} 4. & (-5+\sqrt{-2})-(-5-\sqrt{-2}) \\ & \frac{-5+\sqrt{-2}+5+\sqrt{-2}}{=} \\ & =(-5+5)+(1+1)\sqrt{2}\sqrt{-1} \\ & =2\sqrt{2}\sqrt{-1} \\ & =2\sqrt{2}i \end{aligned}$$

$$\begin{aligned} 5. & (\sqrt{2}+\sqrt{-3})-(\sqrt{2}-\sqrt{-3}) \\ & \frac{\sqrt{2}+\sqrt{-3}-\sqrt{2}+\sqrt{-3}}{=} \\ & =(\sqrt{2}-\sqrt{2})+(1+1)\sqrt{3}\sqrt{-1} \\ & =2\sqrt{3}\sqrt{-1} \\ & =2\sqrt{3}i \end{aligned}$$

$$\begin{aligned} 6. & (-\sqrt{5}-4\sqrt{-2})-(-\sqrt{5}+4\sqrt{-2}) \\ & \frac{-\sqrt{5}-4\sqrt{-2}+\sqrt{5}-4\sqrt{-2}}{=} \\ & =-\sqrt{5}-4\sqrt{-2} \\ & \frac{+ \sqrt{5}-4\sqrt{-2}}{-8\sqrt{-2}=-8\sqrt{2}\sqrt{-1}} \\ & =-8\sqrt{2}i \end{aligned}$$

## EJERCICIO 261

1. 
$$\frac{3-4\sqrt{-1}}{5-3\sqrt{-1}} \cdot \frac{15-20\sqrt{-1}}{-9\sqrt{-1}+12(\sqrt{-1})^2}$$
$$\frac{15-29\sqrt{-1}+12(-1)}{15-29i-12}$$
$$\frac{3-29i}{3-29i}$$
2. 
$$\frac{4+7\sqrt{-1}}{-3-2\sqrt{-1}} \cdot \frac{-12-21\sqrt{-1}}{-8\sqrt{-1}-14(\sqrt{-1})^2}$$
$$\frac{-12-29\sqrt{-1}-14(-1)}{-12-29i+14}$$
$$\frac{2-29i}{2-29i}$$
3. 
$$\frac{7-\sqrt{-4}}{5+\sqrt{-9}} \cdot \frac{35-5\sqrt{4}\sqrt{-1}}{+7\sqrt{9}\sqrt{-1}-\sqrt{4}\sqrt{9}(\sqrt{-1})^2}$$
$$\frac{35-10\sqrt{-1}+21\sqrt{-1}-\sqrt{36}(-1)}{35-10i+21i+6}$$
$$\frac{41+11i}{41+11i}$$
4. 
$$\frac{8-\sqrt{-9}}{11+\sqrt{-25}} \cdot \frac{88-11\sqrt{9}\sqrt{-1}}{+8\sqrt{25}\sqrt{-1}-\sqrt{9}\sqrt{25}(\sqrt{-1})^2}$$
$$\frac{88-33i+40i-15(-1)}{88+7i+15}$$
$$\frac{103+7i}{103+7i}$$

5. 
$$\frac{3+\sqrt{-2}}{5-\sqrt{-2}} \cdot \frac{15+5\sqrt{2}\sqrt{-1}}{-3\sqrt{2}\sqrt{-1}-\sqrt{2}\sqrt{2}(\sqrt{-1})^2}$$
$$\frac{15+2\sqrt{2}\sqrt{-1}-\sqrt{4}(-1)}{15+2\sqrt{2}i+2}$$
$$\frac{17+2\sqrt{2}i}{17+2\sqrt{2}i}$$
6. 
$$\frac{4+\sqrt{-3}}{5-\sqrt{-2}} \cdot \frac{20+5\sqrt{3}\sqrt{-1}}{-4\sqrt{2}\sqrt{-1}-\sqrt{2}\sqrt{3}(\sqrt{-1})^2}$$
$$\frac{20+5\sqrt{3}i-4\sqrt{2}i-\sqrt{6}(-1)}{20+(5\sqrt{3}-4\sqrt{2})i+\sqrt{6}}$$
$$\frac{(20+\sqrt{6})+(5\sqrt{3}-4\sqrt{2})i}{(20+\sqrt{6})+(5\sqrt{3}-4\sqrt{2})i}$$
7. 
$$\frac{\sqrt{2}+\sqrt{-5}}{\sqrt{3}+\sqrt{-2}} \cdot \frac{\sqrt{6}+\sqrt{3}\sqrt{5}\sqrt{-1}}{+\sqrt{2}\sqrt{2}\sqrt{-1}+\sqrt{5}\sqrt{2}(\sqrt{-1})^2}$$
$$\frac{\sqrt{6}+\sqrt{15}i+\sqrt{4}i+\sqrt{10}(-1)}{\sqrt{6}+(\sqrt{15}i+2i)-\sqrt{10}}$$
$$\frac{(\sqrt{6}-\sqrt{10})+(\sqrt{15}+2)i}{(\sqrt{6}-\sqrt{10})+(\sqrt{15}+2)i}$$
8. 
$$\frac{\sqrt{5}+\sqrt{-3}}{\sqrt{5}+2\sqrt{-3}} \cdot \frac{\sqrt{25}+\sqrt{5}\sqrt{3}\sqrt{-1}}{+2\sqrt{5}\sqrt{3}\sqrt{-1}+2\sqrt{9}(\sqrt{-1})^2}$$
$$\frac{5+\sqrt{15}i+2\sqrt{15}i+6(-1)}{5+3\sqrt{15}i-6}$$
$$\frac{3\sqrt{15}i-1}{3\sqrt{15}i-1}$$

## EJERCICIO 262

1. 
$$(1-i)(1+i)$$
$$= 1-i^2$$
$$= 1-(\sqrt{-1})^2$$
$$= 1-(-1)$$
$$= 1+1=2$$
2. 
$$(3+2\sqrt{-1})(3-2\sqrt{-1})$$
$$= 3^2-(2\sqrt{-1})^2$$
$$= 9-[4(-1)]$$
$$= 9+4=13$$
3. 
$$(\sqrt{2}-5i)(\sqrt{2}+5i)$$
$$= (\sqrt{2})^2-(5i)^2$$
$$= 2-[25(\sqrt{-1})^2]$$
$$= 2-[25(-1)]$$
$$= 2+25=27$$
4. 
$$(2\sqrt{3}+4i)(2\sqrt{3}-4i)$$
$$= (2\sqrt{3})^2-(4i)^2$$
$$= 4(3)-[16(\sqrt{-1})^2]$$
$$= 12-[16(-1)]$$
$$= 12+16=28$$
5. 
$$(5-\sqrt{-2})(5+\sqrt{-2})$$
$$= 25-(\sqrt{-2})^2$$
$$= 25-(\sqrt{2}\sqrt{-1})^2$$
$$= 25-[2(\sqrt{-1})^2]$$
$$= 25-[2(-1)]$$
$$= 25+2=27$$
6. 
$$(-9-\sqrt{-5})(-9+\sqrt{-5})$$
$$= 81-(\sqrt{-5})^2$$
$$= 81-(\sqrt{5}\sqrt{-1})^2$$
$$= 81-[5(-1)]$$
$$= 81+5=86$$

## EJERCICIO 263

$$1. \frac{1+\sqrt{-1}}{1-\sqrt{-1}} \cdot \frac{1+\sqrt{-1}}{1+\sqrt{-1}}$$

$$= \frac{1+2\sqrt{-1}+(\sqrt{-1})^2}{1-(\sqrt{-1})^2} = \frac{1+2i-1}{1+1} = \frac{2i}{2} = i$$

$$2. \frac{3+\sqrt{-1}}{3-\sqrt{-1}} \cdot \frac{3+\sqrt{-1}}{3+\sqrt{-1}}$$

$$= \frac{9+6\sqrt{-1}+(-1)}{9-(\sqrt{-1})^2} = \frac{9+6i-1}{9+1} = \frac{8+6i}{10} = \frac{4+3i}{5}$$

$$3. \frac{5-3\sqrt{-1}}{3+4\sqrt{-1}} \cdot \frac{3-4\sqrt{-1}}{3-4\sqrt{-1}}$$

$$= \frac{15-29\sqrt{-1}+12(-1)}{9-(4\sqrt{-1})^2} = \frac{15-29i-12}{9-[16(-1)]} = \frac{3-29i}{25}$$

$$4. \frac{8-5i}{7+6i} \cdot \frac{7-6i}{7-6i} = \frac{56-83i+30i^2}{49-36i^2} = \frac{56-83i-30}{49+36} = \frac{26-83i}{85}$$

$$5. \frac{4+\sqrt{-3}}{5-4\sqrt{-3}} \cdot \frac{5+4\sqrt{-3}}{5+4\sqrt{-3}} = \frac{20+21\sqrt{3}\sqrt{-1}+4(\sqrt{3})^2(-1)}{25-(4\sqrt{3}\sqrt{-1})^2}$$

$$= \frac{20+21\sqrt{3}i-12}{25-(-48)} = \frac{8+21\sqrt{3}i}{73}$$

$$6. \frac{\sqrt{2}+2\sqrt{-5}}{4\sqrt{2}-\sqrt{-5}} \cdot \frac{4\sqrt{2}+\sqrt{-5}}{4\sqrt{2}+\sqrt{-5}}$$

$$= \frac{4(\sqrt{2})^2+9\sqrt{2}\sqrt{5}\sqrt{-1}+2(\sqrt{5})^2(-1)}{16(\sqrt{2})^2-(\sqrt{5}\sqrt{-1})^2}$$

$$= \frac{8+9\sqrt{10}i-10}{32+5} = \frac{9\sqrt{10}i-2}{37}$$

## EJERCICIO 265

$$1. 3x^2-5x+2=0$$

$$x^2 - \frac{5x}{3} + \frac{2}{3} = 0$$

$$x^2 - \frac{5x}{3} = -\frac{2}{3}$$

$$x^2 - \frac{5x}{3} + \frac{25}{36} = \frac{25}{36} - \frac{2}{3}$$

$$\left(x - \frac{5}{6}\right)^2 = \frac{25-24}{36}$$

$$x - \frac{5}{6} = \pm \sqrt{\frac{1}{36}}$$

$$x = \frac{5}{6} \pm \frac{1}{6}$$

$$x_1 = \frac{5+1}{6} = 1$$

$$x_2 = \frac{5-1}{6} = \frac{4}{6} = \frac{2}{3}$$

$$2. 4x^2+3x-22=0$$

$$x^2 + \frac{3x}{4} = \frac{22}{4}$$

$$x^2 + \frac{3x}{4} + \frac{9}{64} = \frac{11}{2} + \frac{9}{64}$$

$$\left(x + \frac{3}{8}\right)^2 = \frac{352+9}{64}$$

Continúa

### 2. Continuación

$$x + \frac{3}{8} = \pm \sqrt{\frac{361}{64}}$$

$$x = -\frac{3}{8} \pm \frac{19}{8}$$

$$x_1 = \frac{-3+19}{8} = \frac{16}{8} = 2$$

$$x_2 = \frac{-3-19}{8} = -\frac{22}{8} = -\frac{11}{4}$$

$$3. x^2+11x=-24$$

$$x^2+11x+\frac{121}{4} = \frac{121}{4}-24$$

$$\left(x + \frac{11}{2}\right)^2 = \frac{121-96}{4}$$

$$x + \frac{11}{2} = \pm \sqrt{\frac{25}{4}}$$

$$x = -\frac{11}{2} \pm \frac{5}{2}$$

$$x_1 = \frac{-11+5}{2} = \frac{-6}{2} = -3$$

$$x_2 = \frac{-11-5}{2} = \frac{-16}{2} = -8$$

$$4. x^2=16x-63$$

$$x^2-16x=-63$$

$$x^2-16x+64=64-63$$

$$(x-8)^2=1$$

$$x-8=\pm 1$$

$$x=8\pm 1$$

$$x_1=8+1=9$$

$$x_2=8-1=7$$

$$5. 12x-4-9x^2=0$$

$$-9x^2+12x=4$$

$$9x^2-12x=-4$$

$$x^2 - \frac{12x}{9} = -\frac{4}{9}$$

$$x^2 - \frac{4x}{3} + \frac{4}{9} = \frac{4}{9} - \frac{4}{9}$$

$$\left(x - \frac{2}{3}\right)^2 = 0$$

$$x - \frac{2}{3} = 0$$

$$x_1 = x_2 = \frac{2}{3}$$

$$6. 5x^2 - 7x - 90 = 0$$

$$x = \frac{7 \pm \sqrt{7^2 - 4(5)(-90)}}{2(5)}$$

$$x = \frac{7 \pm \sqrt{49 + 1.800}}{10}$$

$$x = \frac{7 \pm \sqrt{1.849}}{10} = \frac{7 \pm 43}{10}$$

$$x_1 = \frac{7 + 43}{10} = \frac{50}{10} = 5$$

$$x_2 = \frac{7 - 43}{10} = -\frac{36}{10} = -3\frac{3}{5}$$

$$7. 6x^2 = x + 222$$

$$6x^2 - x - 222 = 0$$

$$x = \frac{1 \pm \sqrt{1^2 + 4(6)(222)}}{2(6)}$$

$$x = \frac{1 \pm \sqrt{5.329}}{12}$$

$$x = \frac{1 \pm 73}{12}$$

$$x_1 = \frac{1 + 73}{12} = \frac{74}{12} = 6\frac{1}{6}$$

$$x_2 = \frac{1 - 73}{12} = \frac{-72}{12} = -6$$

$$8. x + 11 = 10x^2$$

$$10x^2 - x - 11 = 0$$

$$x = \frac{1 \pm \sqrt{1^2 - 4(10)(-11)}}{2(10)}$$

$$x = \frac{1 \pm \sqrt{1 + 440}}{20}$$

$$x = \frac{1 \pm 21}{20}$$

$$x_1 = \frac{1 + 21}{20} = \frac{22}{20} = 1\frac{1}{10}$$

$$x_2 = \frac{1 - 21}{20} = \frac{-20}{20} = -1$$

$$9. 49x^2 - 70x + 25 = 0$$

$$x = \frac{70 \pm \sqrt{(70)^2 - 4(49)(25)}}{2(49)}$$

$$x = \frac{70 \pm \sqrt{4.900 - 4.900}}{98}$$

$$x_1 = x_2 = \frac{70}{98} = \frac{5}{7}$$

$$10. 12x - 7x^2 + 64 = 0$$

$$-7x^2 + 12x + 64 = 0$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(-7)(64)}}{2(-7)}$$

$$x = \frac{-12 \pm \sqrt{144 + 1.792}}{-14}$$

$$x = \frac{-12 \pm \sqrt{1.936}}{-14}$$

$$x = \frac{-12 \pm 44}{-14}$$

$$x_1 = \frac{-12 + 44}{-14} = -\frac{32}{14} = -2\frac{2}{7}$$

$$x_2 = \frac{-12 - 44}{-14} = \frac{-56}{-14} = 4$$

$$11. x^2 = 15x - 56$$

$$x^2 + 15x + 56 = 0$$

$$x = \frac{-15 \pm \sqrt{(15)^2 - 4(1)(56)}}{2(1)}$$

$$x = \frac{-15 \pm \sqrt{225 - 224}}{2}$$

$$x = \frac{-15 \pm 1}{2}$$

$$x_1 = \frac{-15 + 1}{2} = \frac{-14}{2} = -7$$

$$x_2 = \frac{-15 - 1}{2} = \frac{-16}{2} = -8$$

$$12. 32x^2 + 18x - 17 = 0$$

$$x = \frac{-18 \pm \sqrt{(18)^2 - 4(32)(-17)}}{2(32)}$$

$$x = \frac{-18 \pm \sqrt{324 + 2.176}}{64}$$

$$x = \frac{-18 \pm \sqrt{2.500}}{64}$$

$$x = \frac{-18 \pm 50}{64}$$

$$x_1 = \frac{-18 + 50}{64} = \frac{32}{64} = \frac{1}{2}$$

$$x_2 = \frac{-18 - 50}{64} = \frac{-68}{64} = -1\frac{1}{16}$$

$$13. 176x = 121 + 64x^2$$

$$64x^2 - 176x + 121 = 0$$

$$x = \frac{176 \pm \sqrt{(176)^2 - 4(64)(121)}}{2(64)}$$

$$= \frac{176 \pm \sqrt{30.976 - 30.976}}{128}$$

$$x_1 = x_2 = \frac{176}{128} = 1\frac{3}{8}$$

$$14. 8x + 5 = 36x^2$$

$$-36x^2 + 8x + 5 = 0$$

$$x = \frac{-8 \pm \sqrt{(8)^2 - 4(-36)(5)}}{2(-36)}$$

$$x = \frac{-8 \pm \sqrt{64 + 720}}{-72}$$

$$x = \frac{-8 \pm \sqrt{784}}{-72}$$

$$x = \frac{-8 \pm 28}{-72}$$

$$x_1 = \frac{-8 + 28}{-72} = -\frac{20}{72} = -\frac{5}{18}$$

$$x_2 = \frac{-8 - 28}{-72} = \frac{-36}{-72} = \frac{1}{2}$$

$$15. 27x^2 + 12x - 7 = 0$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(27)(-7)}}{2(27)}$$

$$x = \frac{-12 \pm \sqrt{144 + 756}}{54}$$

$$x = \frac{-12 \pm \sqrt{900}}{54}$$

$$x_1 = \frac{-12 + 30}{54} = \frac{18}{54} = \frac{1}{3}$$

$$x_2 = \frac{-12 - 30}{54} = \frac{-42}{54} = -\frac{7}{9}$$

$$\begin{aligned}
 16. \quad & 15x = 25x^2 + 2 \\
 & 25x^2 - 15x + 2 = 0 \\
 & x = \frac{15 \pm \sqrt{(15)^2 - 4(25)(2)}}{2(25)} \\
 & x = \frac{15 \pm \sqrt{225 - 200}}{50} \\
 & x = \frac{15 \pm \sqrt{25}}{50} \\
 & x_1 = \frac{15+5}{50} = \frac{20}{50} = \frac{2}{5} \\
 & x_2 = \frac{15-5}{50} = \frac{10}{50} = \frac{1}{5}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & 8x^2 - 2x - 3 = 0 \\
 & x = \frac{2 \pm \sqrt{(2)^2 - 4(8)(-3)}}{2(8)} \\
 & x = \frac{2 \pm \sqrt{4+96}}{16} \\
 & x = \frac{2 \pm \sqrt{100}}{16} \\
 & x = \frac{2 \pm 10}{16} \\
 & x_1 = \frac{2+10}{16} = \frac{12}{16} = \frac{3}{4} \\
 & x_2 = \frac{2-10}{16} = \frac{-8}{16} = -\frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad & 105 = 2x^2 + x \\
 & 2x^2 + x - 105 = 0 \\
 & x = \frac{-1 \pm \sqrt{(1)^2 - 4(2)(-105)}}{2(2)} \\
 & x = \frac{-1 \pm \sqrt{1+840}}{4} \\
 & x = \frac{-1 \pm \sqrt{841}}{4} \\
 & x = \frac{-1 \pm 29}{4} \\
 & x_1 = \frac{-1+29}{4} = \frac{28}{4} = 7 \\
 & x_2 = \frac{-1-29}{4} = \frac{-30}{4} = -7\frac{1}{2}
 \end{aligned}$$

## EJERCICIO 266

$$\begin{aligned}
 1. \quad & x(x+3) = 5x+3 \\
 & x^2 + 3x = 5x+3 \\
 & x^2 + 3x - 5x - 3 = 0 \\
 & x^2 - 2x - 3 = 0 \\
 & x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-3)}}{2(1)} \\
 & x = \frac{2 \pm \sqrt{4+12}}{2} \\
 & x = \frac{2 \pm 4}{2} \\
 & x_1 = \frac{2+4}{2} = \frac{6}{2} = 3 \\
 & x_2 = \frac{2-4}{2} = \frac{-2}{2} = -1
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 3(3x-2) = (x+4)(4-x) \\
 & 9x-6 = -x^2+16 \\
 & x^2+9x-22=0 \\
 & x = \frac{-9 \pm \sqrt{(9)^2 - 4(1)(-22)}}{2(1)} \\
 & x = \frac{9 \pm \sqrt{169}}{2} \\
 & x_1 = \frac{-9+13}{2} = \frac{4}{2} = 2 \\
 & x_2 = \frac{-9-13}{2} = \frac{-22}{2} = -11
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 9x+1 = 3(x^2-5) - (x-3)(x+2) \\
 & 9x+1 = 3x^2-15-x^2+x+6 \\
 & 9x+1 = 2x^2+x-9 \\
 & 0 = 2x^2-8x-10 \\
 & x = \frac{8 \pm \sqrt{(-8)^2 - 4(2)(-10)}}{2(2)} \\
 & x = \frac{8 \pm \sqrt{64+80}}{4} \\
 & x = \frac{8 \pm 12}{4} \\
 & x_1 = \frac{8+12}{4} = \frac{20}{4} = 5 \\
 & x_2 = \frac{8-12}{4} = \frac{-4}{4} = -1
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & (2x-3)^2 - (x+5)^2 = -23 \\
 & 4x^2 - 12x + 9 - x^2 - 10x - 25 + 23 = 0 \\
 & 3x^2 - 22x + 7 = 0 \\
 & x = \frac{22 \pm \sqrt{(22)^2 - 4(3)(7)}}{2(3)} \\
 & x = \frac{22 \pm \sqrt{400}}{6} \\
 & x = \frac{22 \pm 20}{6} \\
 & x_1 = \frac{22+20}{6} = \frac{42}{6} = 7 \\
 & x_2 = \frac{22-20}{6} = \frac{2}{6} = \frac{1}{3}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & 25(x+2)^2 = (x-7)^2 - 81 \\
 & 25x^2 + 100x + 100 = x^2 - 14x + 49 - 81 \\
 & 24x^2 + 114x + 132 = 0 \\
 & 4x^2 + 19x + 22 = 0 \\
 & x = \frac{-19 \pm \sqrt{(19)^2 - 4(4)(22)}}{2(4)} \\
 & x = \frac{-19 \pm \sqrt{361-352}}{8} \\
 & x = \frac{-19 \pm 3}{8} \\
 & x_1 = \frac{-19+3}{8} = \frac{-16}{8} = -2 \\
 & x_2 = \frac{-19-3}{8} = \frac{-22}{8} = -2\frac{3}{4}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad & 3x(x-2) - (x-6) = 23(x-3) \\
 & 3x^2 - 6x - x + 6 = 23x - 69 \\
 & 3x^2 - 30x + 75 = 0 \\
 & x^2 - 10x + 25 = 0 \\
 & x = \frac{10 \pm \sqrt{(-10)^2 - 4(1)(25)}}{2(1)} \\
 & x = \frac{10 \pm \sqrt{100-100}}{2} \\
 & x_1 = x_2 = \frac{10}{2} = 5
 \end{aligned}$$

$$7. 7(x-3) - 5(x^2-1) = x^2 - 5x(x+2)$$

$$7x - 21 - 5x^2 + 5 = x^2 - 5x^2 - 10x$$

$$7x - 16 - 5x^2 = -4x^2 - 10x$$

$$-x^2 + 17x - 16 = 0$$

$$x = \frac{-17 \pm \sqrt{(17)^2 - 4(-1)(-16)}}{2(-1)}$$

$$x = \frac{-17 \pm \sqrt{225}}{-2}$$

$$x = \frac{-17 \pm 15}{-2}$$

$$x_1 = \frac{-17+15}{-2} = \frac{-2}{-2} = 1$$

$$x_2 = \frac{-17-15}{-2} = \frac{-32}{-2} = 16$$

$$8. (x-5)^2 - (x-6)^2 = (2x-3)^2 - 118$$

$$x^2 - 10x + 25 - x^2 + 12x - 36 = 4x^2 - 12x + 9 - 118$$

$$2x - 11 = 4x^2 - 12x - 109$$

$$4x^2 - 14x - 98 = 0$$

$$2x^2 - 7x - 49 = 0$$

$$x = \frac{7 \pm \sqrt{(-7)^2 - 4(2)(-49)}}{2(2)}$$

$$x = \frac{7 \pm \sqrt{441}}{4}$$

$$x_1 = \frac{7+21}{4} = \frac{28}{4} = 7$$

$$x_2 = \frac{7-21}{4} = \frac{-14}{4} = -3\frac{1}{2}$$

$$9. (5x-2)^2 - (3x+1)^2 - x^2 - 60 = 0$$

$$25x^2 - 20x + 4 - 9x^2 - 6x - 1 - x^2 - 60 = 0$$

$$15x^2 - 26x - 57 = 0$$

$$x = \frac{26 \pm \sqrt{(-26)^2 - 4(15)(-57)}}{2(15)}$$

$$x = \frac{26 \pm \sqrt{676 + 3.420}}{30}$$

$$x = \frac{26 \pm 64}{30}$$

$$x_1 = \frac{26+64}{30} = \frac{90}{30} = 3$$

$$x_2 = \frac{26-64}{30} = \frac{-38}{30} = -1\frac{4}{15}$$

$$10. (x+4)^3 - (x-3)^3 = 343$$

$$x^3 + 12x^2 + 48x + 64 - x^3 + 9x^2 - 27x + 27 - 343 = 0$$

$$21x^2 + 21x - 252 = 0$$

$$-x^2 - x + 12 = 0$$

$$x = \frac{1 \pm \sqrt{(-1)^2 - 4(-1)(12)}}{2(-1)}$$

$$x = \frac{1 \pm \sqrt{49}}{-2}$$

$$x = \frac{1 \pm 7}{-2}$$

$$x_1 = \frac{1+7}{-2} = \frac{8}{-2} = -4$$

$$x_2 = \frac{1-7}{-2} = \frac{-6}{-2} = 3$$

$$11. (x+2)^3 - (x-1)^3 = x(3x+4) + 8$$

$$x^3 + 6x^2 + 12x + 8 - x^3 + 3x^2 - 3x + 1 = 3x^2 + 4x + 8$$

$$6x^2 + 5x + 1 = 0$$

$$x = \frac{-5 \pm \sqrt{(5)^2 - 4(6)(1)}}{2(6)}$$

$$x = \frac{-5 \pm \sqrt{25 - 24}}{12}$$

$$x_1 = \frac{-5+1}{12} = \frac{-4}{12} = -\frac{1}{3}$$

$$x_2 = \frac{-5-1}{12} = \frac{-6}{12} = -\frac{1}{2}$$

$$12. (5x-4)^2 - (3x+5)(2x-1) = 20x(x-2) + 27$$

$$25x^2 - 40x + 16 - 6x^2 - 7x + 5 = 20x^2 - 40x + 27$$

$$19x^2 - 47x + 21 = 20x^2 - 40x + 27$$

$$-x^2 - 7x - 6 = 0$$

$$x = \frac{7 \pm \sqrt{(-7)^2 - 4(-1)(-6)}}{2(-1)}$$

$$x = \frac{7 \pm \sqrt{49 - 24}}{-2}$$

$$x = \frac{7 \pm \sqrt{25}}{-2}$$

$$x_1 = \frac{7+5}{-2} = \frac{12}{-2} = -6$$

$$x_2 = \frac{7-5}{-2} = \frac{2}{-2} = -1$$



## EJERCICIO 267

1.  $x^2 - 3x + 2 = 0$

$$x = -\frac{(-3)}{2} \pm \sqrt{\frac{(-3)^2}{4} - 2}$$

$$x = \frac{3}{2} \pm \sqrt{\frac{9}{4} - 2}$$

$$x = \frac{3}{2} \pm \sqrt{\frac{1}{4}}$$

$$x_1 = \frac{3}{2} + \frac{1}{2} = \frac{4}{2} = 2$$

$$x_2 = \frac{3}{2} - \frac{1}{2} = \frac{2}{2} = 1$$

2.  $x^2 - 2x - 15 = 0$

$$x = -\frac{(-2)}{2} \pm \sqrt{\frac{(-2)^2}{4} - (-15)}$$

$$x = 1 \pm \sqrt{1+15}$$

$$x = 1 \pm 4$$

$$x_1 = 1 + 4 = 5$$

$$x_2 = 1 - 4 = -3$$

3.  $x^2 = 19x - 88$

$$x^2 - 19x + 88 = 0$$

$$x = -\frac{(-19)}{2} \pm \sqrt{\frac{(-19)^2}{4} - 88}$$

$$x = \frac{19}{2} \pm \sqrt{\frac{361}{4} - 88}$$

$$x = \frac{19}{2} \pm \sqrt{\frac{9}{4}}$$

$$x_1 = \frac{19}{2} + \frac{3}{2} = \frac{22}{2} = 11$$

$$x_2 = \frac{19}{2} - \frac{3}{2} = \frac{16}{2} = 8$$

4.  $x^2 + 4x = 285$

$$x^2 + 4x - 285 = 0$$

$$x = -\frac{4}{2} \pm \sqrt{\frac{(4)^2}{4} - (-285)}$$

$$x = -2 \pm \sqrt{4+285}$$

$$x = -2 \pm \sqrt{289}$$

$$x_1 = -2 + 17 = 15$$

$$x_2 = -2 - 17 = -19$$

5.  $5x(x-1) - 2(2x^2 - 7x) = -8$

$$5x^2 - 5x - 4x^2 + 14x + 8 = 0$$

$$x^2 + 9x + 8 = 0$$

$$x = -\frac{9}{2} \pm \sqrt{\frac{(9)^2}{4} - 8}$$

$$x = -\frac{9}{2} \pm \sqrt{\frac{81}{4} - 8}$$

$$x = -\frac{9}{2} \pm \sqrt{\frac{49}{4}}$$

$$x_1 = -\frac{9}{2} + \frac{7}{2} = \frac{-2}{2} = -1$$

$$x_2 = -\frac{9}{2} - \frac{7}{2} = \frac{-16}{2} = -8$$

6.  $x^2 - (7x+6) = x+59$

$$x^2 - 7x - 6 - x - 59 = 0$$

$$x^2 - 8x - 65 = 0$$

$$x = -\frac{(-8)}{2} \pm \sqrt{\frac{(-8)^2}{4} - (-65)}$$

$$x = 4 \pm \sqrt{16+65}$$

$$x = 4 \pm 9$$

$$x_1 = 4 + 9 = 13$$

$$x_2 = 4 - 9 = -5$$

7.  $(x-1)^2 + 11x + 199 = 3x^2 - (x-2)^2$

$$x^2 - 2x + 1 + 11x + 199 = 3x^2 - x^2 + 4x - 4$$

$$x^2 + 9x + 200 = 2x^2 + 4x - 4$$

$$x^2 - 5x - 204 = 0$$

$$x = -\frac{(-5)}{2} \pm \sqrt{\frac{(5)^2}{4} - (-204)}$$

$$x = \frac{5}{2} \pm \sqrt{\frac{25}{4} + 204}$$

$$x = \frac{5}{2} \pm \sqrt{\frac{841}{4}}$$

$$x_1 = \frac{5}{2} + \frac{29}{2} = \frac{34}{2} = 17$$

$$x_2 = \frac{5}{2} - \frac{29}{2} = \frac{-24}{2} = -12$$

8.  $(x-2)(x+2) - 7(x-1) = 21$

$$x^2 - 4 - 7x + 7 - 21 = 0$$

$$x^2 - 7x - 18 = 0$$

$$x = -\frac{(-7)}{2} \pm \sqrt{\frac{(-7)^2}{4} - (-18)}$$

$$x = \frac{7}{2} \pm \sqrt{\frac{49}{4} + 18}$$

$$x = \frac{7}{2} \pm \sqrt{\frac{121}{4}}$$

$$x_1 = \frac{7}{2} + \frac{11}{2} = \frac{18}{2} = 9$$

$$x_2 = \frac{7}{2} - \frac{11}{2} = \frac{-4}{2} = -2$$

9.  $2x^2 - (x-2)(x+5) = 7(x+3)$

$$2x^2 - x^2 - 3x + 10 = 7x + 21$$

$$x^2 - 10x - 11 = 0$$

$$x = -\frac{(-10)}{2} \pm \sqrt{\frac{(-10)^2}{4} - (-11)}$$

$$x = 5 \pm \sqrt{25+11}$$

$$x = 5 \pm \sqrt{36}$$

$$x_1 = 5 + 6 = 11$$

$$x_2 = 5 - 6 = -1$$

10.  $(x-1)(x+2) - (2x-3)(x+4) - x + 14 = 0$

$$x^2 + x - 2 - 2x^2 - 5x + 12 - x + 14 = 0$$

$$-x^2 - 5x + 24 = 0$$

$$x^2 + 5x - 24 = 0$$

$$x = -\frac{5}{2} \pm \sqrt{\frac{(5)^2}{4} - (-24)}$$

$$x = -\frac{5}{2} \pm \sqrt{\frac{25}{4} + 24}$$

$$x = -\frac{5}{2} \pm \sqrt{\frac{121}{4}}$$

$$x_1 = -\frac{5}{2} + \frac{11}{2} = \frac{6}{2} = 3$$

$$x_2 = -\frac{5}{2} - \frac{11}{2} = \frac{-16}{2} = -8$$

## EJERCICIO 268

1.  $\frac{x^2}{5} - \frac{x}{2} = \frac{3}{10}$   $mcm=10$

$$2x^2 - 5x - 3 = 0$$

$$2x^2 - 5x - 3 = 0$$

$$x = \frac{5 \pm \sqrt{(-5)^2 - 4(2)(-3)}}{2(2)}$$

$$x = \frac{5 \pm \sqrt{25+24}}{4}$$

$$x = \frac{5 \pm 7}{4}$$

$$x_1 = \frac{5+7}{4} = \frac{12}{4} = 3$$

$$x_2 = \frac{5-7}{4} = \frac{-2}{4} = -\frac{1}{2}$$

2.  $4x - \frac{13}{x} = \frac{3}{2}$   $mcm=2x$

$$8x^2 - 26 = 3x$$

$$8x^2 - 3x - 26 = 0$$

$$x = \frac{3 \pm \sqrt{(-3)^2 - 4(8)(-26)}}{2(8)}$$

$$x = \frac{3 \pm \sqrt{9+832}}{16}$$

$$x = \frac{3 \pm 29}{16}$$

$$x_1 = \frac{3+29}{16} = \frac{32}{16} = 2$$

$$x_2 = \frac{3-29}{16} = \frac{-26}{16} = -1\frac{5}{8}$$

3.  $\frac{x^2}{6} - \frac{x}{2} = 3(x-5)$   $mcm=6$

$$x^2 - 3x = 18(x-5)$$

$$x^2 - 3x = 18x - 90$$

$$x^2 - 21x + 90 = 0$$

$$x = -\frac{(-21)}{2} \pm \sqrt{\frac{(-21)^2}{4} - 90}$$

$$x = \frac{21}{2} \pm \sqrt{\frac{81}{4}}$$

$$x_1 = \frac{21}{2} + \frac{9}{2} = \frac{30}{2} = 15$$

$$x_2 = \frac{21}{2} - \frac{9}{2} = \frac{12}{2} = 6$$

4.  $\frac{1}{4}(x-4) + \frac{2}{5}(x-5) = \frac{1}{5}(x^2 - 53)$

$$mcm=20$$

$$5(x-4) + 8(x-5) = 4(x^2 - 53)$$

$$5x - 20 + 8x - 40 - 4x^2 + 212 = 0$$

$$-4x^2 + 13x + 152 = 0$$

$$x = \frac{-13 \pm \sqrt{(13)^2 - 4(-4)(152)}}{2(-4)}$$

$$x = \frac{-13 \pm \sqrt{169 + 2.432}}{-8}$$

$$x = \frac{-13 \pm 51}{8}$$

$$x_1 = \frac{-13+51}{8} = \frac{38}{8} = -4\frac{3}{4}$$

$$x_2 = \frac{-13-51}{-8} = \frac{-64}{-8} = 8$$

5.  $\frac{5}{x} - \frac{1}{x+2} = 1$   $mcm=x+2$

$$5\left(1 + \frac{2}{x}\right) - 1 = x + 2 \quad mcm=x$$

$$5x + 10 - x = x^2 + 2x$$

$$x^2 - 2x - 10 = 0$$

$$x = -\frac{(-2)}{2} \pm \sqrt{\frac{(-2)^2}{4} - (-10)}$$

$$x = 1 \pm \sqrt{1+10}$$

$$x = 1 \pm \sqrt{11}$$

$$x_1 = 1 + \sqrt{11}$$

$$x_2 = 1 - \sqrt{11}$$

6.  $\frac{15}{x} - \frac{11x+5}{x^2} = -1$   $mcm=x^2$

$$15x - (11x+5) = -x^2$$

$$x^2 + 4x - 5 = 0$$

$$x = -\frac{4}{2} \pm \sqrt{\frac{(4)^2}{4} - (-5)}$$

$$x = -2 \pm \sqrt{4+5}$$

$$x = -2 \pm 3$$

$$x_1 = -2 + 3 = 1$$

$$x_2 = -2 - 3 = -5$$

7.  $\frac{8x}{3x+5} + \frac{5x-1}{x+1} = 3$   $mcm=(3x+5)(x+1)$

$$8x(x+1) + (5x-1)(3x+5) = 3(3x+5)(x+1)$$

$$8x^2 + 8x + 15x^2 + 22x - 5 = 9x^2 + 24x + 15$$

$$23x^2 + 30x - 5 = 9x^2 + 24x + 15$$

$$14x^2 + 6x - 20 = 0$$

$$x = \frac{-6 \pm \sqrt{(6)^2 - 4(14)(-20)}}{2(14)}$$

$$x = \frac{-6 \pm \sqrt{1.156}}{28} = \frac{-6 \pm 34}{28}$$

$$x_1 = \frac{-6+34}{28} = \frac{28}{28} = 1$$

$$x_2 = \frac{-6-34}{28} = \frac{-40}{28} = -1\frac{3}{7}$$

8.  $\frac{1}{x-2} - \frac{1}{x-1} = \frac{1}{6}$

$$mcm=6(x-2)(x-1)$$

$$6(x-1) - 6(x-2) = (x-2)(x-1)$$

$$6x - 6 - 6x + 12 = x^2 - 3x + 2$$

$$6 = x^2 - 3x + 2$$

$$0 = x^2 - 3x - 4$$

$$x = -\frac{(-3)}{2} \pm \sqrt{\frac{(-3)^2}{4} - (-4)}$$

$$x = \frac{3}{2} \pm \sqrt{\frac{9}{4} + 4}$$

$$x = \frac{3}{2} \pm \sqrt{\frac{25}{4}} = \frac{3}{2} \pm \frac{5}{2}$$

$$x_1 = \frac{3}{2} + \frac{5}{2} = \frac{8}{2} = 4$$

$$x_2 = \frac{3}{2} - \frac{5}{2} = \frac{-2}{2} = -1$$

9.  $1 - \frac{2x-3}{x+5} = \frac{x-2}{10}$   $mcm=10(x+5)$

$$10(x+5) - 10(2x-3) = (x+5)(x-2)$$

$$10x + 50 - 20x + 30 = x^2 + 3x - 10$$

$$-10x + 80 = x^2 + 3x - 10$$

$$0 = x^2 + 13x - 90$$

$$x = -\frac{13}{2} \pm \sqrt{\frac{(13)^2}{4} - (-90)}$$

**Continúa**

## 9. Continuación

$$x = -\frac{13}{2} \pm \sqrt{\frac{169}{4} + 90}$$

$$x = -\frac{13}{2} \pm \sqrt{\frac{529}{4}}$$

$$x = \frac{-13}{2} \pm \frac{23}{2}$$

$$x_1 = \frac{-13}{2} + \frac{23}{2} = \frac{10}{2} = 5$$

$$x_2 = \frac{-13}{2} - \frac{23}{2} = \frac{-36}{2} = -18$$

10.  $\frac{x-13}{x} = 5 - \frac{10(5x+3)}{x^2}$   $mcm = x^2$

$$x(x-13) = 5x^2 - 10(5x+3)$$

$$x^2 - 13x = 5x^2 - 50x - 30$$

$$-4x^2 + 37x + 30 = 0$$

$$x = \frac{-37 \pm \sqrt{(37)^2 - 4(-4)(30)}}{2(-4)}$$

$$x = \frac{-37 \pm \sqrt{1.369 + 480}}{-8}$$

$$x = \frac{37 \pm \sqrt{1.849}}{-8}$$

$$x = \frac{-37 \pm 43}{-8}$$

$$x_1 = \frac{-37 + 43}{-8} = \frac{6}{-8} = -\frac{3}{4}$$

$$x_2 = \frac{-37 - 43}{-8} = \frac{-80}{-8} = 10$$

11.  $\frac{x}{x-2} - \frac{x-2}{x} = \frac{5}{2}$   $mcm = 2x(x-2)$

$$2x(x) - 2(x-2)(x-2) = 5x(x-2)$$

$$2x^2 - 2(x^2 - 4x + 4) = 5x^2 - 10x$$

$$2x^2 - 2x^2 + 8x - 8 = 5x^2 - 10x$$

$$0 = 5x^2 - 18x + 8$$

$$x = \frac{-(-18) \pm \sqrt{(-18)^2 - 4(5)(8)}}{2(5)}$$

$$x = \frac{18 \pm \sqrt{324 - 160}}{10}$$

$$x = \frac{18 \pm \sqrt{164}}{10}$$

$$x = \frac{18 \pm \sqrt{2^2 \cdot 41}}{10} = \frac{18 \pm 2\sqrt{41}}{10} = \frac{9 \pm \sqrt{41}}{5}$$

$$x_1 = \frac{9 + \sqrt{41}}{5} ; x_2 = \frac{9 - \sqrt{41}}{5}$$

12.  $\frac{4x^2}{x-1} - \frac{1-3x}{4} = \frac{20x}{3}$   $mcm = 12(x-1)$

$$12(4x^2) - 3(x-1)(1-3x) = 4(x-1)(20x)$$

$$48x^2 + 9x^2 - 12x + 3 = 80x^2 - 80x$$

$$-23x^2 + 68x + 3 = 0$$

$$x = \frac{-68 \pm \sqrt{(68)^2 - 4(-23)(3)}}{2(-23)}$$

$$x = \frac{-68 \pm \sqrt{4.624 + 276}}{-46} = \frac{-68 \pm \sqrt{4.900}}{-46} = \frac{-68 \pm 70}{-46}$$

$$x_1 = \frac{-68 + 70}{-46} = \frac{2}{-46} = -\frac{1}{23} ; x_2 = \frac{-68 - 70}{-46} = \frac{-138}{-46} = 3$$

13.  $\frac{3x-1}{x} - \frac{2x}{2x-1} - \frac{7}{6} = 0$   $mcm = 6x(2x-1)$

$$6(2x-1)(3x-1) - 6x(2x) - 7x(2x-1) = 0$$

$$6(6x^2 - 5x + 1) - 12x^2 - 14x^2 + 7x = 0$$

$$36x^2 - 30x + 6 - 12x^2 - 14x^2 + 7x = 0$$

$$10x^2 - 23x + 6 = 0$$

$$x = \frac{23 \pm \sqrt{(23)^2 - 4(10)(6)}}{2(10)}$$

$$x = \frac{23 \pm \sqrt{529 - 240}}{20} = \frac{23 \pm \sqrt{289}}{20} = \frac{23 \pm 17}{20}$$

$$x_1 = \frac{23 + 17}{20} = \frac{40}{20} = 2 ; x_2 = \frac{23 - 17}{20} = \frac{6}{20} = \frac{3}{10}$$

14.  $\frac{5x-8}{x-1} = \frac{7x-4}{x+2}$

$$(x+2)(5x-8) = (7x-4)(x-1)$$

$$5x^2 + 2x - 16 = 7x^2 - 11x + 4$$

$$0 = 2x^2 - 13x + 20$$

$$x = \frac{13 \pm \sqrt{(13)^2 - 4(2)(20)}}{2(2)}$$

$$x = \frac{13 \pm \sqrt{169 - 160}}{4} = \frac{13 \pm \sqrt{9}}{4} = \frac{13 \pm 3}{4}$$

$$x_1 = \frac{13 + 3}{4} = \frac{16}{4} = 4 ; x_2 = \frac{13 - 3}{4} = \frac{10}{4} = \frac{5}{2} = 2\frac{1}{2}$$

$$15. \frac{x+3}{2x-1} - \frac{5x-1}{4x+7} = 0$$

$$mcm = (2x-1)(4x+7)$$

$$(x+3)(4x+7) - (5x-1)(2x-1) = 0$$

$$4x^2 + 19x + 21 - 10x^2 + 7x - 1 = 0$$

$$-6x^2 + 26x + 20 = 0$$

$$3x^2 - 13x - 10 = 0$$

$$x = \frac{13 \pm \sqrt{(-13)^2 - 4(3)(-10)}}{2(3)}$$

$$x = \frac{13 \pm \sqrt{169+120}}{6} = \frac{13 \pm \sqrt{289}}{6} = \frac{13 \pm 17}{6}$$

$$x_1 = \frac{13+17}{6} = \frac{30}{6} = 5 ; x_2 = \frac{13-17}{6} = \frac{-4}{6} = -\frac{2}{3}$$

$$16. \frac{1}{4-x} - \frac{1}{6} = \frac{1}{x+1}$$

$$mcm = 6(4-x)(x+1)$$

$$6(x+1) - (4-x)(x+1) = 6(4-x)$$

$$6x + 6 + x^2 - 3x - 4 = 24 - 6x$$

$$x^2 + 3x + 2 = 24 - 6x$$

$$x^2 + 9x - 22 = 0$$

$$x = -\frac{9}{2} \pm \sqrt{\frac{(9)^2}{4} - (-22)}$$

$$x = -\frac{9}{2} \pm \sqrt{\frac{81}{4} + 22} = -\frac{9}{2} \pm \sqrt{\frac{169}{4}} = \frac{-9}{2} \pm \frac{13}{2}$$

$$x_1 = \frac{-9}{2} + \frac{13}{2} = \frac{4}{2} = 2 ; x_2 = \frac{-9}{2} - \frac{13}{2} = \frac{-22}{2} = -11$$

$$17. \frac{x+4}{x+5} - \frac{x+2}{x+3} = \frac{1}{24} \quad mcm = 24(x+5)(x+3)$$

$$24(x+3)(x+4) - 24(x+2)(x+5) = (x+5)(x+3)$$

$$24x^2 + 168x + 288 - 24x^2 - 168x - 240 = x^2 + 8x + 15$$

$$48 = x^2 + 8x + 15$$

$$0 = x^2 + 8x - 33$$

$$x = -\frac{8}{2} \pm \sqrt{\frac{(8)^2}{4} - (-33)}$$

$$x = -4 \pm \sqrt{16+33} = -4 \pm \sqrt{49} = -4 \pm 7$$

$$x_1 = -4+7=3 ; x_2 = -4-7=-11$$

$$18. \frac{5}{x^2-1} - \frac{6}{x+1} = 3\frac{5}{8} \quad mcm = 8(x^2-1)$$

$$40 - 48(x-1) = 29(x^2-1)$$

$$40 - 48x + 48 = 29x^2 - 29$$

$$-29x^2 - 48x + 117 = 0$$

$$x = \frac{-(-48) \pm \sqrt{(-48)^2 - 4(-29)(117)}}{2(-29)}$$

$$x = \frac{48 \pm \sqrt{2.304+13.572}}{-58} = \frac{48 \pm 126}{-58}$$

$$x_1 = \frac{48+126}{-58} = \frac{174}{-58} = -3 ; x_2 = \frac{48-126}{-58} = \frac{-78}{-58} = 1\frac{10}{29}$$

$$19. \frac{x-1}{x+1} + \frac{x+1}{x-1} = \frac{2x+9}{x+3} \quad mcm = (x+1)(x-1)(x+3)$$

$$(x-1)(x-1)(x+3) + (x+1)(x+1)(x+3) = (2x+9)(x+1)(x-1)$$

$$(x^2 - 2x + 1)(x+3) + (x^2 + 2x + 1)(x+3) = (2x+9)(x^2 - 1)$$

$$x^3 + 3x^2 - 2x^2 - 6x + x + 3 + x^3 + 3x^2 + 2x^2 + 6x + x + 3 = 2x^3 - 2x + 9x^2 - 9$$

$$2x^3 + 6x^2 + 2x + 6 = 2x^3 + 9x^2 - 2x - 9$$

$$0 = 3x^2 - 4x - 15$$

$$x = \frac{4 \pm \sqrt{(4)^2 - 4(3)(-15)}}{2(3)}$$

$$x = \frac{4 \pm \sqrt{16+180}}{6} = \frac{4 \pm \sqrt{196}}{6} = \frac{4 \pm 14}{6}$$

$$x_1 = \frac{4+14}{6} = \frac{18}{6} = 3 ; x_2 = \frac{4-14}{6} = \frac{-10}{6} = -1\frac{2}{3}$$

$$20. \frac{3}{x+2} - \frac{1}{x-2} = \frac{1}{x+1} \quad mcm = (x+2)(x-2)(x+1)$$

$$3(x-2)(x+1) - (x+2)(x+1) = (x+2)(x-2)$$

$$3x^2 - 3x - 6 - x^2 - 3x - 2 = x^2 - 4$$

$$2x^2 - 6x - 8 = x^2 - 4$$

$$x^2 - 6x - 4 = 0$$

$$x = -\frac{(-6)}{2} \pm \sqrt{\frac{(-6)^2}{4} - (-4)} = 3 \pm \sqrt{9+4} = 3 \pm \sqrt{13}$$

$$x_1 = 3 + \sqrt{13} ; x_2 = 3 - \sqrt{13}$$

## EJERCICIO 269

1.  $x^2 - x - 6 = 0$   
 $(x-3)(x+2) = 0$   
 $x_1 = 3 \quad x_2 = -2$
2.  $x^2 + 7x = 18$   
 $x^2 + 7x - 18 = 0$   
 $(x+9)(x-2) = 0$   
 $x_1 = -9 \quad x_2 = 2$
3.  $8x - 65 = -x^2$   
 $x^2 + 8x - 65 = 0$   
 $(x+13)(x-5) = 0$   
 $x_1 = -13 \quad x_2 = 5$
4.  $x^2 = 108 - 3x$   
 $x^2 + 3x - 108 = 0$   
 108 2  
 $54 \left| \begin{array}{l} 2 \quad 2^2 \cdot 3 - 3^2 \\ 27 \quad 3 \quad 12 - 9 = 3 \\ 9 \quad 3 \\ 3 \quad 3 \\ 1 \end{array} \right.$   
 $(x+12)(x-9) = 0$   
 $x_1 = -12 \quad x_2 = 9$
5.  $2x^2 + 7x - 4 = 0$   
 $(2x)^2 + 7(2x) - 8 = 0$   
 $\frac{(2x+8)(2x-1)}{2} = 0$   
 $(x+4)(2x-1) = 0$   
 $x+4=0 \quad 2x-1=0$   
 $x_1 = -4 \quad x_2 = \frac{1}{2}$
6.  $6x^2 = 10 - 11x$   
 $6x^2 + 11x - 10 = 0$   
 $(6x)^2 + 11(6x) - 60 = 0$   
 $\frac{(6x+15)(6x-4)}{3 \cdot 2} = 0$   
 $(2x+5)(3x-2) = 0$   
 $2x+5=0 \quad 3x-2=0$   
 $x_1 = -\frac{5}{2} = -2\frac{1}{2} \quad x_2 = \frac{2}{3}$
7.  $20x^2 - 27x = 14$   
 $20x^2 - 27x - 14 = 0$   
 $(20x)^2 - 27(20x) - 280 = 0$   
 $\frac{(20x-35)(20x+8)}{5 \cdot 4} = 0$   
 $(4x-7)(5x+2) = 0$   
 $x_1 = \frac{7}{4} = 1\frac{3}{4} \quad x_2 = -\frac{2}{5}$
8.  $7x = 15 - 30x^2$   
 $30x^2 + 7x - 15 = 0$   
 $(30x)^2 + 7(30x) - 450 = 0$   
 $\frac{(30x+25)(30x-18)}{5 \cdot 6} = 0$   
 $(6x+5)(5x-3) = 0$   
 $6x+5=0 \quad 5x-3=0$   
 $6x=-5 \quad 5x=3$   
 $x_1 = -\frac{5}{6} \quad x_2 = \frac{3}{5}$
9.  $60 = 8x^2 + 157x$   
 $8x^2 + 157x - 60 = 0$   
 $(8x)^2 + 157(8x) - 480 = 0$   
 $\frac{(8x+160)(8x-3)}{8} = 0$   
 $(x+20)(8x-3) = 0$   
 $x+20=0 \quad 8x-3=0$   
 $x_1 = -20 \quad 8x=3$   
 $x_2 = \frac{3}{8}$
10.  $x(x-1) - 5(x-2) = 2$   
 $x^2 - x - 5x + 10 - 2 = 0$   
 $x^2 - 6x + 8 = 0$   
 $(x-4)(x-2) = 0$   
 $x-4=0 \quad x-2=0$   
 $x_1 = 4 \quad x_2 = 2$
11.  $(x-2)^2 - (2x+3)^2 = -80$   
 $x^2 - 4x + 4 - 4x^2 - 12x - 9 + 80 = 0$   
 $-3x^2 - 16x + 75 = 0$   
 $3x^2 + 16x - 75 = 0$   
 $(3x)^2 + 16(3x) - 225 = 0$   
 $\frac{(3x+25)(3x-9)}{3} = 0$
11. **Continuación**  
 $(3x+25)(x-3) = 0$   
 $3x+25=0 \quad x-3=0$   
 $3x=-25 \quad x_2=3$   
 $x_1 = -\frac{25}{3} = -8\frac{1}{3}$
12.  $\frac{6}{x^2} - \frac{9}{x} = -\frac{4}{3} \quad mcm = 3x^2$   
 $18 - 27x = -4x^2$   
 $4x^2 - 27x + 18 = 0$   
 $(4x)^2 - 27(4x) + 72 = 0$   
 $\frac{(4x-24)(4x-3)}{4} = 0$   
 $(x-6)(4x-3) = 0$   
 $x-6=0 \quad 4x-3=0$   
 $x_1 = 6 \quad 4x=3$   
 $x_2 = \frac{3}{4}$
13.  $\frac{x+2}{x} + x = \frac{74}{x} \quad mcm = x$   
 $x+2+x^2 = 74$   
 $x^2 + x - 72 = 0$   
 $(x+9)(x-8) = 0$   
 $x+9=0 \quad x-8=0$   
 $x_1 = -9 \quad x_2 = 8$
14.  $(x+2)^2 - \frac{2x-5}{3} = 3 \quad mcm = 3$   
 $3(x+2)^2 - (2x-5) = 9$   
 $3x^2 + 12x + 12 - 2x + 5 - 9 = 0$   
 $3x^2 + 10x + 8 = 0$   
 $(3x)^2 + 10(3x) + 24 = 0$   
 $\frac{(3x+6)(3x+4)}{3} = 0$   
 $(x+2)(3x+4) = 0$   
 $x+2=0 \quad 3x+4=0$   
 $x_1 = -2 \quad 3x=-4$   
 $x_2 = \frac{-4}{3} = -1\frac{1}{3}$
15.  $\frac{x}{x-2} + x = \frac{3x+15}{4} \quad mcm = 4(x-2)$   
 $4x + 4x(x-2) = (3x+15)(x-2)$   
 $4x + 4x^2 - 8x = 3x^2 + 9x - 30$   
 $x^2 - 13x + 30 = 0$   
 $(x-10)(x-3) = 0$   
 $x-10=0 \quad x-3=0$   
 $x_1 = 10 \quad x_2 = 3$

Continúa

$$16. \frac{6}{x-4} - \frac{4}{x} = \frac{5}{12} \quad mcm=12x(x-4)$$

$$72x - 48(x-4) = 5x(x-4)$$

$$72x - 48x + 192 = 5x^2 - 20x$$

$$5x^2 - 44x - 192 = 0$$

$$(5x)^2 - 44(5x) - 960 = 0$$

$$\frac{(5x-60)(5x+16)}{5} = 0$$

$$(x-12)(5x+16) = 0$$

$$x-12=0 \quad 5x+16=0$$

$$x_1=12 \quad 5x=-16$$

$$x_2 = \frac{-16}{5} = -3\frac{1}{5}$$

$$17. \quad (x-2)^3 - (x-3)^3 = 37$$

$$x^3 - 6x^2 + 12x - 8 - x^3 + 9x^2 - 27x + 27 - 37 = 0$$

$$3x^2 - 15x - 18 = 0$$

$$(3x)^2 - 15(3x) - 54 = 0$$

$$(3x-18)(3x+3) = 0$$

$$3x-18=0$$

$$3x+3=0$$

$$3x=18$$

$$3x=-3$$

$$x_1=6$$

$$x_2=-1$$

$$18. \frac{x-1}{x+1} - 2 = \frac{x+3}{3} \quad mcm=3(x+1)$$

$$3(x-1) - 6(x+1) = (x+3)(x+1)$$

$$3x - 3 - 6x - 6 = x^2 + 4x + 3$$

$$x^2 + 7x + 12 = 0$$

$$(x+4)(x+3) = 0$$

$$x+4=0 \quad x+3=0$$

$$x_1=-4 \quad x_2=-3$$

$$19. \frac{4x-1}{2x+3} = \frac{2x+1}{6x+5}$$

$$(6x+5)(4x-1) = (2x+1)(2x+3)$$

$$24x^2 + 14x - 5 = 4x^2 + 8x + 3$$

$$20x^2 + 6x - 8 = 0$$

$$10x^2 + 3x - 4 = 0$$

$$(10x)^2 + 3(10x) - 40 = 0$$

$$\frac{(10x+8)(10x-5)}{2 \cdot 5} = 0$$

$$(5x+4)(2x-1) = 0$$

$$5x+4=0 \quad 2x-1=0$$

$$5x=-4 \quad 2x=1$$

$$x_1 = \frac{-4}{5} \quad x_2 = \frac{1}{2}$$

$$20. \frac{3x+2}{4} = 5 - \frac{9x+14}{12x} \quad mcm=12x$$

$$3x(3x+2) = 60x - (9x+14)$$

$$9x^2 + 6x = 60x - 9x - 14$$

$$9x^2 - 45x + 14 = 0$$

$$(9x)^2 - 45(9x) + 126 = 0$$

$$\frac{(9x-42)(9x-3)}{3 \cdot 3} = 0$$

$$(3x-14)(3x-1) = 0$$

$$3x-14=0 \quad 3x-1=0$$

$$3x=14$$

$$3x=1$$

$$x_1 = \frac{14}{3}$$

$$x_2 = \frac{1}{3}$$

$$x_1 = 4\frac{2}{3}$$

## EJERCICIO 270

$$1. \quad x^2 + 2ax - 35a^2 = 0$$

$$(x+7a)(x-5a) = 0$$

$$x+7a=0 \quad x-5a=0$$

$$x_1 = -7a \quad x_2 = 5a$$

$$2. \quad 10x^2 = 36a^2 - 37ax$$

$$10x^2 + 37ax - 36a^2 = 0$$

$$x = \frac{-37a \pm \sqrt{(37a)^2 - 4(10)(-36a^2)}}{2(10)}$$

$$x = \frac{-37a \pm \sqrt{2.809a^2}}{20} = \frac{-37a \pm 53a}{20}$$

$$x_1 = \frac{-37a + 53a}{20} = \frac{16a}{20} = \frac{4a}{5}$$

$$x_2 = \frac{-37a - 53a}{20} = \frac{-90a}{20} = \frac{-9a}{2}$$

$$3. \quad a^2x^2 + abx - 2b^2 = 0$$

$$(a^2x)^2 + ab(a^2x) - 2a^2b^2 = 0$$

$$(a^2x + 2ab)(a^2x - ab) = 0$$

$$a^2x + 2ab = 0$$

$$a^2x - ab = 0$$

$$a^2x = -2ab$$

$$a^2x = ab$$

$$x_1 = \frac{-2ab}{a^2}$$

$$x_2 = \frac{ab}{a^2}$$

$$x_1 = -\frac{2b}{a}$$

$$x_2 = \frac{b}{a}$$

4.  $89bx = 42x^2 + 22b^2$   
 $42x^2 - 89bx + 22b^2 = 0$   

$$x = \frac{-(-89b) \pm \sqrt{(-89b)^2 - 4(42)(22b^2)}}{2(42)}$$

$$x = \frac{89 \pm \sqrt{4 \cdot 225b^2}}{84} = \frac{89b \pm 65b}{84}$$

$$x_1 = \frac{89b - 65b}{84} = \frac{24b}{84} = \frac{2b}{7}$$

$$x_2 = \frac{89b + 65b}{84} = \frac{154b}{84} = \frac{11b}{6}$$

5.  $x^2 + ax = 20a^2$   
 $x^2 + ax - 20a^2 = 0$   
 $(x + 5a)(x - 4a) = 0$   
 $x + 5a = 0 \quad x - 4a = 0$   
 $x_1 = -5a \quad x_2 = 4a$

6.  $2x^2 = abx + 3a^2b^2$   
 $2x^2 - abx - 3a^2b^2 = 0$   
 $(2x)^2 - ab(2x) - 6a^2b^2 = 0$   

$$\frac{(2x - 3ab)(2x + 2ab)}{2} = 0$$

$$(2x - 3ab)(x + ab) = 0$$
 $2x - 3ab = 0 \quad x + ab = 0$   
 $2x = 3ab \quad x = -ab$   
 $x_1 = \frac{3ab}{2} \quad x_2 = -ab$

7.  $b^2x^2 + 2abx = 3a^2$   
 $b^2x^2 + 2abx - 3a^2 = 0$   
 $(b^2x)^2 + 2ab(b^2x) - 3a^2b^2 = 0$   

$$\frac{(b^2x + 3ab)(b^2x - ab)}{b \cdot b} = 0$$

$$(bx + 3a)(bx - a) = 0$$
 $bx + 3a = 0 \quad bx - a = 0$   
 $bx = -3a \quad bx = a$   
 $x_1 = -\frac{3a}{b} \quad x_2 = \frac{a}{b}$

8.  $x^2 + ax - bx = ab$   
 $x^2 + ax - bx - ab = 0$   
 $x(x + a) - b(x + a) = 0$   
 $(x - b)(x + a) = 0$   
 $x - b = 0 \quad x + a = 0$   
 $x_1 = b \quad x_2 = -a$

9.  $x^2 - 2ax = 6ab - 3bx$   
 $x^2 + 3bx - 2ax - 6ab = 0$   
 $x(x + 3b) - 2a(x + 3b) = 0$   
 $(x + 3b)(x - 2a) = 0$   
 $x + 3b = 0 \quad x - 2a = 0$   
 $x_1 = -3b \quad x_2 = 2a$

10.  $3(2x^2 - mx) + 4nx - 2mn = 0$   
 $3x(2x - m) + 2n(2x - m) = 0$   
 $(2x - m)(3x + 2n) = 0$   
 $2x - m = 0 \quad 3x + 2n = 0$   
 $2x = m \quad 3x = -2n$   
 $x_1 = \frac{m}{2} \quad x_2 = -\frac{2n}{3}$

11.  $x^2 - a^2 - bx - ab = 0$   
 $(x^2 - a^2) - b(x + a) = 0$   
 $(x + a)(x - a) - b(x + a) = 0$   
 $(x - a - b)(x + a) = 0$   
 $x - a - b = 0 \quad x + a = 0$   
 $x_1 = a + b \quad x_2 = -a$

12.  $abx^2 - x(b - 2a) = 2$   
 $abx^2 - bx + 2ax - 2 = 0$   
 $abx^2 + 2ax - bx - 2 = 0$   
 $ax(bx + 2) - (bx + 2) = 0$   
 $(bx + 2)(ax - 1) = 0$   
 $bx + 2 = 0 \quad ax - 1 = 0$   
 $bx = -2 \quad ax = 1$   
 $x_1 = \frac{-2}{b} \quad x_2 = \frac{1}{a}$

13.  $x^2 - 2ax + a^2 - b^2 = 0$   

$$x = \frac{-(-2a) \pm \sqrt{(2a)^2 - 4(a^2 - b^2)}}{2}$$

$$x = \frac{2a \pm \sqrt{4a^2 - 4a^2 + 4b^2}}{2} = \frac{2a \pm 2b}{2}$$

$$x_1 = \frac{2a + 2b}{2} = \frac{2(a + b)}{2} = a + b$$

$$x_2 = \frac{2a - 2b}{2} = \frac{2(a - b)}{2} = a - b$$

$$14. 4x(x-b) + b^2 = 4m^2$$

$$4x^2 - 4bx + b^2 - 4m^2 = 0$$

$$x = \frac{-(-4b) \pm \sqrt{(-4b)^2 - 4(4)(b^2 - 4m^2)}}{2(4)}$$

$$x = \frac{4b \pm \sqrt{16b^2 - 16b^2 + 64m^2}}{8}$$

$$x = \frac{4b \pm \sqrt{64m^2}}{8} = \frac{4b \pm 8m}{8}$$

$$x_1 = \frac{4b+8m}{8} = \frac{4(b+2m)}{8} = \frac{b+2m}{2}$$

$$x_2 = \frac{4b-8m}{8} = \frac{4(b-2m)}{8} = \frac{b-2m}{2}$$

$$15. x^2 - b^2 + 4a^2 - 4ax = 0$$

$$x^2 - 4ax - b^2 + 4a^2 = 0$$

$$x = \frac{-(-4a) \pm \sqrt{(-4a)^2 - 4(-b^2 + 4a^2)}}{2}$$

$$x = \frac{4a \pm \sqrt{16a^2 + 4b^2 - 16a^2}}{2} = \frac{4a \pm 2b}{2}$$

$$x_1 = \frac{4a+2b}{2} = \frac{2(2a+b)}{2} = 2a+b$$

$$x_2 = \frac{4a-2b}{2} = \frac{2(2a-b)}{2} = 2a-b$$

$$16. x^2 - (a+2)x = -2a$$

$$x^2 - ax - 2x + 2a = 0$$

$$x(x-a) - 2(x-a) = 0$$

$$(x-a)(x-2) = 0$$

$$x-a=0 \quad x-2=0$$

$$x_1 = a \quad x_2 = 2$$

$$17. x^2 + 2x(4-3a) = 48a$$

$$x^2 + 8x - 6ax - 48a = 0$$

$$x(x+8) - 6a(x+8) = 0$$

$$(x+8)(x-6a) = 0$$

$$x+8=0 \quad x-6a=0$$

$$x_1 = -8 \quad x_2 = 6a$$

$$18. x^2 - 2x = m^2 + 2m$$

$$x^2 - m^2 - 2x - 2m = 0$$

$$(x+m)(x-m) - 2(x+m) = 0$$

$$(x-m-2)(x+m) = 0$$

$$x-m-2=0 \quad x+m=0$$

$$x_1 = m+2 \quad x_2 = -m$$

$$19. x^2 + m^2x(m-2) = 2m^5$$

$$x^2 + xm^3 - 2xm^2 - 2m^5 = 0$$

$$x(x+m^3) - 2m^2(x+m^3) = 0$$

$$(x+m^3)(x-2m^2) = 0$$

$$x+m^3=0 \quad x-2m^2=0$$

$$x_1 = -m^3 \quad x_2 = 2m^2$$

$$20. 6x^2 - 15ax = 2bx - 5ab$$

$$6x^2 - 2bx - 15ax + 5ab = 0$$

$$2x(3x-b) - 5a(3x-b) = 0$$

$$(3x-b)(2x-5a) = 0$$

$$3x-b=0 \quad 2x-5a=0$$

$$3x=b \quad 2x=5a$$

$$x_1 = \frac{b}{3} \quad x_2 = \frac{5a}{2}$$

$$21. \frac{3x}{4} + \frac{a}{2} - \frac{x^2}{2a} = 0 \quad mcm = 4a$$

$$3ax + 2a^2 - 2x^2 = 0$$

$$2x^2 - 3ax - 2a^2 = 0$$

$$(2x)^2 - 3a(2x) - 4a^2 = 0$$

$$\frac{(2x-4a)(2x+a)}{2} = 0$$

$$(x-2a)(2x+a) = 0$$

$$x-2a=0 \quad 2x+a=0$$

$$x_1 = 2a \quad 2x = -a$$

$$x_2 = -\frac{a}{2}$$

$$22. \frac{2x-b}{2} = \frac{2bx-b^2}{3x}$$

$$3x(2x-b) = 2(2bx-b^2)$$

$$6x^2 - 3bx - 4bx + 2b^2 = 0$$

$$3x(2x-b) - 2b(2x-b) = 0$$

$$(2x-b)(3x-2b) = 0$$

$$2x-b=0 \quad 3x-2b=0$$

$$2x=b \quad 3x=2b$$

$$x_1 = \frac{b}{2} \quad x_2 = \frac{2b}{3}$$



$$\begin{aligned}
 23. \quad \frac{a+x}{a-x} + \frac{a-2x}{a+x} &= -4 \quad mcm = a^2 - x^2 \\
 (a+x)(a+x) + (a-2x)(a-x) &= -4(a^2 - x^2) \\
 a^2 + 2ax + x^2 + a^2 - 3ax + 2x^2 &= -4a^2 + 4x^2 \\
 6a^2 - ax - x^2 &= 0 \\
 x^2 + ax - 6a^2 &= 0 \\
 (x+3a)(x-2a) &= 0 \\
 x+3a=0 \quad x-2a=0 \\
 x_1 = -3a \quad x_2 = 2a
 \end{aligned}$$

$$\begin{aligned}
 24. \quad \frac{x^2}{x-1} &= \frac{a^2}{2(a-2)} \\
 2(a-2)x^2 &= a^2(x-1) \\
 x^2(2a-4) &= a^2x - a^2
 \end{aligned}$$

$$\begin{aligned}
 x^2(2a-4) - a^2x + a^2 &= 0 \\
 x = \frac{-(-a^2) \pm \sqrt{(-a^2)^2 - 4(2a-4)(a^2)}}{2(2a-4)}
 \end{aligned}$$

$$x = \frac{a^2 \pm \sqrt{a^4 - 8a^3 + 16a^2}}{2(2a-4)}$$

$$x = \frac{a^2 \pm \sqrt{a^2(a^2 - 8a + 16)}}{4a-8}$$

$$x = \frac{a^2 \pm \sqrt{a^2(a-4)^2}}{4(a-2)} = \frac{a^2 \pm a^2 - 4a}{4(a-2)}$$

$$x_1 = \frac{a^2 + a^2 - 4a}{4(a-2)} = \frac{2a^2 - 4a}{4(a-2)} = \frac{2a(a-2)}{4(a-2)} = \frac{a}{2}$$

$$x_2 = \frac{a^2 - (a^2 - 4a)}{4(a-2)} = \frac{4a}{4(a-2)} = \frac{a}{a-2}$$

$$\begin{aligned}
 25. \quad x + \frac{2}{x} &= \frac{1}{a} + 2a \quad mcm = ax \\
 ax^2 + 2a &= x + 2a^2x \\
 ax^2 - x + 2a - 2a^2x &= 0 \\
 x(ax-1) - 2a(ax-1) &= 0 \\
 (ax-1)(x-2a) &= 0 \\
 ax-1=0 \quad x-2a=0 \\
 ax=1 \quad x=2a \\
 x_1 = \frac{1}{a} \quad x_2 = 2a
 \end{aligned}$$

$$\begin{aligned}
 26. \quad \frac{2x-b}{b} - \frac{x}{x+b} &= \frac{2x}{4b} \quad mcm = 4b(x+b) \\
 4(2x-b)(x+b) - 4bx &= 2x(x+b) \\
 8x^2 + 4bx - 4b^2 - 4bx &= 2x^2 + 2bx \\
 6x^2 - 2bx - 4b^2 &= 0 \\
 3x^2 - bx - 2b^2 &= 0 \\
 (3x)^2 - b(3x) - 6b^2 &= 0 \\
 \frac{(3x-3b)(3x+2b)}{3} &= 0 \\
 (x-b)(3x+2b) &= 0 \\
 x-b=0 \quad 3x+2b=0 \\
 x_1 = b \quad 3x = -2b \\
 x_2 &= -\frac{2b}{3}
 \end{aligned}$$

## EJERCICIO 271

$$1. 3x^2 = 48$$

$$\begin{aligned}
 x^2 &= 16 \\
 x &= \sqrt{16} \\
 x &= \pm 4
 \end{aligned}$$

$$2. 5x^2 - 9 = 46$$

$$\begin{aligned}
 5x^2 &= 55 \\
 x^2 &= 11 \\
 x &= \sqrt{11} \\
 x &= \pm \sqrt{11}
 \end{aligned}$$

$$4. 9x^2 - a^2 = 0$$

$$\begin{aligned}
 9x^2 &= a^2 \\
 x^2 &= \frac{a^2}{9}
 \end{aligned}$$

$$x = \sqrt{\frac{a^2}{9}}$$

$$x = \pm \frac{a}{3}$$

$$5. (x+5)(x-5) = -7$$

$$3. 7x^2 + 14 = 0$$

$$\begin{aligned}
 x^2 + 2 &= 0 \\
 x^2 &= -2 \\
 x &= \sqrt{-2} \\
 x &= \sqrt{2} \sqrt{-1} \\
 x &= \pm \sqrt{2} i
 \end{aligned}$$

$$x^2 - 25 = -7$$

$$x^2 = 18$$

$$x = \sqrt{18}$$

$$x = \sqrt{3^2 \cdot 2}$$

$$x = \pm 3\sqrt{2}$$

$$6. (2x-3)(2x+3)-135=0$$

$$4x^2-9-135=0$$

$$4x^2=144$$

$$x^2=36$$

$$x=\sqrt{36}$$

$$x=\pm 6$$

$$7. 3(x+2)(x-2)=(x-4)^2+8x$$

$$3x^2-12=x^2-8x+16+8x$$

$$2x^2-28=0$$

$$2x^2=28$$

$$x^2=14$$

$$x=\pm\sqrt{14}$$

$$8. \left(x+\frac{1}{3}\right)\left(x-\frac{1}{3}\right)=\frac{1}{3}$$

$$x^2-\frac{1}{9}-\frac{1}{3}=0$$

$$x^2=\frac{4}{9}$$

$$x=\pm\sqrt{\frac{4}{9}}$$

$$x=\pm\frac{2}{3}$$

$$9. (2x-1)(x+2)-(x+4)(x-1)+5=0$$

$$2x^2+3x-2-x^2-3x+4+5=0$$

$$x^2+7=0$$

$$x^2=-7$$

$$x=\sqrt{7}\sqrt{-1}$$

$$x=\pm\sqrt{7}i$$

$$10. \frac{5}{2x^2}-\frac{1}{6x^2}=\frac{7}{12} \quad mcm=12x^2$$

$$30-2=7x^2$$

$$28=7x^2$$

$$4=x^2$$

$$\sqrt{4}=x$$

$$\pm 2=x$$

$$11. \frac{2x-3}{x-3}=\frac{x-2}{x-1} \quad mcm=(x-3)(x-1)$$

$$(2x-3)(x-1)=(x-2)(x-3)$$

$$2x^2-5x+3=x^2-5x+6$$

$$x^2-3=0$$

$$x^2=3$$

$$x=\pm\sqrt{3}$$

$$12. \frac{x^2-5}{3}+\frac{4x^2-1}{5}-\frac{14x^2-1}{15}=0$$

$$5x^2-25+12x^2-3-14x^2+1=0$$

$$3x^2-27=0$$

$$3x^2=27$$

$$x^2=9$$

$$x=\sqrt{9}$$

$$x=\pm 3$$

$$13. 2x-3-\frac{x^2+1}{x-2}=-7 \quad mcm=x-2$$

$$2x(x-2)-3(x-2)-(x^2+1)=-7(x-2)$$

$$2x^2-4x-3x+6-x^2-1=-7x+14$$

$$x^2+5=14$$

$$x^2=9$$

$$x=\sqrt{9}$$

$$x=\pm 3$$

$$14. 3-\frac{3}{4x^2-1}=2 \quad mcm=4x^2-1$$

$$3(4x^2-1)-3=2(4x^2-1)$$

$$12x^2-6=8x^2-2$$

$$4x^2=4$$

$$x^2=1$$

$$x=\sqrt{1}$$

$$x=\pm 1$$

## EJERCICIO 272

$$1. x^2=5x$$

$$x^2-5x=0$$

$$x(x-5)=0$$

$$x_1=0 \quad x-5=0$$

$$x_2=5$$

$$2. 4x^2=-32x$$

$$4x^2+32x=0$$

$$4x(x+8)=0$$

$$4x=0 \quad x+8=0$$

$$x_1=0 \quad x_2=-8$$

$$3. x^2-3x=3x^2-4x$$

$$0=2x^2-x$$

$$0=x(2x-1)$$

$$0=x_1 \quad 0=2x-1$$

$$1=2x \Rightarrow \frac{1}{2}=x_2$$

$$4. \quad 5x^2 + 4 = 2(x+2)$$

$$5x^2 + 4 = 2x + 4$$

$$5x^2 - 2x = 0$$

$$x(5x-2)=0$$

$$x_1=0 \quad 5x-2=0$$

$$5x=2$$

$$x_2 = \frac{2}{5}$$

$$7. \quad (4x-1)(2x+3) = (x+3)(x-1)$$

$$8x^2 + 10x - 3 = x^2 + 2x - 3$$

$$7x^2 + 8x = 0$$

$$x(7x+8)=0$$

$$x_1=0 \quad 7x+8=0$$

$$7x = -8$$

$$x_2 = -\frac{8}{7}$$

$$x_2 = -1\frac{1}{7}$$

$$5. \quad (x-3)^2 - (2x+5)^2 = -16$$

$$x^2 - 6x + 9 - 4x^2 - 20x - 25 + 16 = 0$$

$$-3x^2 - 26x = 0$$

$$x(3x+26)=0$$

$$x_1=0 \quad 3x+26=0$$

$$3x = -26$$

$$x_2 = -\frac{26}{3} = -8\frac{2}{3}$$

$$6. \quad \frac{x^2}{3} - \frac{x-9}{6} = \frac{3}{2} \quad mcm=12$$

$$4x^2 - 2x + 18 = 18$$

$$2x(2x-1)=0$$

$$2x=0 \quad 2x-1=0$$

$$x_1=0 \quad 2x=1$$

$$x_2 = \frac{1}{2}$$

$$8. \quad \frac{x+1}{x-1} - \frac{x+4}{x-2} = 1 \quad mcm=(x-1)(x-2)$$

$$(x+1)(x-2) - (x+4)(x-1) = (x-1)(x-2)$$

$$x^2 - x - 2 - x^2 - 3x + 4 = x^2 - 3x + 2$$

$$0 = x^2 + x$$

$$0 = x(x+1)$$

$$x_1=0 \quad x+1=0$$

$$x_2 = -1$$

## EJERCICIO 273

$$1. \quad x + \sqrt{4x+1} = 5$$

$$\sqrt{4x+1} = 5 - x$$

$$(\sqrt{4x+1})^2 = (5-x)^2$$

$$4x+1 = 25 - 10x + x^2$$

$$0 = x^2 - 14x + 24$$

$$0 = (x-12)(x-2)$$

$$x-12=0$$

$$x_1=12 \rightarrow \text{Rechazo sol extraña}$$

$$x-2=0$$

$$x_2=2 \rightarrow \text{sol que satisface}$$

$$2. \quad 2x - \sqrt{x-1} = 3x - 7$$

$$7 - x = \sqrt{x-1}$$

$$(7-x)^2 = (\sqrt{x-1})^2$$

$$49 - 14x + x^2 = x - 1$$

$$x^2 - 15x + 50 = 0$$

$$(x-10)(x-5)=0$$

$$x-10=0$$

$$x_1=10 \rightarrow \text{Rechazo sol extraña}$$

$$x-5=0$$

$$x_2=5 \rightarrow \text{sol que satisface}$$

$$3. \quad \sqrt{5x-1} + \sqrt{x+3} = 4$$

$$(\sqrt{5x-1} + \sqrt{x+3})^2 = 16$$

$$5x-1 + 2\sqrt{5x^2+14x-3} + x+3 = 16$$

$$2\sqrt{5x^2+14x-3} = 14 - 6x$$

$$(\sqrt{5x^2+14x-3})^2 = (7-3x)^2$$

$$5x^2 + 14x - 3 = 49 - 42x + 9x^2$$

$$0 = 4x^2 - 56x + 52$$

$$0 = x^2 - 14x + 13$$

$$0 = (x-13)(x-1)$$

$$x-13=0$$

$$x_1=13 \rightarrow \text{Rechazo por sol extraña}$$

$$x-1=0$$

$$x_2=1 \rightarrow \text{sol que satisface}$$

4.  $2\sqrt{x} - \sqrt{x+5} = 1$   
 $(2\sqrt{x})^2 = (1 + \sqrt{x+5})^2$   
 $4x = 1 + 2\sqrt{x+5} + x + 5$   
 $3x - 6 = 2\sqrt{x+5}$   
 $(3x - 6)^2 = (2\sqrt{x+5})^2$   
 $9x^2 - 36x + 36 = 4x + 20$   
 $9x^2 - 40x + 16 = 0$   
 $(9x)^2 - 40(9x) + 144 = 0$   
 $\frac{(9x - 36)(9x - 4)}{9} = 0$   
 $(x - 4)(9x - 4) = 0$   
 $x - 4 = 0$   
 $x_1 = 4 \rightarrow \text{sol que satisfice}$   
 $9x - 4 = 0$   
 $9x = 4$   
 $x_2 = \frac{4}{9} \rightarrow \text{Rechazo por sol extraña}$
5.  $\sqrt{2x-1} + \sqrt{x+3} = 3$   
 $(\sqrt{2x-1})^2 = (3 - \sqrt{x+3})^2$   
 $2x - 1 = 9 - 6\sqrt{x+3} + x + 3$   
 $x - 13 = -6\sqrt{x+3}$   
 $(6\sqrt{x+3})^2 = (13 - x)^2$   
 $36(x+3) = 169 - 26x + x^2$   
 $36x + 108 = 169 - 26x + x^2$   
 $0 = x^2 - 62x + 61$   
 $0 = (x - 61)(x - 1)$   
 $x - 61 = 0$   
 $x_1 = 61 \rightarrow \text{Rechazo por sol extraña}$   
 $x - 1 = 0$   
 $x_2 = 1 \rightarrow \text{sol que satisfice}$
6.  $\sqrt{x-3} + \sqrt{2x+1} - 2\sqrt{x} = 0$   
 $(\sqrt{x-3} + \sqrt{2x+1})^2 = (2\sqrt{x})^2$   
 $x - 3 + 2\sqrt{2x^2 - 5x - 3} + 2x + 1 = 4x$   
 $(2\sqrt{2x^2 - 5x - 3})^2 = (x + 2)^2$   
 $4(2x^2 - 5x - 3) = x^2 + 4x + 4$   
 $8x^2 - 20x - 12 = x^2 + 4x + 4$

**Continúa**

## 6. Continuación

- $7x^2 - 24x - 16 = 0$   
 $(7x)^2 - 24(7x) - 112 = 0$   
 $\frac{(7x - 28)(7x + 4)}{7} = 0$   
 $(x - 4)(7x + 4) = 0$   
 $x - 4 = 0 \Rightarrow x_1 = 4 \rightarrow \text{sol factible}$   
 $7x + 4 = 0$   
 $7x = -4 \Rightarrow x_2 = -\frac{4}{7} \rightarrow \text{sol inadmisibile}$
7.  $\sqrt{5x-1} - \sqrt{3-x} = \sqrt{2x}$   
 $(\sqrt{5x-1} - \sqrt{2x})^2 = (\sqrt{3-x})^2$   
 $5x - 1 - 2\sqrt{10x^2 - 2x} + 2x = 3 - x$   
 $-2\sqrt{10x^2 - 2x} = -8x + 4$   
 $8x - 4 = 2\sqrt{10x^2 - 2x}$   
 $4(2x - 1) = 2\sqrt{10x^2 - 2x}$   
 $(4x - 2)^2 = (\sqrt{10x^2 - 2x})^2$   
 $16x^2 - 16x + 4 = 10x^2 - 2x$   
 $6x^2 - 14x + 4 = 0$   
 $(6x)^2 - 14(6x) + 24 = 0$   
 $\frac{(6x - 12)(6x - 2)}{6} = 0$   
 $(x - 2)(6x - 2) = 0$   
 $x - 2 = 0$   
 $x_1 = 2 \rightarrow \text{sol factible}$   
 $6x - 2 = 0$   
 $6x = 2$   
 $x_2 = \frac{1}{3} \rightarrow \text{sol inadmisibile}$
8.  $\sqrt{3x+1} + \sqrt{5x} = \sqrt{16x+1}$   
 $3x + 1 + 2\sqrt{15x^2 + 5x + 5x} = 16x + 1$   
 $2\sqrt{15x^2 + 5x} = 8x$   
 $(\sqrt{15x^2 + 5x})^2 = (4x)^2$   
 $15x^2 + 5x = 16x^2$   
 $0 = x^2 - 5x$   
 $0 = x(x - 5)$   
 $x_1 = 0 \rightarrow \text{sol admisible}$   
 $x - 5 = 0$   
 $x_2 = 5 \rightarrow \text{sol admisible}$

$$\begin{aligned}
 9. \quad & \sqrt{2x + \sqrt{4x-3}} = 3 \\
 & 2x + \sqrt{4x-3} = 9 \\
 & (\sqrt{4x-3})^2 = (9-2x)^2 \\
 & 4x-3 = 81 - 36x + 4x^2 \\
 & 0 = 4x^2 - 40x + 84 \\
 & 0 = x^2 - 10x + 21 \\
 & 0 = (x-7)(x-3) \\
 & x-7=0 \\
 & x_1 = 7 \rightarrow \text{Rechazo por} \\
 & \quad \text{sol inadmissible} \\
 & x-3=0 \\
 & x_2 = 3 \rightarrow \text{sol aceptada}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad & \sqrt{x+3} + \frac{6}{\sqrt{x+3}} = 5 \\
 & (\sqrt{x+3})^2 + 6 = 5\sqrt{x+3} \\
 & (x+9) = (5\sqrt{x+3})^2 \\
 & x^2 - 7x + 6 = 0 \\
 & (x-1)(x-6) = 0 \\
 & x-1=0 \\
 & x_1 = 1 \rightarrow \text{sol admisible} \\
 & x-6=0 \\
 & x_2 = 6 \rightarrow \text{sol admisible}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad & \sqrt{x} + \frac{4}{\sqrt{x}} = 5 \\
 & (\sqrt{x})^2 + 4 = 5\sqrt{x} \\
 & (x+4) = (5\sqrt{x})^2 \\
 & x^2 + 8x + 16 = 25x \\
 & x^2 - 17x + 16 = 0 \\
 & (x-16)(x-1) = 0 \\
 & x-16=0 \\
 & x_1 = 16 \rightarrow \text{sol admisible} \\
 & x-1=0 \\
 & x_2 = 1 \rightarrow \text{sol admisible}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad & 2\sqrt{x} = \sqrt{x+7} + \frac{8}{\sqrt{x+7}} \\
 & 2\sqrt{x^2+7x} = \sqrt{(x+7)^2} + 8 \\
 & (2\sqrt{x^2+7x})^2 = (x+15)^2 \\
 & 4x^2 + 28x = x^2 + 30x + 225 \\
 & 3x^2 - 2x - 225 = 0 \\
 & (3x)^2 - 2(3x) - 675 = 0 \\
 & \frac{(3x-27)(3x+25)}{3} = 0 \\
 & (x-9)(3x+25) = 0 \\
 & x-9=0 \Rightarrow x_1 = 9 \rightarrow \text{sol aceptada} \\
 & 3x+25=0 \Rightarrow x_2 = -\frac{25}{3} \rightarrow \text{sol inadmissible}
 \end{aligned}$$

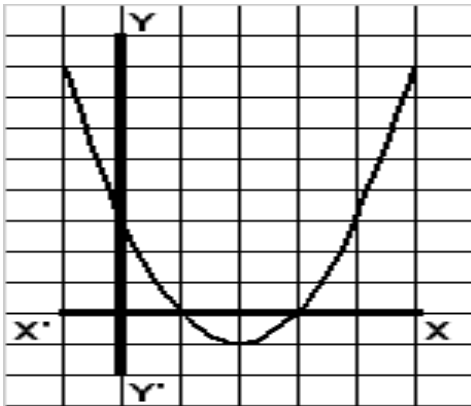
$$\begin{aligned}
 13. \quad & \sqrt{x + \sqrt{x+8}} = 2\sqrt{x} \\
 & x + \sqrt{x+8} = 4x \\
 & (\sqrt{x+8})^2 = (3x)^2 \\
 & x+8 = 9x^2 \\
 & 9x^2 - x - 8 = 0 \\
 & (9x)^2 - 1(9x) - 72 = 0 \\
 & \frac{(9x-9)(9x+8)}{9} = 0 \\
 & x-1=0 \Rightarrow x_1 = 1 \rightarrow \text{sol aceptada} \\
 & 9x+8=0 \Rightarrow x_2 = -\frac{8}{9} \rightarrow \text{sol rechazada}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad & \sqrt{6-x} + \sqrt{x+7} - \sqrt{12x+1} = 0 \\
 & (\sqrt{6-x} + \sqrt{x+7})^2 = (\sqrt{12x+1})^2 \\
 & 6-x + 2\sqrt{42-x-x^2} + x+7 = 12x+1 \\
 & 2\sqrt{42-x-x^2} = 12x-12 \\
 & (\sqrt{42-x-x^2})^2 = (6x-6)^2 \\
 & 42-x-x^2 = 36x^2 - 72x + 36 \\
 & 0 = 37x^2 - 71x - 6 \\
 & (37x)^2 - 71(37x) - 222 = 0 \\
 & \frac{(37x-74)(37x+3)}{37} = 0 \\
 & (x-2)(37x+3) = 0 \\
 & x-2=0 \Rightarrow x_1 = 2 \rightarrow \text{sol aceptada} \\
 & 37x+3=0 \\
 & 37x = -3 \Rightarrow x_2 = -\frac{3}{37} \rightarrow \text{sol inadmissible}
 \end{aligned}$$

## EJERCICIO 274

11.  $x^2 - 4x + 3 = 0$

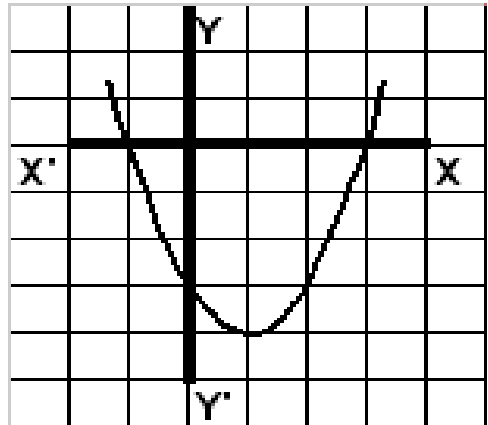
x	y
0	3
1	0
2	-1
3	0
-1	8



sol:  $x_1 = 1$   $x_2 = 3$

13.  $x^2 - 2x - 3 = 0$

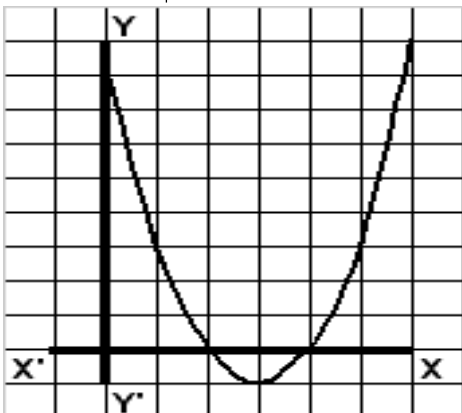
x	y
0	-3
1	-4
2	-3
3	0
-1	0



sol:  $x_1 = -1$   $x_2 = 3$

12.  $x^2 - 6x + 8 = 0$

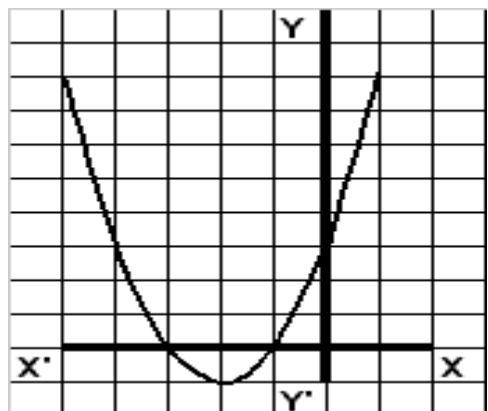
x	y
0	8
1	3
2	0
3	-1
4	0



sol:  $x_1 = 2$   $x_2 = 4$

14.  $x^2 + 4x + 3 = 0$

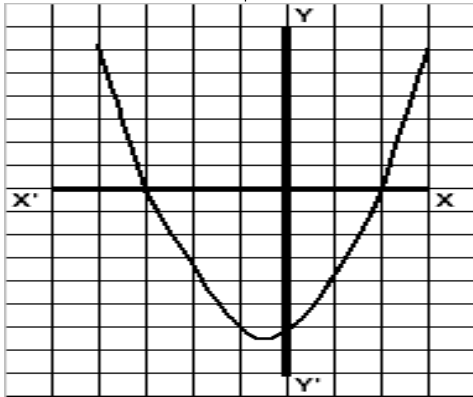
x	y
0	3
-1	0
-2	-1
-3	0
1	8



sol:  $x_1 = -3$   $x_2 = -1$

15.  $x^2 = 6 - x$   
 $x^2 + x - 6 = 0$

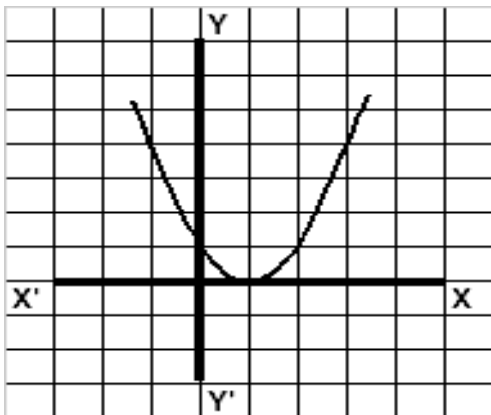
x	y
0	-6
1	-4
2	0
3	6
-1	-6
-3	0



sol:  $x_1 = -3$   $x_2 = 2$

16.  $x^2 = 2x - 1$   
 $x^2 - 2x + 1 = 0$

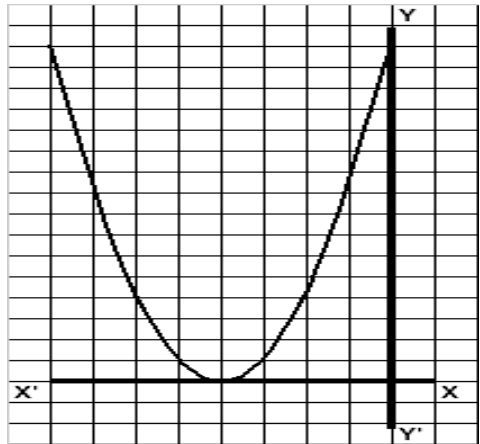
x	y
0	1
1	0
2	1
3	4
-1	4



sol:  $x_1 = x_2 = 1$

17.  $x^2 + 8x + 16 = 0$

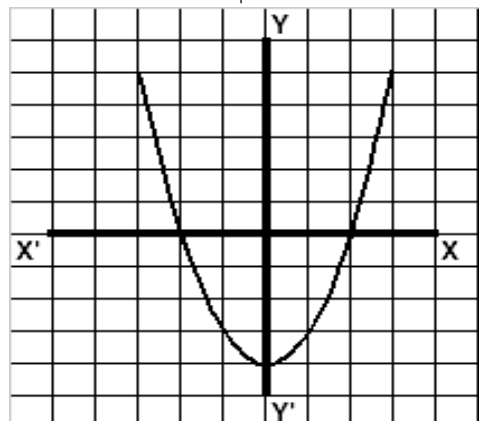
x	y
0	16
-2	4
-4	0
-6	4



sol:  $x_1 = x_2 = -4$

18.  $x^2 - 4 = 0$

x	y
1	-3
2	0
3	5
-1	-3
-2	0
-3	5
0	-4

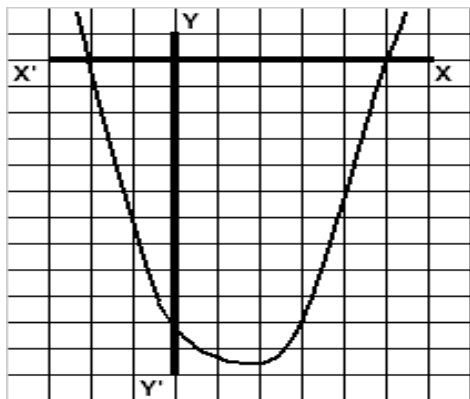


sol:  $x_1 = -2$   $x_2 = 2$

19.  $x^2 = 3x + 10$

$x^2 - 3x - 10 = 0$

x	y
0	-10
3	-10
5	0
-1	-6
-2	0

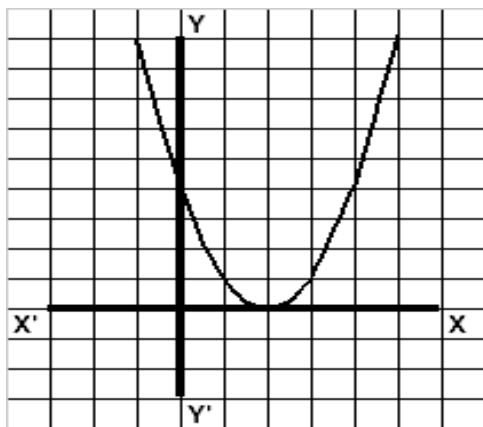


sol:  $x_1 = -2$   $x_2 = 5$

20.  $x^2 - 4x = -4$

$x^2 - 4x + 4 = 0$

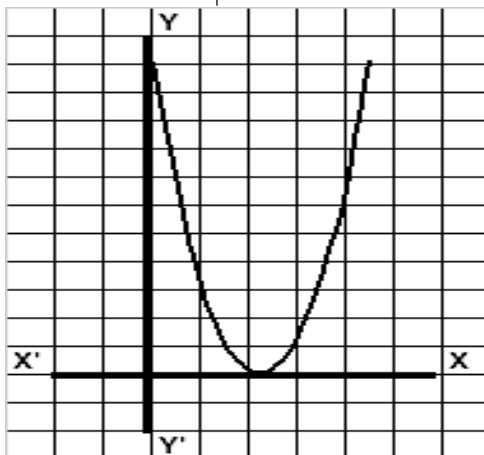
x	y
0	4
1	1
2	0
3	1
-1	9



sol:  $x_1 = x_2 = 2$

21.  $2x^2 - 9x + 10 = 0$

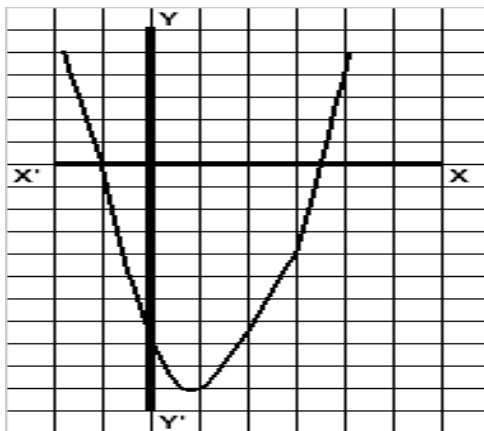
x	y
0	10
1	3
2	0
3	1
4	6



sol:  $x_1 = 2$   $x_2 = 2\frac{1}{2}$

22.  $2x^2 - 5x - 7 = 0$

x	y
0	-7
1	-10
3	-4
4	5
-1	0



sol:  $x_1 = -1$   $x_2 = 3\frac{1}{2}$



## EJERCICIO 275

1.  $x \rightarrow N^\circ$  mayor

$9 - x \rightarrow N^\circ$  menor

$$x^2 + (9 - x)^2 = 53$$

$$x^2 + 81 - 18x + x^2 = 53$$

$$2x^2 - 18x + 28 = 0$$

$$x^2 - 9x + 14 = 0$$

$$(x - 7)(x - 2) = 0$$

$$x_1 = 7 \quad x_2 = 2$$

$7 \rightarrow N^\circ$  mayor

$9 - 7 = 2 \rightarrow N^\circ$  menor

2.  $x \rightarrow N^\circ$  positivo

$$\frac{3x}{5} \rightarrow \text{Otro Número}$$

$$x\left(\frac{3x}{5}\right) = 2.160$$

$$3x^2 = 10.800$$

$$x^2 = 3.600$$

$$x = \pm \sqrt{3.600}$$

$$x_1 = 60 \quad x_2 = -60$$

$60 \rightarrow N^\circ$  positivo

$$\frac{3(60)}{5} = 36 \rightarrow \text{Otro Número}$$

3.  $x \rightarrow$  Edad de A

$x - 3 \rightarrow$  Edad de B

$$x^2 + (x - 3)^2 = 317$$

$$x^2 + x^2 - 6x + 9 = 317$$

$$2x^2 - 6x - 308 = 0$$

$$x^2 - 3x - 154 = 0$$

$$(x - 14)(x + 11) = 0$$

$$x_1 = 14 \quad x_2 = -11$$

$14$  años  $\rightarrow$  Edad de A

$14 - 3 = 11$  años  $\rightarrow$  Edad de B

4.  $x \rightarrow$  Un Número

$3x \rightarrow$  El otro Número

$$(3x)^2 - x^2 = 1.800$$

$$9x^2 - x^2 = 1.800$$

$$8x^2 = 1.800$$

$$x^2 = 225$$

$$x = \pm \sqrt{225}$$

$$x_1 = 15 \quad x_2 = -15$$

$15 \rightarrow$  Un Número

$3(15) = 45 \rightarrow$  El otro Número

5.  $x \rightarrow N^\circ$  buscado

$$x^2 - 9 = 8(x - 2)$$

$$x^2 - 9 = 8x - 16$$

$$x^2 - 8x + 7 = 0$$

$$(x - 7)(x - 1) = 0$$

$$x_1 = 7 \quad x_2 = 1$$

$7 \rightarrow N^\circ$  buscado

6.  $x + 1 \rightarrow N^\circ$  mayor

$x \rightarrow N^\circ$  menor

$$(x + 1)^2 - 57 = 3x$$

$$x^2 + 2x + 1 - 57 = 3x$$

$$x^2 - x - 56 = 0$$

$$(x - 8)(x + 7) = 0$$

$$x_1 = 8 \quad x_2 = -7$$

$8 \rightarrow N^\circ$  menor

$8 + 1 = 9 \rightarrow N^\circ$  mayor

7.  $x + 4 \rightarrow$  Largo

$x \rightarrow$  Ancho

$$\text{Area} = x(x + 4)$$

$$= x^2 + 4x$$

$$\text{Doble del area} = 2x^2 + 8x$$

$$(x + 8)(x + 4) = 2x^2 + 8x$$

$$x^2 + 12x + 32 = 2x^2 + 8x$$

$$x^2 - 4x - 32 = 0$$

$$(x - 8)(x + 4) = 0$$

$$x_1 = 8 \quad x_2 = -4$$

$8m + 4m = 12m \rightarrow$  Largo

$8m \rightarrow$  Ancho

8.  $x \rightarrow N^\circ$  sacos comp.

$$\frac{1.000}{x} \text{bs.} \rightarrow \text{costo cada saco}$$

$$\frac{1.000}{x + 10} = \frac{1.000}{x} - 5$$

$$1.000x = (x + 10)1.000 - 5x(x + 10)$$

$$10^3x = 10^3x + 10^4 - 5x^2 - 50x$$

$$5x^2 + 50x - 10^4 = 0$$

$$x^2 + 10x - 2.000 = 0$$

$$(x + 50)(x - 40) = 0$$

$$x_1 = -50 \quad x_2 = 40$$

$40 \rightarrow N^\circ$  sacos comp.

$$\frac{1.000}{40} \text{bs.} = 25 \text{bs.} \rightarrow \text{costo cada saco}$$

9.  $4x \rightarrow$  Costo caballo

$x \rightarrow$  Costo arreos

$$(4x)^2 + x^2 = 860.625$$

$$16x^2 + x^2 = 860.625$$

$$17x^2 = 860.625$$

$$x^2 = 50.625$$

$$x = \pm \sqrt{50.625}$$

$$x_1 = 225 \quad x_2 = -225$$

$$4(225) = 900$$

$900$  sucres  $\rightarrow$  Costo caballo

$225$  sucres  $\rightarrow$  Costo arreos

10.  $x - 7 \rightarrow N^\circ$  menor

$x \rightarrow N^\circ$  mayor

$$(x - 7 + x)(x - 7) = 184$$

$$(2x - 7)(x - 7) = 184$$

$$2x^2 - 21x + 49 = 184$$

$$2x^2 - 21x - 135 = 0$$

$$(2x)^2 - 21(2x) - 270 = 0$$

$$(2x - 30)(2x + 9) = 0$$

$$(x - 15)(2x + 9) = 0$$

$$x_1 = 15 \quad x_2 = -\frac{9}{2}$$

$15 \rightarrow N^\circ$  mayor

$15 - 7 = 8 \rightarrow N^\circ$  menor

11.  $x \rightarrow$  Edad de A

$23 - x \rightarrow$  Edad de B

$$x(23 - x) = 102$$

$$23x - x^2 = 102$$

$$x^2 - 23x + 102 = 0$$

$$(x - 17)(x - 6) = 0$$

$$x_1 = 17 \quad x_2 = 6$$

$17$  años  $\rightarrow$  Edad de A

$6$  años  $\rightarrow$  Edad de B

12.  $x \rightarrow N^\circ$  de libros

$$\frac{180}{x} \rightarrow \text{Costo } c/u$$

$$\frac{180}{x-6} = \frac{180}{x} + 1$$

$$180x = 180(x-6) + x(x-6)$$

$$180x = 180x - 1.080 + x^2 - 6x$$

$$0 = x^2 - 6x - 1.080$$

$$0 = (x-36)(x+30)$$

$$x_1 = 36 \quad x_2 = -30$$

36  $\rightarrow$  Libros

$$\frac{180}{36} = \$5 \rightarrow \text{Costo } c/u$$

13.  $x \rightarrow N^\circ$  de filas

$$\frac{180}{x} \rightarrow N^\circ \text{ soldados cada fila}$$

$$\frac{180}{x} - 8 = x$$

$$180 - 8x = x^2$$

$$0 = x^2 + 8x - 180$$

$$0 = (x+18)(x-10)$$

$$x_1 = -18 \quad x_2 = 10$$

10  $\rightarrow N^\circ$  de filas

$$\frac{180}{10} = 18 \rightarrow N^\circ \text{ soldados}$$

cada fila

14.  $x \rightarrow$  Costo del reloj

$$x\% \text{ de } x = \frac{x^2}{100}$$

$$\frac{x^2}{100} + x = 75$$

$$x^2 + 100x = 7.500$$

$$x^2 + 100x - 7.500 = 0$$

$$(x+150)(x-50) = 0$$

$$x_1 = -150 \quad x_2 = 50$$

50 soles  $\rightarrow$  Costo del reloj

15.  $x \rightarrow$  Pers. comp.

$$\frac{1.200}{x} - 194 = x$$

$$1.200 - 194x = x^2$$

$$x^2 + 194x - 1.200 = 0$$

$$(x+200)(x-6) = 0$$

$$x_1 = -200 \quad x_2 = 6$$

6  $\rightarrow$  Pers. comp. el auto

16.  $x \rightarrow$  Relojes comp.

$$\frac{192}{x} \rightarrow \text{Costo cada reloj}$$

$$\frac{192}{x} = \frac{3x}{4}$$

$$768 = 3x^2$$

$$256 = x^2$$

$$\pm\sqrt{256} = x$$

$$x_1 = 16 \quad x_2 = -16$$

16  $\rightarrow$  Relojes comp.

$$\frac{192}{16} = \$12 \rightarrow \text{Costo cada reloj}$$

17.  $x \rightarrow$  Libros comp.

$$\frac{150}{x} \rightarrow \text{Costo cada lib.}$$

$$\frac{150}{x} + 1 = \frac{150}{x-5}$$

$$150(x-5) + x(x-5) = 150x$$

$$150x - 750 + x^2 - 5x = 150x$$

$$x^2 - 5x - 750 = 0$$

$$(x-30)(x+25) = 0$$

$$x_1 = 30 \quad x_2 = -25$$

30  $\rightarrow$  Libros comp.

$$\frac{150}{30} = \$5 \rightarrow \text{Costo cada lib.}$$

18.  $x \rightarrow$  Libros comp.

$$\frac{200}{x} - 10 = x$$

$$200 - 10x = x^2$$

$$x^2 + 10x - 200 = 0$$

$$(x+20)(x-10) = 0$$

$$x_1 = -20 \quad x_2 = 10$$

10  $\rightarrow$  Libros comp.

19.  $x \rightarrow$  Plumas comp.

$$\frac{24}{x} \rightarrow \text{Precio } c/u$$

$$\frac{24}{x} - 1 = \frac{24}{x+4}$$

$$24(x+4) - x(x+4) = 24x$$

$$24x + 96 - x^2 - 4x = 24x$$

$$x^2 + 4x - 96 = 0$$

$$(x+12)(x-8) = 0$$

$$x_1 = -12 \quad x_2 = 8$$

8  $\rightarrow$  Plumas comp.

$$\frac{24}{8} = \$3 \rightarrow \text{Precio } c/u$$

20.  $x \rightarrow$  Tiempo de recorrido

$$\frac{240}{x} + 20 = \frac{240}{x-2}$$

$$240(x-2) + 20x(x-2) = 240x$$

$$240x - 480 + 20x^2 - 40x = 240x$$

$$20x^2 - 40x - 480 = 0$$

$$x^2 - 2x - 24 = 0$$

$$(x-6)(x+4) = 0$$

$$x_1 = 6 \quad x_2 = -4$$

6 horas  $\rightarrow$  Tiempo de recorrido

21.  $x \rightarrow$  Caballos comp.

$$\frac{2.000}{x} \rightarrow \text{Precio cada caballo}$$

$$\frac{2.000}{x} + 60 = \frac{2.000 + 80}{x-2}$$

$$2.000(x-2) + 60x(x-2) = 2.080x$$

$$2.000x - 4.000 + 60x^2 - 120x = 2.080x$$

$$60x^2 - 200x - 4.000 = 0$$

$$3x^2 - 10x - 200 = 0$$

$$(3x-30)(x+20) = 0$$

$$(3x-30)(3x+20) = 0$$

$$(x-10)(3x+20) = 0$$

$$x_1 = 10 \quad x_2 = -\frac{20}{3}$$

10  $\rightarrow$  Caballos comp.

$$\frac{2.000}{10} = \$200 \rightarrow \text{Precio } c/\text{caballo}$$

22.  $x \rightarrow N^\circ$  menor

$x+1 \rightarrow N^\circ$  intermedio

$x+2 \rightarrow N^\circ$  mayor

$$\frac{x+2}{x+1} = \frac{3x}{10}$$

$$10(x+2) = 3x(x+1)$$

$$10x + 20 = 3x^2 + 3x$$

$$0 = 3x^2 - 7x - 20$$

$$0 = (3x)^2 - 7(3x) - 60$$

$$0 = (3x-12)(3x+5)$$

$$0 = (x-4)(3x+5)$$

$$x_1 = 4 \quad x_2 = -\frac{5}{3}$$

4  $\rightarrow N^\circ$  menor

4+1=5  $\rightarrow N^\circ$  intermedio

4+2=6  $\rightarrow N^\circ$  mayor

23.  $x \rightarrow \text{Un } N^{\circ}$ .

$$\frac{180}{x} \rightarrow \text{El otro } N^{\circ}.$$

$$\frac{180}{x} = 1\frac{1}{4}$$

$$\frac{180}{x^2} = \frac{5}{4}$$

$$720 = 5x^2$$

$$144 = x^2$$

$$\pm\sqrt{144} = x$$

$$x_1 = 12 \quad x_2 = -12$$

$$12 \rightarrow \text{Un } N^{\circ}.$$

$$\frac{180}{12} = 15 \rightarrow \text{El otro } N^{\circ}.$$

24.  $x \rightarrow N^{\circ}$  naranjas comp.

$$\frac{150}{x} \rightarrow \text{Costo } c / \text{naranja}$$

$$\left(\frac{150}{x} + 1\right)(x-5) = 150$$

$$(150+x)(x-5) = 150x$$

$$150x - 750 + x^2 - 5x = 150x$$

$$x^2 - 5x - 750 = 0$$

$$(x-30)(x+25) = 0$$

$$x_1 = 30 \quad x_2 = -25$$

$$30 \rightarrow N^{\circ} \text{ naranjas comp.}$$

$$\frac{150}{30} = 5 \text{ ctvs.} \rightarrow \text{Costo } c / \text{naranja}$$

25.  $x \rightarrow \text{Costo del caballo}$

$$\frac{x^2}{100} + x = 171$$

$$x^2 + 100x = 17.100$$

$$x^2 + 100x - 17.100 = 0$$

$$(x+190)(x-90) = 0$$

$$x_1 = -190 \quad x_2 = 90$$

$$90 \text{ Q.} \rightarrow \text{Costo del caballo}$$

26.  $x \rightarrow N^{\circ}$  mayor

$$\frac{352}{x} \rightarrow N^{\circ} \text{ menor}$$

$$\frac{x}{352} = 2 + \frac{10}{352}$$

$$\frac{x^2}{352} = 2 + \frac{10x}{352}$$

$$x^2 = 704 + 10x$$

**Continúa**

26. **Continuación**

$$x^2 - 10x - 704 = 0$$

$$(x-32)(x+22) = 0$$

$$x_1 = 32 \quad x_2 = -22$$

$$32 \rightarrow N^{\circ} \text{ mayor}$$

$$\frac{352}{32} = 11 \rightarrow N^{\circ} \text{ menor}$$

27.  $x \rightarrow \text{Long. pieza mayor}$

$$20 - x \rightarrow \text{Long. pieza menor}$$

$$x \cdot x = 9(20-x)(20-x)$$

$$x^2 = 9(400 - 40x + x^2)$$

$$x^2 = 3.600 - 360x + 9x^2$$

$$0 = 8x^2 - 360x + 3.600$$

$$0 = x^2 - 45x + 450$$

$$0 = (x-30)(x-15)$$

$$x_1 = 30 \quad x_2 = 15$$

$$15m \rightarrow \text{Long. pieza mayor}$$

$$20 - 15 = 5m \rightarrow \text{Long. pieza menor}$$

28.  $x \rightarrow \text{Tiempo en horas}$

$$\frac{200}{x} \rightarrow \text{Veloc. del tren}$$

$$\frac{200}{x} = \frac{200}{x-1} + 10$$

$$200(x-1) = 200x + 10x(x-1)$$

$$200x - 200 = 200x + 10x^2 - 10x$$

$$0 = 10x^2 - 10x + 200$$

$$0 = x^2 - x + 20$$

$$0 = (x-5)(x+4)$$

$$x_1 = 5 \quad x_2 = -4$$

$$\frac{200}{5} = 40 \text{ Km/h} \rightarrow \text{Veloc. del tren}$$

29.  $x \rightarrow \text{Dias trabaj.}$

$$\frac{84}{x} \rightarrow \text{Valor del jornal}$$

$$\frac{84}{x} - 1 = \frac{84}{x+2}$$

$$84(x+2) - x(x+2) = 84x$$

$$84x + 168 - x^2 - 2x = 84x$$

$$x^2 + 2x - 168 = 0$$

$$(x+14)(x-12) = 0$$

$$x_1 = -14 \quad x_2 = 12$$

$$12 \rightarrow \text{Dias trabaj.}$$

$$\frac{84}{12} = 7 \text{ col} \rightarrow \text{Valor del jornal}$$

30.  $x \rightarrow \text{Personas que van}$

$$\frac{90}{x} \rightarrow \text{Valor } c / u$$

$$\frac{90}{x-3} - 1 = \frac{90}{x}$$

$$90x - x(x-3) = 90(x-3)$$

$$90x - x^2 + 3x = 90x - 270$$

$$x^2 - 3x - 270 = 0$$

$$(x-18)(x+15) = 0$$

$$x_1 = 18 \quad x_2 = -15$$

$$18 \rightarrow \text{Personas que van}$$

$$\frac{90}{18} = \$5 \rightarrow \text{Valor } c / u$$

31.  $x \rightarrow N^{\circ}$  buscado

$$\frac{84}{x} - 5 = x$$

$$84 - 5x = x^2$$

$$x^2 + 5x - 84 = 0$$

$$(x+12)(x-7) = 0$$

$$x_1 = -12 \quad x_2 = 7$$

$$7 \rightarrow N^{\circ} \text{ buscado}$$

32.  $x \rightarrow \text{Edad actual } A$

$$x - 6 = \sqrt{x+6}$$

$$(x-6)^2 = (\sqrt{x+6})^2$$

$$x^2 - 12x + 36 = x + 6$$

$$x^2 - 13x + 30 = 0$$

$$(x-10)(x-3) = 0$$

$$x_1 = 10 \quad x_2 = 3$$

$$10 \text{ años} \rightarrow \text{Edad actual } A$$

33.  $x \rightarrow \text{Libros comp.}$

$$\frac{40}{x} \rightarrow \text{Precio de } c / \text{libro}$$

$$x-2 \rightarrow N^{\circ} \text{ de plumas}$$

$$\frac{40}{x} = \frac{40}{x-2} - 1$$

$$40(x-2) = 40x - x(x-2)$$

$$40x - 80 = 40x - x^2 + 2x$$

$$x^2 - 2x - 80 = 0$$

$$(x-10)(x+8) = 0$$

$$x_1 = 10 \quad x_2 = -8$$

$$10 \rightarrow \text{Libros comp.}$$

$$\frac{40}{10} = \$4 \rightarrow \text{Precio } c / \text{libro}$$

## EJERCICIO 276

1.  $3x^2 + 5x - 2 = 0$

$$b^2 - 4ac = 5^2 - 4(3)(-2) = 25 + 24 = 49$$

Reales y desiguales, racionales

2.  $2x^2 - 4x + 1 = 0$

$$b^2 - 4ac = (-4)^2 - 4(2)(1) = 16 - 8 = 8$$

Reales y desiguales, irracionales

3.  $4x^2 - 4x + 1 = 0$

$$b^2 - 4ac = (-4)^2 - 4(4)(1) = 16 - 16 = 0$$

Reales e iguales

4.  $3x^2 - 2x + 5 = 0$

$$b^2 - 4ac = (-2)^2 - 4(3)(5) = 4 - 60 = -56$$

Imaginarias

5.  $x^2 - 10x + 25 = 0$

$$b^2 - 4ac = (-10)^2 - 4(1)(25) = 100 - 100 = 0$$

Reales e iguales

6.  $x^2 - 5x - 5 = 0$

$$b^2 - 4ac = (-5)^2 - 4(1)(-5) = 25 + 20 = 45$$

Reales y desiguales, irracionales

7.  $2x^2 - 9x + 7 = 0$

$$b^2 - 4ac = (-9)^2 - 4(2)(7) = 81 - 56 = 25$$

Reales y desiguales, racionales

8.  $36x^2 + 12x + 1 = 0$

$$b^2 - 4ac = (12)^2 - 4(36)(1) = 144 - 144 = 0$$

Reales e iguales

9.  $4x^2 - 5x + 3 = 0$

$$b^2 - 4ac = (-5)^2 - 4(4)(3) = 25 - 48 = -23$$

Imaginarias

10.  $x^2 + x - 1 = 0$

$$b^2 - 4ac = (1)^2 - 4(1)(-1) = 1 + 4 = 5$$

Reales y desiguales, irracionales

11.  $5x^2 - 7x + 8 = 0$

$$b^2 - 4ac = (-7)^2 - 4(5)(8) = 49 - 160 = -111$$

Imaginarias

12.  $x^2 - 10x - 11 = 0$

$$b^2 - 4ac = (-10)^2 - 4(1)(-11) = 100 + 44 = 144$$

Reales y desiguales, racionales

## EJERCICIO 277

1.  $x^2 + x - 6 = 0$

$$\text{Suma } 2 + (-3) = -1$$

$$\text{Producto } 2(-3) = -6$$

Si son raíces

2.  $x^2 - 4x - 5 = 0$

$$\text{Suma } 1 + 5 = 6$$

No son raíces

3.  $2x^2 - x - 1 = 0$

$$x^2 - \frac{x}{2} - \frac{1}{2} = 0$$

$$\text{Suma } 1 - \frac{1}{2} = \frac{1}{2}$$

$$\text{Producto } 1\left(-\frac{1}{2}\right) = -\frac{1}{2}$$

Si son raíces

4.  $3x^2 + 8x - 3 = 0$

$$x^2 + \frac{8x}{3} - 1 = 0$$

$$\text{Suma } -3 + \frac{1}{3} = -\frac{8}{3}$$

Continúa

### 4. Continuación

$$\text{Producto } -3\left(\frac{1}{3}\right) = -1$$

Si son raíces

5.  $5x^2 - 11x + 2 = 0$

$$x^2 - \frac{11x}{5} + \frac{2}{5} = 0$$

$$\text{Suma } 2 - \frac{1}{5} = \frac{9}{5}$$

No son raíces

6.  $4x^2 + 17x + 4 = 0$

$$x^2 + \frac{17x}{4} + 1 = 0$$

$$\text{Suma } -4 - \frac{1}{4} = -\frac{17}{4}$$

$$\text{Producto } -4\left(-\frac{1}{4}\right) = 1$$

Si son raíces

7.  $5x^2 + 24x - 5 = 0$

$$x^2 + \frac{24}{5}x - 1 = 0$$

Continúa

### 7. Continuación

$$\text{Suma } -5 - \frac{1}{5} = -\frac{26}{5}$$

No son raíces

8.  $x^2 + 3x - 28 = 0$

$$\text{Suma } 4 - 7 = -3$$

$$\text{Producto } 4(-7) = -28$$

Si son raíces

9.  $6x^2 + x - 2 = 0$

$$x^2 + \frac{x}{6} - \frac{1}{3} = 0$$

$$\text{Suma } \frac{1}{2} - \frac{2}{3} = -\frac{1}{6}$$

$$\text{Producto } \left(\frac{1}{2}\right)\left(-\frac{2}{3}\right) = -\frac{1}{3}$$

Si son raíces

10.  $8x^2 - 2x - 3 = 0$

$$x^2 - \frac{1}{4}x - \frac{3}{8} = 0$$

$$\text{Suma } \frac{1}{2} - \frac{3}{4} = -\frac{1}{4}$$

No son raíces

## EJERCICIO 278

1. Suma  $3+4=7$

Producto  $3(4)=12$

Luego  $x^2-7x+12=0$

2. Suma  $-1+3=2$

Producto  $-1(3)=-3$

Luego  $x^2-2x-3=0$

3. Suma  $-5-7=-12$

Producto  $-5(-7)=35$

Luego  $x^2+12x+35=0$

4. Suma  $-10+11=1$

Producto  $-10(1)=-110$

Luego  $x^2-x-110=0$

5. Suma  $1+\frac{1}{2}=\frac{3}{2}$

Producto  $1\left(\frac{1}{2}\right)=\frac{1}{2}$

Luego  $x^2-\frac{3x}{2}+\frac{1}{2}=0$

$\Rightarrow 2x^2-3x+1=0$

6. Suma  $-2-\frac{1}{5}=-\frac{11}{5}$

Producto  $-2\left(-\frac{1}{5}\right)=\frac{2}{5}$

Luego  $x^2+\frac{11x}{5}+\frac{2}{5}=0$

$\Rightarrow 5x^2+11x+2=0$

7. Suma  $3-\frac{2}{3}=\frac{7}{3}$

Producto  $3\left(-\frac{2}{3}\right)=-2$

Luego  $x^2-\frac{7x}{3}-2=0$

$\Rightarrow 3x^2-7x-6=0$

8. Suma  $-2-\frac{3}{2}=-\frac{7}{2}$

Producto  $-2\left(-\frac{3}{2}\right)=3$

Luego  $x^2+\frac{7x}{2}+3=0$

$\Rightarrow 2x^2+7x+6=0$

9. Suma  $-\frac{1}{2}+\frac{3}{4}=\frac{1}{4}$

Producto  $\left(-\frac{1}{2}\right)\left(\frac{3}{4}\right)=-\frac{3}{8}$

Luego  $x^2-\frac{x}{4}-\frac{3}{8}=0$

$\Rightarrow 4x^2-x-\frac{3}{2}=0$

$\Rightarrow 8x^2-2x-3=0$

10. Suma  $-5+\frac{2}{7}=-\frac{33}{7}$

Producto  $-5\left(\frac{2}{7}\right)=-\frac{10}{7}$

Luego  $x^2+\frac{33x}{7}-\frac{10}{7}=0$

$\Rightarrow 7x^2+33x-10=0$

11. Suma  $6-\frac{5}{3}=\frac{13}{3}$

Producto  $6\left(-\frac{5}{3}\right)=-10$

Luego  $x^2-\frac{13}{3}x-10=0$

$\Rightarrow 3x^2-13x-30=0$

12. Suma  $-2-\frac{1}{8}=-\frac{17}{8}$

Producto  $-2\left(-\frac{1}{8}\right)=\frac{1}{4}$

Luego  $x^2+\frac{17}{8}x+\frac{1}{4}=0$

$\Rightarrow 8x^2+17x+2=0$

13. Suma  $18-52=-34$

Producto  $18(-52)=-936$

Luego  $x^2+34x-936=0$

14. Suma  $-15-11=-26$

Producto  $-15(-11)=165$

Luego  $x^2+26x+165=0$

15. Suma  $0+2=2$

Producto  $0(2)=0$

Luego  $x^2-2x=0$

16. Suma  $0-\frac{1}{3}=-\frac{1}{3}$

Producto  $0\left(-\frac{1}{3}\right)=0$

Luego  $x^2+\frac{x}{3}=0$

$\Rightarrow 3x^2+x=0$

17. Suma  $5-5=0$

Producto  $5(-5)=-25$

Luego  $x^2-25=0$

18. Suma  $\frac{1}{2}-\frac{1}{2}=0$

Producto  $\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)=-\frac{1}{4}$

Luego  $x^2-\frac{1}{4}=0$

$\Rightarrow 4x^2-1=0$

19. Suma  $7+7=14$

Producto  $7(7)=49$

Luego  $x^2-14x+49=0$

20. Suma  $8-\frac{11}{3}=\frac{13}{3}$

Producto  $8\left(-\frac{11}{3}\right)=-\frac{88}{3}$

Luego  $x^2-\frac{13}{3}x-\frac{88}{3}=0$

$\Rightarrow 3x^2-13x-88=0$

21. Suma  $-\frac{5}{6}-\frac{9}{2}=-\frac{16}{3}$

Producto  $\left(-\frac{5}{6}\right)\left(-\frac{9}{2}\right)=\frac{15}{4}$

Luego  $x^2+\frac{16}{3}x+\frac{15}{4}=0$

$\Rightarrow 12x^2+64x+45=0$

22. Suma  $-\frac{11}{2}+\frac{2}{7}=-\frac{73}{14}$

Producto  $\left(-\frac{11}{2}\right)\left(\frac{2}{7}\right)=-\frac{11}{7}$

Luego  $x^2+\frac{73}{14}x-\frac{11}{7}=0$

$\Rightarrow 14x^2+73x-22=0$

23. Suma  $2a-a=a$

Producto  $2a(-a)=-2a^2$

Luego  $x^2-ax-2a^2=0$

$$24. \text{ Suma } -\frac{2b}{3} + \frac{b}{4} = -\frac{5b}{12}$$

$$\text{Producto } \left(-\frac{2b}{3}\right)\left(\frac{b}{4}\right) = -\frac{b^2}{6}$$

$$\text{Luego } x^2 + \frac{5b}{12}x - \frac{b^2}{6} = 0$$

$$\Rightarrow 12x^2 + 5bx - 2b^2 = 0$$

$$25. \text{ Suma } m - \frac{m}{2} = \frac{m}{2}$$

$$\text{Producto } m\left(-\frac{m}{2}\right) = -\frac{m^2}{2}$$

$$\text{Luego } x^2 - \frac{m}{2}x - \frac{m^2}{2} = 0$$

$$\Rightarrow 2x^2 - mx - m^2 = 0$$

$$26. \text{ Suma } b + a - b = a$$

$$\text{Producto } b(a-b) = ab - b^2$$

$$\text{Luego } x^2 - ax + ab - b^2 = 0$$

$$27. \text{ Suma } \frac{a}{2} - \frac{b}{3} = \frac{3a-2b}{6}$$

$$\text{Producto } \left(\frac{a}{2}\right)\left(-\frac{b}{3}\right) = -\frac{ab}{6}$$

$$\text{Luego } x^2 - \frac{3a-2b}{6}x - \frac{ab}{6} = 0$$

$$\Rightarrow 6x^2 - (3a-2b)x - ab = 0$$

$$28. \text{ Suma } 1 + \sqrt{2} + 1 - \sqrt{2} = 2$$

$$\text{Producto } (1 + \sqrt{2})(1 - \sqrt{2}) = -1$$

$$\text{Luego } x^2 - 2x - 1 = 0$$

$$29. \text{ Suma } 2 + \sqrt{5} + 2 - \sqrt{5} = 4$$

$$\text{Producto } (2 + \sqrt{5})(2 - \sqrt{5}) = -1$$

$$\text{Luego } x^2 - 4x - 1 = 0$$

$$30. \text{ Suma } 3 + \sqrt{-1} + 3 - \sqrt{-1} = 6$$

$$\text{Producto } (3 + \sqrt{-1})(3 - \sqrt{-1}) = 10$$

$$\text{Luego } x^2 - 6x + 10 = 0$$

## EJERCICIO 279

$$1. x^2 - 11x + 30 = 0$$

$$(x-6)(x-5) = 0$$

$$x_1 = 6 \quad x_2 = 5$$

$$2. x^2 + 33x + 260 = 0$$

$$x = -\frac{33}{2} \pm \sqrt{\frac{(33)^2}{4} - 260}$$

$$x = \frac{-33}{2} \pm \sqrt{\frac{1.089 - 1.040}{4}}$$

$$x = \frac{-33}{2} \pm \sqrt{\frac{49}{4}}$$

$$x = \frac{-33}{2} \pm \frac{7}{2}$$

$$x_1 = -\frac{33}{2} + \frac{7}{2} = -\frac{26}{2} = -13$$

$$x_2 = \frac{-33}{2} - \frac{7}{2} = \frac{-40}{2} = -20$$

$$3. x^2 + x - 306 = 0$$

$$(x+18)(x-17) = 0$$

$$x_1 = -18 \quad x_2 = 17$$

$$4. x^2 + 49x + 294 = 0$$

$$(x+42)(x+7) = 0$$

$$x_1 = -42 \quad x_2 = -7$$

$$5. x^2 - 6x - 247 = 0$$

$$(x-19)(x+13) = 0$$

$$x_1 = 19 \quad x_2 = -13$$

$$6. x^2 - \frac{3}{2}x - 1 = 0$$

$$2x^2 - 3x - 2 = 0$$

$$(2x)^2 - 3(2x) - 4 = 0$$

$$(2x-4)(2x+1) = 0$$

$$(x-2)(2x+1) = 0$$

$$x_1 = 2 \quad x_2 = -\frac{1}{2}$$

$$7. x^2 + \frac{22}{3}x + 8 = 0$$

$$3x^2 + 22x + 24 = 0$$

$$(3x)^2 + 22(3x) + 72 = 0$$

$$(3x+18)(3x+4) = 0$$

$$(x+6)(3x+4) = 0$$

$$x_1 = -6 \quad x_2 = -\frac{4}{3}$$

$$8. x^2 - \frac{x}{4} - \frac{3}{8} = 0$$

$$8x^2 - 2x - 3 = 0$$

$$(8x)^2 - 2(8x) - 24 = 0$$

$$(8x-6)(8x+4) = 0$$

$$(4x-3)(2x+1) = 0$$

$$x_1 = \frac{3}{4} \quad x_2 = -\frac{1}{2}$$

$$9. x^2 + \frac{95}{7}x - 6 = 0$$

$$7x^2 + 95x - 42 = 0$$

$$(7x)^2 + 95(7x) - 294 = 0$$

$$(7x+98)(7x-3) = 0$$

$$(x+14)(7x-3) = 0$$

$$x_1 = -14 \quad x_2 = \frac{3}{7}$$

$$10. x^2 + \frac{10}{3}x + 1 = 0$$

$$3x^2 + 10x + 3 = 0$$

$$x = \frac{-10 \pm \sqrt{(10)^2 - 4(3)(3)}}{2(3)}$$

$$x = \frac{-10 \pm \sqrt{64}}{6} = \frac{-10 \pm 8}{6}$$

$$x_1 = \frac{-10+8}{6} = \frac{-2}{6} = -\frac{1}{3}$$

$$x_2 = \frac{-10-8}{6} = \frac{-18}{6} = -3$$

$$11. x^2 - \frac{31}{40}x + \frac{3}{20} = 0$$

$$40x^2 - 31x + 6 = 0$$

$$(40x)^2 - 31(40x) + 240 = 0$$

$$(40x-16)(40x-15) = 0$$

$$(5x-2)(8x-3) = 0$$

$$x_1 = \frac{2}{5} \quad x_2 = \frac{3}{8}$$

$$12. \quad x^2 + \frac{x}{6} - \frac{5}{9} = 0$$

$$18x^2 + 3x - 10 = 0$$

$$(18x)^2 + 3(18x) - 180 = 0$$

$$(18x+15)(18x-12) = 0$$

$$(6x+5)(3x-2) = 0$$

$$x_1 = \frac{-5}{6} \quad x_2 = \frac{2}{3}$$

$$13. \quad x^2 - \frac{7}{20}x - \frac{3}{10} = 0$$

$$20x^2 - 7x - 6 = 0$$

$$(20x)^2 - 7(20x) - 120 = 0$$

$$(20x-15)(20x+8) = 0$$

$$(4x-3)(5x+2) = 0$$

$$x_1 = \frac{3}{4} \quad x_2 = \frac{-2}{5}$$

$$14. \quad x^2 - \frac{21x}{5} - 4 = 0$$

$$5x^2 - 21x - 20 = 0$$

$$(5x)^2 - 21(5x) - 100 = 0$$

$$(5x-25)(5x+4) = 0$$

$$(x-5)(5x+4) = 0$$

$$x_1 = 5 \quad x_2 = -\frac{4}{5}$$

$$15. \quad x^2 - \frac{59}{72}x + \frac{1}{6} = 0$$

$$72x^2 - 59x + 12 = 0$$

$$(72x)^2 - 59(72x) + 864 = 0$$

$$(72x-32)(72x-27) = 0$$

$$(9x-4)(8x-3) = 0$$

$$x_1 = \frac{4}{9} \quad x_2 = \frac{3}{8}$$

$$16. \quad x^2 - 2x - 4 = 0$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2(1)}$$

$$x = \frac{2 \pm \sqrt{20}}{2} = \frac{2 \pm 2\sqrt{5}}{2}$$

$$x_1 = \frac{2 + 2\sqrt{5}}{2} = \frac{2(1 + \sqrt{5})}{2} = 1 + \sqrt{5}$$

$$x_2 = \frac{2 - 2\sqrt{5}}{2} = \frac{2(1 - \sqrt{5})}{2} = 1 - \sqrt{5}$$

$$17. \quad x^2 - x - \frac{11}{4} = 0$$

$$4x^2 - 4x - 11 = 0$$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(4)(-11)}}{2(4)}$$

$$x = \frac{4 \pm \sqrt{64 \cdot 3}}{8} = \frac{4 \pm 8\sqrt{3}}{8}$$

$$x_1 = \frac{4 + 8\sqrt{3}}{8} = \frac{4(1 + 2\sqrt{3})}{8} = \frac{1 + 2\sqrt{3}}{2} = \frac{1}{2} + \sqrt{3}$$

$$x_2 = \frac{4 - 8\sqrt{3}}{8} = \frac{4(1 - 2\sqrt{3})}{8} = \frac{1 - 2\sqrt{3}}{2} = \frac{1}{2} - \sqrt{3}$$

$$18. \quad x^2 + \frac{4}{3}x - \frac{59}{9} = 0$$

$$9x^2 + 12x - 59 = 0$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(9)(-59)}}{2(9)}$$

$$x = \frac{-12 \pm \sqrt{2 \cdot 268}}{18} = \frac{-12 \pm \sqrt{2^2 \cdot 3^4 \cdot 7}}{18} = \frac{-12 \pm 18\sqrt{7}}{18}$$

$$x_1 = \frac{-12 + 18\sqrt{7}}{18} = \frac{6(-2 + 3\sqrt{7})}{18} = \frac{-2 + 3\sqrt{7}}{3} = -\frac{2}{3} + \sqrt{7}$$

$$x_2 = \frac{-12 - 18\sqrt{7}}{18} = \frac{-6(2 + 3\sqrt{7})}{18} = \frac{-2 - 3\sqrt{7}}{3} = -\frac{2}{3} - \sqrt{7}$$

$$19. \quad x^2 - ax - 2a^2 = 0$$

$$(x-2a)(x+a) = 0$$

$$x_1 = 2a \quad x_2 = -a$$

$$20. \quad x^2 + 7bx + 10b^2 = 0$$

$$(x+5b)(x+2b) = 0$$

$$x_1 = -5b \quad x_2 = -2b$$

$$21. \quad x^2 - \frac{mx}{2} - \frac{m^2}{9} = 0$$

$$18x^2 - 9mx - 2m^2 = 0$$

$$(18x)^2 - 9m(18x) - 36m^2 = 0$$

$$(18x-12m)(18x+3m) = 0$$

$$(6x-4m)(6x+m) = 0$$

$$x_1 = \frac{4m}{6} = \frac{2m}{3} \quad x_2 = -\frac{m}{6}$$

## EJERCICIO 280

1.  $x^2 - 16x + 63 = 0$

$$x = \frac{-(-16) \pm \sqrt{(-16)^2 - 4(63)}}{2}$$

$$x = \frac{16 \pm \sqrt{4}}{2} = \frac{16 \pm 2}{2}$$

$$x_1 = \frac{16+2}{2} = \frac{18}{2} = 9$$

$$x_2 = \frac{16-2}{2} = \frac{14}{2} = 7$$

$$x^2 - 16x + 63 = (x-9)(x-7)$$

2.  $x^2 + 24x + 143 = 0$

$$x = \frac{-24 \pm \sqrt{(24)^2 - 4(143)}}{2}$$

$$x = \frac{-24 \pm \sqrt{4}}{2} = \frac{-24 \pm 2}{2}$$

$$x_1 = \frac{-24+2}{2} = \frac{-22}{2} = -11$$

$$x_2 = \frac{-24-2}{2} = \frac{-26}{2} = -13$$

$$x^2 + 24x + 143 = [x - (-11)][x - (-13)] \\ = (x+11)(x+13)$$

3.  $x^2 - 26x - 155 = 0$

$$x = \frac{-(-26) \pm \sqrt{(-26)^2 - 4(-155)}}{2}$$

$$x = 13 \pm \sqrt{324} = 13 \pm 18$$

$$x_1 = 13 + 18 = 31$$

$$x_2 = 13 - 18 = -5$$

$$x^2 - 26x - 155 = (x-31)(x+5)$$

4.  $2x^2 + x - 6 = 0$

$$x = \frac{-1 \pm \sqrt{(1)^2 - 4(2)(-6)}}{2(2)}$$

$$x = \frac{-1 \pm \sqrt{49}}{4} = \frac{-1 \pm 7}{4}$$

$$x_1 = \frac{-1+7}{4} = \frac{6}{4} = \frac{3}{2}$$

$$x_2 = \frac{-1-7}{4} = \frac{-8}{4} = -2$$

$$2x^2 + x - 6 = 2\left(x - \frac{3}{2}\right)(x+2) \\ = 2\left(\frac{2x-3}{2}\right)(x+2) \\ = (2x-3)(x+2)$$

5.  $12x^2 + 5x - 2 = 0$

$$x = \frac{-5 \pm \sqrt{(5)^2 - 4(12)(-2)}}{2(12)}$$

$$x = \frac{-5 \pm \sqrt{121}}{24} = \frac{-5 \pm 11}{24}$$

$$x_1 = \frac{-5+11}{24} = \frac{6}{24} = \frac{1}{4}$$

$$x_2 = \frac{-5-11}{24} = \frac{-16}{24} = -\frac{2}{3}$$

$$12x^2 + 5x - 2 = 12\left(x - \frac{1}{4}\right)\left(x + \frac{2}{3}\right) \\ = 12\left(\frac{4x-1}{4}\right)\left(\frac{3x+2}{3}\right) \\ = \frac{12(4x-1)(3x+2)}{12} \\ = (4x-1)(3x+2)$$

6.  $5x^2 + 41x + 8$

$$x = \frac{-41 \pm \sqrt{(41)^2 - 4(5)(8)}}{2(5)}$$

$$x = \frac{-41 \pm \sqrt{1.521}}{10} = \frac{-41 \pm 39}{10}$$

$$x_1 = \frac{-41+39}{10} = -\frac{2}{10} = -\frac{1}{5}$$

$$x_2 = \frac{-41-39}{10} = \frac{-80}{10} = -8$$

$$5x^2 + 41x + 8 = 5\left(x + \frac{1}{5}\right)(x+8) \\ = (5x+1)(x+8)$$

7.  $6x^2 + 7x - 10$

$$x = \frac{-7 \pm \sqrt{(7)^2 - 4(6)(-10)}}{2(6)}$$

$$x = \frac{-7 \pm \sqrt{289}}{12} = \frac{-7 \pm 17}{12}$$

$$x_1 = \frac{-7+17}{12} = \frac{10}{12} = \frac{5}{6}$$

$$x_2 = \frac{-7-17}{12} = \frac{-24}{12} = -2$$

$$6x^2 + 7x - 10 = 6\left(x - \frac{5}{6}\right)(x+2) \\ = (6x-5)(x+2)$$

8.  $12x^2 - 25x + 12$

$$x = \frac{-(-25) \pm \sqrt{(-25)^2 - 4(12)(12)}}{2(12)}$$

$$x = \frac{25 \pm \sqrt{49}}{24} = \frac{25 \pm 7}{24}$$

$$x_1 = \frac{25+7}{24} = \frac{32}{24} = \frac{4}{3}$$

$$x_2 = \frac{25-7}{24} = \frac{18}{24} = \frac{3}{4}$$

$$12x^2 - 25x + 12 = 12\left(x - \frac{4}{3}\right)\left(x - \frac{3}{4}\right) \\ = \frac{12(3x-4)(4x-3)}{12} \\ = (3x-4)(4x-3)$$

9.  $8x^2 + 50x + 63$

$$x = \frac{50 \pm \sqrt{(50)^2 - 4(8)(63)}}{2(8)}$$

$$x = \frac{-50 \pm \sqrt{484}}{16} = \frac{-50 \pm 22}{16}$$

$$x_1 = \frac{-50+22}{16} = \frac{-28}{16} = -\frac{7}{4}$$

$$x_2 = \frac{-50-22}{16} = \frac{-72}{16} = -\frac{9}{2}$$

$$8x^2 + 50x + 63 = 8\left(x + \frac{7}{4}\right)\left(x + \frac{9}{2}\right) \\ = (4x+7)(2x+9)$$

10.  $27x^2 + 30x + 7$

$$x = \frac{-30 \pm \sqrt{(30)^2 - 4(27)(7)}}{2(27)}$$

$$x = \frac{-30 \pm \sqrt{144}}{54} = \frac{-30 \pm 12}{54}$$

$$x_1 = \frac{-30+12}{54} = -\frac{18}{54} = -\frac{1}{3}$$

$$x_2 = \frac{-30-12}{54} = -\frac{42}{54} = -\frac{7}{9}$$

$$27x^2 + 30x + 7 = 27\left(x + \frac{1}{3}\right)\left(x + \frac{7}{9}\right) \\ = (3x+1)(9x+7)$$



11.  $30x^2 - 61x + 30$

$$x = \frac{-(-61) \pm \sqrt{(-61)^2 - 4(30)(30)}}{2(30)}$$

$$x = \frac{61 \pm \sqrt{121}}{60} = \frac{61 \pm 11}{60}$$

$$x_1 = \frac{61+11}{60} = \frac{72}{60} = \frac{6}{5}$$

$$x_2 = \frac{61-11}{60} = \frac{50}{60} = \frac{5}{6}$$

$$30x^2 - 61x + 30 = 30 \left( x - \frac{6}{5} \right) \left( x - \frac{5}{6} \right) \\ = (5x-6)(6x-5)$$

12.  $11x^2 - 153x - 180$

$$x = \frac{-(-153) \pm \sqrt{(-153)^2 - 4(11)(-180)}}{2(11)}$$

$$x = \frac{153 \pm \sqrt{31.329}}{22} = \frac{153 \pm 177}{22}$$

$$x_1 = \frac{153+177}{22} = \frac{330}{22} = 15$$

$$x_2 = \frac{153-177}{22} = -\frac{24}{22} = -\frac{12}{11}$$

$$11x^2 - 153x - 180 = 11 \left( x - 15 \right) \left( x + \frac{12}{11} \right) \\ = (x-15)(11x+12)$$

13.  $6 - x - x^2$

$$x^2 + x - 6$$

$$x = -\frac{1}{2} \pm \sqrt{\frac{1}{4} - (-6)} = -\frac{1}{2} \pm \sqrt{\frac{25}{4}}$$

$$x_1 = -\frac{1}{2} + \frac{5}{2} = \frac{4}{2} = 2$$

$$x_2 = -\frac{1}{2} - \frac{5}{2} = -\frac{6}{2} = -3$$

$$x^2 + x - 6 = (x-2)(x+3)$$

$$6 - x - x^2 = (2-x)(3+x)$$

14.  $5 - 9x - 2x^2$

$$x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(-2)(5)}}{2(-2)}$$

$$x = \frac{9 \pm \sqrt{121}}{-4} = \frac{9 \pm 11}{-4}$$

$$x_1 = \frac{9+11}{-4} = \frac{20}{-4} = -5$$

$$x_2 = \frac{9-11}{-4} = \frac{-2}{-4} = \frac{1}{2}$$

**Continúa**

#### 14. Continuación

$$5 - 9x - 2x^2 = -2(x+5) \left( x - \frac{1}{2} \right)$$

$$= -(x+5)(2x-1)$$

$$= (x+5)(1-2x)$$

15.  $15 + 4x - 4x^2$

$$x = \frac{-4 \pm \sqrt{(4)^2 - 4(15)(-4)}}{2(-4)} \quad x = \frac{-4 \pm \sqrt{256}}{-8}$$

$$x_1 = \frac{-4+16}{-8} = \frac{12}{-8} = -\frac{3}{2}$$

$$x_2 = \frac{-4-16}{-8} = \frac{-20}{-8} = \frac{5}{2}$$

$$15 + 4x - 4x^2 = -4 \left( x + \frac{3}{2} \right) \left( x - \frac{5}{2} \right)$$

$$= -(2x+3)(2x-5)$$

$$= (3+2x)(5-2x)$$

16.  $4 + 13x - 12x^2$

$$12x^2 - 13x - 4$$

$$x = \frac{-(-13) \pm \sqrt{(-13)^2 - 4(12)(-4)}}{2(12)} \quad x = \frac{13 \pm \sqrt{361}}{24}$$

$$x_1 = \frac{13+19}{24} = \frac{32}{24} = \frac{4}{3}$$

$$x_2 = \frac{13-19}{24} = \frac{-6}{24} = -\frac{1}{4}$$

$$12x^2 - 13x - 4 = 12 \left( x - \frac{4}{3} \right) \left( x + \frac{1}{4} \right)$$

$$= (3x-4)(1+4x)$$

$$4 + 13x - 12x^2 = (4-3x)(1+4x)$$

17.  $72x^2 - 55x - 7$

$$x = \frac{-(-55) \pm \sqrt{(-55)^2 - 4(72)(-7)}}{2(72)} \quad x = \frac{55 \pm \sqrt{5.041}}{144}$$

$$x_1 = \frac{55+71}{144} = \frac{126}{144} = \frac{7}{8}$$

$$x_2 = \frac{55-71}{144} = \frac{-16}{144} = -\frac{1}{9}$$

$$72x^2 - 55x - 7 = 72 \left( x - \frac{7}{8} \right) \left( x + \frac{1}{9} \right)$$

$$= (8x-7)(9x+1)$$

18.  $6 + 31x - 30x^2$

$$x = \frac{-31 \pm \sqrt{(31)^2 - 4(-30)(6)}}{2(-30)}$$

$$x = \frac{-31 \pm \sqrt{1.681}}{-60}$$

$$x_1 = \frac{-31 + 41}{-60} = \frac{10}{-60} = -\frac{1}{6}$$

$$x_2 = \frac{-31 - 41}{-60} = \frac{-72}{-60} = \frac{6}{5}$$

$$\begin{aligned} 6 + 31x - 30x^2 &= -30 \left( x + \frac{1}{6} \right) \left( x - \frac{6}{5} \right) \\ &= -(6x + 1)(5x - 6) \\ &= (1 + 6x)(6 - 5x) \end{aligned}$$

19.  $10x^2 + 207x - 63$

$$x = \frac{-207 \pm \sqrt{(207)^2 - 4(10)(-63)}}{2(10)}$$

$$x = \frac{-207 \pm \sqrt{45.369}}{20}$$

$$x_1 = \frac{-207 + 213}{20} = \frac{6}{20} = \frac{3}{10}$$

$$x_2 = \frac{-207 - 213}{20} = \frac{-420}{20} = -21$$

$$\begin{aligned} 10x^2 + 207x - 63 &= 10 \left( x - \frac{3}{10} \right) (x + 21) \\ &= (10x - 3)(x + 21) \end{aligned}$$

20.  $100 - 15x - x^2$

$$x^2 + 15x - 100$$

$$x = -\frac{15}{2} \pm \sqrt{\frac{(15)^2}{4} - (-100)}$$

$$x = \frac{-15}{2} \pm \sqrt{\frac{625}{4}}$$

$$x_1 = \frac{-15}{2} + \frac{25}{2} = \frac{10}{2} = 5$$

$$x_2 = \frac{-15}{2} - \frac{25}{2} = \frac{-40}{2} = -20$$

$$\begin{aligned} x^2 + 15x - 100 &= (x - 5)(x + 20) \\ -x^2 - 15x + 100 &= -(x - 5)(x + 20) \\ &= (5 - x)(20 + x) \end{aligned}$$

21.  $18x^2 + 31x - 49$

$$x = \frac{-31 \pm \sqrt{(31)^2 - 4(18)(-49)}}{2(18)}$$

$$x = \frac{-31 \pm \sqrt{4.489}}{36}$$

$$x_1 = \frac{-31 + 67}{36} = \frac{36}{36} = 1$$

$$x_2 = \frac{-31 - 67}{36} = \frac{-98}{36} = -\frac{49}{18}$$

$$\begin{aligned} 18x^2 + 31x - 49 &= 18(x - 1) \left( x + \frac{49}{18} \right) \\ &= (x - 1)(18x + 49) \end{aligned}$$

22.  $6x^2 - ax - 2a^2$

$$x = \frac{-(-a) \pm \sqrt{(-a)^2 - 4(6)(-2a^2)}}{2(6)} = \frac{a \pm \sqrt{49a^2}}{12}$$

$$x_1 = \frac{a + 7a}{12} = \frac{8a}{12} = \frac{2a}{3}$$

$$x_2 = \frac{a - 7a}{12} = \frac{-6a}{12} = -\frac{1}{2}a$$

$$\begin{aligned} 6x^2 - ax - 2a^2 &= 6 \left( x - \frac{2}{3}a \right) \left( x + \frac{a}{2} \right) \\ &= (3x - 2a)(2x + a) \end{aligned}$$

23.  $5x^2 + 22xy - 15y^2$

$$x = \frac{-22y \pm \sqrt{(22y)^2 - 4(5)(-15y^2)}}{2(5)}$$

$$x = \frac{-22y \pm \sqrt{784y^2}}{10} = \frac{-22 \pm 28y}{10}$$

$$x_1 = \frac{-22y + 28y}{10} = \frac{6y}{10} = \frac{3}{5}y$$

$$x_2 = \frac{-22y - 28y}{10} = \frac{-50y}{10} = -5y$$

$$\begin{aligned} 5x^2 + 22xy - 15y^2 &= 5 \left( x - \frac{3y}{5} \right) (x + 5y) \\ &= (5x - 3y)(x + 5y) \end{aligned}$$

24.  $15x^2 - 32mx - 7m^2$

$$x = \frac{-(-32m) \pm \sqrt{(-32m)^2 - 4(15)(-7m^2)}}{2(15)}$$

$$x = \frac{32m \pm \sqrt{1.444m^2}}{30} = \frac{32m \pm 38m}{30}$$

$$x_1 = \frac{32m + 38m}{30} = \frac{70m}{30} = \frac{7m}{3}$$

$$x_2 = \frac{32m - 38m}{30} = \frac{-6m}{30} = -\frac{m}{5}$$

$$\begin{aligned} 15x^2 - 32mx - 7m^2 &= 15 \left( x + \frac{m}{5} \right) \left( x - \frac{7m}{3} \right) \\ &= (5x + m)(3x - 7m) \end{aligned}$$

## EJERCICIO 282

1.  $x^4 - 1 = 0$

$$(x^2 + 1)(x^2 - 1) = 0$$

$$x^2 + 1 = 0 \quad x^2 - 1 = 0$$

$$x^2 = -1 \quad x^2 = 1$$

$$x = \pm\sqrt{-1} \quad x = \pm\sqrt{1}$$

$$x = \pm i \quad x = \pm 1$$

2.  $x^3 + 1 = 0$

$$(x+1)(x^2 - x + 1) = 0$$

$$x+1=0$$

$$x_1 = -1$$

$$x^2 - x + 1 = 0$$

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4}}{2} = \frac{1 \pm \sqrt{-3}}{2}$$

$$x = \frac{1}{2} \pm \sqrt{-\frac{3}{4}} = \frac{1}{2} \pm \frac{\sqrt{3}\sqrt{-1}}{2}$$

$$x_2 = \frac{1}{2} + \frac{i\sqrt{3}}{2} = \frac{1+i\sqrt{3}}{2}$$

$$x_3 = \frac{1}{2} - \frac{i\sqrt{3}}{2} = \frac{1-i\sqrt{3}}{2}$$

3.  $x^4 = 81$

$$x^4 - 81 = 0$$

$$(x^2 - 9)(x^2 + 9) = 0$$

$$(x-3)(x+3)(x^2 + 9) = 0$$

$$x-3=0 \quad x+3=0$$

$$x_1 = 3 \quad x_2 = -3$$

$$x^2 + 9 = 0$$

$$x^2 = -9$$

$$x = \pm\sqrt{9}\sqrt{-1} = \pm\sqrt{9}i$$

$$x_3 = 3i \quad x_4 = -3i$$

4.  $x^4 - 256 = 0$

$$(x^2 - 16)(x^2 + 16) = 0$$

$$(x+4)(x-4)(x^2 + 16) = 0$$

$$x+4=0 \quad x-4=0$$

$$x_1 = -4 \quad x_2 = 4$$

$$x^2 + 16 = 0$$

$$x^2 = -16$$

$$x = \pm\sqrt{16}\sqrt{-1} = \pm 4i$$

$$x_3 = 4i \quad x_4 = -4i$$

5.  $(x^3 + 8) = 0$

$$(x+2)(x^2 - 2x + 4) = 0$$

$$x+2=0$$

$$x_1 = -2$$

$$x^2 - 2x + 4 = 0$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4}}{2} = \frac{2 \pm \sqrt{-4}}{2}$$

$$x = 1 \pm \sqrt{-\frac{12}{4}} = 1 \pm \frac{2\sqrt{3}\sqrt{-1}}{2} = 1 + i\sqrt{3}$$

$$x_2 = 1 + i\sqrt{3} \quad x_3 = 1 - i\sqrt{3}$$

6.  $x^4 - 625 = 0$

$$(x^2 - 25)(x^2 + 25) = 0$$

$$(x+5)(x-5)(x^2 + 25) = 0$$

$$x+5=0 \quad x-5=0$$

$$x_1 = -5 \quad x_2 = 5$$

$$x^2 + 25 = 0$$

$$x^2 = -25$$

$$x = \pm\sqrt{25}\sqrt{-1} = \pm 5i$$

$$x_3 = 5i \quad x_4 = -5i$$

7.  $x^3 + 64 = 0$

$$(x+4)(x^2 - 4x + 16) = 0$$

$$x+4=0$$

$$x_1 = -4$$

$$x^2 - 4x + 16 = 0$$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(16)}}{2(1)}$$

$$x = \frac{4 \pm \sqrt{16 - 64}}{2}$$

$$x_2 = \frac{4 + \sqrt{-48}}{2} = \frac{4 + 4\sqrt{3}\sqrt{-1}}{2} = 2 + 2\sqrt{3}i$$

$$x_3 = \frac{4 - \sqrt{-48}}{2} = \frac{4 - 4\sqrt{3}\sqrt{-1}}{2} = 2 - 2\sqrt{3}i$$

8.  $x^6 - 729 = 0$

$$(x^3 - 27)(x^3 + 27) = 0$$

$$(x-3)(x^2 + 3x + 9)(x+3)(x^2 - 3x + 9) = 0$$

$$x-3=0 \quad x+3=0$$

$$x_1 = 3 \quad x_2 = -3$$

$$x^2 + 3x + 9 = 0$$

Continúa

## 8. Continuación

$$x = \frac{-3}{2} \pm \sqrt{\frac{(3)^2}{4} - 9}$$

$$x = \frac{-3}{2} \pm \frac{\sqrt{27}\sqrt{-1}}{\sqrt{4}} = \frac{-3}{2} \pm \frac{3\sqrt{3}i}{2}$$

$$x_3 = \frac{-3 - 3\sqrt{3}i}{2} \quad x_4 = \frac{-3 + 3\sqrt{3}i}{2}$$

$$x^2 - 3x + 9 = 0$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 9}}{2}$$

$$x = \frac{3}{2} \pm \frac{\sqrt{27}\sqrt{-1}}{\sqrt{4}} = \frac{3}{2} \pm \frac{3\sqrt{3}i}{2}$$

$$x_5 = \frac{3 + 3\sqrt{3}i}{2} \quad x_6 = \frac{3 - 3\sqrt{3}i}{2}$$

9.  $x^3 = 8$

$$x^3 - 8 = 0$$

$$(x-2)(x^2 + 2x + 4) = 0$$

$$x-2=0$$

$$x_1 = 2$$

$$x^2 + 2x + 4 = 0$$

$$x = \frac{-2}{2} \pm \sqrt{\frac{(2)^2}{4} - 4}$$

$$x = -1 \pm \sqrt{3}\sqrt{-1}$$

$$x = -1 \pm \sqrt{3}i$$

$$x_2 = -1 + \sqrt{3}i$$

$$x_3 = -1 - \sqrt{3}i$$

10.  $x^4 = 64$

$$x^4 - 64 = 0$$

$$(x^2 - 8)(x^2 + 8) = 0$$

$$x^2 = 8 \quad x^2 = -8$$

$$x = \sqrt{2^2 \cdot 2} \quad x = \sqrt{8}\sqrt{-1}$$

$$x = \pm 2\sqrt{2} \quad x = \pm 2\sqrt{2}i$$

$$x_1 = 2\sqrt{2} \quad x_3 = 2\sqrt{2}i$$

$$x_2 = -2\sqrt{2} \quad x_4 = -2\sqrt{2}i$$

## EJERCICIO 283

1.  $x^4 - 10x^2 + 9 = 0$   
 $(x^2 - 9)(x^2 - 1) = 0$   
 $(x+3)(x-3)(x+1)(x-1) = 0$   
 $x+3=0 \quad x-3=0$   
 $x_1 = -3 \quad x_2 = 3$   
 $x+1=0 \quad x-1=0$   
 $x_3 = -1 \quad x_4 = 1$
2.  $x^4 - 13x^2 + 36 = 0$   
 $(x^2 - 4)(x^2 - 9) = 0$   
 $x^2 - 4 = 0 \quad x^2 - 9 = 0$   
 $x^2 = 4 \quad x^2 = 9$   
 $x = \pm\sqrt{4} \quad x = \pm\sqrt{9}$   
 $x_1 = 2 \quad x_3 = 3$   
 $x_2 = -2 \quad x_4 = -3$
3.  $x^4 - 29x^2 + 100 = 0$   
 $(x^2 - 25)(x^2 - 4) = 0$   
 $(x+5)(x-5)(x+2)(x-2) = 0$   
 $x+5=0 \quad x-5=0$   
 $x_1 = -5 \quad x_2 = 5$   
 $x+2=0 \quad x-2=0$   
 $x_3 = -2 \quad x_4 = 2$
4.  $x^4 - 61x^2 + 900 = 0$   
 $(x^2 - 36)(x^2 - 25) = 0$   
 $x^2 - 36 = 0 \quad x^2 - 25 = 0$   
 $x^2 = 36 \quad x^2 = 25$   
 $x = \pm\sqrt{36} \quad x = \pm\sqrt{25}$   
 $x_1 = 6 \quad x_3 = 5$   
 $x_2 = -6 \quad x_4 = -5$
5.  $x^4 + 3x^2 - 4 = 0$   
 $(x^2 + 4)(x^2 - 1) = 0$   
 $(x^2 + 4)(x+1)(x-1) = 0$   
 $x+1=0 \quad x-1=0$   
 $x_1 = -1 \quad x_2 = 1$   
 $x^2 + 4 = 0$   
 $x^2 = -4$   
 $x = \sqrt{4}\sqrt{-1} = \pm 2i$   
 $x_3 = 2i \quad x_4 = -2i$
6.  $x^4 + 16x^2 - 225 = 0$   
 $(x^2 + 25)(x^2 - 9) = 0$   
 $(x^2 + 25)(x+3)(x-3) = 0$   
 $x+3=0 \quad x-3=0$   
 $x_1 = -3 \quad x_2 = 3$   
 $x^2 + 25 = 0$   
 $x = \pm\sqrt{25}\sqrt{-1}$   
 $x_3 = 5i \quad x_4 = -5i$
7.  $x^4 - 45x^2 - 196 = 0$   
 $(x^2 - 49)(x^2 + 4) = 0$   
 $(x+7)(x-7)(x^2 + 4) = 0$   
 $x+7=0 \quad x-7=0$   
 $x_1 = -7 \quad x_2 = 7$   
 $x^2 + 4 = 0$   
 $x^2 = -4$   
 $x = \sqrt{4}\sqrt{-1} = \pm 2i$   
 $x_3 = 2i \quad x_4 = -2i$
8.  $x^4 - 6x^2 + 5 = 0$   
 $(x^2 - 5)(x^2 - 1) = 0$   
 $(x^2 - 5)(x+1)(x-1) = 0$   
 $x+1=0 \quad x-1=0$   
 $x_1 = -1 \quad x_2 = 1$   
 $x^2 - 5 = 0$   
 $x^2 = 5$   
 $x = \pm\sqrt{5}$   
 $x_3 = \sqrt{5} \quad x_4 = -\sqrt{5}$
9.  $4x^4 - 37x^2 + 9 = 0$   
 $(4x^2)^2 - 37(4x^2) + 36 = 0$   
 $(4x^2 - 36)(4x^2 - 1) = 0$   
 $(x^2 - 9)(4x^2 - 1) = 0$   
 $x^2 - 9 = 0 \quad 4x^2 - 1 = 0$   
 $x^2 = 9 \quad x = \pm\sqrt{\frac{1}{4}}$   
 $x = \pm\sqrt{9}$   
 $x_1 = 3 \quad x_3 = \frac{1}{2}$   
 $x_2 = -3 \quad x_4 = -\frac{1}{2}$
10.  $9x^4 - 40x^2 + 16 = 0$   
 $(9x^2)^2 - 40(9x^2) + 144 = 0$   
 $(9x^2 - 36)(9x^2 - 4) = 0$   
 $(x^2 - 4)(9x^2 - 4) = 0$   
 $(x+2)(x-2)(9x^2 - 4) = 0$   
 $x+2=0 \quad x-2=0$   
 $x_1 = -2 \quad x_2 = 2$   
 $9x^2 - 4 = 0$   
 $x = \pm\sqrt{\frac{4}{9}}$   
 $x_3 = \frac{2}{3} \quad x_4 = -\frac{2}{3}$
11.  $25x^4 + 9x^2 - 16 = 0$   
 $25(x^2)^2 + 9x^2 - 16 = 0$   
 $x^2 = \frac{-9 \pm \sqrt{(9)^2 - 4(25)(-16)}}{2(25)}$   
 $x^2 = \frac{-9 \pm \sqrt{1.681}}{50} = \frac{-9 \pm 41}{50}$   
 $x^2 = \frac{-9 + 41}{50} = \frac{32}{50} = \frac{16}{25}$   
 $x = \pm\sqrt{\frac{16}{25}} \quad x_1 = \frac{4}{5} \quad x_2 = -\frac{4}{5}$   
 $x^2 = \frac{-9 - 41}{50} = \frac{-50}{50} = -1$   
 $x = \pm\sqrt{-1} \quad x_3 = i \quad x_4 = -i$
12.  $4x^4 + 11x^2 - 3 = 0$   
 $(4x^2)^2 + 11(4x^2) - 12 = 0$   
 $(4x^2 + 12)(4x^2 - 1) = 0$   
 $(x^2 + 3)(4x^2 - 1) = 0$   
 $x^2 + 3 = 0$   
 $x^2 = -3$   
 $x = \pm\sqrt{-3} = \pm\sqrt{3}\sqrt{-1} = \pm\sqrt{3}i$   
 $x_1 = \sqrt{3}i \quad x_2 = -\sqrt{3}i$   
 $4x^2 - 1 = 0$   
 $(2x+1)(2x-1) = 0$   
 $2x+1=0 \quad 2x-1=0$   
 $x_3 = -\frac{1}{2} \quad x_4 = \frac{1}{2}$

$$\begin{aligned}
13. \quad & (2x^2+1)^2 - (x^2-3)^2 = 80 \\
& 4x^4 + 4x^2 + 1 - x^4 + 6x^2 - 9 = 80 \\
& 3x^4 + 10x^2 - 88 = 0 \\
& (3x^2)^2 + 10(3x^2) - 264 = 0 \\
& (3x^2 + 22)(3x^2 - 12) = 0 \\
& (3x^2 + 22)(x^2 - 4) = 0 \\
& (3x^2 + 22)(x+2)(x-2) = 0 \\
& x+2=0 \quad x-2=0 \\
& x_1 = -2 \quad x_2 = 2 \\
& 3x^2 + 22 = 0 \\
& x^2 = \frac{-22}{3} \\
& x = \pm \frac{\sqrt{22} \sqrt{-1}}{\sqrt{3}} \\
& x_3 = i \frac{\sqrt{22}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{i\sqrt{66}}{3} \\
& x_4 = -i \frac{\sqrt{22}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{-i\sqrt{66}}{3}
\end{aligned}$$

$$\begin{aligned}
14. \quad & x^2(3x^2+2) = 4(x^2-3)+13 \\
& 3x^4 + 2x^2 = 4x^2 - 12 + 13 \\
& 3x^4 - 2x^2 - 1 = 0 \\
& (3x^2)^2 - 2(3x^2) - 3 = 0 \\
& (3x^2 - 3)(3x^2 + 1) = 0 \\
& (x^2 - 1)(3x^2 + 1) = 0 \\
& (x+1)(x-1)(3x^2 + 1) = 0 \\
& x+1=0 \quad x-1=0 \\
& x_1 = -1 \quad x_2 = 1 \\
& 3x^2 + 1 = 0 \\
& x = \frac{\sqrt{-1}}{\sqrt{3}} = \pm \frac{i}{\sqrt{3}} \\
& x_3 = \frac{i}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{i\sqrt{3}}{3} \\
& x_4 = -\frac{i}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{-i\sqrt{3}}{3}
\end{aligned}$$

## EJERCICIO 284

$$\begin{aligned}
1. \quad & x^6 - 7x^3 - 8 = 0 \\
& (x^3 - 8)(x^3 + 1) = 0 \\
& x^3 - 8 = 0 \quad x^3 + 1 = 0 \\
& x^3 = 8 \quad x^3 = -1 \\
& x = \sqrt[3]{8} \quad x = \sqrt[3]{-1} \\
& x_1 = 2 \quad x_2 = -1 \\
& (x^3 - 8) = 0 \\
& (x-2)(x^2 + 2x + 4) = 0 \\
& x^2 + 2x + 4 = 0 \\
& (\text{ver ejerc. 282 prob.9}) \\
& x_3 = -1 + \sqrt{3}i \\
& x_4 = -1 - \sqrt{3}i \\
& (x^3 + 1) = 0 \\
& (x+1)(x^2 - x + 1) \\
& (\text{ver ejerc. 282 prob.2}) \\
& x_5 = \frac{1 + \sqrt{3}i}{2} \quad x_6 = \frac{1 - \sqrt{3}i}{2}
\end{aligned}$$

$$\begin{aligned}
2. \quad & x^6 + 30x^3 + 81 = 0 \\
& (x^3 + 27)(x^3 + 3) = 0 \\
& x^3 + 27 = 0 \quad x^3 + 3 = 0 \\
& x^3 = -27 \quad x^3 = -3 \\
& x = \sqrt[3]{-27} \quad x = \sqrt[3]{-3} \\
& x = -3 \quad x = -\sqrt[3]{3}
\end{aligned}$$

$$\begin{aligned}
3. \quad & 8x^6 + 15x^3 - 2 = 0 \\
& (8x^3)^2 + 15(8x^3) - 16 = 0 \\
& (8x^3 + 16)(8x^3 - 1) = 0 \\
& (x^3 + 2)(8x^3 - 1) = 0 \\
& x^3 + 2 = 0 \quad 8x^3 - 1 = 0 \\
& x^3 = -2 \quad x = \sqrt[3]{\frac{1}{8}} \\
& x = \sqrt[3]{-2} \quad x = \frac{1}{2} \\
& x = -\sqrt[3]{2}
\end{aligned}$$

$$\begin{aligned}
4. \quad & x^8 - 41x^4 + 400 = 0 \\
& (x^4 - 25)(x^4 - 16) = 0 \\
& (x^2 + 5)(x^2 - 5)(x^2 + 4)(x^2 - 4) = 0 \\
& x^2 - 5 = 0 \quad x^2 - 4 = 0 \\
& x = \pm\sqrt{5} \quad x = \pm\sqrt{4} \\
& x = \pm 2
\end{aligned}$$

$$\begin{aligned}
5. \quad & x^{10} - 33x^5 + 32 = 0 \\
& (x^5 - 32)(x^5 - 1) = 0 \\
& x^5 - 32 = 0 \quad x^5 - 1 = 0 \\
& x = \sqrt[5]{32} \quad x = \sqrt[5]{1} \\
& x = 2 \quad x = 1
\end{aligned}$$

$$\begin{aligned}
6. \quad & x^{-4} - 13x^{-2} + 36 = 0 \\
& (x^{-2} - 9)(x^{-2} - 4) = 0 \\
& x^{-2} - 9 = 0 \quad x^{-2} - 4 = 0 \\
& x^{-2} = 9 \quad x^{-2} = 4 \\
& \frac{1}{x^2} = 9 \quad \frac{1}{x^2} = 4 \\
& \frac{1}{9} = x^2 \quad \frac{1}{4} = x^2 \\
& \pm\sqrt{\frac{1}{9}} = x \quad \pm\sqrt{\frac{1}{4}} = x \\
& x_1 = \frac{1}{3}; \quad x_2 = -\frac{1}{3}; \quad x_3 = \frac{1}{2}; \quad x_4 = -\frac{1}{2}
\end{aligned}$$

7.  $x^{-6} + 35x^{-3} = -216$

$$x^{-6} + 35x^{-3} + 216 = 0$$

$$(x^{-3} + 27)(x^{-3} + 8) = 0$$

$$x^{-3} + 27 = 0 \quad x^{-3} + 8 = 0$$

$$x^{-3} = -27 \quad x^{-3} = -8$$

$$\frac{1}{x^3} = -27 \quad \frac{1}{x^3} = -8$$

$$\sqrt[3]{\frac{1}{-27}} = x \quad \sqrt[3]{\frac{1}{-8}} = x$$

$$x = -\frac{1}{3} \quad x = -\frac{1}{2}$$

10.  $x + x^{\frac{1}{2}} = 6$

$$x + x^{\frac{1}{2}} - 6 = 0$$

$$\left(x^{\frac{1}{2}} + 3\right)\left(x^{\frac{1}{2}} - 2\right) = 0$$

$$x^{\frac{1}{2}} + 3 = 0 \quad x^{\frac{1}{2}} - 2 = 0$$

$$\sqrt{x} = -3 \quad \sqrt{x} = 2$$

$$x = (-3)^2 \quad x = (2)^2$$

$$x = 9 \quad x = 4$$

8.  $x^{-10} = 242x^{-5} + 243$

$$x^{-10} - 242x^{-5} - 243 = 0$$

$$(x^{-5} - 243)(x^{-5} + 1) = 0$$

$$x^{-5} - 243 = 0 \quad x^{-5} + 1 = 0$$

$$x^{-5} = 243 \quad x^{-5} = -1$$

$$\frac{1}{x^5} = 243 \quad \frac{1}{x^5} = -1$$

$$\sqrt[5]{\frac{1}{243}} = x \quad \sqrt[5]{\frac{1}{-1}} = x$$

$$x = \frac{1}{3} \quad x = -1$$

11.  $3x = 16\sqrt{x} - 5$

$$3x - 16x^{\frac{1}{2}} + 5 = 0$$

$$9x - 16\left(3x^{\frac{1}{2}}\right) + 15 = 0$$

$$\left(3x^{\frac{1}{2}} - 15\right)\left(3x^{\frac{1}{2}} - 1\right) = 0$$

$$3x^{\frac{1}{2}} - 15 = 0 \quad 3x^{\frac{1}{2}} - 1 = 0$$

$$\sqrt{x} = \frac{15}{3} \quad \sqrt{x} = \frac{1}{3}$$

$$x = (5)^2 \quad x = \left(\frac{1}{3}\right)^2$$

$$x = 25 \quad x = \frac{1}{9}$$

9.  $x^3 - 9x^{\frac{3}{2}} + 8 = 0$

$$\left(x^{\frac{3}{2}} - 8\right)\left(x^{\frac{3}{2}} - 1\right) = 0$$

$$x^{\frac{3}{2}} - 8 = 0 \quad x^{\frac{3}{2}} - 1 = 0$$

$$\sqrt{x^3} = 8 \quad \sqrt{x^3} = 1$$

$$x^3 = 64 \quad x^3 = 1$$

$$x = \sqrt[3]{64} \quad x = 1$$

$$x = 4$$

12.  $2x^{\frac{1}{2}} - 5x^{\frac{1}{4}} + 2 = 0$

$$4x^{\frac{1}{2}} - 5\left(2x^{\frac{1}{4}}\right) + 4 = 0$$

$$\left(2x^{\frac{1}{4}} - 4\right)\left(2x^{\frac{1}{4}} - 1\right) = 0$$

$$\left(x^{\frac{1}{4}} - 2\right)\left(2x^{\frac{1}{4}} - 1\right) = 0$$

$$x^{\frac{1}{4}} - 2 = 0 \quad 2x^{\frac{1}{4}} - 1 = 0$$

$$x^{\frac{1}{4}} = 2 \quad 2\sqrt[4]{x} = 1$$

$$\sqrt[4]{x} = 2 \quad x = \left(\frac{1}{2}\right)^4$$

$$x = (2)^4 \quad x = \frac{1}{16}$$

$$x = 16$$

## EJERCICIO 285

1.  $\sqrt{5 + \sqrt{24}}$

$$m = \sqrt{(5)^2 - 24}$$

$$m = \sqrt{1}$$

$$m = 1$$

$$= \sqrt{\frac{5+1}{2}} + \sqrt{\frac{5-1}{2}}$$

$$= \sqrt{3} + \sqrt{2}$$

3.  $\sqrt{8 + \sqrt{28}}$

$$m = \sqrt{(8)^2 - 28}$$

$$m = \sqrt{36}$$

$$m = 6$$

$$= \sqrt{\frac{8+6}{2}} + \sqrt{\frac{8-6}{2}}$$

$$= \sqrt{7} + 1$$

5.  $\sqrt{14 + \sqrt{132}}$

$$m = \sqrt{(14)^2 - 132}$$

$$m = \sqrt{64} = 8$$

$$= \sqrt{\frac{14+8}{2}} + \sqrt{\frac{14-8}{2}}$$

$$= \sqrt{11} + \sqrt{3}$$

7.  $\sqrt{11 + 2\sqrt{30}}$

$$m = \sqrt{11 + 2\sqrt{120}}$$

$$m = \sqrt{(11)^2 - 120} = 1$$

$$= \sqrt{\frac{11+1}{2}} + \sqrt{\frac{11-1}{2}}$$

$$= \sqrt{6} + \sqrt{5}$$

2.  $\sqrt{8 - \sqrt{60}}$

$$m = \sqrt{(8)^2 - 60}$$

$$m = \sqrt{4}$$

$$m = 2$$

$$= \sqrt{\frac{8+2}{2}} - \sqrt{\frac{8-2}{2}}$$

$$= \sqrt{5} - \sqrt{3}$$

4.  $\sqrt{32 - \sqrt{700}}$

$$m = \sqrt{(32)^2 - 700}$$

$$m = \sqrt{324} = 18$$

$$= \sqrt{\frac{32+18}{2}} - \sqrt{\frac{32-18}{2}}$$

$$= \sqrt{25} - \sqrt{7}$$

$$= 5 - \sqrt{7}$$

6.  $\sqrt{13 + \sqrt{88}}$

$$m = \sqrt{(13)^2 - 88}$$

$$m = \sqrt{81} = 9$$

$$= \sqrt{\frac{13+9}{2}} + \sqrt{\frac{13-9}{2}}$$

$$= \sqrt{11} + \sqrt{2}$$

8.  $\sqrt{84 - 18\sqrt{3}}$

$$m = \sqrt{84 - 9\sqrt{972}}$$

$$m = \sqrt{(84)^2 - 972}$$

$$m = \sqrt{6.084} = 78$$

$$= \sqrt{\frac{84+78}{2}} - \sqrt{\frac{84-78}{2}}$$

$$= \sqrt{81} - \sqrt{3} = 9 - \sqrt{3}$$

$$\begin{aligned}
 9. & \sqrt{21+6\sqrt{10}} \\
 & \sqrt{21+\sqrt{360}} \\
 m &= \sqrt{(21)^2 - 360} \\
 m &= \sqrt{81} = 9 \\
 &= \sqrt{\frac{21+9}{2}} + \sqrt{\frac{21-9}{2}} = \sqrt{15} + \sqrt{6}
 \end{aligned}$$

$$\begin{aligned}
 10. & \sqrt{28+14\sqrt{3}} \\
 & \sqrt{28+\sqrt{588}} \\
 m &= \sqrt{(28)^2 - 588} \\
 m &= \sqrt{196} = 14 \\
 &= \sqrt{\frac{28+14}{2}} + \sqrt{\frac{28-14}{2}} \\
 &= \sqrt{21} + \sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 11. & \sqrt{14-4\sqrt{6}} \\
 & \sqrt{14-\sqrt{96}} \\
 m &= \sqrt{(14)^2 - 96} \\
 m &= \sqrt{100} = 10 \\
 &= \sqrt{\frac{14+10}{2}} - \sqrt{\frac{14-10}{2}} \\
 &= \sqrt{12} - \sqrt{2} \\
 &= \sqrt{2^2 \cdot 3} - \sqrt{2} = 2\sqrt{3} - \sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 12. & \sqrt{55+30\sqrt{2}} \\
 & \sqrt{55+\sqrt{1.800}} \\
 m &= \sqrt{(55)^2 - 1.800} \\
 m &= \sqrt{1.225} = 35 \\
 &= \sqrt{\frac{55+35}{2}} + \sqrt{\frac{55-35}{2}} \\
 &= \sqrt{45} + \sqrt{10} = 3\sqrt{5} + \sqrt{10}
 \end{aligned}$$

$$\begin{aligned}
 13. & \sqrt{73-12\sqrt{35}} \\
 & \sqrt{73-\sqrt{5.040}} \\
 m &= \sqrt{(73)^2 - 5.040} \\
 m &= \sqrt{289} = 17 \\
 &= \sqrt{\frac{73+17}{2}} - \sqrt{\frac{73-17}{2}} \\
 &= \sqrt{45} - \sqrt{28} = 3\sqrt{5} - 2\sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 14. & \sqrt{253-60\sqrt{7}} \\
 & \sqrt{253-\sqrt{25.200}} \\
 m &= \sqrt{(253)^2 - 25.200} \\
 m &= \sqrt{38.809} = 197 \\
 &= \sqrt{\frac{253+197}{2}} - \sqrt{\frac{253-197}{2}} \\
 &= \sqrt{225} - \sqrt{28} = 15 - 2\sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 15. & \sqrt{293-30\sqrt{22}} \\
 & \sqrt{293-\sqrt{19.800}} \\
 m &= \sqrt{(293)^2 - 19.800} \\
 m &= \sqrt{66.049} = 257 \\
 &= \sqrt{\frac{293+257}{2}} - \sqrt{\frac{293-257}{2}} \\
 &= \sqrt{275} - \sqrt{18} = 5\sqrt{11} - 3\sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 16. & \sqrt{\frac{5}{6} + \sqrt{\frac{2}{3}}} \\
 m &= \sqrt{\left(\frac{5}{6}\right)^2 - \frac{2}{3}} \\
 m &= \sqrt{\frac{1}{36}} = \frac{1}{6} \\
 &= \sqrt{\frac{\frac{5}{6} + \frac{1}{6}}{2}} + \sqrt{\frac{\frac{5}{6} - \frac{1}{6}}{2}} \\
 &= \sqrt{\frac{1}{2}} + \sqrt{\frac{1}{3}} = \frac{\sqrt{1}\sqrt{2}}{\sqrt{2}\sqrt{2}} + \frac{\sqrt{1}\sqrt{3}}{\sqrt{3}\sqrt{3}} \\
 &= \frac{1}{2}\sqrt{2} + \frac{1}{3}\sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 17. & \sqrt{\frac{3}{4} - \sqrt{\frac{1}{2}}} \\
 m &= \sqrt{\left(\frac{3}{4}\right)^2 - \frac{1}{2}} \\
 m &= \sqrt{\frac{1}{16}} = \frac{1}{4} \\
 &= \sqrt{\frac{\frac{3}{4} + \frac{1}{4}}{2}} - \sqrt{\frac{\frac{3}{4} - \frac{1}{4}}{2}} \\
 &= \sqrt{\frac{1}{2}} - \sqrt{\frac{1}{4}} = \frac{\sqrt{2}}{2} - \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 18. & \sqrt{\frac{9}{16} + \sqrt{\frac{1}{8}}} \\
 m &= \sqrt{\left(\frac{9}{16}\right)^2 - \frac{1}{8}} \\
 m &= \sqrt{\frac{49}{256}} = \frac{7}{16} \\
 &= \sqrt{\frac{\frac{9}{16} + \frac{7}{16}}{2}} + \sqrt{\frac{\frac{9}{16} - \frac{7}{16}}{2}} \\
 &= \sqrt{\frac{1}{2}} + \sqrt{\frac{1}{16}} = \frac{\sqrt{2}}{2} + \frac{1}{4}
 \end{aligned}$$

$$\begin{aligned}
 19. & \sqrt{6+4\sqrt{2}} \\
 & \sqrt{6+\sqrt{32}} \\
 m &= \sqrt{(6)^2 - 32} \\
 m &= \sqrt{4} = 2 \\
 &= \sqrt{\frac{6+2}{2}} + \sqrt{\frac{6-2}{2}} \\
 &= \sqrt{4} + \sqrt{2} = 2 + \sqrt{2}
 \end{aligned}$$

$$\begin{aligned}
 20. & \sqrt{7+4\sqrt{3}} \\
 & \sqrt{7+\sqrt{48}} \\
 m &= \sqrt{(7)^2 - 48} = 1 \\
 &= \sqrt{\frac{7+1}{2}} + \sqrt{\frac{7-1}{2}} \\
 &= \sqrt{4} + \sqrt{3} = 2 + \sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 21. & \sqrt{8+2\sqrt{7}} \\
 & \sqrt{8+\sqrt{28}} \\
 m &= \sqrt{(8)^2 - 28} \\
 m &= \sqrt{36} = 6 \\
 &= \sqrt{\frac{8+6}{2}} + \sqrt{\frac{8-6}{2}} \\
 &= \sqrt{7} + 1
 \end{aligned}$$

$$\begin{aligned}
 22. & \frac{\sqrt{10+2\sqrt{21}}}{\sqrt{10+\sqrt{84}}} \\
 & m = \sqrt{(10)^2 - 84} \\
 & m = \sqrt{16} = 4 \\
 & = \sqrt{\frac{10+4}{2}} + \sqrt{\frac{10-4}{2}} \\
 & = \sqrt{7} + \sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 23. & \frac{\sqrt{18+6\sqrt{5}}}{\sqrt{18+\sqrt{180}}} \\
 & m = \sqrt{(18)^2 - 180} \\
 & m = \sqrt{144} = 12 \\
 & = \sqrt{\frac{18+12}{2}} + \sqrt{\frac{18-12}{2}} \\
 & = \sqrt{15} + \sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 24. & \frac{\sqrt{24-2\sqrt{143}}}{\sqrt{24-\sqrt{572}}} \\
 & m = \sqrt{(24)^2 - 572} \\
 & m = \sqrt{4} = 2 \\
 & = \sqrt{\frac{24+2}{2}} - \sqrt{\frac{24-2}{2}} \\
 & = \sqrt{13} - \sqrt{11}
 \end{aligned}$$

$$\begin{aligned}
 25. & \frac{\sqrt{30-20\sqrt{2}}}{\sqrt{30-\sqrt{800}}} \\
 & m = \sqrt{(30)^2 - 800} \\
 & m = \sqrt{100} = 10 \\
 & = \sqrt{\frac{30+10}{2}} - \sqrt{\frac{30-10}{2}} \\
 & = \sqrt{20} - \sqrt{10} = 2\sqrt{5} - \sqrt{10}
 \end{aligned}$$

$$\begin{aligned}
 26. & \frac{\sqrt{9+6\sqrt{2}}}{\sqrt{9+\sqrt{72}}} \\
 & m = \sqrt{(9)^2 - 72} \\
 & m = \sqrt{9} = 3 \\
 & = \sqrt{\frac{9+3}{2}} + \sqrt{\frac{9-3}{2}} \\
 & = \sqrt{6} + \sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 27. & \frac{\sqrt{98-24\sqrt{5}}}{\sqrt{98-\sqrt{2.880}}} \\
 & m = \sqrt{(98)^2 - 2.880} \\
 & m = \sqrt{6.724} = 82 \\
 & = \sqrt{\frac{98+82}{2}} - \sqrt{\frac{98-82}{2}} \\
 & = \sqrt{90} - \sqrt{8} = 3\sqrt{10} - 2\sqrt{2}
 \end{aligned}$$

## EJERCICIO 286

Los problemas de este ejercicio se resuelven aplicando la siguiente formula:

$u = a + (n - 1)r$  donde:

$u$  es el término enésimo ;  $a$  es el primer término de la progresión ;  $n$  es la cantidad de términos ;  $r$  es la razón de cambio.

1.  $a=7$   $n=9$   $r=10-7=3$

$$u = 7 + 8(3) = 7 + 24 = 31$$

2.  $a=5$   $n=12$   $r=10-5=5$

$$u = 5 + 11(5) = 5 + 55 = 60$$

3.  $a=9$   $n=48$   $r=15-12=3$

$$u = 9 + 47(3) = 9 + 141 = 150$$

4.  $a=3$   $n=63$   $r=17-10=7$

$$u = 3 + 62(7) = 3 + 434 = 437$$

5.  $a=11$   $n=12$   $r=6-11=-5$

$$u = 11 + 11(-5) = 11 - 55 = -44$$

6.  $a=19$   $n=28$   $r=5-12=-7$

$$u = 19 + 27(-7) = 19 - 189 = -170$$

7.  $a=3$   $n=13$   $r=-5-(-1)=-4$

$$u = 3 + 12(-4) = 3 - 48 = -45$$

8.  $a=8$   $n=54$   $r=0-8=-8$

$$u = 8 + 53(-8) = 8 - 424 = -416$$

9.  $a=-7$   $n=31$   $r=1-(-3)=4$

$$u = -7 + 30(4) = -7 + 120 = 113$$

10.  $a=-8$   $n=17$   $r=12-2=10$

$$u = -8 + 16(10) = -8 + 160 = 152$$

11.  $a = \frac{1}{2}$   $n = 12$   $r = \frac{3}{4} - \frac{1}{2} = \frac{1}{4}$

$$u = \frac{1}{2} + 11\left(\frac{1}{4}\right) = \frac{1}{2} + \frac{11}{4} = \frac{13}{4} = 3\frac{1}{4}$$

15.  $a = \frac{7}{2}$   $n = 27$   $r = \frac{21}{4} - \frac{7}{2} = \frac{7}{4}$

$$u = \frac{7}{2} + 26\left(\frac{7}{4}\right) = \frac{7}{2} + \frac{91}{2} = \frac{98}{2} = 49$$

12.  $a = \frac{2}{3}$   $n = 17$   $r = \frac{5}{6} - \frac{2}{3} = \frac{1}{6}$

$$u = \frac{2}{3} + 16\left(\frac{1}{6}\right)$$

$$u = \frac{2}{3} + \frac{8}{3} = \frac{10}{3} = 3\frac{1}{3}$$

16.  $a = \frac{7}{9}$   $n = 36$   $r = \frac{1}{3} - \frac{7}{9} = -\frac{4}{9}$

$$u = \frac{7}{9} + 35\left(-\frac{4}{9}\right)$$

$$u = \frac{7}{9} - \frac{140}{9} = -\frac{133}{9} = -14\frac{7}{9}$$

13.  $a = \frac{3}{8}$   $n = 25$   $r = \frac{11}{24} - \frac{3}{8} = \frac{1}{12}$

$$u = \frac{3}{8} + 24\left(\frac{1}{12}\right)$$

$$u = \frac{3}{8} + 2 = \frac{19}{8} = 2\frac{3}{8}$$

17.  $a = \frac{2}{7}$   $n = 15$   $r = \frac{1}{8} - \frac{2}{7} = -\frac{9}{56}$

$$u = \frac{2}{7} + 14\left(-\frac{9}{56}\right)$$

$$u = \frac{2}{7} - \frac{126}{56} = -\frac{110}{56} = -1\frac{27}{28}$$

14.  $a = \frac{1}{3}$   $n = 19$   $r = \frac{7}{8} - \frac{1}{3} = \frac{13}{24}$

$$u = \frac{1}{3} + 18\left(\frac{13}{24}\right)$$

$$u = \frac{1}{3} + \frac{39}{4} = \frac{121}{12} = 10\frac{1}{12}$$

18.  $a = -\frac{3}{5}$   $n = 21$   $r = -\frac{14}{15} + \frac{3}{5} = -\frac{1}{15}$

$$u = -\frac{3}{5} + 20\left(-\frac{1}{15}\right)$$

$$u = -\frac{3}{5} - \frac{20}{15} = -\frac{109}{15} = -7\frac{4}{15}$$



$$\begin{array}{ll}
 \text{19. } a = -\frac{1}{4} \quad n = 13 \quad r = -\frac{9}{4} + \frac{1}{4} = -2 & \text{22. } a = \frac{14}{5} \quad n = 41 \quad r = \frac{27}{10} - \frac{14}{5} = -\frac{1}{10} \\
 u = -\frac{1}{4} + 12(-2) = -\frac{1}{4} - 24 = -\frac{97}{4} = -24\frac{1}{4} & u = \frac{14}{5} + 40\left(-\frac{1}{10}\right) \\
 & u = \frac{14}{5} - 4 = -\frac{6}{5} = -1\frac{1}{5} \\
 \text{20. } a = -\frac{5}{6} \quad n = 19 \quad r = -\frac{1}{3} + \frac{5}{6} = \frac{1}{2} & \text{23. } a = -\frac{3}{5} \quad n = 26 \quad r = \frac{3}{10} + \frac{3}{5} = \frac{9}{10} \\
 u = -\frac{5}{6} + 18\left(\frac{1}{2}\right) = -\frac{5}{6} + 9 = \frac{49}{6} = 8\frac{1}{6} & u = -\frac{3}{5} + 25\left(\frac{9}{10}\right) \\
 & u = -\frac{3}{5} + \frac{45}{2} = \frac{219}{10} = 21\frac{9}{10} \\
 \text{21. } a = \frac{11}{3} \quad n = 33 \quad r = \frac{35}{12} - \frac{11}{3} = -\frac{3}{4} & \text{24. } a = -4 \quad n = 19 \\
 u = \frac{11}{3} + 32\left(-\frac{3}{4}\right) = \frac{11}{3} - 24 = -\frac{61}{3} = -20\frac{1}{3} & r = -\frac{2}{3} + 4 = \frac{10}{3} \\
 & u = -4 + 18\left(\frac{10}{3}\right) \\
 & u = -4 + 60 = 56 \\
 & \text{25. } a = 3 \quad n = 39 \\
 & r = -\frac{5}{4} - 3 = -\frac{17}{4} \\
 & u = 3 + 38\left(-\frac{17}{4}\right) \\
 & u = 3 - \frac{323}{2} = -\frac{317}{2} = -158\frac{1}{2}
 \end{array}$$

## EJERCICIO 287

Para resolver los problemas de este ejercicio se utilizan las siguientes formulas:

$$a = u - (n-1)r \quad r = \frac{u-a}{n-1} \quad n = \frac{u-a+r}{r}$$

Donde  $u$  es el término enésimo ;  $r$  es la razón de cambio ;  $n$  es la cantidad de términos ;  $a$  es el primer término de la progresión.

1.  $u = 20 \quad r = \frac{2}{7} \quad n = 15$

$$a = 20 - (14)\left(\frac{2}{7}\right)$$

$$a = 20 - 4 = 16$$

2.  $u = -18 \quad n = 32 \quad r = 3$

$$a = -18 - (31)(3)$$

$$a = -18 - 93 = -111$$

3.  $u = 1 \quad n = 9 \quad r = 1 - \frac{3}{4} = \frac{1}{4}$

$$a = 1 - (8)\left(\frac{1}{4}\right) = 1 - 2 = -1$$

4.  $u = \frac{25}{3} \quad n = 7$

Se plantea la ecuación para encontrar la razón

$$\frac{25}{3} - 2r = 7$$

$$-2r = 7 - \frac{25}{3}$$

$$-2r = -\frac{4}{3}$$

Continúa

### 4. Continuación

$$r = \frac{4}{6} = \frac{2}{3}$$

$$a = \frac{25}{3} - (6)\left(\frac{2}{3}\right)$$

$$a = \frac{25}{3} - \frac{12}{3} = \frac{13}{3} = 4\frac{1}{3}$$

5.  $a = 3 \quad n = 6 \quad u = 8$

$$r = \frac{8-3}{6-1} = \frac{5}{5} = 1$$

6.  $a = -1 \quad n = 10 \quad u = -4$

$$r = \frac{-4 - (-1)}{10-1} = -\frac{3}{9} = -\frac{1}{3}$$

7.  $a = \frac{1}{2} \quad n = 17 \quad u = -\frac{3}{8}$

$$r = \frac{\frac{3}{8} - \frac{1}{2}}{17-1} = \frac{-\frac{1}{8}}{16} = -\frac{1}{128}$$

8.  $a = 5 \quad n = 18 \quad u = -80$

$$r = \frac{-80-5}{18-1} = \frac{-85}{17} = -5$$

9.  $a = -42 \quad n = 92 \quad u = 1.050$

$$r = \frac{1.050 - (-42)}{92-1} = \frac{1.092}{91} = 12$$

10.  $a = 4 \quad u = 30$

$$r = 6 - 4 = 2$$

$$n = \frac{30-4+2}{2} = \frac{28}{2} = 14$$

11.  $a = 5 \quad u = 18$

$$r = \frac{16}{3} - 5 = \frac{1}{3}$$

$$n = \frac{18-5+\frac{1}{3}}{\frac{1}{3}}$$

$$n = \frac{13+\frac{1}{3}}{\frac{1}{3}} = \frac{40}{\frac{1}{3}} = 40$$

12.  $a = \frac{26}{5} \quad u = 18$

$$r = 6 - \frac{26}{5} = \frac{4}{5}$$

$$n = \frac{18 - \frac{26}{5} + \frac{4}{5}}{\frac{4}{5}}$$

$$n = \frac{18 - \frac{22}{5} + \frac{68}{5}}{\frac{4}{5}} = \frac{5}{\frac{4}{5}} = \frac{68}{4} = 17$$

## EJERCICIO 288

$$\begin{aligned}
 1. \quad r &= 19 - 15 = 4 \\
 a &= 15 \quad n = 8 \\
 u &= 15 + (7)4 \\
 u &= 15 + 28 = 43 \\
 s &= \frac{(15 + 43)8}{2} \\
 s &= (58)(4) = 232
 \end{aligned}$$

$$\begin{aligned}
 2. \quad a &= 31 \quad n = 19 \\
 r &= 7 \\
 u &= 31 + (18)7 \\
 u &= 31 + 126 = 157 \\
 s &= \frac{(31 + 157)(19)}{2} \\
 s &= \frac{3.572}{2} = 1.786
 \end{aligned}$$

$$\begin{aligned}
 3. \quad a &= 42 \quad n = 24 \quad r = -10 \\
 u &= 42 + (23)(-10) \\
 u &= -188 \\
 s &= \frac{(42 - 188)(24)}{2} \\
 s &= (-146)(12) = -1.752
 \end{aligned}$$

$$\begin{aligned}
 4. \quad a &= -10 \quad n = 80 \quad r = 4 \\
 u &= -10 + (79)(4) \\
 u &= -10 + 316 = 306 \\
 s &= \frac{(-10 + 306)(80)}{2} \\
 s &= (296)(40) = 11.840
 \end{aligned}$$

$$\begin{aligned}
 5. \quad a &= 11 \quad n = 60 \quad r = -10 \\
 u &= 11 + (59)(-10) \\
 u &= 11 - 590 = -579 \\
 s &= \frac{(11 - 579)(60)}{2} \\
 s &= (-568)(30) = -17.040
 \end{aligned}$$

$$\begin{aligned}
 6. \quad a &= -5 \quad n = 50 \quad r = -8 \\
 u &= -5 + (49)(-8) \\
 u &= -5 - 392 = -397 \\
 s &= \frac{(-5 - 397)(50)}{2} \\
 s &= (-402)(25) = -10.050
 \end{aligned}$$

$$\begin{aligned}
 7. \quad a &= \frac{1}{2} \quad n = 9 \quad r = \frac{1}{2} \\
 u &= \frac{1}{2} + (8)\left(\frac{1}{2}\right) \\
 u &= \frac{1}{2} + 4 = \frac{9}{2} \\
 s &= \frac{\left(\frac{1}{2} + \frac{9}{2}\right)(9)}{2} \\
 s &= \frac{45}{2} = 22\frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad a &= \frac{3}{10} \quad n = 14 \quad r = \frac{1}{10} \\
 u &= \frac{3}{10} + (13)\left(\frac{1}{10}\right) \\
 u &= \frac{3}{10} + \frac{13}{10} = \frac{8}{5} \\
 s &= \frac{\left(\frac{3}{10} + \frac{8}{5}\right)(14)}{2} \\
 s &= \frac{133}{10} = 13\frac{3}{10}
 \end{aligned}$$

$$\begin{aligned}
 9. \quad a &= \frac{3}{4} \quad n = 19 \quad r = \frac{3}{4} \\
 u &= \frac{3}{4} + 18\left(\frac{3}{4}\right) \\
 u &= \frac{3}{4} + \frac{27}{2} = \frac{57}{4} \\
 s &= \frac{19\left(\frac{3}{4} + \frac{57}{4}\right)}{2} \\
 s &= \frac{19(15)}{2} = \frac{285}{2} = 142\frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 10. \quad a &= \frac{2}{5} \quad n = 34 \quad r = -\frac{3}{11} \\
 u &= \frac{2}{5} + 33\left(-\frac{3}{11}\right) \\
 u &= \frac{2}{5} - 9 = -\frac{43}{5} \\
 s &= \frac{34\left(\frac{2}{5} - \frac{43}{5}\right)}{2} \\
 s &= -\frac{1.394}{10} = -139\frac{2}{5}
 \end{aligned}$$

$$\begin{aligned}
 11. \quad a &= \frac{7}{3} \quad n = 11 \quad r = \frac{4}{5} \\
 r &= \frac{47}{15} - \frac{7}{3} = \frac{47 - 35}{15} = \frac{4}{5} \\
 u &= \frac{7}{3} + 10\left(\frac{4}{5}\right) \\
 u &= \frac{7}{3} + 8 = \frac{31}{3} \\
 s &= \frac{11\left(\frac{7}{3} + \frac{31}{3}\right)}{2} \\
 s &= \frac{418}{6} = 69\frac{2}{3}
 \end{aligned}$$

$$\begin{aligned}
 12. \quad a &= \frac{13}{4} \quad n = 46 \\
 r &= \frac{73}{20} - \frac{13}{4} = \frac{8}{20} = \frac{2}{5} \\
 u &= \frac{13}{4} + 45\left(\frac{2}{5}\right) \\
 u &= \frac{13}{4} + 18 = \frac{85}{4} \\
 s &= \frac{46\left(\frac{13}{4} + \frac{85}{4}\right)}{2} \\
 s &= \frac{4.508}{8} = 563\frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 13. \quad a &= -2 \quad n = 17 \quad r = \frac{1}{4} + 2 = \frac{9}{4} \\
 u &= -2 + 16\left(\frac{9}{4}\right) = -2 + 36 = 34 \\
 s &= \frac{17(-2 + 34)}{2} = 17(16) = 272
 \end{aligned}$$

$$\begin{aligned}
 14. \quad a &= -5 \quad n = 12 \quad r = -\frac{37}{8} + 5 = \frac{3}{8} \\
 u &= -5 + 11\left(\frac{3}{8}\right) = -\frac{7}{8} \\
 s &= \frac{12\left(-5 - \frac{7}{8}\right)}{2} \\
 s &= 6\left(-\frac{47}{8}\right) = -\frac{141}{4} = -35\frac{1}{4}
 \end{aligned}$$

## EJERCICIO 289

1.  $u=11$   $a=3$   $n=5$

$$r = \frac{11-3}{5-1} = \frac{8}{4} = 2$$

$$\Rightarrow 3+2=5$$

$$5+2=7$$

$$7+2=9$$

$$\text{Luego } \div 3. 5. 7. 9. 11.$$

2.  $u=-5$   $a=19$   $m=7$

$$r = \frac{-5-19}{7+1} = \frac{-24}{8} = -3$$

$$\Rightarrow 19-3=16$$

$$16-3=13$$

$$13-3=10$$

$$10-3=7$$

$$7-3=4$$

$$4-3=1$$

$$1-3=-2$$

$$\text{Luego } \div 19. 16. 13. 10. 7. 4. 1. -2. -5.$$

3.  $u=-73$   $a=-13$   $n=7$

$$r = \frac{-73+13}{7-1} = \frac{-60}{6} = -10$$

$$\Rightarrow -13-10=-23$$

$$-23-10=-33$$

$$-33-10=-43$$

$$-43-10=-53$$

$$-53-10=-63$$

$$\text{Luego } \div -13. -23. -33. -43. -53. -63. -73.$$

4.  $u=53$   $a=-42$   $m=4$

$$r = \frac{53+42}{4+1} = \frac{95}{5} = 19$$

$$\Rightarrow -42+19=-23$$

$$-23+19=-4$$

$$-4+19=15$$

$$15+19=34$$

$$\text{Luego } \div -42. -23. -4. 15. 34. 53.$$

5.  $u=-9$   $a=-81$   $n=7$

$$r = \frac{-9+81}{7-1} = \frac{72}{6} = 12$$

$$\Rightarrow -81+12=-69$$

$$-69+12=-57$$

$$-57+12=-45$$

$$-45+12=-33$$

$$-33+12=-21$$

$$\text{Luego } \div -81. -69. -57. -45. -33. -21. -9.$$

6.  $u=3$   $a=1$   $m=3$

$$r = \frac{3-1}{3+1} = \frac{2}{4} = \frac{1}{2}$$

$$\Rightarrow 1 + \frac{1}{2} = \frac{3}{2}$$

$$\frac{3}{2} + \frac{1}{2} = 2$$

$$2 + \frac{1}{2} = \frac{5}{2}$$

$$\text{Luego } \div 1. \frac{3}{2}. 2. \frac{5}{2}. 3.$$

$$\div 1. 1\frac{1}{2}. 2. 2\frac{1}{2}. 3.$$

7.  $u=12$   $a=5$   $n=6$

$$r = \frac{12-5}{6-1} = \frac{7}{5}$$

$$\Rightarrow 5 + \frac{7}{5} = \frac{32}{5}$$

$$\frac{32}{5} + \frac{7}{5} = \frac{39}{5}$$

$$\frac{39}{5} + \frac{7}{5} = \frac{46}{5}$$

$$\frac{46}{5} + \frac{7}{5} = \frac{53}{5}$$

$$\text{Luego } \div 5. \frac{32}{5}. \frac{39}{5}. \frac{46}{5}. \frac{53}{5}. 12.$$

$$\div 5. 6\frac{2}{5}. 7\frac{4}{5}. 9\frac{1}{5}. 10\frac{3}{5}. 12.$$

8.  $u=3$   $a=-4$   $m=5$

$$r = \frac{3+4}{5+1} = \frac{7}{6}$$

$$\Rightarrow -4 + \frac{7}{6} = -\frac{17}{6}$$

$$-\frac{17}{6} + \frac{7}{6} = -\frac{5}{3}$$

$$-\frac{5}{3} + \frac{7}{6} = -\frac{1}{2}$$

$$-\frac{1}{2} + \frac{7}{6} = \frac{2}{3}$$

$$\frac{2}{3} + \frac{7}{6} = \frac{11}{6}$$

$$\text{Luego } \div -4. -\frac{17}{6}. -\frac{5}{3}. -\frac{1}{2}. \frac{2}{3}. \frac{11}{6}. 3.$$

$$\div -4. -2\frac{5}{6}. -1\frac{2}{3}. -\frac{1}{2}. \frac{2}{3}. -1\frac{5}{6}. 3.$$

$$9. u = \frac{1}{8} \quad a = \frac{3}{4} \quad n = 7$$

$$r = \frac{\frac{1}{8} \cdot \frac{3}{4}}{7-1} = \frac{\frac{3}{32}}{6} = \frac{5}{48}$$

$$\Rightarrow \frac{3}{4} \cdot \frac{5}{48} = \frac{31}{48}$$

$$\frac{31}{48} \cdot \frac{5}{48} = \frac{13}{24}$$

$$\frac{13}{24} \cdot \frac{5}{48} = \frac{7}{16}$$

$$\frac{7}{16} \cdot \frac{5}{48} = \frac{1}{3}$$

$$\frac{1}{3} \cdot \frac{5}{48} = \frac{11}{48}$$

$$\text{Luego } + \frac{3}{4} \cdot \frac{31}{48} \cdot \frac{13}{24} \cdot \frac{7}{16} \cdot \frac{1}{3} \cdot \frac{11}{48} \cdot \frac{1}{8}$$

$$10. u = 3 \quad a = -1 \quad m = 6$$

$$r = \frac{3+1}{6+1} = \frac{4}{7}$$

$$\Rightarrow -1 + \frac{4}{7} = -\frac{3}{7}$$

$$-\frac{3}{7} + \frac{4}{7} = \frac{1}{7}$$

$$\frac{1}{7} + \frac{4}{7} = \frac{5}{7}$$

$$\frac{5}{7} + \frac{4}{7} = \frac{9}{7}$$

$$\frac{9}{7} + \frac{4}{7} = \frac{13}{7}$$

$$\frac{13}{7} + \frac{4}{7} = \frac{17}{7}$$

$$\text{Luego } + -1 \cdot \frac{3}{7} \cdot \frac{1}{7} \cdot \frac{5}{7} \cdot \frac{9}{7} \cdot \frac{13}{7} \cdot \frac{17}{7} \cdot 3$$

$$+ -1 \cdot \frac{3}{7} \cdot \frac{1}{7} \cdot \frac{5}{7} \cdot \frac{12}{7} \cdot \frac{16}{7} \cdot \frac{23}{7} \cdot 3$$

$$11. u = -\frac{1}{8} \quad a = \frac{2}{3} \quad n = 7$$

$$r = \frac{\frac{1}{8} \cdot \frac{2}{3}}{7-1} = \frac{\frac{2}{24}}{6} = \frac{19}{144}$$

$$\Rightarrow \frac{2}{3} \cdot \frac{19}{144} = \frac{77}{144}$$

$$\frac{77}{144} \cdot \frac{19}{144} = \frac{29}{72}$$

$$\frac{29}{72} \cdot \frac{19}{144} = \frac{13}{48}$$

Continúa

## 11. Continuación

$$\frac{13}{48} \cdot \frac{19}{144} = \frac{5}{36}$$

$$\frac{5}{36} \cdot \frac{19}{144} = \frac{1}{144}$$

$$\text{Luego } + \frac{2}{3} \cdot \frac{77}{144} \cdot \frac{29}{72} \cdot \frac{13}{48} \cdot \frac{5}{36} \cdot \frac{1}{144} \cdot \frac{1}{8}$$

$$12. u = -5 \quad a = -2 \quad m = 7$$

$$r = \frac{-5+2}{7+1} = -\frac{3}{8}$$

$$\Rightarrow -2 \cdot \frac{3}{8} = -\frac{19}{8}$$

$$-\frac{19}{8} \cdot \frac{3}{8} = -\frac{11}{4}$$

$$-\frac{11}{4} \cdot \frac{3}{8} = -\frac{25}{8}$$

$$-\frac{25}{8} \cdot \frac{3}{8} = -\frac{7}{2}$$

$$-\frac{7}{2} \cdot \frac{3}{8} = -\frac{31}{8}$$

$$-\frac{31}{8} \cdot \frac{3}{8} = -\frac{17}{4}$$

$$-\frac{17}{4} \cdot \frac{3}{8} = -\frac{37}{8}$$

$$\text{Luego } + -2 \cdot -2 \cdot \frac{3}{8} \cdot -2 \cdot \frac{3}{4} \cdot -3 \cdot \frac{1}{8} \cdot -3 \cdot \frac{1}{2} \cdot -3 \cdot \frac{7}{8} \cdot -4 \cdot \frac{1}{4} \cdot -4 \cdot \frac{5}{8} \cdot -5$$

$$13. u = -\frac{7}{10} \quad a = \frac{1}{2} \quad n = 10$$

$$r = \frac{\frac{7}{10} \cdot \frac{1}{2}}{10-1} = \frac{\frac{6}{20}}{9} = \frac{2}{15}$$

$$\Rightarrow \frac{1}{2} \cdot \frac{2}{15} = \frac{11}{30}$$

$$\frac{11}{30} \cdot \frac{2}{15} = \frac{7}{30}$$

$$\frac{7}{30} \cdot \frac{2}{15} = \frac{1}{10}$$

$$\frac{1}{10} \cdot \frac{2}{15} = \frac{1}{30}$$

$$\frac{1}{30} \cdot \frac{2}{15} = \frac{1}{6}$$

$$\frac{1}{6} \cdot \frac{2}{15} = \frac{3}{10}$$

$$-\frac{3}{10} \cdot \frac{2}{15} = \frac{13}{30}$$

$$-\frac{13}{30} \cdot \frac{2}{15} = \frac{17}{30}$$

$$-\frac{17}{30} \cdot \frac{2}{15} = \frac{17}{30}$$

$$\text{Luego } + \frac{1}{2} \cdot \frac{11}{30} \cdot \frac{7}{30} \cdot \frac{1}{10} \cdot \frac{1}{30} \cdot \frac{1}{6} \cdot \frac{3}{10} \cdot \frac{13}{30} \cdot \frac{17}{30} \cdot \frac{7}{10}$$

## EJERCICIO 290

1.  $a=7$   $n=20$   $r=7$

$$u = 7 + (19)(7)$$

$$u = 7 + 133 = 140$$

$$s = \frac{(7+140)(20)}{2}$$

$$s = 147 \cdot 10 = 1.470$$

2.  $a=5$   $n=80$   $r=5$

$$u = 5 + (79)(5)$$

$$u = 5 + 395 = 400$$

$$s = \frac{(5+400)(80)}{2}$$

$$s = 405 \cdot 40 = 16.200$$

3.  $a=9$   $n=43$   $r=10$

$$u = 9 + (42)(10)$$

$$u = 9 + 420 = 429$$

$$s = \frac{(9+429)(43)}{2}$$

$$s = 219 \cdot 43 = 9.417$$

4.  $a=2$   $n=100$   $r=2$

$$u = 2 + (99)(2)$$

$$u = 2 + 198 = 200$$

$$s = \frac{(2+200)(100)}{2}$$

$$s = 202 \cdot 50 = 10.100$$

5.  $a=9$   $n=100$   $r=2$

$$u = 9 + (99)(2)$$

$$u = 9 + 198 = 207$$

$$s = \frac{(9+207)(100)}{2}$$

$$s = 216 \cdot 50 = 10.800$$

6.  $a=8$   $n=50$   $r=3$

$$u = 8 + (49)(3)$$

$$u = 8 + 147 = 155$$

$$s = \frac{(8+155)(50)}{2}$$

$$s = 163 \cdot 25$$

$$s = 4.075 \div 100$$

$$s = \$40,75$$

7. 32  $\rightarrow$  N° normal de dientes en la boca de un adulto

$$a=10$$
  $n=32$   $r=2$

$$u = 10 + (31)(2) = 72$$

$$s = \frac{(10+72)(32)}{2}$$

$$s = 1.312 \div 10$$

$$s = \$131,20$$

8.  $a=77$   $n=72$   $r=11$

$$u = 77 + (71)(11) = 858$$

$$s = \frac{(77+858)(72)}{2}$$

$$s = 935 \cdot 36 = 33.660$$

9.  $n=5 \cdot 12 = 60$

$$a=2$$
  $r=3$

$$u = 2 + (59)(3)$$

$$u = 2 + 177 = 179$$

$$s = \frac{(2+179)(60)}{2}$$

$$s = 181 \cdot 30 = 5.430 \text{ bs.}$$

10.  $a=600$   $r=25$

$$\text{Si } n=8$$

$$u = 600 + (7)(25)$$

$$u = 775 \div 100$$

Avanzó 7,75m en

el 8° segundo

$s \rightarrow$  Distancia

recorrida en 8 seg.

$$s = \frac{(600+775)(8)}{2}$$

$$s = 1.375 \cdot 4$$

$$s = 5.500 \div 100 = 55m$$

11.  $s=2.400$   $n=3$

$x \rightarrow$  Ahorro el 2° año

$\frac{x}{2} \rightarrow$  Ahorro el 1° año

$$r = x - \frac{x}{2} = \frac{x}{2}$$

Luego el 3° año Ahorra:

$$x + \frac{x}{2} = \frac{3x}{2}$$

**Continúa**

## 11. Continuación.

$$\Rightarrow \frac{x}{2} + x + \frac{3x}{2} = 2.400$$

$$x + 2x + 3x = 4.800$$

$$6x = 4.800$$

$$x = 800$$

$$\text{El 1° año ahorro} \rightarrow \frac{x}{2} = \frac{800}{2} = 400 \text{ sucres}$$

Para el 2° año

$$a=400$$
  $n=2$   $r = \frac{x}{2} = \frac{800}{2} = 400$

$$u = 400 + (1)(400) = 800 \text{ sucres}$$

Para el 3° año

$$a=400$$
  $n=3$   $r=400$

$$u = 400 + (2)(400) = 1.200 \text{ sucres}$$

12. 2° y 4° = 22

$$3^{\circ} \text{ y } 7^{\circ} = 34$$

El término medio entre

el 2° y el 4° es el 3°

por tan to es una progresión

impar. Luego el duplo

del 3° término es 22

$x \rightarrow$  3° término

$$2x = 22$$

$$x = 11$$

Luego 11  $\rightarrow$  3° término

Como  $3^{\circ} + 7^{\circ} = 34$

$$11 + 7^{\circ} = 34$$

$$7^{\circ} = 23$$

23  $\rightarrow$  es el 7° término

Interpolación para conocer

el 4° término

$$+ 11 \dots 23$$

Donde  $n=5$   $a=11$   $u=23$

$$r = \frac{23-11}{5-1} = \frac{12}{4} = 3$$

4° término  $\rightarrow 3^{\circ} + r = 11 + 3 = 14$

2° término  $\rightarrow 22 - 4^{\circ} = 22 - 14 = 8$

13.  $n=32$   $a=5$   $r=3$

$$u = 5 + (31)(3)$$

$$u = 5 + 93 = 98$$

$$s = \frac{(5+98)32}{2}$$

$$s = 103 \cdot 16 = \$1.648$$

14.  $a=50 \quad r=-5\frac{1}{2} \quad n=8$

$$u = 50 + (7) \left( -\frac{11}{2} \right)$$

$$u = \frac{100 - 77}{2} = \frac{23}{2} = 11\frac{1}{2} \text{ Km}$$

$$s = \frac{\left( 50 + \frac{23}{2} \right) 8}{2} = 246 \text{ Km}$$

15.  $3^\circ$  y  $10^\circ$  términos son equidistantes a los extremos  $1^\circ$  y  $12^\circ$ , Luego la suma de estos extremos es igual a la suma de los términos equidistantes  $3^\circ + 10^\circ = 1^\circ + 12^\circ$

$$\text{como } 1^\circ + 12^\circ = 53\frac{1}{2}$$

$$\Rightarrow 3^\circ + 10^\circ = 53\frac{1}{2}$$

16.  $n=11 \quad a=-2 \quad u=-52$

$$r = \frac{-52 - (-2)}{11-1} = -\frac{50}{10} = -5$$

$$2^\circ \text{ térm.} \rightarrow -2 - 5 = -7$$

$$3^\circ \text{ térm.} \rightarrow -7 - 5 = -12$$

$$4^\circ \text{ térm.} \rightarrow -12 - 5 = -17$$

$$5^\circ \text{ térm.} \rightarrow -17 - 5 = -22$$

$$6^\circ \text{ térm.} \rightarrow -22 - 5 = -27$$

17.  $a=500 \quad u=1.900 \quad r=200$

$$n = \frac{1.900 - 500 + 200}{200}$$

$$n = 8 \text{ años}$$

18.  $n=11 \quad a=1.180 \quad u=6.180$

$$r = \frac{6.180 - 1.180}{11-1}$$

$$r = \frac{5.000}{10} = \$500$$

19.  $n=5 \quad u=3.000 \quad r=-300$

$$a = 3.000 - (4)(-300)$$

$$a = 3.000 + 1.200 = 4.200 \text{ soles}$$

20.  $a=161 \quad r=322 \quad n=5$

$$u = 161 + (4)(322) = 1.449$$

$$s = \frac{(1.449 + 161)(5)}{2}$$

$$s = \frac{(1.610)(5)}{2}$$

$$s = \frac{8.050}{2} = 4.025$$

$$= 4.025 \div 10 = 402,5 \text{ pies}$$

21.  $a=51 \quad r=2 \quad u=813$

$$n = \frac{813 - 51 + 2}{2} = \frac{764}{2} = 382$$

$$s = \frac{(813 + 51)(382)}{2}$$

$$s = (864)(191) = 165.024$$

22.  $5^\circ \rightarrow 31 \quad 9^\circ \rightarrow 59$

interpolando

$$n=5 \quad a=31 \quad u=59$$

$$r = \frac{59 - 31}{5-1} = \frac{28}{4} = 7$$

$$10^\circ \text{ térm.} \rightarrow 59 + 7 = 66$$

$$11^\circ \text{ térm.} \rightarrow 66 + 7 = 73$$

$$12^\circ \text{ térm.} \rightarrow 73 + 7 = 80$$

23.  $n=3 \quad a=12.500 \quad u=20.500$

$$a + u = 12.500 + 20.500$$

$$a + u = 33.000$$

$$\text{Luego } 2(2^\circ \text{ term.}) = 33.000$$

$$2^\circ \text{ term.} = 16.500 \text{ colones}$$

## EJERCICIO 291

1.  $a=3 \quad n=7$

$$r = 6 \div 3 = 2$$

$$u = 3(2^{7-1})$$

$$u = 3(2^6)$$

$$u = 3 \cdot 64 = 192$$

2.  $a=\frac{1}{3} \quad n=8$

$$r = 3 \div 1 = 3$$

$$u = \frac{1}{3}(3^{8-1})$$

$$u = 3^6 = 729$$

3.  $a=8 \quad n=9$

$$r = 4 \div 8 = \frac{1}{2}$$

$$u = 8 \left[ \left( \frac{1}{2} \right)^{9-1} \right]$$

$$u = \frac{8}{2^8} = \frac{1}{2^5} = \frac{1}{32}$$

4.  $a=1 \quad n=6$

$$r = \frac{4}{25} \cdot \frac{5}{2} = \frac{2}{5}$$

$$u = 1 \left[ \left( \frac{2}{5} \right)^{6-1} \right]$$

$$u = \frac{2^5}{5^5} = \frac{32}{3.125}$$

5.  $a=3 \quad n=7$

$$r = 2 \div 3 = \frac{2}{3}$$

$$u = 3 \left[ \left( \frac{2}{3} \right)^{7-1} \right]$$

$$u = \frac{2^6}{3^5} = \frac{64}{243}$$

6.  $a=\frac{1}{2} \quad n=6$

$$r = \frac{1}{5} \cdot 2 = \frac{2}{5}$$

$$u = \frac{1}{2} \left[ \left( \frac{2}{5} \right)^{6-1} \right]$$

$$u = \frac{2^4}{5^5} = \frac{16}{3.125}$$

7.  $a=\frac{9}{4} \quad n=8$

$$r = 3 \cdot \frac{4}{9} = \frac{4}{3}$$

$$u = \frac{9}{4} \left[ \left( \frac{4}{3} \right)^{7} \right]$$

$$u = \frac{4^6}{3^5} = \frac{4.096}{243} = 16\frac{208}{243}$$

8.  $a=-3 \quad n=6$

$$r = 6 \div (-3) = -2$$

$$u = -3 \left[ (-2)^5 \right]$$

$$u = -3(-32) = 96$$

9.  $a=3 \quad n=9$

$$r = -1 \div 3 = -\frac{1}{3}$$

$$u = 3 \left[ \left( -\frac{1}{3} \right)^8 \right]$$

$$u = \frac{1}{3^7} = \frac{1}{2.187}$$

10.  $a=\frac{5}{6} \quad n=5$

$$r = \frac{1}{2} \cdot \frac{6}{5} = \frac{3}{5}$$

$$u = \frac{5}{6} \left[ \left( \frac{3}{5} \right)^4 \right]$$

$$u = \frac{3^3}{2 \cdot 5^3} = \frac{27}{250}$$

$$11. a=16 \quad n=8$$

$$r=1 \div (-4) = -\frac{1}{4}$$

$$u=16 \left[ \left( -\frac{1}{4} \right)^7 \right]$$

$$u = -\frac{1}{4^5} = -\frac{1}{1.024}$$

$$12. a = \frac{3}{4} \quad n=8$$

$$r = \frac{1}{3}(-2) = -\frac{2}{3}$$

$$u = \frac{3}{4} \left[ \left( -\frac{2}{3} \right)^7 \right]$$

$$u = -\frac{2^5}{3^6} = -\frac{32}{729}$$

$$13. a = -\frac{3}{5} \quad n=5$$

$$r = \frac{3}{2} \left( -\frac{5}{3} \right) = -\frac{5}{2}$$

$$u = -\frac{3}{5} \left[ \left( -\frac{5}{2} \right)^4 \right]$$

$$u = -\frac{3 \cdot 5^3}{2^4} = -\frac{375}{16} = -23\frac{7}{16}$$

$$14. a = -\frac{3}{4} \quad n=10$$

$$r = -\frac{1}{4} \left( -\frac{4}{3} \right) = \frac{1}{3}$$

$$u = -\frac{3}{4} \left[ \left( \frac{1}{3} \right)^9 \right]$$

$$u = -\frac{1}{4 \cdot 3^8} = -\frac{1}{26.244}$$

## EJERCICIO 292

$$1. r = \frac{1}{2} \quad u = \frac{1}{64} \quad n=7$$

$$a = \frac{\frac{1}{64}}{\left( \frac{1}{2} \right)^6} = \frac{\frac{1}{2^6}}{\frac{1}{2^6}} = \frac{2^6}{2^6} = 1$$

$$2. r = \frac{2}{3} \quad u = \frac{64}{2.187} \quad n=9$$

$$a = \frac{\frac{64}{2.187}}{\left( \frac{2}{3} \right)^8} = \frac{\frac{2^6}{2^6 \cdot 3^8}}{\frac{2^8}{3^8}} = \frac{2^6 \cdot 3^8}{2^8 \cdot 3^8} = \frac{3}{2^2} = \frac{3}{4}$$

$$3. r = \frac{32}{625} \cdot \frac{125}{16} = \frac{2}{5}$$

$$u = \frac{32}{625} \quad n=6$$

$$a = \frac{\frac{32}{625}}{\left( \frac{2}{5} \right)^5} = \frac{\frac{2^5}{5^4}}{\frac{2^5}{5^5}} = \frac{2^5 \cdot 5^5}{2^5 \cdot 5^4} = 5$$

$$4. a=2 \quad u=64 \quad n=6$$

$$r = \sqrt[5]{\frac{64}{2}} = \sqrt[5]{\frac{2^6}{2}} = \sqrt[5]{2^5} = 2$$

$$5. a = \frac{1}{3} \quad u=243 \quad n=7$$

$$r = \sqrt[6]{\frac{243}{\frac{1}{3}}} = \sqrt[6]{729} = \sqrt[6]{3^6} = \pm 3$$

$$6. a=-5 \quad u=640 \quad n=8$$

$$r = \sqrt[7]{\frac{640}{-5}}$$

$$r = \sqrt[7]{-128} = \sqrt[7]{-2^7} = -2$$

$$7. a = \frac{729}{2} \quad u = \frac{3}{2} \quad n=6$$

$$r = \sqrt[5]{\frac{\frac{3}{2}}{\frac{729}{2}}} = \sqrt[5]{\frac{1}{243}} = \frac{1}{3}$$

$$8. a=8 \quad u = \frac{1}{512} \quad n=7$$

$$r = \sqrt[6]{\frac{1}{\frac{512}{8}}} = \sqrt[6]{\frac{1}{4.096}} = \sqrt[6]{\frac{1}{4^6}} = \pm \frac{1}{4}$$

$$9. a = \frac{625}{16} \quad u=1 \quad n=5$$

$$r = \sqrt[4]{\frac{1}{\frac{625}{16}}} = \sqrt[4]{\frac{16}{625}} = \sqrt[4]{\frac{2^4}{5^4}} = \pm \frac{2}{5}$$

$$10. a = \frac{27}{64} \quad u = -\frac{2}{81} \quad n=8$$

$$r = \sqrt[7]{\frac{\frac{2}{81}}{\frac{27}{64}}}$$

$$r = \sqrt[7]{-\frac{2 \cdot 2^6}{3^4 \cdot 3^3}} = \sqrt[7]{-\frac{2^7}{3^7}} = -\frac{2}{3}$$

## EJERCICIO 293

$$1. a=6 \quad n=5$$

$$r = 3 \div 6 = \frac{1}{2}$$

$$u = 6 \left[ \left( \frac{1}{2} \right)^4 \right] = 6 \left( \frac{1}{16} \right) = \frac{3}{8}$$

$$s = \frac{\left( \frac{3}{8} \right) \left( \frac{1}{2} \right) - 6}{\frac{1}{2} - 1}$$

$$s = -\frac{93}{16}(-2) = \frac{93}{8} = 11\frac{5}{8}$$

$$2. a=4 \quad n=6$$

$$r = -8 \div 4 = -2$$

$$u = 4 \left[ (-2)^5 \right]$$

$$u = 4(-32) = -128$$

$$s = \frac{-128(-2) - 4}{-2 - 1}$$

$$s = \frac{252}{-3} = -84$$

$$3. a=12 \quad n=7$$

$$r = 4 \div 12 = \frac{1}{3}$$

$$u = 12 \left[ \left( \frac{1}{3} \right)^6 \right] = 12 \left( \frac{1}{729} \right) = \frac{4}{243}$$

$$s = \frac{\left( \frac{4}{243} \right) \left( \frac{1}{3} \right) - 12}{\frac{1}{3} - 1}$$

$$s = -\frac{8.744}{729} \left( -\frac{3}{2} \right)$$

$$s = \frac{26.232}{1.458} = 17\frac{1.446}{1.458} = 17\frac{241}{243}$$

$$4. a = \frac{1}{4} \quad n=10$$

$$r = \frac{1}{2} \cdot 4 = 2$$

$$u = \frac{1}{4} \left[ 2^9 \right] = 128$$

$$s = \frac{128(2) - \frac{1}{4}}{2 - 1}$$

$$s = \frac{1.023}{4} = 255\frac{3}{4}$$

$$5. a = \frac{9}{4} \quad n = 8$$

$$r = \frac{3}{2} \cdot \frac{4}{9} = \frac{2}{3}$$

$$u = \frac{9}{4} \left[ \left( \frac{2}{3} \right)^7 \right] = \frac{2^5}{3^5}$$

$$s = \frac{\frac{2^5}{3^5} \left( \frac{2}{3} \right) - \frac{9}{4}}{\frac{2}{3} - 1}$$

$$s = \frac{2^8 - 3^8}{3^6 \cdot 2^2} (-3)$$

$$s = \frac{-6.305}{2.916} (-3)$$

$$s = \frac{18.915}{2.916} = 6 \frac{1.419}{2.916} = 6 \frac{473}{972}$$

$$6. a = -\frac{1}{10} \quad n = 7$$

$$r = \frac{1}{5} (-10) = -2$$

$$u = -\frac{1}{10} [(-2)^6] = -\frac{64}{10} = -\frac{32}{5}$$

$$s = \frac{-\frac{32}{5} (-2) + \frac{1}{10}}{-2 - 1}$$

$$s = \frac{\frac{129}{10}}{-3} = -\frac{129}{30} = -4 \frac{3}{10}$$

$$7. a = -6 \quad n = 10$$

$$r = -3 \div (-6) = \frac{1}{2}$$

$$u = -6 \left[ \left( \frac{1}{2} \right)^9 \right] = -\frac{3}{2^8}$$

$$s = \frac{-\frac{3}{2^8} \left( \frac{1}{2} \right) + 6}{\frac{1}{2} - 1}$$

$$s = \frac{\frac{3.069}{512}}{-\frac{1}{2}} = \frac{6.138}{-512} = -11 \frac{253}{256}$$

$$8. a = 2 \quad n = 8$$

$$r = -1 \div 2 = -\frac{1}{2}$$

$$u = 2 \left[ \left( -\frac{1}{2} \right)^7 \right] = -\frac{1}{2^6} = -\frac{1}{64}$$

$$s = \frac{-\frac{1}{64} \left( -\frac{1}{2} \right) - 2}{-\frac{1}{2} - 1}$$

$$s = \frac{\frac{255}{128}}{\frac{3}{2}} = \frac{510}{384} = 1 \frac{126}{384} = 1 \frac{21}{64}$$

$$9. a = \frac{3}{2} \quad n = 6$$

$$r = 1 \div \frac{3}{2} = \frac{2}{3}$$

$$u = \frac{3}{2} \left( \frac{2}{3} \right)^5 = \frac{2^4}{3^4} = \frac{16}{81}$$

$$s = \frac{\frac{16}{81} \left( \frac{2}{3} \right) - \frac{3}{2}}{\frac{2}{3} - 1}$$

$$s = \frac{-\frac{1 \frac{179}{486}}{1}}{-\frac{1}{3}} = 4 \frac{17}{162}$$

$$10. a = 9 \quad n = 6$$

$$r = 1 \div (-3) = -\frac{1}{3}$$

$$u = 9 \left( -\frac{1}{3} \right)^5 = -\frac{1}{3^3} = -\frac{1}{27}$$

$$s = \frac{-\frac{1}{27} \left( -\frac{1}{3} \right) - 9}{-\frac{1}{3} - 1}$$

$$s = \frac{-\frac{728}{81}}{-\frac{4}{3}}$$

$$s = \frac{2.184}{324} = 6 \frac{240}{324} = 6 \frac{20}{27}$$

## EJERCICIO 294

$$1. a = 5 \quad u = 3.125 \quad n = 5$$

$$r = \sqrt[4]{\frac{3.125}{5}} = \sqrt{25} \pm 5$$

$$5(\pm 5) = \pm 25$$

$$\pm 25(\pm 5) = 125$$

$$125(\pm 5) = \pm 625$$

$$\div \div 5: \pm 25: 125: \pm 625: 3.125$$

$$2. a = -7 \quad u = -224 \quad m = 4$$

$$r = \sqrt[5]{\frac{-224}{-7}} = \sqrt[5]{32} = 2$$

$$-7 \cdot 2 = -14$$

$$-14 \cdot 2 = -28$$

$$-28 \cdot 2 = -56$$

$$-56 \cdot 2 = -112$$

$$\div \div -7: -14: -28: -56: -112: -224$$

$$3. a = 128 \quad u = 2 \quad n = 7$$

$$r = \sqrt[6]{\frac{2}{128}} = \sqrt[6]{\frac{1}{2^6}} = \pm \frac{1}{2}$$

$$128 \left( \pm \frac{1}{2} \right) = \pm 64$$

$$\pm 64 \left( \pm \frac{1}{2} \right) = 32$$

$$32 \left( \pm \frac{1}{2} \right) = \pm 16$$

$$\pm 16 \left( \pm \frac{1}{2} \right) = 8$$

$$8 \left( \pm \frac{1}{2} \right) = \pm 4$$

$$\div \div 128: \pm 64: 32: \pm 16: 8: \pm 4: 2$$

$$4. a = \frac{9}{2} \quad u = \frac{16}{27} \quad n = 6$$

$$r = \sqrt[5]{\frac{\frac{16}{27}}{\frac{9}{2}}} = \sqrt[5]{\frac{2^5}{3^5}} = \frac{2}{3}$$

$$\frac{9}{2} \left( \frac{2}{3} \right) = 3$$

$$3 \left( \frac{2}{3} \right) = 2$$

$$2 \left( \frac{2}{3} \right) = \frac{4}{3}$$

$$\frac{4}{3} \left( \frac{2}{3} \right) = \frac{8}{9}$$

$$\div \div \frac{9}{2}: 3: 2: \frac{4}{3}: \frac{8}{9}: \frac{16}{27}$$

$$\div \div 4 \frac{1}{2}: 3: 2: 1 \frac{1}{3}: \frac{8}{9}: \frac{16}{27}$$



$$5. a=2 \quad u=\frac{2 \cdot 187}{64} \quad m=6$$

$$r = \sqrt[7]{\frac{2 \cdot 187}{64}} = \sqrt[7]{\frac{3^7}{2^7}} = \frac{3}{2}$$

$$2\left(\frac{3}{2}\right) = 3$$

$$3\left(\frac{3}{2}\right) = \frac{9}{2}$$

$$\frac{9}{2}\left(\frac{3}{2}\right) = \frac{27}{4}$$

$$\frac{27}{4}\left(\frac{3}{2}\right) = \frac{81}{8}$$

$$\frac{81}{8}\left(\frac{3}{2}\right) = \frac{243}{16}$$

$$\frac{243}{16}\left(\frac{3}{2}\right) = \frac{729}{32}$$

$$\div \div 2: 3: 4 \frac{1}{2}: 6 \frac{3}{4}: 10 \frac{1}{8}: 15 \frac{3}{16}: 22 \frac{25}{32}: 34 \frac{11}{64}$$

$$6. a=\frac{4}{9} \quad u=\frac{27}{256} \quad n=6$$

$$r = \sqrt[5]{\frac{27}{\frac{4}{9}}} = \sqrt[5]{\frac{3^5}{4^5}} = \frac{3}{4}$$

$$\frac{4}{9}\left(\frac{3}{4}\right) = \frac{1}{3}$$

$$\frac{1}{3}\left(\frac{3}{4}\right) = \frac{1}{4}$$

$$\frac{1}{4}\left(\frac{3}{4}\right) = \frac{3}{16}$$

$$\frac{3}{16}\left(\frac{3}{4}\right) = \frac{9}{64}$$

$$\div \div \frac{4}{9}: \frac{1}{3}: \frac{1}{4}: \frac{3}{16}: \frac{9}{64}: \frac{27}{256}$$

$$7. a=8 \quad u=\frac{1}{32} \quad m=7$$

$$r = \sqrt[8]{\frac{1}{\frac{32}{8}}} = \sqrt[8]{\frac{1}{2^8}} = \pm \frac{1}{2}$$

$$8\left(\pm \frac{1}{2}\right) = \pm 4$$

$$\pm 4\left(\pm \frac{1}{2}\right) = 2$$

$$2\left(\pm \frac{1}{2}\right) = \pm 1$$

$$\pm 1\left(\pm \frac{1}{2}\right) = \frac{1}{2}$$

$$\frac{1}{2}\left(\pm \frac{1}{2}\right) = \pm \frac{1}{4}$$

$$\pm \frac{1}{4}\left(\pm \frac{1}{2}\right) = \frac{1}{8}$$

$$\frac{1}{8}\left(\pm \frac{1}{2}\right) = \pm \frac{1}{16}$$

$$\div \div 8: \pm 4: 2: \pm 1: \frac{1}{2}: \pm \frac{1}{4}: \frac{1}{8}: \pm \frac{1}{16}: \frac{1}{32}$$

## EJERCICIO 295

$$1. a=2 \quad r=\frac{1}{2} \quad \frac{1}{2} = \frac{1}{4}$$

$$s = \frac{2}{1 - \frac{1}{4}} = \frac{2}{\frac{3}{4}} = \frac{8}{3} = 2\frac{2}{3}$$

$$2. a=\frac{1}{2} \quad r=\frac{1}{6} \cdot 2 = \frac{1}{3}$$

$$s = \frac{\frac{1}{2}}{1 - \frac{1}{3}} = \frac{\frac{1}{2}}{\frac{2}{3}} = \frac{3}{4}$$

$$3. a=-5 \quad r=\frac{-2}{-5} = \frac{2}{5}$$

$$s = \frac{-5}{1 - \frac{2}{5}} = \frac{-5}{\frac{3}{5}} = -\frac{25}{3} = -8\frac{1}{3}$$

$$4. a=-4 \quad r=-\frac{8}{3}\left(-\frac{1}{4}\right) = \frac{2}{3}$$

$$s = \frac{-4}{1 - \frac{2}{3}} = \frac{-4}{\frac{1}{3}} = -12$$

$$5. a=\frac{3}{4} \quad r=\frac{1}{4}\left(\frac{4}{3}\right) = \frac{1}{3}$$

$$s = \frac{\frac{3}{4}}{1 - \frac{1}{3}} = \frac{\frac{3}{4}}{\frac{2}{3}} = \frac{9}{8} = 1\frac{1}{8}$$

$$6. a=\frac{1}{6} \quad r=\frac{1}{7} \cdot 6 = \frac{6}{7}$$

$$s = \frac{\frac{1}{6}}{1 - \frac{6}{7}} = \frac{\frac{1}{6}}{\frac{1}{7}} = \frac{7}{6} = 1\frac{1}{6}$$

$$7. a=2 \quad r=-\frac{2}{5} \cdot \frac{1}{2} = -\frac{1}{5}$$

$$s = \frac{2}{1 + \frac{1}{5}} = \frac{2}{\frac{6}{5}} = \frac{10}{6} = 1\frac{2}{3}$$

$$8. a=-14 \quad r=\frac{-6}{-14} = \frac{3}{7}$$

$$s = \frac{-14}{1 - \frac{3}{7}} = \frac{-14}{\frac{4}{7}} = -\frac{98}{4} = -24\frac{1}{2}$$

## EJERCICIO 296

$$1. \frac{6}{10} + \frac{6}{100} + \frac{6}{1.000} \dots$$

$$a = \frac{6}{10} \quad r = \frac{6}{100} \left(\frac{10}{6}\right) = \frac{1}{10}$$

$$s = \frac{\frac{6}{10}}{1 - \frac{1}{10}} = \frac{\frac{6}{10}}{\frac{9}{10}} = \frac{6}{9} = \frac{2}{3}$$

$$2. \frac{12}{100} + \frac{12}{10.000} + \frac{12}{1.000.000} \dots$$

$$a = \frac{12}{100} \quad r = \frac{12}{10.000} \left(\frac{100}{12}\right) = \frac{1}{100}$$

$$s = \frac{\frac{12}{100}}{1 - \frac{1}{100}} = \frac{\frac{12}{100}}{\frac{99}{100}} = \frac{12}{99} = \frac{4}{33}$$

$$3. \frac{159}{1.000} + \frac{159}{1.000.000} \dots$$

$$a = \frac{159}{10^3} \quad r = \frac{159}{10^6} \left(\frac{10^3}{159}\right) = \frac{1}{10^3}$$

$$s = \frac{\frac{159}{10^3}}{1 - \frac{1}{10^3}} = \frac{\frac{159}{10^3}}{\frac{999}{10^3}} = \frac{159}{999} = \frac{53}{333}$$

$$4. \frac{32}{100} + \frac{32}{10.000} + \frac{32}{1.000.000} \dots$$

$$a = \frac{32}{100} \quad r = \frac{32}{10.000} \left( \frac{100}{32} \right) = \frac{1}{100}$$

$$s = \frac{\frac{32}{100}}{1 - \frac{1}{100}} = \frac{\frac{32}{100}}{\frac{99}{100}} = \frac{32}{99}$$

$$5. \frac{144}{10^3} + \frac{144}{10^6} + \frac{144}{10^9} \dots$$

$$a = \frac{144}{10^3} \quad r = \frac{144}{10^6} \left( \frac{10^3}{144} \right) = \frac{1}{10^3}$$

$$s = \frac{\frac{144}{10^3}}{1 - \frac{1}{10^3}} = \frac{\frac{144}{10^3}}{\frac{999}{10^3}} = \frac{144}{999} = \frac{16}{111}$$

$$6. \frac{3}{10} + \frac{5}{100} + \frac{5}{1.000} \dots$$

$$a = \frac{5}{100} \quad r = \frac{5}{1.000} \left( \frac{100}{5} \right) = \frac{1}{10}$$

$$s = \frac{\frac{5}{100}}{1 - \frac{1}{10}} = \frac{\frac{5}{100}}{\frac{9}{10}} = \frac{5}{90} = \frac{1}{18}$$

$$s = \frac{\frac{3}{10} + \frac{1}{18}}{1 - \frac{1}{18}} = \frac{\frac{64}{180}}{\frac{17}{180}} = \frac{16}{45}$$

$$7. \frac{18}{100} + \frac{1}{10^3} + \frac{1}{10^4} \dots$$

$$a = \frac{1}{10^3} \quad r = \frac{1}{10^4} \cdot 10^3 = \frac{1}{10}$$

$$s = \frac{\frac{1}{10^3}}{1 - \frac{1}{10}} = \frac{\frac{1}{10^3}}{\frac{9}{10}} = \frac{1}{900}$$

$$s = \frac{\frac{18}{100} + \frac{1}{900}}{1 - \frac{1}{900}} = \frac{\frac{163}{900}}{\frac{899}{900}} = \frac{163}{899}$$

$$8. \frac{3}{10} + \frac{18}{10^3} + \frac{18}{10^5} \dots$$

$$a = \frac{18}{10^3} \quad r = \frac{18}{10^5} \left( \frac{10^3}{18} \right) = \frac{1}{100}$$

$$s = \frac{\frac{18}{10^3}}{1 - \frac{1}{100}} = \frac{\frac{18}{10^3}}{\frac{99}{100}} = \frac{1800}{99} = \frac{200}{11}$$

$$s = \frac{\frac{3}{10} + \frac{1}{55}}{1 - \frac{1}{55}} = \frac{\frac{175}{550}}{\frac{540}{550}} = \frac{7}{22}$$

$$9. 2 + \frac{18}{100} + \frac{18}{10^4} + \frac{18}{10^6} \dots$$

$$a = \frac{18}{100} \quad r = \frac{18}{10^4} \left( \frac{100}{18} \right) = \frac{1}{100}$$

$$s = \frac{\frac{18}{100}}{1 - \frac{1}{100}} = \frac{\frac{18}{100}}{\frac{99}{100}} = \frac{2}{11}$$

$$s = 2 + \frac{2}{11} = \frac{24}{11}$$

## EJERCICIO 297

1.  $a=2 \quad r=2$

Para saber cuanto gano el sábado  $\rightarrow n=6$

$$u = 2(2^5) = 64 \text{ Lempiras}$$

Para saber cuanto gané de lunes a sábado utilizo  $S$  para los 6 primeros términos de la progresión.

$$\div \div 2: 4: 8 \dots$$

Donde  $a=2 \quad r=2 \quad u=64$

$$s = \frac{64(2) - 2}{2 - 1} = 126 \text{ Lempiras}$$

2.  $n=20 \quad r=2 \quad a=1$

$$u = 1(2^{19}) = 524.288$$

$$s = \frac{524.288(2) - 1}{2 - 1}$$

$$s = 1.048.575 \div 100$$

$$s = \$ 10.485,75$$

3.  $n=8 \quad r=\frac{1}{3} \quad u=1$

$$a = \frac{1}{\left(\frac{1}{3}\right)^7} = \frac{1}{\frac{1}{2.187}} = 2.187 \text{ balboas}$$

4.  $n=9 \rightarrow$  Impar

Como es una sucesión impar los términos equidistan, luego la multiplicación del primer y último término es igual al producto entre el 3º y el 7º término.

Entonces la respuesta es:

$$= \frac{1}{216}$$

5.  $n=5 \quad u=\frac{8}{81}$

$$3^{\text{er}} \text{ término} = \sqrt{\frac{4}{81}} = \frac{2}{9}$$

Se encuentra la razón para  $n=3$ , entre el 3º y 5º término.

$$r = \sqrt{\frac{\frac{8}{81}}{\frac{2}{9}}} = \sqrt{\frac{36}{81}} = \frac{2}{3}$$

$$\frac{2}{9} \cdot \frac{3}{2} = \frac{1}{3} \rightarrow 2^{\text{o}} \text{ término}$$

$$\frac{1}{3} \cdot \frac{3}{2} = \frac{1}{2} \rightarrow 1^{\text{o}} \text{ término}$$

6.  $a=\frac{1}{4} \quad u=\frac{1}{32} \quad n=4$

$$r = \sqrt[3]{\frac{\frac{1}{32}}{\frac{1}{4}}} = \sqrt[3]{\frac{1}{8}} = \frac{1}{2}$$

$$\frac{1}{32} \cdot 2 = \frac{1}{16} \rightarrow 6^{\text{o}} \text{ término}$$

7.  $r=\frac{2}{3} \quad u=160 \quad n=5$

$$a = \frac{160}{\left(\frac{2}{3}\right)^4} = \frac{160}{\frac{16}{81}} = 810$$

$$s = \frac{160\left(\frac{2}{3}\right) - 810}{\frac{2}{3} - 1}$$

$$= \frac{2.110 - 810}{-\frac{1}{3}} = \frac{1.300}{-\frac{1}{3}} = -\$ 3.900$$

8.  $a=59.049 \quad u=100.000 \quad n=6$

$$r = \sqrt[5]{\frac{100.000}{59.049}} = \sqrt[5]{\frac{10^5}{9^5}} = \frac{10}{9}$$

$$9. r = \frac{1}{3} \quad a = 24.300 \quad n = 6$$

$$u = 24.300 \left( \frac{1}{3} \right)^5 = \frac{24.300}{243} = 100$$

$$s = \frac{100 \left( \frac{1}{3} \right) - 24.300}{\frac{1}{3} - 1} = \frac{-\frac{72.800}{3}}{-\frac{2}{3}} = \frac{72.800}{2} = 36.400 \text{ bs.}$$

$$10. n = 15 \quad a = 1 \quad r = 3$$

$$u = (3)^{14} = 4.782.969$$

$$s = \frac{4.782.969(3) - 1}{3 - 1} = \frac{14.348.906}{2} = \$7.174.453$$

## EJERCICIO 298

$$1. \text{Log}(532 \cdot 0,184)$$

$$= \text{Log } 532 + \text{Log } 0,184$$

$$= 2,72591 + \bar{1},26482$$

$$= 1,99073$$

$$\Rightarrow 10^{1,99073} = 97,888$$

$$2. \text{Log}191,7 + \text{Log}432$$

$$= 2,28262 + 2,63548$$

$$= 4,9181$$

$$\Rightarrow \text{Antilog } 4,9181 = 82.814,4$$

$$3. \text{Log}0,7 + \text{Log}0,013 + \text{Log}0,9$$

$$= \bar{1},84510 + \bar{2},11394 + \bar{1},95424$$

$$= -2,08672$$

$$\Rightarrow 10^{-2,08672} = 0,00819$$

$$4. \text{Log}7,5 + \text{Log}8,16 + \text{Log}0,35 + \text{Log}10,037$$

$$= 0,875061 + 0,911690 + \bar{1},544068 + 4,001603$$

$$= 4 - 1 + 2,332422$$

$$= 5,332422$$

$$\Rightarrow 10^{5,332422} = 214.991,85$$

$$\cong 214.992$$

$$5. \text{Log}3,2 + \text{Log}4,3 + \text{Log}7,8 + \text{Log}103,4 + \text{Log}0,019$$

$$= 0,505149 + 0,633468 + 0,892094 + 2,014520 + \bar{2},278753$$

$$= 2,323988 \Rightarrow \text{Antilog } 2,323988 = 210,857$$

$$6. \text{Log}95,18 - \text{Log}7,23$$

$$= 1,978317 - 0,859138$$

$$= 1,119179 \Rightarrow \text{Antilog } 1,119179 = 13,15767031 \cong 13,1577$$

$$7. \text{Log}8,125 - \text{Log}0,9324$$

$$= \text{Log}8,125 + \text{Colog } 0,9324$$

$$= 0,909823 + 0,030397$$

$$= 0,940220 \Rightarrow 10^{0,940220} = 8,714063 \cong 8,7141$$

$$8. \text{Log}7,653,95 - \text{Log}12,354$$

$$= \text{log}7,653,95 + \text{Colog } 12,354$$

$$= 3,883885 + \bar{2},908192$$

$$= 2,792077 \Rightarrow \text{Antilog}2,792077 = 619,55$$

$$9. \text{Log}0,72183 - \text{Log}0,0095$$

$$= \text{Log}0,72183 + \text{Colog } 0,0095$$

$$= \bar{1},858434 + 2,022276$$

$$= 1,88071 \Rightarrow 10^{1,88071} = 75,981873 \cong 75,982$$

$$10. \text{Log}9,114 - \text{Log}0,02$$

$$= \text{Log}9,114 + \text{Colog } 0,02$$

$$= 3,959709 + 1,698970$$

$$= 5,658679 \Rightarrow \text{Antilog}5,658679 = 455.699,97 \cong 455.700$$

$$11. \text{Log } 2^{10} = 10(\text{log } 2)$$

$$= 10(0,301029)$$

$$= 3,010299$$

$$\text{Anti log } 3,010299 = 1.024$$

$$12. \text{Log } 0,15^3 = 3(\text{log } 0,15)$$

$$= 3(\bar{1},176091)$$

$$= 3(-1) + 3(0,176091)$$

$$= -2,471727$$

$$10^{-2,471727} = 0,00337499 \cong 0,003375$$

$$13. \text{Log } 18,65^4 = 4(\text{log } 18,65)$$

$$= 4(1,270678)$$

$$= 5,082715$$

$$\text{Anti log } 5,082715 = 120.980,4916$$

$$\cong 120.980,5$$

$$14. \text{Log}(2 \cdot 0,084)^2 = \text{log}(0,168)^2$$

$$= 2(\text{log } 0,168)$$

$$= 2(\bar{1},225309)$$

$$= 2(-1) + 2(0,225309)$$

$$= -1,549382 = \bar{2},450618$$

$$10^{-1,549382} = 0,028223963 \cong 0,028224$$

$$\text{Anti log } \bar{2},450618 = 0,028224$$

$$15. \text{Log } 7,2^6 = 6(\text{log } 7,2)$$

$$= 6(0,857332)$$

$$= 5,143994$$

$$\text{Anti log } 5,143994 = 139.313,75$$

$$16. \text{Log}\sqrt{3} = \frac{\log 3}{2} = \frac{0,477121}{2} = 0,238560$$

$$\text{Antilog} 0,238560 = 1,7320483 \approx 1,73205$$

$$17. \text{Log}\sqrt[3]{2} = \frac{\log 2}{3} = \frac{0,301029}{3} = 0,100343$$

$$10^{0,100343} = 1,259921$$

$$18. \text{Log}\sqrt[4]{5} = \frac{\log 5}{4} = \frac{0,698970}{4} = 0,174742$$

$$\text{Antilog} 0,174742 = 1,495348 \approx 1,49535$$

$$19. \text{Log}\sqrt[5]{63} = \frac{\log 63}{5} = \frac{1,799340}{5} = 0,359868$$

$$10^{0,359868} = 2,290172$$

$$20. \text{Log}\sqrt[7]{815} = \frac{\log 815}{7} = \frac{2,911157}{7} = 0,415879$$

$$\text{Antilog} 0,415879 = 2,605431$$

## EJERCICIO 299

$$1. \text{Log} 515 + \log 78,19 + \text{colog} 6,13$$

$$= 2,711807 + 1,893151 + \bar{1},212539$$

$$= 3,817497 \rightarrow \text{Antilog} 3,817497 = 6.568,96 \approx 6.569$$

$$2. \text{Log} 23,054 + \log 934,5 + \text{colog} 8.164$$

$$= 1,36275 + 2,97058 + \bar{4},0881$$

$$= 0,42143 \rightarrow \text{Antilog} 0,42143 = 2,63894$$

$$3. \text{Log} 8,14 + \log 9,73 + \text{colog} 0,6 + \text{colog} 7,8$$

$$= 0,91062 + 0,98811 + 0,22185 + \bar{1},10791$$

$$= 1,22849 \rightarrow \text{Antilog} 1,22849 = 16,923461 \approx 16,9235$$

$$4. \text{Log} 513,4 + \log 9,132 + \text{colog} 85,3 + \text{colog} 10,764$$

$$= 2,71046 + 0,96057 + \bar{2},06905 + \bar{2},96802$$

$$= 0,7081 \rightarrow \text{Antilog} 0,7081 = 5,10622$$

$$5. \text{Log} 53,245 + \log 4.325,6 + \text{colog} 32,815 + \text{colog} 91,79$$

$$= 1,72628 + 3,63605 + \bar{2},48392 + \bar{2},03721$$

$$= 1,88346 \rightarrow \text{Antilog} 1,88346 = 76,4645$$

$$6. \text{Log} 32,6 + \log 841,9 + \text{colog} 0,017 + \text{colog} 732,14$$

$$= 1,51322 + 2,92526 + 1,76955 + \bar{3},135406$$

$$= 3,343436 \rightarrow \text{Antilog} 3,343436 = 2.205,139151$$

Como existe un signo negativo en la operación entonces este afecta el resultado total, luego la respuesta final es  $\approx -2.205,14$

$$7. \text{Log} 95,36 + \log 0,14 + \text{colog} 83,7 + \text{colog} 2,936$$

$$= 1,97937 + \bar{1},14613 + \bar{2},07727 + \bar{1},53224$$

$$= -1,26499 \rightarrow \text{Antilog} -1,26499 = 0,054326$$

El signo negativo se anula puesto que se encuentra en el numerador y en el denominador luego la respuesta es positiva

$$8. \text{Log} 7,2 + \log 8,135 + \text{colog} 0,003 + \text{colog} 9.134,7$$

$$= 0,85733 + 0,91036 + 2,52288 + \bar{4},03930$$

$$= 0,32987 \rightarrow \text{Antilog} 0,32987 = -2,137333 \approx -2,13734$$

$$9. 3^5 \cdot 0,2^4 = 5 \log 3 + 4 \log 0,2$$

$$= 5(0,47712) + 4(\bar{1},30103)$$

$$= 2,38561 - 2,79588$$

$$= -0,41027 \rightarrow 10^{-0,41027} = 0,3888$$

\* En la tabla se busca  $\bar{1},58973$   
 $\rightarrow \text{Anti log} 0,58973 = 0,3888$

$$10. \frac{1}{2} \log 5 + \frac{2}{3} \log 3$$

$$= \frac{1}{2}(0,69897) + \frac{2}{3}(0,47712)$$

$$= 0,349485 + 0,31808$$

$$= 0,66757$$

$$\rightarrow \text{Anti log} 0,66757 = 4,651199 \approx 4,6512$$

$$11. \frac{1}{5} \log 2 + \frac{1}{2} \log 3 + \frac{3}{4} \log 5$$

$$= \frac{1}{5}(0,30103) + \frac{1}{2}(0,47712) + \frac{3}{4}(0,69897)$$

$$= 0,060206 + 0,23856 + 0,5242275$$

$$= 0,82299$$

$$\rightarrow \text{Anti log} 0,82299 = 6,65257 \approx 6,6526$$

$$12. 8 \log 3 + 5 \text{colog} 5,6$$

$$= 8(0,47712) + 5(\bar{1},25181)$$

$$= 3,81696 - 3,74095$$

$$= 0,07601$$

$$\rightarrow \text{Anti log} 0,07601 = 1,19127 \approx 1,1913$$

$$13. 7 \log 0,53 + 3 \text{colog} 2,5$$

$$= 7(\bar{1},72428) + 3(\bar{1},60206)$$

$$= -1,93004 - 1,19382$$

$$= -3,12386 \rightarrow 10^{-3,12386} = 0,000751865$$

\* En la tabla se busca  $\bar{4},87614$

$$\begin{aligned}
 14. & \frac{2}{5} \log 3 + \frac{5}{3} \operatorname{colog} 2 \\
 &= \frac{2}{5} (0,47712) + \frac{5}{3} (\bar{1},69897) \\
 &= 0,190848 - 0,501717 \\
 &= -0,310869 \rightarrow 10^{-0,310869} = 0,488799 \cong 0,4888 \\
 &* \text{ En la tabla se busca } \bar{1},68914
 \end{aligned}$$

$$\begin{aligned}
 15. & \frac{\operatorname{Log} 7,86 + \operatorname{Log} 8,14}{2} \\
 &= \frac{0,89542 + 0,91062}{2} \\
 &= \frac{1,80604}{2} \\
 &= 0,90302 \rightarrow \operatorname{Antilog} 0,90302 = 7,9987
 \end{aligned}$$

$$\begin{aligned}
 16. & \frac{\operatorname{Log} 932,5 + \operatorname{Log} 813,6 + \operatorname{Log} 0,005}{2} \\
 &= \frac{2,96965 + 2,91041 + \bar{3},69897}{2} \\
 &= \frac{3,57903}{2} \\
 &= 1,78952 \quad \operatorname{Antilog} 1,78952 = 61,59138
 \end{aligned}$$

$$\begin{aligned}
 17. & \frac{\operatorname{Log} 93,7 + \operatorname{Log} 104,2 + \operatorname{colog} 8,35 + \operatorname{colog} 7,3}{2} \\
 &= \frac{1,97174 + 2,01787 + \bar{1},07831 + \bar{1},13668}{2} \\
 &= \frac{2,2046}{2} = 1,1023 \rightarrow \operatorname{Antilog} 1,1023 = 12,656174
 \end{aligned}$$

$$\begin{aligned}
 18. & \frac{\operatorname{Log} 23,725 + \operatorname{Log} 9,182 + \operatorname{Log} 7,184}{3} \\
 &= \frac{1,37521 + 0,96294 + 0,85637}{3} \\
 &= \frac{3,19452}{3} = 1,06484 \quad \operatorname{Antilog} 1,06484 = -11,610207
 \end{aligned}$$

$$\begin{aligned}
 19. & \frac{\operatorname{Log} 12,316 + \operatorname{Log} 0,25 + \operatorname{colog} 931,8 + \operatorname{colog} 0,07}{4} \\
 &= \frac{4,09047 + \bar{1},39794 + \bar{3},03068 + 1,15490}{4} \\
 &= \frac{1,67399}{4} = 0,41849 \rightarrow \operatorname{Antilog} 0,41849 = 2,621125
 \end{aligned}$$

$$\begin{aligned}
 20. & \frac{\operatorname{Log} 56,813 + \operatorname{colog} 22,117}{5} \\
 &= \frac{4,75446 + \bar{5},65527}{5} \\
 &= \frac{0,40973}{5} = 0,081946 \rightarrow \operatorname{Antilog} 0,081946 = 1,20766
 \end{aligned}$$

$$\begin{aligned}
 21. & \frac{3}{2} \log 0,0316 + \frac{3}{2} \operatorname{colog} 0,1615 \\
 &= \frac{3}{2} (\bar{2},49969 + 0,79183) \\
 &= \frac{3}{2} (-0,70848) = -1,06272 = \bar{2},93728 \\
 &10^{-1,06272} = 0,086552 \\
 &\operatorname{Anti} \log \bar{2},93728 = 0,08655625
 \end{aligned}$$

$$\begin{aligned}
 22. & \frac{3}{4} \log 3 + \frac{2}{3} \operatorname{colog} 5 \\
 &= \frac{3}{4} (0,47712) + \frac{2}{3} (\bar{1},30103) \\
 &= 0,35784 - 0,46598 \\
 &= -0,10814 = \bar{1},89186 \\
 &\operatorname{Anti} \log \bar{1},89186 = 0,77958
 \end{aligned}$$

$$\begin{aligned}
 23. & \frac{\operatorname{Log} 15 + \operatorname{Colog} 4}{7} \\
 &= \frac{1,17609 + \bar{1},39794}{7} \\
 &= \frac{0,57403}{7} = 0,082 \\
 &\operatorname{Antilog} 0,082 = 1,20782
 \end{aligned}$$

$$\begin{aligned}
 24. & \frac{\operatorname{Log} 5 + \operatorname{Colog} 3}{5} \\
 &= \frac{0,69897 + \bar{1},52288}{5} = 0,04437 \\
 &\operatorname{Antilog} 0,04437 = -1,10756
 \end{aligned}$$

$$\begin{aligned}
 25. & \frac{6}{5} (\operatorname{Log} 5 + \operatorname{Colog} 8) \\
 &= \frac{6}{5} (0,69897 + \bar{1},09691) \\
 &= \frac{6}{5} (-0,20412) = -0,24494 = \bar{1},75506 \\
 &\operatorname{Anti} \log \bar{1},75506 = 0,568926 \cong 0,56893
 \end{aligned}$$

$$\begin{aligned}
 26. & \frac{\operatorname{Log} 3 + \operatorname{Colog} 5}{2} + \frac{\operatorname{Log} 5 + \operatorname{Colog} 7}{3} \\
 &= \frac{3(0,47712 + \bar{1},30103) + 2(0,69897 + \bar{1},15490)}{6} \\
 &= \frac{3(-0,22185) + 2(-0,14613)}{6} \\
 &= \frac{-0,6655 - 0,29226}{6} \\
 &= \frac{-0,95781}{6} = -0,159635 = \bar{1},840364 \\
 &10^{-0,159635} = 0,6924126 \\
 &\operatorname{Anti} \log \bar{1},840364 = 0,69241
 \end{aligned}$$

$$27. \frac{\text{Log } 2}{7} + \frac{\text{Log } 3}{5} + \frac{\text{Log } 0,2}{3}$$

$$= \frac{15(0,30103) + 21(0,47712) + 35(\bar{1},30103)}{105}$$

$$= \frac{4,51545 + 10,01952 - 24,46395}{105}$$

$$= \frac{-9,92898}{105} = -0,094562 = \bar{1},905438$$

$$\text{Anti log } \bar{1},905438 = 0,8043369 \approx 0,80434$$

$$28. \frac{\text{Log } 32,14}{2} + \frac{\text{Log } 59,3}{3} + \frac{\text{Co log } 317,6}{4}$$

$$= \frac{6(1,50705) + 4(1,77305) + 3(\bar{3},49812)}{12}$$

$$= \frac{9,0423 + 7,0922 - 7,50564}{12}$$

$$= \frac{8,62886}{12} = 0,71907$$

$$\text{Anti log } 0,71907 = 5,2368483 \approx 5,23685$$

$$29. \frac{2 \log 0,75 + \log 39,162 + \text{co log } 0,07 + \text{co log } 3,89}{2}$$

$$= \frac{2(\bar{1},87506) + 1,59286 + 1,15490 + \bar{1},41005}{2}$$

$$= \frac{1,90793}{2} = 0,953965 = 8,99425 \approx 8,9943$$

$$30. \frac{3 \log 0,2 + 2 \log 0,3 + 4 \text{co log } 0,05 + \text{co log } 3,25}{2}$$

$$= \frac{3(\bar{1},30103) + 2(\bar{1},47712) + 4(1,30103) + \bar{1},48812}{2}$$

$$= \frac{-3 + 0,90309 - 2 + 0,95424 + 5,20412 - 1 + 0,48812}{2}$$

$$= \frac{1,54957}{2} = 0,774785$$

$$\text{Anti log } 0,774785 = 5,95366$$

## EJERCICIO 300

$$1. 36 = 2^2 \cdot 3^2$$

$$\text{Log } 36 = 2 \log 2 + 2 \log 3$$

$$= 2(0,301030) + 2(0,477121)$$

$$= 0,60206 + 0,954242$$

$$\text{Log } 36 = 1,556302$$

$$2. 75 = 3 \cdot 5^2$$

$$\text{Log } 75 = \log 3 + 2 \log 5$$

$$= 0,477121 + 2(0,698970)$$

$$= 0,477121 + 1,39794$$

$$\text{Log } 75 = 1,875061$$

$$3. 30 = 2 \cdot 3 \cdot 5$$

$$\text{Log } 30 = \log 2 + \log 3 + \log 5$$

$$= 0,301030 + 0,477121 + 0,698970$$

$$\text{Log } 30 = 1,477121$$

$$4. 48 = 2^4 \cdot 3$$

$$\text{Log } 48 = 4 \log 2 + \log 3$$

$$= 4(0,301030) + 0,477121$$

$$= 1,20412 + 0,477121$$

$$\text{Log } 48 = 1,681241$$

$$5. 120 = 2^3 \cdot 3 \cdot 5$$

$$\text{Log } 120 = 3 \log 2 + \log 3 + \log 5$$

$$= 3(0,30103) + 0,477121 + 0,69897$$

$$= 0,90309 + 1,176091$$

$$\text{Log } 120 = 2,079181$$

$$6. 98 = 7^2 \cdot 2$$

$$\text{Log } 98 = 2 \log 7 + \log 2$$

$$= 2(0,845098) + 0,30103$$

$$= 1,690196 + 0,30103$$

$$\text{Log } 98 = 1,991226$$

$$7. 343 = 7^3$$

$$\text{Log } 343 = 3 \log 7$$

$$= 3(0,845098)$$

$$\text{Log } 343 = 2,535294$$

$$\text{Log } 0,343 = \bar{1},535294$$

$$8. 225 = 5^2 \cdot 3^2$$

$$\text{Log } 225 = 2 \log 5 + 2 \log 3$$

$$= 2(0,69897) + 2(0,477121)$$

$$= 1,39794 + 0,954242$$

$$= 2,352182$$

$$\text{Log } 22,5 = 1,352182$$

$$9. 196 = 2^2 \cdot 7^2$$

$$\text{Log } 196 = 2(\log 2 + \log 7)$$

$$= 2(0,30103 + 0,845098)$$

$$= 2(1,146128)$$

$$= 2,292256$$

$$\text{Log } 1,96 = 0,292256$$

$$\begin{aligned}
 10. \quad 875 &= 5^3 \cdot 7 \\
 \text{Log } 875 &= 3\log 5 + \log 7 \\
 &= 3(0,69897) + 0,845098 \\
 &= 2,09691 + 0,845098 \\
 &= 2,942008 \\
 \text{Log } 0,875 &= \bar{1},942008
 \end{aligned}$$

$$\begin{aligned}
 11. \quad 2.025 &= 3^4 \cdot 5^2 \\
 \text{Log } 2.025 &= 4\log 3 + 2\log 5 \\
 &= 4(0,477121) + 2(0,69897) \\
 &= 1,908484 + 1,39794 \\
 &= 3,306424 \\
 \text{Log } 202,5 &= 2,306424
 \end{aligned}$$

$$\begin{aligned}
 12. \quad 448 &= 2^6 \cdot 7 \\
 \text{Log } 448 &= 6\log 2 + \log 7 \\
 &= 6(0,30103) + 0,845098 \\
 &= 1,80618 + 0,845098 \\
 &= 2,651278 \\
 \text{Log } 44,8 &= 1,651278
 \end{aligned}$$

$$\begin{aligned}
 13. \quad 2\frac{1}{2} &= \frac{5}{2} = 2,5 \\
 25 &= 5^2 \\
 \text{Log } 25 &= 2(0,69897) \\
 &= 1,39794 \\
 \text{Log } 2\frac{1}{2} &= 0,397940
 \end{aligned}$$

$$\begin{aligned}
 14. \quad 1\frac{1}{2} &= \frac{3}{2} = 1,5 \\
 15 &= 3 \cdot 5 \\
 \text{Log } 15 &= \log 3 + \log 5 \\
 &= 0,477121 + 0,698970 \\
 &= 1,176091 \\
 \text{Log } 1\frac{1}{2} &= 0,176091
 \end{aligned}$$

$$\begin{aligned}
 15. \quad 1\frac{2}{5} &= \frac{7}{5} = 1,4 \\
 14 &= 7 \cdot 2 \\
 \text{Log } 14 &= \log 7 + \log 2 \\
 &= 0,845098 + 0,30103 \\
 &= 1,146128 \\
 \text{Log } 1\frac{2}{5} &= 0,146128
 \end{aligned}$$

$$\begin{aligned}
 16. \quad 2\frac{1}{3} &= \frac{7}{3} \\
 \text{Log } 2\frac{1}{3} &= \log \frac{7}{3} \\
 &= \log 7 + \text{colog } 3 \\
 &= 0,845098 + \bar{1},522879 \\
 &= 0,367977
 \end{aligned}$$

$$\begin{aligned}
 17. \quad 13 &= \frac{143}{11} \\
 \text{Log } 13 &= \log \frac{143}{11} \\
 &= \log 143 + \text{colog } 11 \\
 &= 2,155336 + \bar{2},958607 \\
 \text{Log } 13 &= 1,113943
 \end{aligned}$$

$$\begin{aligned}
 18. \quad 25 &= \frac{225}{9} \\
 \text{Log } 25 &= \log \frac{225}{9} \\
 &= \log 225 + \text{colog } 9 \\
 &= 2,352183 + \bar{1},045757 \\
 \text{Log } 25 &= 1,397940
 \end{aligned}$$

## EJERCICIO 301

$$\begin{aligned}
 1. \quad 5^x &= 3 \\
 \text{Log } 5^x &= \log 3 \\
 x \log 5 &= \log 3 \\
 x(0,69897) &= 0,477121 \\
 x &= \frac{0,477121}{0,69897} = 0,6826
 \end{aligned}$$

$$\begin{aligned}
 2. \quad 7^x &= 512 \\
 \text{Log } 7^x &= \log 512 \\
 x \log 7 &= \log 512 \\
 x &= \frac{2,70927}{0,845098} = 3,205864 \\
 x &\approx 3,2059
 \end{aligned}$$

$$\begin{aligned}
 3. \quad 0,2^x &= 0,0016 \\
 \text{Log } 0,2^x &= \log 0,0016 \\
 x \log 0,2 &= \log 0,0016 \\
 x(\bar{1},30103) &= \bar{3},20412
 \end{aligned}$$

$$\begin{aligned}
 x &= \frac{\bar{3},20412}{\bar{1},30103} \\
 x &= \frac{-3}{-0,69897} + \frac{0,20412}{-0,69897} \\
 x &= 4,29203 - 0,29203 \\
 x &= 4
 \end{aligned}$$

$$\begin{aligned}
 4. \quad 9^x &= 0,576 \\
 \text{Log } 9^x &= \log 0,576 \\
 x \log 9 &= \bar{1},76042 \\
 x(0,95424) &= \bar{1},76042 \\
 x &= \frac{\bar{1},76042}{0,95424} \\
 &= \frac{-0,23958}{0,95424} \\
 x &= -0,2510689 \\
 x &\approx -0,25107
 \end{aligned}$$

$$\begin{aligned}
 5. \quad 3^{x+1} &= 729 \\
 \text{Log } 3^{x+1} &= 729 \\
 (x+1)\log 3 &= \log 729 \\
 (x+1)(0,477121) &= 2,86273 \\
 x+1 &= 6,00944 \\
 x &= 6,00944 - 1 \\
 x &= 5,00944 \Rightarrow x \approx 5
 \end{aligned}$$

$$\begin{aligned}
 6. \quad 5^{x-2} &= 625 \\
 \text{Log } 5^{x-2} &= \log 625 \\
 (x-2)\log 5 &= 2,79588 \\
 x-2 &= \frac{2,79588}{0,69897} \\
 x-2 &= 4 \Rightarrow x = 6
 \end{aligned}$$

$$\begin{aligned}
 7. \quad 2^{3x+1} &= 128 \\
 \text{Log } 2^{3x+1} &= \log 128 \\
 (3x+1)\log 2 &= 2,10721 \\
 (3x+1)(0,30103) &= 2,10721 \\
 3x+1 &= 7 \\
 3x &= 6 \\
 x &= 2
 \end{aligned}$$

$$\begin{aligned}
 8. \quad 3^{2x-1} &= 2.187 \\
 \text{Log } 3^{2x-1} &= \log 2.187 \\
 (2x-1)\log 3 &= 3,33985 \\
 (2x-1)(0,477121) &= 3,33985 \\
 2x-1 &= 7 \\
 2x &= 8 \Rightarrow x = 4
 \end{aligned}$$

$$\begin{aligned}
 9. \quad 11^{2x} &= 915 \\
 \text{Log } 11^{2x} &= \log 915 \\
 2x \log 11 &= 2,96142 \\
 2x &= \frac{2,96142}{1,04139} \\
 2x &= 2,84372 \\
 x &= 1,42186
 \end{aligned}$$

## EJERCICIO 302

1.  $a=3 \quad u=48 \quad r=6 \div 3=2$

$$n = \frac{\text{Log}48 + \text{Colog}3}{\text{Log}2} + 1$$

$$n = \frac{1,68124 + \bar{1},522879}{0,30103} + 1$$

$$n = \frac{1,204119}{0,30103} + 1 = 4 + 1 = 5$$

2.  $a=2 \quad u=\frac{243}{16} \quad r=\frac{3}{2}$

$$n = \frac{\text{Log}\frac{243}{16} + \text{Colog}2}{\text{Log}\frac{3}{2}} + 1$$

$$n = \frac{\text{Log}243 + \text{colog}16 + \text{colog}2}{\text{Log}1,5} + 1$$

$$n = \frac{2,38461 + \bar{2},79588 + \bar{1},69897}{0,176091} + 1$$

$$n = \frac{0,87946}{0,176091} + 1 = 4,994 + 1 \quad n=5,994 \quad n \cong 6$$

3.  $a=4 \quad u=512 \quad r=8 \div 4=2$

$$n = \frac{\text{Log}512 + \text{Colog}4}{\text{Log}2} + 1$$

$$n = \frac{2,70927 + \bar{1},39794}{0,30103} + 1$$

$$n = \frac{2,10721}{0,30103} + 1 = 7 + 1 = 8$$

4.  $a=6 \quad u=\frac{2.048}{81} \quad r=\frac{8}{6}=\frac{4}{3}$

$$n = \frac{\text{Log}\frac{2.048}{81} + \text{Colog}6}{\text{Log}\frac{4}{3}}$$

$$n = \frac{\text{Log}2.048 + \text{Colog}81 + \text{Colog}6}{\text{Log}4 + \text{Colog}3}$$

$$n = \frac{3,31133 + \bar{2},09151 + \bar{1},22184}{0,60206 + 1,522879} + 1$$

$$n = \frac{0,62468}{0,124939} + 1$$

$$n = 4,999879 + 1$$

$$n = 5,999879$$

$$n \cong 6$$

5.  $a=2 \quad u=\frac{625}{8} \quad r=\frac{5}{2}=2,5$

$$n = \frac{\text{Log}\frac{625}{8} + \text{Colog}2}{\text{Log}2,5} + 1$$

$$n = \frac{\text{Log}625 + \text{Colog}8 + \text{Colog}2}{\text{Log}2,5} + 1$$

$$n = \frac{2,79588 + \bar{1},09691 + \bar{1},69897}{0,39794} + 1$$

$$n = \frac{1,59176}{0,39794} + 1 = 4 + 1 = 5$$

## EJERCICIO 303

1.  $c=500 \quad r=0,06 \quad t=3$

$$C = 500(1 + 0,06)^3$$

$$C = 500(1,06)^3$$

$$\text{Log} C = \text{Log} 500(1,06)^3$$

$$\text{Log} C = \text{Log} 500 + 3 \log 1,06$$

$$\text{Log} C = 2,69897 + 3(0,02531)$$

$$\text{Log} C = 2,7749$$

$$\text{Anti log } 2,7749 = \$595,51$$

2.  $c=3.500 \quad r=0,07 \quad t=5$

$$C = 3.500(1 + 0,07)^5$$

$$\text{Log} C = \text{Log} 3.500(1,07)^5$$

$$\text{Log} C = \text{Log} 3.500 + 5 \text{Log} 1,07$$

$$= 3,54407 + 5(0,02938)$$

$$= 3,54407 + 0,1469$$

$$\text{Log} C = 3,69097$$

$$\text{Anti log } 3,69097 = 4.908,94 \text{ soles}$$

3.  $c=8.132 \quad r=0,09 \quad t=10$

$$C = 8.132(1 + 0,09)^{10}$$

$$\text{Log} C = \text{Log} 8.132(1,09)^{10}$$

$$= \text{Log} 8.132 + 10 \text{Log} 1,09$$

$$= 3,91020 + 10(0,03743)$$

$$= 3,91020 + 0,3743$$

$$\text{Log} C = 4,2845$$

$$\text{Anti log } 4,2845 = 19.253,070 \text{ bs.}$$



4.  $c=930 \quad r=0,035 \quad t=7$

$$C=930(1+0,035)^7$$

$$\text{Log } C = \text{Log } 930(1,035)^7$$

$$= \text{Log } 930 + 7 \text{Log } 1,035$$

$$= 2,9684829 + 7(0,0149403)$$

$$= 2,9684829 + 0,1045821$$

$$\text{Log } C = 3,073065 \quad \text{Anti log } 3,073065 = \$1.183,2186$$

5.  $C=12.318 \quad t=6$

$$r=4\frac{1}{4}=\frac{17}{4}=4,25 \Rightarrow \frac{4,25}{100}=0,0425$$

$$C=12.318(1+0,0425)^6$$

$$\text{Log } C = \text{Log } 12.318(1,0425)^6$$

$$= \text{Log } 12.318 + 6 \text{Log } 1,0425$$

$$= 4,0905402 + 6(0,018076)$$

$$= 4,0905402 + 0,108456$$

$$\text{Log } C = 4,1989962$$

$$\text{Anti log } 4,1989962 = \$15.812,34204$$

6.  $C=24.186 \quad t=7$

$$r=5\frac{1}{2}=\frac{11}{2}=5,5 \Rightarrow \frac{5,5}{100}=0,055$$

$$C=24.186(1+0,055)^7$$

$$\text{Log } C = \text{Log } 24.186(1,055)^7$$

$$= \text{Log } 24.186 + 7 \text{Log } 1,055$$

$$= 4,383564 + 7(0,0232524)$$

$$= 4,383564 + 0,1627668$$

$$\text{Log } C = 4,5463308$$

$$\text{Anti log } 4,5463308 = 35.182,83244 \text{ sucres}$$

7.  $C=54.293 \quad t=5$

$$r=3\frac{3}{4}=\frac{15}{4}=3,75 \Rightarrow \frac{3,75}{100}=0,0375$$

$$\text{Log } C = \text{Log } 54.293(1,0375)^5$$

$$= \text{Log } 54.293 + 5 \text{Log } 1,0375$$

$$= 4,734743 + 5(0,015988)$$

$$= 4,734743 + 0,07994$$

$$= 4,814683$$

$$\text{Anti log } 4,814683 = \$65.265,399$$

8.  $c=800 \quad t=4 \quad r=\frac{0,03}{2}=0,015$

$$C=800(1+0,015)^4$$

$$\text{Log } C = \text{Log } 800(1+0,015)^4$$

$$= \text{Log } 800 + 4 \text{Log } 1,015$$

$$= 2,90309 + 4(0,00647)$$

$$= 2,90309 + 0,02588$$

$$\text{Log } C = 2,92897 \quad \text{Anti log } C = \$849,09$$

9.  $c=900 \quad t=\frac{12}{3}=4 \quad r=\frac{0,04}{4}=0,01$

$$C=900(1+0,01)^4$$

$$\text{Log } C = \text{Log } 900 + 4 \text{Log } 1,01$$

$$= 2,954242 + 4(0,004321)$$

$$= 2,954242 + 0,017284$$

$$= 2,971526$$

$$\text{Anti log } 2,971526 = \$936,54$$

10.  $r=0,05 \quad C=972,60 \quad t=4$

$$c = \frac{972,60}{(1+0,05)^4}$$

$$\text{Log } c = \text{Log } 972,60 + 4 \text{Log } 1,05$$

$$= 2,987934 + 4(\bar{1},978811)$$

$$= 2,987934 - 0,084756$$

$$\text{Log } c = 2,903178$$

$$\text{Anti log } 2,903178 = \$800,16$$

11.  $C=1.893,5 \quad t=6$

$$r=4\frac{1}{2}=\frac{9}{2}=4,5 \Rightarrow \frac{4,5}{100}=0,045$$

$$c = \frac{1.893,5}{(1+0,045)^6}$$

$$\text{Log } c = \text{Log } 1.893,5 + 6 \text{Log } 1,045$$

$$= 3,277265 + 6(\bar{1},980883)$$

$$= 3,277265 - 0,114702$$

$$= 3,162563$$

$$\text{Anti log } 3,162563 = \$1.454,02$$

12.  $C=54.198,16 \quad r=0,08 \quad t=7$

$$c = \frac{54.198,16}{(1+0,08)^7}$$

$$\text{Log } c = \text{Log } 54.198,16 + 7 \text{Log } 1,08$$

$$= 4,733984 + 7(\bar{1},966576)$$

$$= 4,733984 - 0,233968$$

$$\text{Log } c = 4,500016$$

$$\text{Anti log } 4,500016 = 31.623,9 \approx 31.624 Q.$$

13.  $c=600$   $r=0,03$   $C=695,56$

$$t = \frac{\text{Log}695,56 - \text{Log}600}{\text{Log}1,03}$$

$$t = \frac{2,842334 - 2,778151}{0,012837}$$

$$t = \frac{0,064183}{0,012837} = 4,9998 \cong 5 \text{ años}$$

14.  $c=1.215$   $C=1.709,61$   $r=0,05$

$$t = \frac{\text{Log}1.709,61 - \text{log}1.215}{\text{Log}(1+0,05)}$$

$$t = \frac{3,232897 - 3,084576}{0,021189}$$

$$t = \frac{0,148321}{0,021189} = 7 \text{ años}$$

15.  $c=800$   $t=4$   $C=1.048,63$

$$\text{Log}(1+r) = \frac{\text{log}1.048,63 - \text{log}800}{4}$$

$$\text{Log}(1+r) = \frac{3,020622 - 2,903089}{4}$$

$$\text{Log}(1+r) = \frac{0,117533}{4} = 0,029384$$

$$\text{Anti log } 0,029384 = 1,07$$

$$1+r=1,07$$

$$r=0,07 \Rightarrow 7\%$$

16.  $c=6.354$   $t=4$   $C=7.151,46$

$$\text{Log}(1+r) = \frac{\text{Log}7.151,46 - \text{Log}6.354}{4}$$

$$= \frac{3,854394 - 3,803047}{4}$$

$$\text{Log}(1+r) = 0,012836$$

$$\text{Anti log } 0,012836 = 1,03$$

$$1+r=1,03$$

$$r=0,03 \Rightarrow 3\%$$

17.  $c=900$   $r=0,05$   $t=2+\frac{1}{3}=2,33333$

$$C = 900(1+0,05)^{2,33333}$$

$$\text{Log } C = \text{Log } 900 + 2,33333 \text{log } 1,05$$

$$= 2,954242 + 2,33333(0,0211892)$$

$$= 2,954242 + 0,049441$$

$$= 3,003683$$

$$\text{Anti log } 3,003683 = 1.008,52$$

Los intereses producidos representan la diferencia entre la suma inicial y lo que se ha convertido

$$\Rightarrow \text{Intereses producidos} = 1.008,52 - 900$$

$$= \$108,52$$

## EJERCICIO 304

1.  $c=40.000$   $r=0,05$   $t=10$

$$a = \frac{40.000(0,05)(1,05)^{10}}{(1,05)^{10} - 1}$$

$$\text{Log}(1,05)^{10} = 10 \text{Log } 1,05$$

$$= 10(0,0211892)$$

$$= 0,211892$$

$$\text{Anti log } 0,211892 = 1,62889$$

$$\text{Log } a = \text{log } 40.000 + \text{log } 0,05 + \text{log } 1,62889 + c \text{log } 0,62889$$

$$= 4,602059 + \bar{2},69897 + 0,211892 + 0,2014253$$

$$= 3,7143463$$

$$\text{Anti log } 3,7143463 = \$5.180,21$$

2.  $c = 85.000$   $r = 0,03$   $t = 12$

$$a = \frac{85.000(0,03)(1+0,03)^{12}}{(1+0,03)^{12} - 1}$$

$$\begin{aligned} \text{Log}(1,03)^{12} &= 12 \log 1,03 \\ &= 12(0,012837) \\ &= 0,154044 \end{aligned}$$

Anti log 0,154044 = 1,425761

$$\begin{aligned} \text{Log } a &= \log 85.000 + \log 0,03 + \log 1,425761 + \text{co log } 0,425761 \\ &= 4,929418 + \bar{2},477121 + 0,154044 + 0,370834 \\ &= 3,931417 \end{aligned}$$

Anti log 3,931417 = 8.539,2 soles

3.  $c = 600.000$   $r = 0,05$   $t = 20$

$$a = \frac{600.000(0,05)(1+0,05)^{20}}{(1+0,05)^{20} - 1}$$

$$\begin{aligned} \text{Log}(1,05)^{20} &= 20 \log 1,05 \\ &= 20(0,0211892) \\ &= 0,423784 \end{aligned}$$

Anti log 0,423784 = 2,65328

$$\begin{aligned} \text{Log } a &= \log 600.000 + \log 0,05 + \log 2,65328 + \text{co log } 1,65328 \\ &= 5,778151 + \bar{2},69897 + 0,423784 + \bar{1},781653 \\ &= 4,682558 \end{aligned}$$

Anti log 4,682558 = \$ 48.145,75

4.  $c = 5'000.000$   $r = 0,06$   $t = 30$

$$a = \frac{5'000.000(0,06)(1+0,06)^{30}}{(1+0,06)^{30} - 1}$$

$$\begin{aligned} \text{Log}(1,06)^{30} &= 30 \log 1,06 \\ &= 30(0,025306) \\ &= 0,75918 \end{aligned}$$

Anti log 0,75918 = 5,7435

$$\begin{aligned} \text{log } a &= \log 5'000.000 + \log 0,06 + \log 5,7435 + \text{co log } 4,7435 \\ &= 6,69897 + \bar{2},778151 + 0,75918 + \bar{1},323901 \\ &= 5,5602 \end{aligned}$$

Anti log 5,5602 = 363.245,2 bs.

5.  $c = 3.000$   $r = 0,06$   $t = 5$

$$a = 3.000 \cdot 0,237396$$

$$a = 712,188 \cong 712,19 \text{ bs.}$$

$$a = \frac{3.000(0,06)(1,06)^5}{(1,06)^5 - 1}$$

$$a = \frac{180(1,338226)}{0,338226}$$

$$a = \frac{240,88068}{0,338226}$$

$$a = 712,1885367 \cong 712,19 \text{ bs.}$$

NOTA:

0,237396 → Vr. que aparece en la tabla de interés compuesto decreciente para el 6% en 5 años.

1,338226 → Vr. que aparece en la tabla de interés compuesto para el 6% a 5 años.

6.  $c = 12.000$   $r = 0,07$   $t = 12$

$$a = 12.000 \cdot 0,125902$$

$$a = 1.510,824 \text{ bs.}$$

7.  $c = 350.000$   $r = 4\frac{1}{2}\%$   $t = 3$

$$a = 350.000 \cdot 0,363773$$

$$a = 127.320,55 \text{ sucres}$$

8.  $c = 425.000$   $r = 6\%$   $t = 10$

$$a = 425.000 \cdot 0,135868$$

$$a = 57.743,9 \text{ soles}$$

9.  $c = 90.750$   $r = 5\%$   $t = 25$

$$a = 90.750 \cdot 0,070952$$

$$a = 6.438,894 \text{ bs.}$$

10.  $c = 73.550$   $r = 5\frac{1}{2}\%$   $t = 30$

$$a = 73.550 \cdot 0,068805$$

$$a = 5.060,60775 \cong 5.060,61 \text{ bs.}$$

11.  $c = 473.000$   $r = 3\frac{1}{2}\%$   $t = 9$

$$a = 473.000 \cdot 0,131446$$

$$a = 62.173,958 \cong 62.173,96 \text{ sucres}$$

12.  $c = 45.800$     $r = 4\%$     $t = 30$

$$a = 45.800 \cdot 0,057830$$

$$a = 2.648,614 \text{ soles}$$

$$a = \frac{45.800(0,04)(1,04)^{30}}{(1,04)^{30} - 1}$$

$$\text{Log}(1,04)^{30} = 30 \log 1,04$$

$$= 30(0,017033)$$

$$= 0,51099$$

$$\text{Anti log } 0,51099 = 3,243321$$

$$\text{Log } a = \text{Log } 45.800 + \log 0,04 + \log 3,243321 + c \log 2,243321$$

$$= 4,660865 + \bar{2},60206 + 0,510989 + \bar{1},649108$$

$$= 3,423022$$

$$\text{Anti log } 3,423022 = 2.648,61 \text{ soles}$$

## EJERCICIO 305

1.  $c = 30.000$     $r = 0,06$     $t = 9$

$$i = \frac{30.000(0,06)}{(1+0,06)^{10} - (1+0,06)}$$

$$\text{Log}(1,06)^{10} = 10 \log 1,06$$

$$= 10(0,02531)$$

$$= 0,2531$$

$$\text{Anti log } 0,2531 = 1,791018$$

$$\text{Log } i = \text{Log } 30.000 + \log 0,06 + c \log 0,731018$$

$$= 4,477121 + \bar{2},778151 + 0,136072$$

$$= 3,391344$$

$$\text{Anti log } 3,391344 = \$ 2.462,38$$

3.  $c = 200.000$     $r = 0,05$     $t = 40$

$$i = \frac{200.000(0,05)}{(1,05)^{41} - 1,05}$$

$$\text{Log}(1,05)^{41} = 41 \log 1,05$$

$$= 41(0,0211892)$$

$$= 0,868757$$

$$\text{Anti log } 0,868757 = 7,391915$$

$$\text{Log } i = \text{Log } 200.000 + \log 0,05 + c \log 6,341915$$

$$= 5,30103 + \bar{2},69897 + \bar{1},19777$$

$$= 3,19777$$

$$\text{Anti log } 3,19777 = \$ 1.576,79$$

2.  $c = 90.000$     $r = 0,04$     $t = 20$

$$i = \frac{90.000(0,04)}{(1,04)^{21} - 1,04}$$

En la tabla de interés

$$\text{compuesto}(1,04)^{21} = 2,278768$$

$$\text{Log } i = \text{Log } 90.000 + \log 0,04 + c \log 1,238768$$

$$= 4,95424 + \bar{2},60206 + \bar{1},90701$$

$$= 3,4633$$

$$\text{Anti log } 3,4633 = 2.906,03 \text{ sucres}$$

4.  $c = 40.000$     $r = 0,06$     $t = 25$

$$i = \frac{40.000(0,06)}{(1,06)^{26} - 1,06}$$

$$(1,06)^{26} \rightarrow 4,549383$$

$$\text{Log } i = \log 40.000 + \log 0,06 + c \log 3,489383$$

$$= 4,60206 + \bar{2},778151 + \bar{1},457251$$

$$= 2,837462$$

$$\text{Anti log } 2,837462 = \$ 687,79$$