

1. Realiza la operación:

$$\begin{array}{llll}
 1. \frac{x^3(x^3)^3x}{x(-3x)^3(x^3)^3} & 2. \frac{-2 \cdot 3x^2(-2)}{-2(3x^3)^3(-1)} & 3. \frac{-3(x^3)^3x}{-3(-2x^3)^2(-x)} & 4. \frac{x^2(-2x^3)x^2}{-3(2x^2)^2(-3)} \\
 5. \frac{(-x^2)^3(x^3)^3(-2)}{(-2x)^2(-1)x^2} & 6. \frac{(x^2)^3(-1)(3x^2)^2}{2(x^2)^2(x^2)^2} & 7. \frac{(-x^3)^2(-1)(2x^3)^2}{3(-2x)(-2)} & 8. \frac{(-x^2)^3(2x)^3(-2x)}{3(-3x^2)(-3x)} \\
 9. \frac{2x^2(-x^3)^2(-2x)^2}{(3x^2)^3 \cdot 2(-3)} & 10. \frac{2x^3(-3x^2)^2(-2x)}{(3x)^2(-x^2)^2(-2x)} & 11. \frac{(-3x^2)^3 3x^3(x^2)^3}{(2x)^2(3x^2)^3(-3)} & 12. \frac{(x^3)^3(-2x^3)^2 3x^2}{-3(-2x^2)^3(2x^2)^2} \\
 13. \frac{2(-2x^3)^3(-2x^2)}{(-2x^2)^3(-1)(-3x)^2} & 14. \frac{3(-x)^3(2x)^2}{(-2x^2)^3(2x^2)^2 2x} & 15. \frac{x(-x)x^3}{(-3x)^2(x^3)^2(2x^3)^3} & 16. \frac{(-2x^2)^2(-2)(x^2)^2}{(-2x)^3(3x^3)^2(3x)^3} \\
 17. \frac{(-2x)^2(-x^2)^3 2x}{(2x^2)^3(-2x)^3(-x^2)^3} & 18. \frac{(-3x^2)^3(2x^3)^3 2x^3}{(3x^2)^2(-2x^2)(-3x^2)^3} & 19. \frac{(-3x^3)^2 x(-3x)^3}{(3x)^3(-2x)^3(2x^2)^2} & 20. \frac{-3(3x^2)^3(-3x^2)}{(-2x^2)^3(x^2)^2(-3x^2)^3}
 \end{array}$$

2. Realiza la operación:

$$\begin{array}{llll}
 1. \frac{2y^3(3y^2)^2(3y)^3}{y^2(2xy^2)^2 3xy} & 2. \frac{2xy^3(3xy^2)^2 3y}{-3x \cdot 2xy^2(-3)} & 3. \frac{(y^3)^2(-3y^3)(-x)^3}{-y(2x)^3(y^3)^2} & 4. \frac{(2x)^3(-xy^3)(-y^3)}{(-y)^3x(-2x)} \\
 5. \frac{(2xy)^3 3xy^2(2y^3)^2}{(3x)^2(-xy)(-xy^3)} & 6. \frac{(-xy)^2(xy^2)^2(-2y^3)}{(2y^3)^3(-3)(-3y)^3} & 7. \frac{(xy^3)^2(xy)^3(-3xy^2)}{(-2y^3)^2(-y^2)^2(-y^3)} & 8. \frac{(-3y)^2(-3x)(-3xy^2)^2}{2xy^2(-x)^2 2y^2} \\
 9. \frac{(-2xy^3)^3(-3y)^3 3xy^2}{-3(-2xy^3)^2(-3y^2)^2} & 10. \frac{(-2y^3)^2(2y^3)^3(2y^2)^3}{-xy^3(3y^3)^2(-1)} & 11. \frac{-3(-x)x}{xy^3(-2xy^2)^3(-2xy^2)} & 12. \frac{(-2xy^3)^2(2y^2)^2(3x)^2}{-3xy^2(2y^3)^3 2xy^3}
 \end{array}$$

3. Halla el valor numérico de la siguiente expresión:

$$\begin{array}{lll}
 1. x^3+2x^2-2 ; x = -3 & 2. -2x^4-x^2-2x+1 ; x = 2 & 3. x^3-2x^2+3x+3 ; x = -1 \\
 4. 2x^4-x^3-x^2-2x ; x = 2 & 5. -3x^4-2x^3-3x+2 ; x = -2 & 6. 2(2x-3)-2(x+2) ; x = -1 \\
 7. -2(3x-2)-3(x+2) ; x = -3 & 8. -3(3x-1)+2(3x-3) ; x = 2 & 9. x-x(3x-1)-3(x+1) ; x = -3 \\
 10. 3x(3x+1)-3(x-2) ; x = -2 & 11. x+(x-3)^2-(x+2)(x+2) ; x = 2 & 12. x(2x^2+x-3)-(3x+3)^2 ; x = -2 \\
 13. x+(x-3)(x+3)-(3x+2)^2 ; x = -1 & 14. -(3x+2)(3x-2)+2x^2(x-2) ; x = 1 & 15. x-(3x-2)(3x+2)-3x(x+2) ; x = -2
 \end{array}$$

4. Realiza la operación:

$$\begin{array}{lll}
 1. -3x-(-4x^2+1)-(-3x^2-x) & 2. -(2x-4)-(-3x+4)+(-4x-4) & 3. (-3x-2)-(-3x+2)-(-4x-1) \\
 4. -(x-2)-(x^3+4x+3)-(3x+4) & 5. (x-1)-(-3x+3)-(-4x^2-x+4) & 6. -(x-3)-(x+2)-(-2x^3+2x^2+2x) \\
 7. -(3x^2+x+4)-(-x+3)+(x^2+3x+2) & 8. (-4x^3+3x^2-3)-(-4x-4)-(-3x+1) & 9. (-2x+3)-(x^3+3x^2+x-2)+(-4x-2) \\
 10. -(x^2-2x-1)-(-3x^2+3x-4)-(-2x+1) & 11. -(-x^3+x^2+4x+4)+(-4x+4)-(-x-4) & 12. -(-x^3-3x)-(-3x^3-3x^2+1)-(-x^3+x^2)
 \end{array}$$

5. Realiza la operación:

$$\begin{array}{llll}
 1. (-2x+3)(-2x^2-2x) & 2. (x+2)(-4x^3+4x-3) & 3. (x^2+1)(-2x^2-2x+3) & 4. (-3x^2-3x)(4x^2-2x-4) \\
 5. (-2x^3+x^2)(3x^3-x+4) & 6. (-3x^2+x+4)(-x^3-4x^2-x) & 7. (3x+2)(3x-2) & 8. (4x^2-1)(4x^2+1) \\
 9. (x^3-2x^2)(x^3+2x^2) & 10. (x^2+3x)(3x-x^2) & 11. (-2x^2+3)(2x^2+3) & 12. (2x^2-3)^2 \\
 13. (-x^2+2x)^2 & 14. (-2x-3)^2 & 15. (3x^3-2x)^2 & 16. (3x^3-5x^2)^2
 \end{array}$$

17. $\left(x^2 - \frac{1}{3}\right)\left(x^2 + \frac{1}{3}\right)$

18. $\left(\frac{1}{2}x - \frac{2}{3}\right)\left(\frac{1}{2}x + \frac{2}{3}\right)$

19. $\left(2x^2 - \frac{3}{2}\right)^2$

20. $\left(\frac{2}{3}x - \frac{1}{2}\right)^2$

6. Realiza la operación:

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

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

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

4. $-(x+1)^2 - (3x^3-x)(x^2-1)$

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

6. $-(2x^2+x)(2x^2-x) - (3x-1)^2$

7. $-(x-1)(2x^2-2x) + (x+3)(x-3)$

8. $-2x + (3x+2)^2 + (3x-1)(3x+1)$

9. $3x^3 - (3x-2)^2 - (3x-3)(3x+3)$

10. $2x(x^2-2x-1) + (3x+3)(3x-3)$

11. $-2x(2x-3) + (x^2+2x)(x^2-2x)$

12. $-(2x+2)(2x^2-1) + 3(3x^2-x-1)$

13. $(x^2-2)(x^3+x+2) + (2x+1)(2x-1)$

14. $-x^2(-2x+3)(3x-3) - x(3x-1)^2$

15. $-3x^2 + (x+1)(x-1) + (x-2)(3x^2-1)$

16. $2(-x+3)(-x-3) + 2x^2(2x^3+3x)^2$

17. $2x(-2x-1)(-2x+1) + 3x^3(2x-2)^2$

18. $-(3x^2-2)^2 + (3x^2-3)(2x^2+3x-2)$

19. $2x + (x^2-2)(x^2+2) - (x-3)(2x^2+3)$

20. $(2x+3)(2x-3) + 2x^3(3x^3+2x^2-x)$

21. $2x-3x(3x-1) - (3x^2+3x)(x^2+x-2)$

22. $-2x^2(2x^3+2x^2) - (3x^2+x)(3x^2-x)$

23. $(2x^2-3)(x^2-2x+3) + (3x+2)(3x-2)$

24. $-3x^3 - x^2(2x^2-x+2) - (3x-1)(x^2+3)$

25. $-(3x+2)(3x-2) - (x-1)(2x^3-3x^2-3x)$

26. $-(2x+2)(2x-2) - (x-2)(3x^3-2x^2-3x)$

27. $-2x^2 - 2x^2(3x^2-2x+3) - (x+2)(2x+2)$

28. $-2x^3(-x-2)(-x+2) + 2x^3(x+2)(3x+2)$

29. $3x+2x(3x^3+x^2-2) - (2x-2)(2x^2+2x+1)$

30. $-3x^3(2x^3-2x-3) - (2x^3+3x)(2x^3-3x-1)$

7. Realiza la siguiente división:

1. $\begin{cases} \text{D: } -16x-8x^2-7 \\ \text{d: } 3+2x \end{cases}$

2. $\begin{cases} \text{D: } x^3-8 \\ \text{d: } -x^2-2x-4 \end{cases}$

3. $\begin{cases} \text{D: } 3x^3-x-2 \\ \text{d: } -1-3x \end{cases}$

4. $\begin{cases} \text{D: } 8x^3+6x^2+10x-1 \\ \text{d: } 1-4x \end{cases}$

5. $\begin{cases} \text{D: } 9x^3+18x^2+17x+6 \\ \text{d: } 3x^2+4x+3 \end{cases}$

6. $\begin{cases} \text{D: } -12x^3-8x^2-8x-13 \\ \text{d: } -4x-4 \end{cases}$

7. $\begin{cases} \text{D: } 4x^4-2x^3-4x+2 \\ \text{d: } -2x-1 \end{cases}$

8. $\begin{cases} \text{D: } 3x^4+x^3+8x^2+17x+2 \\ \text{d: } -4x-3x^2 \end{cases}$

9. $\begin{cases} \text{D: } -4x^6+15x^5-23x^4+3x^3-7x+3 \\ \text{d: } x^3-3x^2+3x+3 \end{cases}$

10. $\begin{cases} \text{D: } 14-13x-12x^2+4x^3+2x^4+4x^5 \\ \text{d: } 4-2x-4x^2 \end{cases}$

11. $\begin{cases} \text{D: } 4x^5+16x^4+11x^3+11x^2-2x-6 \\ \text{d: } 1-3x-4x^3 \end{cases}$

12. $\begin{cases} \text{D: } 1+8x-4x^3-5x^4-2x^5-x^6 \\ \text{d: } 2+4x+x^2+x^3 \end{cases}$

8. Realiza, usando la regla de Ruffini, la división:

1. $\begin{cases} \text{D: } -3x^3-10x^2-6x \\ \text{d: } x+2 \end{cases}$

2. $\begin{cases} \text{D: } x^4+2x^3+3x-1 \\ \text{d: } x+2 \end{cases}$

3. $\begin{cases} \text{D: } -4x^3+4x^2+7x-2 \\ \text{d: } x-2 \end{cases}$

4. $\begin{cases} \text{D: } 2x^4+5x^3-12x^2-x \\ \text{d: } x+4 \end{cases}$

5. $\begin{cases} \text{D: } -x^4+x^3+9x^2-6x-9 \\ \text{d: } x-3 \end{cases}$

6. $\begin{cases} \text{D: } 2x^4-2x^3-7x-7 \\ \text{d: } x+1 \end{cases}$

7. $\begin{cases} \text{D: } -2x^4+3x^2+8x-3-6x^3 \\ \text{d: } x+3 \end{cases}$

8. $\begin{cases} \text{D: } 4x^3-12x-8x^2+3x^4-6 \\ \text{d: } x+2 \end{cases}$

9. $\begin{cases} \text{D: } -2x^2+8x^3+4x-2x^4+13 \\ \text{d: } x-4 \end{cases}$

10. $\begin{cases} \text{D: } x^6+3x^5-3x^4-8x^3-9x-1 \\ \text{d: } x+3 \end{cases}$

11. $\begin{cases} \text{D: } x^3 - \frac{19}{4}x^2 + 3x + \frac{1}{2} \\ \text{d: } x-4 \end{cases}$

12. $\begin{cases} \text{D: } \frac{4}{3}x^4 + \frac{4}{3}x^3 - \frac{1}{2}x^2 - \frac{1}{2}x \\ \text{d: } x+1 \end{cases}$

9. Dado el polinomio $2x^3-6mx^2-x+3m$, determina el valor de m , sabiendo que es divisible por $x+1$.10. Calcula el valor de m , sabiendo que el polinomio $3mx^3-4mx^2+2x$ es divisible por $x-1$.11. Halla m para que el resto de la división del polinomio $-mx^3+x^2-6x+m$ por $x+3$ sea -1 .12. Halla el valor de m para que el polinomio $3x^3+3x^2-7x-2m^2$ sea divisible por $x+2$.

13. Dado el polinomio $2m^2x^3-5x^2+5mx+2$, determina m , sabiendo que el resto de su división por $x-1$ es 4.

14. Calcula m , sabiendo que el resto de la división del polinomio $6x^3-2m^2x^2-6x-m$ por $x-2$ es 2.

15. Dados los polinomios $-nx^2-2x-2m$ y $-2mx^2+n$, calcula los valores de m y n , sabiendo que el resto de sus divisiones por $x-1$ es 2.

16. Dado el polinomio $x^3+nx^2-mx+21$, determina m y n para que el resto de las divisiones por $x+2$ y $x+3$ sea 3.

17. Determina m y n para que el polinomio $x^3+nx^2-2mx+3$ sea divisible por $x-1$ y $x-3$.

18. Halla los valores de m y n para que los polinomios $x^2+3nx+m$ y $-3nx^2-x-m$ sean divisibles por $x-1$.

19. Descompón, al máximo, en producto de factores:

- | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 1. $x-x^3$ | 2. x^3-9x | 3. $4x^3-x$ | 4. x^2-x^4 | 5. x^6-x^2 | 6. $3-3x^4$ |
| 7. $3x^4-48$ | 8. $x-81x^5$ | 9. x^6-81x^2 | 10. $48-3x^4$ | 11. $2x^6-2x^2$ | 12. $4x^3+4x^2+x$ |
| 13. $18x^2-12x+2$ | 14. $12x^2-12x+3$ | 15. $3x^2+18x+27$ | 16. $12x^2+36x+27$ | 17. $3x^3-18x^2+27x$ | 18. $8x^4+24x^3+18x^2$ |
| 19. $27x^3+36x^2+12x$ | 20. x^8-2x^4+1 | 21. $3x^2-6x-9$ | 22. $3x^2-3x-6$ | 23. $2x^2+2x-4$ | 24. $2x^2+4x-6$ |
| 25. $3x^5-243x$ | 26. $-x^5+2x^3-x$ | 27. $x^6-2x^4+x^2$ | 28. $162x^6-2x^2$ | 29. $2x^4-4x^2+2$ | 30. $-3x^6+48x^2$ |
| 31. x^3+x^2-4x-4 | 32. x^3+x^2-9x-9 | 33. x^3-x^2-4x+4 | 34. $2x^2+10x+12$ | 35. x^9-8x^5+16x | 36. $3x^3-9x^2+6x$ |
| 37. $3x^5-6x^3+3x$ | 38. $x^4+4x^3+3x^2$ | 39. $2x^3+8x^2+6x$ | 40. x^3-5x^2+8x-4 | 41. x^3+5x^2+8x+4 | 42. $3x^6-6x^4+3x^2$ |
| 43. $3x^4+6x^3-9x^2$ | 44. $3x^4-24x^2+48$ | 45. $3x^4+9x^3+6x^2$ | 46. x^8-32x^4+256 | 47. $x^3-2x^2-9x+18$ | 48. $3x^4-3x^3-18x^2$ |
| 49. $4x^3+4x^2-9x-9$ | 50. $9x^3-9x^2-4x+4$ | 51. $x^3+7x^2+15x+9$ | 52. $2x^5-16x^3+32x$ | 53. $3x^8-54x^4+243$ | 54. $-x^6+18x^4-81x^2$ |
| 55. $x^3-8x^2+21x-18$ | 56. $x^3+3x^2-16x-48$ | 57. $4x^3-8x^2-9x+18$ | 58. $81x^9-72x^5+16x$ | 59. $-3x^5+24x^3-48x$ | 60. $3x^5-54x^3+243x$ |

20. Descompón, al máximo, en producto de factores:

- | | | | |
|-------------------------|--------------------------------|-------------------------------|------------------------------------|
| 1. x^4y^5-16y | 2. $32x^4y^4-2$ | 3. $3y^6-3x^4y^2$ | 4. $48xy^6-3x^5y^2$ |
| 5. $2xy^2+6x^2y+4x^3$ | 6. $x^2y^3-x^2y^2-4y+4$ | 7. $x^5y^6-2x^3y^4+xy^2$ | 8. $y^8-32x^4y^4+256x^8$ |
| 9. $3xy^5-54xy^3+243xy$ | 10. $xy^3+2x^2y^2-2xy^2-4x^2y$ | 11. $48x^5y^8-216x^3y^4+243x$ | 12. $y^3+4xy^2-y^2+4x^2y-4xy-4x^2$ |

21. Halla el M.c.d. y m.c.m. de los siguientes polinomios:

- | | | | | | |
|--|---|--|--|---|---|
| 1. $\begin{cases} 9x^2-1 \\ 9x^2-3x \\ 9x^2+6x+1 \end{cases}$ | 2. $\begin{cases} x^2-16 \\ x^2+x-12 \\ x^2-7x+12 \end{cases}$ | 3. $\begin{cases} 2x-4 \\ 4-x^2 \\ 2x^2+8x+8 \end{cases}$ | 4. $\begin{cases} x^2-4 \\ x^2-x-2 \\ x^2+3x+2 \end{cases}$ | 5. $\begin{cases} 3x^2-3 \\ x^2-2x+1 \\ 3x^2+6x+3 \end{cases}$ | 6. $\begin{cases} x^2-1 \\ x^2+2x+1 \\ 3x^4-6x^2+3 \end{cases}$ |
| 7. $\begin{cases} 1-x^2 \\ x^2+2x+1 \\ x^4-2x^3+x^2 \end{cases}$ | 8. $\begin{cases} 9x+9 \\ 9x+27 \\ 3x^2+12x+9 \end{cases}$ | 9. $\begin{cases} 2x^2-2 \\ 2x^4-2 \\ 2x^4-4x^2+2 \end{cases}$ | 10. $\begin{cases} 4x+8 \\ 4x+12 \\ 2x^2+10x+12 \end{cases}$ | 11. $\begin{cases} 2x^2-4x-6 \\ 2x^2-12x+18 \\ x^3-5x^2+3x+9 \end{cases}$ | 12. $\begin{cases} 9x+18 \\ 3x^3+9x^2 \\ 3x^2+15x+18 \end{cases}$ |
| 13. $\begin{cases} 6x^2-9 \\ 27-12x^4 \\ 4x^4-12x^2+9 \end{cases}$ | 14. $\begin{cases} x^4-9x^2 \\ x^2+6x+9 \\ x^5-18x^3+81x \end{cases}$ | 15. $\begin{cases} x^2+2x \\ x^4-x^3-2x^2 \\ x^3+x^2-4x-4 \end{cases}$ | 16. $\begin{cases} 2x^2+2x \\ x^3-2x^2-3x \\ x^3+x^2-9x-9 \end{cases}$ | 17. $\begin{cases} 2x^3-2x \\ 2x^5-2x \\ 2x^3+4x^2+2x \end{cases}$ | 18. $\begin{cases} 2x-2x^5 \\ 2x^3+4x^2+2x \\ 2x^5-4x^3+2x \end{cases}$ |

$$\begin{array}{llll}
 19. \begin{cases} 4x+2 \\ 4x^2-4x+1 \\ 32x^4-16x^2+2 \end{cases} & 20. \begin{cases} 3x^2+9x+6 \\ 3x^2+12x+12 \\ x^3+5x^2+8x+4 \end{cases} & 21. \begin{cases} x^2-9 \\ x^2-x-6 \\ x^3+2x^2-9x-18 \end{cases} & 22. \begin{cases} x^4-4 \\ x^4-4x^2+4 \\ 2x^6+8x^4+8x^2 \end{cases} \\
 23. \begin{cases} x^2-x-2 \\ x^2+3x+2 \\ x^3+x^2-4x-4 \end{cases} & 24. \begin{cases} x^2-4 \\ 16x^2-x^6 \\ x^8-32x^4+256 \end{cases} \\
 25. \begin{cases} x^2-x \\ x^3-3x^2+2x \\ x^3-5x^2+8x-4 \end{cases} & 26. \begin{cases} 1-x^2 \\ 2x^3+4x^2+2x \\ 2x^6-4x^4+2x^2 \end{cases} & 27. \begin{cases} 2x^3+3x^2-1 \\ x^3-x^2-5x-3 \\ 2x^3-x^2-2x+1 \end{cases} & 28. \begin{cases} 3x^2+9x \\ x^2-6x+9 \\ 3x^3-18x^2+27x \end{cases} \\
 29. \begin{cases} -3x^2 \\ 3x^2+6x \\ 3x^3+15x^2+18x \end{cases} & 30. \begin{cases} 2x^3-7x^2+2x+3 \\ 2x^3-3x^2-8x-3 \\ 4x^3+8x^2+5x+1 \end{cases}
 \end{array}$$

22. Halla el M.c.d. y m.c.m. de los siguientes polinomios:

$$\begin{array}{llll}
 1. \begin{cases} y^4-x^2 \\ y^5-x^2y \\ y^9-x^4y \end{cases} & 2. \begin{cases} 3x^2y+3x \\ 3x^5y^4-3x \\ x^2y^2-2xy+1 \end{cases} & 3. \begin{cases} 9x^2y^2-4 \\ 3x^2y^2-2xy \\ 81x^5y^5-16xy \end{cases} & 4. \begin{cases} y^2-9x^2 \\ y^2+3xy-2y-6x \\ y^2-3xy-2y+6x \end{cases} \\
 5. \begin{cases} xy-3x^2 \\ 2xy-6x^2 \\ xy^2-5x^2y+6x^3 \end{cases} \\
 6. \begin{cases} xy^2+xy \\ y^3-xy^2+y^2-xy \\ y^4-xy^3+y^3-xy^2 \end{cases} & 7. \begin{cases} 3y^2+3xy-6x^2 \\ xy^2+4x^2y+4x^3 \\ 3y^3+9xy^2-12x^3 \end{cases} & 8. \begin{cases} y^2-x^2 \\ y^2-2xy+x^2 \\ xy^5-2x^3y^3+x^5y \end{cases} & 9. \begin{cases} 9y+18 \\ 9y+18x \\ 3y^2+6xy+6y+12x \end{cases} \\
 10. \begin{cases} 2y^3+4xy^2-6x^2y \\ 2y^3-4xy^2+2x^2y \\ y^3+xy^2-5x^2y+3x^3 \end{cases}
 \end{array}$$

23. Simplifica, al máximo, la fracción:

$$\begin{array}{llll}
 1. \frac{x^2+2x-3}{x^2+6x+9} & 2. \frac{9x^2-6x+1}{9x^2-1} & 3. \frac{3-x}{x^2-5x+6} & 4. \frac{4x^2+4x+1}{4x^2-1} \\
 5. \frac{x^2-9}{x^2+4x+3} & 6. \frac{2x^2-7x+6}{x^2-4x+4} \\
 7. \frac{x^2+4x+4}{-2x^2-8x-8} & 8. \frac{3x^2+11x+6}{x^2-9} & 9. \frac{4x^2-9}{4x^2-12x+9} & 10. \frac{3x^2+12x+9}{x^2+6x+9} \\
 11. \frac{x^2-4x+3}{x^2-9} & 12. \frac{3x^3-27x}{243x-3x^5} \\
 13. \frac{2x^2+6x}{9-x^2} & 14. \frac{3x^2+10x+3}{x^2+2x-3} & 15. \frac{2x^2+12x+18}{-x^2-6x-9} & 16. \frac{9x^2-15x-6}{3x^2-12x+12} \\
 17. \frac{12x^2-36x+27}{12x^2-27} & 18. \frac{x^2-4x+4}{x^3-3x^2+4} \\
 19. \frac{x^4+x^3-x^2-x}{x^4-2x^2+1} & 20. \frac{3x^3-6x^2}{3x^3-9x^2+6x} & 21. \frac{3x^3-5x^2-2x}{x^3-3x^2+2x} & 22. \frac{6x^2-3x^3}{3x^3-3x^2-6x} \\
 23. \frac{2x^3+7x^2+6x}{x^3+5x^2+6x} & 24. \frac{12x^2+32x-12}{4x^2-36} \\
 25. \frac{4x^3+4x^2}{2x^3+8x^2+6x} & 26. \frac{2x^4-2x^3-4x^2}{x^4-4x^2} & 27. \frac{6x^3+10x^2-4x}{2x^3+8x^2+8x} & 28. \frac{6x^3+18x^2+12x}{2x^3+8x^2+8x} \\
 29. \frac{6x+4x^2-2x^3}{x^3-5x^2+3x+9} & 30. \frac{x^3+4x^2-3x-18}{x^3-7x+6} \\
 31. \frac{6x^3+24x^2+18x}{2x^3+10x^2+12x} & 32. \frac{2x^3-18x}{x^3+3x^2-9x-27} & 33. \frac{2x^3+3x^2-8x+3}{x^3+3x^2-x-3} & 34. \frac{x^3-2x^2-9x+18}{x^3-7x^2+16x-12} \\
 35. \frac{x^3-5x^2+6x}{x^3-7x^2+16x-12} & 36. \frac{3x^3-x^2-20x-12}{x^3-4x^2-3x+18}
 \end{array}$$

24. Halla el valor numérico de la siguiente fracción:

$$\begin{array}{llll}
 1. \frac{x^4-x^3}{x^4-x^2}; x=1 & 2. \frac{3x}{x^2-3x}; x=0 & 3. \frac{3x+9}{x^2-9}; x=-3 & 4. \frac{6x^2-6x}{2x^2-6x}; x=1 \\
 5. \frac{27x+81}{9x^2-81}; x=-3 \\
 6. \frac{2x^2-6x}{x^2-9}; x=3 & 7. \frac{3x-3}{x^2-3x+2}; x=-1 & 8. \frac{2x^2-4x-6}{x^2-2x-3}; x=-1 & 9. \frac{x^2+x-6}{x^2-9}; x=-3 \\
 10. \frac{2x^2+x-1}{x^2-1}; x=-1 \\
 11. \frac{2x^2+x-3}{x^2-1}; x=-1 & 12. \frac{2x^2-5x-3}{x^2-2x-3}; x=3 & 13. \frac{9x^2+18x}{3x^2+12x+12}; x=-2 & 14. \frac{3x^2-12x+9}{3x^2+6x-9}; x=1 \\
 15. \frac{2x^3-5x^2+3x}{x^3+x^2-2x}; x=\frac{3}{2}
 \end{array}$$

25. Realiza la operación:

$$\begin{array}{llll}
 1. \frac{x-1}{x} + \frac{x^2+x-3}{x^2-3x} - 1 & 2. \frac{x^2+x+1}{x^2+x} + \frac{x-3}{3x} - \frac{1}{3} & 3. \frac{x^2-x-1}{x^2-x-6} - 1 + \frac{x-4}{x-3} & 4. \frac{x^2+x+6}{x^2+2x-3} + \frac{x-3}{x-1} - 1 \\
 5. \frac{x^2+x-10}{x^2-5x+6} - 2 + \frac{x-6}{x-2} & 6. \frac{x^2+4x-3}{x^2-4x+3} + \frac{x}{x-1} + 1 & 7. \frac{x}{x-2} + \frac{2}{3} - \frac{x+4}{6-3x} & 8. \frac{x^2+3x-4}{x^2-x-2} - 2 + \frac{x-1}{x+1}
 \end{array}$$

$$\begin{array}{llll}
9. \frac{x+4}{x+1} + \frac{x^2-2x-9}{x^2+4x+3} - 1 & 10. \frac{x^2+3x-8}{x^2-2x} + \frac{x-4}{x} - 2 & 11. \frac{x+3}{x-1} + 1 + \frac{x^2+x+6}{x^2-4x+3} & 12. \frac{2x+1}{4x+6} + \frac{2x+5}{8x+12} - \frac{1}{4} \\
13. \frac{x^2+x+30}{2x^2+4x} + \frac{x-15}{2x} + 2 & 14. 4 - \frac{x^2+x-6}{x^2+3x+2} - \frac{x+7}{x+1} & 15. \frac{x+1}{x^2-9} + \frac{7}{3x-9} - \frac{1}{3x+9} & 16. \frac{x^2+x-3}{x^2-5x+6} - \frac{x}{x-3} + \frac{x+1}{x-2} \\
17. \frac{2x-1}{2x^2+2x} + \frac{1}{2x} + \frac{1}{2x+2} & 18. 4 - \frac{x+5}{x+2} - \frac{x^2+x+1}{x^2+3x+2} & 19. \frac{x+6}{x+2} + \frac{x^2-2x-12}{x^2+5x+6} - 1 & 20. 1 + \frac{x^2+2x+9}{x^2+2x-3} - \frac{x+6}{-x-3} \\
21. \frac{x^2+2x+9}{4x-x^2-3} - \frac{x-15}{x-3} + 5 & 22. \frac{x^2+x+2}{4x^2-4} - \frac{x}{4x+4} + \frac{x+1}{x-1} & 23. \frac{5}{4} - \frac{2x-5}{4x-6} - \frac{4x^2+4x+9}{16x^2-36} & 24. \frac{x+3}{x+1} - \frac{x^2+x+4}{1-x^2} + \frac{x+1}{x-1} \\
25. \frac{x+17}{3x+6} - \frac{4}{3} - \frac{x^2+x-7}{-x^2-5x-6} & 26. \frac{x^2+x-18}{x^2-4} - \frac{8}{x+2} - \frac{x+1}{2-x} & 27. \frac{x^2-8x+1}{2x^2-2} - \frac{1}{2} - \frac{x^2+x+1}{1-x^2} & 28. \frac{x^2+x-5}{3x^2+9x+6} - \frac{x+6}{-3x-3} - \frac{2}{3} \\
29. \frac{x^2+x+1}{x^2-1} + \frac{2x+3}{2x+2} - \frac{2x-5}{2x-2} & 30. \frac{1}{2x-2} + \frac{2x+3}{2x+2} + \frac{x^2+x+1}{x^2-1} & 31. \frac{7}{2x} - \frac{3}{2x+4} + \frac{x^2+x+7}{x^3+x^2-2x} & 32. -\frac{3}{-x-3} - \frac{x}{x^2+5x+6} - \frac{1}{x+2}
\end{array}$$

26. Realiza la operación:

$$\begin{array}{lll}
1. \frac{x^2-1}{x^2+x-2} : \frac{x+1}{x+2} & 2. \frac{3x^2-3x}{x^2+3x+2} : \frac{x-1}{x+2} & 3. \frac{12x^2-6x}{x^4-9x^2} \cdot \frac{x^2+3x}{4x-2} \\
4. \frac{4x^2-4}{x^3-7x-6} \cdot \frac{x-3}{2} & 5. \left(\frac{12x^2-6x}{18x^2-9x}\right)^{-2} \frac{4x}{27} & 6. \left(\frac{x^2+x}{2x^2+2x}\right)^{-2} : 8 \\
7. \left(\frac{2x^2-2x}{3x^2-3x}\right)^2 \frac{27x}{4x+12} & 8. \frac{6x+6}{4x^2+6x} : \frac{3x+3}{2x^2+3x} & 9. \frac{2x^2-2x}{4x^4-16x^2} \cdot \frac{4x^3-8x^2}{x-1} \\
10. \frac{4x^2-6x}{x^3-6x^2+9x} : \frac{4x-6}{x-3} & 11. \left(\frac{18x-12}{6x^2-4x}\right)^2 \frac{x^3-2x^2}{27} & 12. \frac{12x^2+6x}{12x+12} : \frac{2x+1}{3x+3} \\
13. \frac{2x^2-4x+2}{3x^2+12x+12} \cdot \frac{3x+6}{2x-2} & 14. \frac{4x^2-36}{x^3-x^2-2x} : \frac{2x^2-18}{x^2-2x} & 15. \frac{3x+9}{3x^3-18x+27} \cdot \frac{x-3}{x+3} \\
16. \frac{9x^2+36x+36}{2x^2-12x+18} \cdot \frac{2x-6}{9x+18} & 17. \frac{9x^4-18x^3+9x^2}{9x^2-81} : \frac{x^3-2x^2+x}{3x+9} & 18. \frac{3x^2-12x+12}{x^2-4} \left(\frac{3x}{x^2-5x+6} : \frac{3x}{x-3}\right) \\
19. \left(\frac{2x^2+6x}{x^2+6x+9}\right)^2 \frac{(x+3)^2}{4x^2} & 20. \left(\frac{3x+3}{x^2+2x+1}\right)^{-2} : \frac{x^3+x^2-x-1}{18x} & 21. \frac{x^2-4}{2x-2} \left(\frac{2}{x^2-5x+6} : \frac{1}{x-3}\right) \\
22. \left(\frac{2x^2}{2x^2-6x}\right)^{-2} \frac{2x^3-x^2}{x^3-9x^2+27x-27} & 23. \left(\frac{8x^3-24x^2+18x}{16x^2-48x+36}\right)^{-2} \frac{x^3-2x^2}{4x+8} & 24. \frac{9x^2-1}{x^2-4} : \left(\frac{9x^2-3x}{x^2-x-6} : \frac{3x}{x-3}\right) \\
25. \frac{4x^2-8x}{x^3-4x} : \left(\frac{x^2-2x}{x^2+5x+6} : \frac{x^2}{2x+6}\right) & 26. \frac{x-3}{2x^2-6x} \cdot \frac{6x}{x^2-6x+9} : \frac{3x}{x^2-3x} & 27. \left(\frac{x+2}{x^2+4x+4}\right)^2 \left(\frac{2}{x-2} : \frac{6x^2+6x-12}{x-2}\right) \\
28. \left(\frac{3x^3-12x^2+9x}{3x^3+6x^2-9x}\right)^2 \frac{x^3+4x^2-3x-18}{x^3-5x^2+3x+9} & 29. \left(\frac{x^2+6x+9}{x^3+7x^2+15x+9}\right)^2 \frac{2x^3+7x^2+8x+3}{x-1} & 30. \left(\frac{2x}{2x-2}\right)^{-2} : \left(\frac{x^3+2x^2-3x}{x^2+2x} : \frac{3x^3-2x^2}{x^2+x-2}\right)
\end{array}$$

27. Realiza la operación:

$$\begin{array}{lll}
1. \left(\frac{x}{x-2} + \frac{x-2}{x+2} + 1\right) \frac{x+2}{x} & 2. \left(\frac{1}{x} - \frac{1}{2x} - \frac{1}{2x+4}\right) : \frac{1}{2x} & 3. \left(\frac{x^2+x-8}{x^2-4} - 1 + \frac{x-2}{x+2}\right) \frac{x+2}{x-3} \\
4. \left(\frac{x-12}{x+1} + 2 + \frac{x^2+x+26}{x^2+4x+3}\right) \frac{1}{2} & 5. \left(4 - \frac{x-4}{x-3} - \frac{x^2+x-22}{x^2-9}\right) \frac{x-3}{x-1} & 6. \left(\frac{x+4}{x-1} + \frac{x^2+x+12}{x^2-3x+2} - 2\right) : \frac{3}{x-2}
\end{array}$$

$$7. \left(\frac{x+8}{x+1} + \frac{x^2+x+21}{x^2-x-2} + 7 \right) : \frac{3x+3}{x-2}$$

$$8. \left(\frac{4x+9}{x+1} - \frac{x^2+x-10}{x^2-1} - \frac{x+1}{x-1} \right) \frac{x-1}{2x}$$

$$9. \left(\frac{x^2+x+16}{x^2+4x+3} + \frac{2x-15}{x+3} + 1 \right) \frac{x+3}{2x-2}$$

$$10. \left(\frac{x-12}{x-1} + 1 + \frac{x^2+x+39}{x^2+2x-3} \right) \left(2 - \frac{x-3}{x-2} \right)$$

$$11. \left(\frac{x+1}{x+2} + \frac{x^2+x+14}{x^2-4} - \frac{6}{x-2} \right) : \frac{2x-6}{x+2}$$

$$12. \left(\frac{x+22}{4x-4} + \frac{11}{2} + \frac{x}{x-1} \right) \left(\frac{8}{9x+9} - \frac{4}{9x} \right)$$

$$13. \left(\frac{11}{x+3} - \frac{7}{x+1} - \frac{x-1}{x^2+4x+3} \right) \left(2 - \frac{x-7}{x-3} \right)$$

$$14. \left(\frac{13}{5x+10} + \frac{2}{5x-15} + \frac{x+1}{x^2-x-6} \right) \frac{x+2}{2}$$

$$15. \left(3 + \frac{x^2+x+3}{2x^2-4x} + \frac{2x-3}{2x} \right) : \left(\frac{1}{2} + \frac{2x-3}{2x} \right)$$

$$16. \left(\frac{x}{x-2} - 1 \right) : \frac{1}{x-2} - \frac{x+1}{x+2} \left(2 - \frac{x-2}{x+1} \right)$$

$$17. \left(\frac{x+2}{x+1} - 1 \right) : \frac{1}{x+1} + \frac{x+3}{x-3} \left(2 - \frac{x+1}{x+3} \right)$$

$$18. \left(\frac{x+4}{x+3} - 1 \right) (x+3) + \left(2 + \frac{x+7}{-x-2} \right) : \frac{x+3}{x+2}$$

$$19. \left(\frac{4}{3} + \frac{x-11}{3x+9} \right) \frac{x+3}{x-1} + \frac{x-3}{3} \left(-1 - \frac{x-2}{3-x} \right)$$

$$20. \left(1 - \frac{x+7}{3-x} \right) : \frac{x+1}{x-3} + \frac{x-2}{x-1} : \left(2 - \frac{x^2+3x+10}{x^2+x+4} \right)$$

$$21. \left(\frac{x+5}{x+1} + \frac{x^2+2x+3}{x^2-1} - 2 \right) : \left(\frac{x-1}{x+1} + 1 \right)$$

$$22. \left(\frac{14x-3}{2x+2} + \frac{2x-5}{2x-2} + \frac{x^2+x+1}{x^2-1} \right) : \frac{3x-3}{x+1}$$

$$23. \left(\frac{5}{-6x-18} + \frac{6x-7}{6x-18} + \frac{x^2+x+1}{x^2-9} \right) \frac{x+3}{x^2+x}$$

$$24. \left(\frac{x^2+x+6}{x-3} - 8 + 4x + \frac{x^2+x+30}{x+3} \right) \frac{x+3}{2x^2-2x}$$

$$25. \left(\frac{2x^2+3x-2}{6x^2-6x} + \frac{2x+13}{6x+18} - \frac{2}{3} \right) \left(2 + \frac{x^2+x-2}{x+1} \right)$$

$$26. \left(\frac{x^2-2x-21}{x^2+3x} - 2 + \frac{x+7}{x} \right) \frac{x^2+6x+9}{4}$$

$$27. \left(\frac{x-5}{x} + 1 + \frac{x^2+3x+5}{x^2+x} \right) \frac{x^3+x^2-x-1}{9x^3+18x^2}$$

$$28. \left(3 + \frac{x^2-x+1}{3x^2+3x} - \frac{x+1}{3x} \right)^2 : \frac{9x^2+12x+4}{3x^2+6x+3}$$

$$29. \left(4 - \frac{x^2+x-48}{x^2-9} - \frac{x-4}{x+3} \right)^2 : \frac{4x^2+8x}{3x^2-18x+27}$$

$$30. \left(\frac{x+1}{x-1} - \frac{x^2+x-6}{1-x^2} - \frac{6}{x+1} \right)^2 : \frac{x^3-3x-2}{8x^2-8x+2}$$

28. Realiza la operación:

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

$$2. \frac{y-9x^2+1}{6x^2y+6x^2} + 1 - \frac{3x^2+1}{6x^2}$$

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

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

$$5. 4 - \frac{y^2+y-9x-18}{y^2-y-2} - \frac{y-3x-5}{y+1}$$

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

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

$$8. \frac{y+3x-2}{y-1} - 2 + \frac{y^2+y-9x^2-1}{y^2+3xy-y-3x}$$

$$9. \frac{y^2+y+4x-24}{y^2-xy-3y+3x} - \frac{y-x+8}{y-x} + \frac{y+1}{y-3}$$

$$10. 4 - \frac{y^2+y-27x^2+9x}{y^2+3xy+y+3x} - \frac{y+9x+1}{y+1}$$

$$11. \left(1 - \frac{x-1}{x} \right) \frac{x}{y+3x} + \frac{x}{y-3x} \left(2 - \frac{y-3x}{xy+3x^2} \right)$$

$$12. \left(\frac{y-2}{2y} + \frac{y^2+y-x}{y^2-xy} - \frac{1}{2} \right)^2 : \frac{3y^3}{xy^2-2x^2y+x^3}$$

$$13. \left(y+1 - \frac{xy-y-3x+2}{x} \right) : \frac{y-2}{x} + 2x \left(\frac{2x-3}{2x} + \frac{1}{x} \right)$$

$$14. \left(1 + \frac{y^2+y+39x^2+3x}{y^2+3xy+2y+6x} + \frac{y-14x-3}{y+2} \right) : \frac{y-3x}{y+2}$$

$$15. \left(\frac{y^2+y+x^2-6}{y^2-xy+2y-2x} + \frac{y+x}{y+2} + \frac{y+1}{y-x} \right)^2 : \frac{9y^2-12y+4}{y-x}$$

$$16. \left(\frac{3xy+y-15x-9}{3xy+y+9x^2+3x} + \frac{3xy+y-3x+3}{3xy+y-3x-1} - 1 \right) \left(2 - \frac{y-5}{y-3} \right)$$

— Soluciones —

1.1. $\frac{-1}{27}$ 1.2. $\frac{2}{9x^7}$ 1.3. $\frac{-x^3}{4}$ 1.4. $\frac{-x^3}{18}$ 1.5. $\frac{-x^{11}}{2}$ 1.6. $\frac{-9x^2}{2}$ 1.7. $\frac{-x^{11}}{3}$ 1.8. $\frac{16x^7}{27}$ 1.9. $\frac{-4x^4}{81}$ 1.10. $2x$ 1.11. $\frac{x^7}{4}$ 1.12. $\frac{x^7}{8}$ 1.13. $\frac{4x^3}{9}$ 1.14. $\frac{3}{16x^6}$ 1.15. $\frac{-1}{72x^{12}}$ 1.16. $\frac{1}{243x^4}$ 1.17. $\frac{-1}{8x^6}$ 1.18. $\frac{-8x^6}{9}$ 1.19. $\frac{9}{32}$ 1.20. $\frac{9}{8x^8}$ 2.1. $\frac{81y^3}{2x^3}$ 2.2. $3xy^6$ 2.3. $\frac{-3y^2}{8}$ 2.4. $4x^2y^3$ 2.5. $\frac{32y^7}{3}$ 2.6. $\frac{-x^4}{324y^3}$ 2.7. $\frac{3x^6}{4y^2}$ 2.8. $\frac{-243y^2}{4}$ 2.9. $-6x^2y^4$ 2.10. $\frac{256y^{12}}{9x}$ 2.11. $\frac{3}{16x^3y^{11}}$ 2.12. $\frac{-3x^2}{y^4}$ 3.1. -11 3.2. -39 3.3. -3 3.4. 16 3.5. -24 3.6. -12 3.7. 25 3.8. -9 3.9. -27 3.10. 42 3.11. 3 3.12. -15 3.13. -10 3.14. -7 3.15. -34 4.1. $7x^2-2x-1$ 4.2. $-9x-4$ 4.3. $4x-3$ 4.4. $-x^3-8x-5$ 4.5. $4x^2+5x-8$ 4.6. $2x^3-2x^2-4x+1$ 4.7. $-2x^2+3x-5$

- 4.8. $-4x^3+3x^2+7x$ 4.9. $-x^3-3x^2-7x+3$ 4.10. $-4x^2+x+4$ 4.11. x^3-x^2-7x+4 4.12. $-3x^3+2x^2+3x-1$ 5.1. $4x^3-2x^2-6x$ 5.2. $-4x^4-8x^3+4x^2+5x-6$ 5.3. $-2x^4-2x^3+x^2-2x+3$ 5.4. $-12x^4-6x^3+18x^2+12x$ 5.5. $-6x^6+3x^5+2x^4-9x^3+4x^2$ 5.6. $3x^5+11x^4-5x^3-17x^2-4x$ 5.7. $9x^2-4$ 5.8. $16x^4-1$ 5.9. x^6-4x^4 5.10. $9x^2-x^4$ 5.11. $-4x^4+9$ 5.12. $4x^4-12x^2+9$ 5.13. $x^4-4x^3+4x^2$ 5.14. $4x^2+12x+9$ 5.15. $9x^6-12x^4+4x^2$ 5.16. $9x^6-30x^5+25x^4$ 5.17. $x^4 - \frac{1}{9}$ 5.18. $\frac{1}{4}x^2 - \frac{4}{9}$ 5.19. $4x^4-6x^2 + \frac{9}{4}$
- 5.20. $\frac{4}{9}x^2 - \frac{2}{3}x + \frac{1}{4}$ 6.1. x^3+2x^2-6x+9 6.2. $-2x^2-3x-4$ 6.3. $5x^2-6x$ 6.4. $-3x^5+4x^3-x^2-3x-1$ 6.5. $-5x^2-18x-13$ 6.6. $-4x^4-8x^2+6x-1$ 6.7. $-2x^3+5x^2-2x-9$ 6.8. $18x^2+10x+3$ 6.9. $3x^3-18x^2+12x+5$ 6.10. $2x^3+5x^2-2x-9$ 6.11. x^4-8x^2+6x 6.12. $-4x^3+5x^2-x-1$ 6.13. $x^5-x^3+6x^2-2x-5$ 6.14. $6x^4-24x^3+15x^2-x$ 6.15. $3x^3-8x^2-x+1$ 6.16. $8x^8+24x^6+18x^4+2x^2-18$ 6.17. $12x^5-24x^4+20x^3-2x$ 6.18. $-3x^4+9x^3-9x+2$ 6.19. $x^4-2x^3+6x^2-x+5$ 6.20. $6x^6+4x^5-2x^4+4x^2-9$ 6.21. $-3x^4-6x^3-6x^2+11x$ 6.22. $-4x^5-13x^4+x^2$ 6.23. $2x^4-4x^3+12x^2+6x-13$ 6.24. $-2x^4-5x^3-x^2-9x+3$ 6.25. $-2x^4+5x^3-9x^2-3x+4$ 6.26. $-3x^4+8x^3-5x^2-6x+4$ 6.27. $-6x^4+4x^3-10x^2-6x-4$ 6.28. $4x^5+16x^4+16x^3$ 6.29. $6x^4-2x^3+x+2$ 6.30. $-10x^6+6x^4+11x^3+9x^2+3x$
- 7.1. $\begin{cases} C: -4x-2 \\ r: -1 \end{cases}$ 7.2. $\begin{cases} C: -x+2 \\ r: 0 \end{cases}$ 7.3. $C: -x^2+\frac{1}{3}x+\frac{2}{9}; r: \frac{-16}{9}$ 7.4. $\begin{cases} C: -2x^2-2x-3 \\ r: 2 \end{cases}$ 7.5. $\begin{cases} C: 3x+2 \\ r: 0 \end{cases}$ 7.6. $\begin{cases} C: 3x^2-x+3 \\ r: -1 \end{cases}$ 7.7. $C: -2x^3+2x^2-x+\frac{5}{2}; r: \frac{9}{2}$ 7.8. $\begin{cases} C: -x^2+x-4 \\ r: x+2 \end{cases}$ 7.10. $\begin{cases} C: -x^3-2x+4 \\ r: 3x-2 \end{cases}$ 7.11. $\begin{cases} C: -x^2-4x-2 \\ r: -4x-4 \end{cases}$ 7.12. $\begin{cases} C: -x^3-x^2+2 \\ r: -3 \end{cases}$ 8.1. $\begin{cases} C: -3x^2-4x+2 \\ r: -4 \end{cases}$ 8.2. $\begin{cases} C: x^3+3 \\ r: -7 \end{cases}$ 8.3. $\begin{cases} C: -4x^2-4x-1 \\ r: -4 \end{cases}$ 8.4. $\begin{cases} C: 2x^3-3x^2-1 \\ r: 4 \end{cases}$ 8.5. $\begin{cases} C: -x^3-2x^2+3x+3 \\ r: 0 \end{cases}$ 8.6. $\begin{cases} C: 2x^3-4x^2+4x-11 \\ r: 4 \end{cases}$ 8.7. $\begin{cases} C: -2x^3+3x-1 \\ r: 0 \end{cases}$ 8.8. $\begin{cases} C: 3x^3-2x^2-4x-4 \\ r: 2 \end{cases}$ 8.9. $\begin{cases} C: -2x^3-2x-4 \\ r: -3 \end{cases}$ 8.10. $\begin{cases} C: x^5-3x^3+x^2-3x \\ r: -1 \end{cases}$ 8.11. $C: x^2-\frac{3}{4}x; r: \frac{1}{2}$ 8.12. $C: \frac{4}{3}x^3-\frac{1}{2}x; r: 0$ 9. $\frac{-1}{3}$ 10. 2 11. -1 12. 1, -1 13. $\frac{-7}{2}$ 14. $\frac{-17}{8}$ 15. $(\frac{-3}{2}, -1)$ 16. $(-21, 8)$ 17. $(\frac{1}{2}, -3)$ 18. $(-3, \frac{2}{3})$ 19.1. $-x(x+1)(x-1)$ 19.2. $x(x-3)(x+3)$ 19.3. $x(2x+1)(2x-1)$ 19.4. $-x^2(x+1)(x-1)$ 19.5. $x^2(x^2+1)(x+1)(x-1)$ 19.6. $-3(x^2+1)(x+1)(x-1)$ 19.7. $3(x^2+4)(x+2)(x-2)$ 19.8. $-x(9x^2+1)(3x+1)(3x-1)$ 19.9. $x^2(x^2+9)(x+3)(x-3)$ 19.10. $-3(x^2+4)(x+2)(x-2)$ 19.11. $2x^2(x^2+1)(x+1)(x-1)$ 19.12. $x(2x+1)^2$ 19.13. $2(3x-1)^2$ 19.14. $3(2x-1)^2$ 19.15. $3(x+3)^2$ 19.16. $3(2x+3)^2$ 19.17. $3x(x-3)^2$ 19.18. $2x^2(2x+3)^2$ 19.19. $3x(3x+2)^2$ 19.20. $(x^2+1)^2(x+1)^2(x-1)^2$ 19.21. $3(x-3)(x+1)$ 19.22. $3(x-2)(x+1)$ 19.23. $2(x+2)(x-1)$ 19.24. $2(x+3)(x-1)$ 19.25. $3x(x^2+9)(x+3)(x-3)$ 19.26. $-x(x+1)^2(x-1)^2$ 19.27. $x^2(x+1)^2(x-1)^2$ 19.28. $2x^2(9x^2+1)(3x+1)(3x-1)$ 19.29. $2(x+1)^2(x-1)^2$ 19.30. $-3x^2(x^2+4)(x+2)(x-2)$ 19.31. $(x+1)(x+2)(x-2)$ 19.32. $(x+1)(x+3)(x-3)$ 19.33. $(x-1)(x+2)(x-2)$ 19.34. $2(x+2)(x+3)$ 19.35. $x(x^2+2)^2(x^2-2)^2$ 19.36. $3x(x-1)(x-2)$ 19.37. $3x(x+1)^2(x-1)^2$ 19.38. $x^2(x+1)(x+3)$ 19.39. $2x(x+1)(x+3)$ 19.40. $(x-1)(x-2)^2$ 19.41. $(x+1)(x+2)^2$ 19.42. $3x^2(x+1)^2(x-1)^2$ 19.43. $3x^2(x+3)(x-1)$ 19.44. $3(x+2)^2(x-2)^2$ 19.45. $3x^2(x+2)(x+1)$ 19.46. $(x^2+4)^2(x+2)^2(x-2)^2$ 19.47. $(x-2)(x+3)(x-3)$ 19.48. $3x^2(x+2)(x-3)$ 19.49. $(x+1)(2x+3)(2x-3)$ 19.50. $(x-1)(3x+2)(3x-2)$ 19.51. $(x+1)(x+3)^2$ 19.52. $2x(x+2)^2(x-2)^2$ 19.53. $3(x^2+3)^2(x^2-3)^2$ 19.54. $-x^2(x+3)^2(x-3)^2$ 19.55. $(x-2)(x-3)^2$ 19.56. $(x+3)(x+4)(x-4)$ 19.57. $(x-2)(2x+3)(2x-3)$ 19.58. $x(3x^2+2)^2(3x^2-2)^2$ 19.59. $-3x(x+2)^2(x-2)^2$ 19.60. $3x(x+3)^2(x-3)^2$ 20.1. $y(x^2y^2+4)(xy+2)(xy-2)$ 20.2. $2(4x^2y^2+1)(xy+1)(xy-1)$ 20.3. $3y^2(y^2+x^2)(y+x)(y-x)$ 20.4. $3xy^2(4y^2+x^2)(2y+x)(2y-x)$ 20.5. $2x(y+x)(y+2x)$ 20.6. $(y-1)(xy+2)(xy-2)$ 20.7. $xy^2(xy+1)^2(xy-1)^2$ 20.8. $(y^2+4x^2)^2(y+2x)^2(y-2x)^2$ 20.9. $3xy(y+3)^2(y-3)^2$ 20.10. $xy(y-2)(y+2x)$ 20.11. $3x(2xy^2+3)^2(2xy^2-3)^2$ 20.12. $(y-1)(y+2x)^2$ 21.1. 1; $3x(3x-1)(3x+1)^2$ 21.2. 1; $(x-3)(x-4)(x+4)$ 21.3. 1; $2(x-2)(x+2)^2$ 21.4. 1; $(x+1)(x-2)(x+2)$ 21.5. 1; $3(x-1)^2(x+1)^2$ 21.6. $x+1$; $3(x-1)^2(x+1)^2$ 21.7. 1; $x^2(x+1)^2(x-1)^2$ 21.8. 3; $9(x+1)(x+3)$ 21.9. $2(x+1)(x-1)$; $2(x+1)^2(x-1)^2(x^2+1)$ 21.10. 2; $4(x+2)(x+3)$ 21.11. $x-3$; $2(x+1)(x-3)^2$ 21.12. 2; $9x^2(x+2)(x+3)$ 21.13. $2x^2-3$; $3(2x^2+3)(2x^2-3)^2$ 21.14. $x+3$; $x^2(x-3)^2(x+3)^2$ 21.15. 1; $x^2(x+1)(x-2)(x+2)$ 21.16. $x+1$; $2x(x+1)(x-3)(x+3)$ 21.17. $2x(x+1)$; $2x(x-1)(x^2+1)(x+1)^2$ 21.18. $2x(x+1)$; $2x(x^2+1)(x-1)^2(x+1)^2$ 21.19. 1; $2(2x-1)^2(2x+1)^2$ 21.20. $x+2$; $3(x+1)(x+2)^2$ 21.21. $x-3$; $(x+2)(x+3)(x-3)$ 21.22. 1; $2x^2(x^2+2)^2(x^2-2)^2$ 21.23. $x+1$; $(x+1)(x-2)(x+2)$ 21.24. $(x+2)(x-2)$; $x^2(x+2)^2(x-2)^2(x^2+4)^2$ 21.25. $x-1$; $x(x-1)(x-2)^2$ 21.26. $x+1$; $2x^2(x+1)^2(x-1)^2$ 21.27. $x+1$; $(x-1)(x-3)(2x-1)(x+1)^2$ 21.28. 1; $3x(x+3)(x-3)^2$ 21.29. $3x$; $3x^2(x+2)(x+3)$ 21.30. $2x+1$; $(x+1)(x-1)(x-3)(2x+1)^2$ 22.1. $(y^2+x)(y^2-x)$; $y(y^2+x)(y^2-x)(y^4+x^2)$ 22.2. 1; $3x(xy+1)(xy-1)^2(x^2y^2+1)$ 22.3. $3xy-2$; $xy(3xy-2)(3xy+2)(9x^2y^2+4)$ 22.4. 1; $(y-2)(y+3x)(y-3x)$ 22.5. $x(y-3x)$; $2x(y-2x)(y-3x)$ 22.6. $y(y+1)$; $xy^2(y+1)(y-x)$ 22.7. $y+2x$; $3x(y-x)(y+2x)^2$ 22.8. $y-x$; $xy(y+x)^2(y-x)^2$ 22.9. 3; $9(y+2)(y+2x)$ 22.10. $y-x$; $2y(y+3x)(y-x)^2$ 23.1. $\frac{x-1}{x+3}$ 23.2. $\frac{3x-1}{3x+1}$ 23.3. $\frac{-1}{x-2}$ 23.4. $\frac{2x+1}{2x-1}$ 23.5. $\frac{x-3}{x+1}$ 23.6. $\frac{2x-3}{x-2}$ 23.7. $\frac{-1}{2}$ 23.8. $\frac{3x+2}{x-3}$ 23.9. $\frac{2x+3}{2x-3}$ 23.10. $\frac{3x+3}{x+3}$ 23.11. $\frac{x-1}{x+3}$ 23.12. $\frac{-1}{x^2+9}$ 23.13. $\frac{-2x}{x-3}$ 23.14. $\frac{3x+1}{x-1}$ 23.15. -2 23.16. $\frac{3x+1}{x-2}$ 23.17. $\frac{2x-3}{2x+3}$ 23.18. $\frac{1}{x+1}$ 23.19. $\frac{x}{x-1}$ 23.20. $\frac{x}{x-1}$ 23.21. $\frac{3x+1}{x-1}$ 23.22. $\frac{-x}{x+1}$ 23.23. $\frac{2x+3}{x+3}$ 23.24. $\frac{3x-1}{x-3}$ 23.25. $\frac{2x}{x+3}$ 23.26. $\frac{2x+2}{x+2}$ 23.27. $\frac{3x-1}{x+2}$ 23.28. $\frac{3x+3}{x+2}$ 23.29. $\frac{-2x}{x-3}$ 23.30. $\frac{x+3}{x-1}$ 23.31. $\frac{3x+3}{x+2}$ 23.32. $\frac{2x}{x+3}$ 23.33. $\frac{2x-1}{x+1}$ 23.34. $\frac{x+3}{x-2}$ 23.35. $\frac{x}{x-2}$ 23.36. $\frac{3x+2}{x-3}$ 24.1. $\frac{1}{2}$ 24.2. -1 24.3. $\frac{-1}{2}$ 24.4. 0 24.5. $\frac{-1}{2}$ 24.6. 1 24.7. -1 24.8. 2 24.9. $\frac{5}{6}$ 24.10. $\frac{3}{2}$ 24.11. no tiene 24.12. $\frac{7}{4}$ 24.13. no tiene 24.14. $\frac{-1}{2}$ 24.15. 0 25.1. $\frac{x}{x-3}$ 25.2. $\frac{x}{x+1}$ 25.3. $\frac{x+1}{x+2}$ 25.4. $\frac{x}{x+3}$ 25.5. $\frac{2}{x-3}$ 25.6. $\frac{3x}{x-3}$ 25.7. $\frac{2x}{x-2}$ 25.8. $\frac{2}{x-2}$ 25.9. $\frac{x}{x+3}$ 25.10. $\frac{1}{x-2}$ 25.11. $\frac{3x}{x-3}$ 25.12. $\frac{x+1}{2x+3}$ 25.13. $\frac{3x-2}{x+2}$ 25.14. $\frac{2x}{x+2}$ 25.15. $\frac{3}{x-3}$ 25.16. $\frac{x+3}{x-3}$ 25.17. $\frac{2}{x+1}$ 25.18. $\frac{2x+1}{x+1}$ 25.19. $\frac{x}{x+3}$ 25.20. $\frac{3x}{x-1}$ 25.21. $\frac{3x+3}{x-1}$ 25.22. $\frac{2x+3}{2x-2}$ 25.23. $\frac{x+2}{2x+3}$ 25.24. $\frac{3x+2}{x-1}$ 25.25. $\frac{1}{x+3}$ 25.26. $\frac{2x}{x+2}$ 25.27. $\frac{x-2}{x+1}$ 25.28. $\frac{1}{x+2}$ 25.29. $\frac{x+2}{x-1}$ 25.30. $\frac{2x}{x-1}$ 25.31. $\frac{3}{x-1}$ 25.32. $\frac{1}{x+2}$ 26.1. 1 26.2. $\frac{3x}{x+1}$ 26.3. $\frac{3}{x-3}$ 26.4. $\frac{2x-2}{x+2}$ 26.5. $\frac{x}{3}$ 26.6. $\frac{1}{2}$ 26.7. $\frac{3x}{x+3}$ 26.8. 1 26.9. $\frac{2x}{x+2}$ 26.10. $\frac{1}{x-3}$ 26.11. $\frac{x-2}{3}$ 26.12. $\frac{3x}{2}$ 26.13. $\frac{x-1}{x+2}$ 26.14. $\frac{2}{x+1}$ 26.15. $\frac{1}{x-3}$ 26.16. $\frac{x+2}{x-3}$ 26.17. $\frac{3x}{x-3}$ 26.18. $\frac{3}{x+2}$ 26.19. 1 26.20. $\frac{2x}{x-1}$ 26.21. $\frac{x+2}{x-1}$ 26.22. $\frac{2x-1}{x-3}$ 26.23. $\frac{x-2}{x+2}$ 26.24. $\frac{3x+1}{x-2}$ 26.25. $\frac{2x}{x-2}$ 26.26. $\frac{1}{x-3}$ 26.27. $\frac{3x-3}{x+2}$ 26.28. $\frac{x-2}{x+1}$ 26.29. $\frac{2x+3}{x-1}$ 26.30. $\frac{3x-2}{x+3}$ 27.1. $\frac{3x-2}{x-2}$ 27.2. $\frac{2}{x+2}$ 27.3. $\frac{x}{x-2}$ 27.4. $\frac{2x-2}{x+3}$ 27.5. $\frac{2x+2}{x+3}$ 27.6. $\frac{3x}{x-1}$ 27.7. $\frac{3x-3}{x+1}$ 27.8. 1 27.9. $\frac{2x-2}{x+1}$ 27.10. $\frac{3x}{x+3}$ 27.11. $\frac{x}{x-2}$ 27.12. $\frac{3}{x+1}$ 27.13. $\frac{3}{x+3}$ 27.14. $\frac{2x-3}{x-3}$ 27.15. $\frac{3x-3}{x-2}$ 27.16. $\frac{x}{x+2}$ 27.17. $\frac{2x+2}{x-3}$ 27.18. $\frac{2x}{x+3}$ 27.19. $\frac{2x}{x-1}$ 27.20. $\frac{3x}{x-1}$ 27.21. $\frac{3}{x-1}$ 27.22. $\frac{3x}{x-1}$ 27.23. $\frac{2}{x-3}$ 27.24. $\frac{3x}{x-3}$ 27.25. $\frac{2x-1}{x-1}$ 27.26. 1 27.27. $\frac{x-1}{x+2}$ 27.28. 3 27.29. $\frac{3x}{x+2}$ 27.30. $\frac{2}{x-2}$ 28.1. $\frac{y+2x}{xy+3}$ 28.2. $\frac{y-2}{2y+2}$ 28.3. $\frac{1}{2y-2x}$ 28.4. $\frac{2y}{y-x}$ 28.5. $\frac{2y+3x}{y-2}$ 28.6. $\frac{1}{y-x}$ 28.7. $\frac{3y-3}{y+2x}$ 28.8. $\frac{1}{y+3x}$ 28.9. $\frac{y}{y-x}$ 28.10. $\frac{2y}{y+3x}$ 28.11. $\frac{2}{y-3x}$ 28.12. $\frac{x}{3y}$ 28.13. $\frac{2xy}{y-2}$ 28.14. $\frac{3y+x}{3x+y}$ 28.15. $\frac{1}{y-x}$ 28.16. $\frac{y-3}{y+3x}$