EXERCICES COMPLÉMENTAIRES : EQUATIONS DU SECOND DEGRÉ ET TRINÔME DU SECOND DEGRÉ

Résoudre les équations suivantes :

1. $x^2 + 12x + 35 = 0$
2. $-48x^2 + 80x - 25 = 0$
3. $x^2 + 7x + 9 = 0$
4. $x^2 + 11x + 10 = 0$
5. $-27x^2 + 30x - 7 = 0$
6. $-x^2 + 7x - 9 = 0$
7. $x^2 - x - 42 = 0$
8. $-x^2 + 5x + 14 = 0$
9. $-x^2 + 9 = 0$
10. $x^2 + 15x + 54 = 0$
11. $-4x^2 - 11x - 6 = 0$
12. $x^2 + 5x - 3 = 0$
13. $x^2 - x - 20 = 0$
14. $33x^2 - 113x + 10 = 0$
15. $x^2 + 6x + 3 = 0$
16. $x^2 - 16x + 63 = 0$
17. $11x^2 + 59x + 20 = 0$
18. $x^2 + 4x - 10 = 0$
19. $x^2 + 4x - 21 = 0$
20. $-20x^2 + 9x + 18 = 0$
21. $x^2 + 2x - 10 = 0$
22. $x^2 + 9x + 20 = 0$
23. $-27x^2 - 3x + 14 = 0$
24. $x^2 + 2x - 7 = 0$
25. $x^2 + 5x = 0$
26. $-x^2 - 5x - 4 = 0$
27. $-x^2 + 9x = 0$
28. $x^2 - 6x + 9 = 0$
29. $-5x^2 + 49x - 36 = 0$
30. $x^2 + 6x - 4 = 0$

Factoriser les trinômes suivants :

1. $Q(t) = t^2 - 7t$
2. $P(x) = -33x^2 - 10x + 8$
3. $P(x) = -x^2 + 5x + 9$
4. $P(y) = y^2 - 15y + 56$
5. $P(y) = 10y^2 - y - 24$
6. $Q(y) = y^2 + 3y - 3$
7. $Q(z) = z^2 + 11z + 10$
8. $R(y) = -33y^2 - 14y - 1$
9. $P(y) = y^2 + 2y + 6$
10. $Q(x) = x^2 - 14x + 48$
11. $Q(t) = 16t^2 + 40t + 9$
12. $S(z) = -z^2 + 5z + 4$
13. $S(y) = 405y^2 + 630y + 245$
14. $R(z) = z^2 + 2z - 15$
15. $P(t) = 28t^2 + 13t - 6$
16. $R(z) = -z^2 - 9$
17. $Q(y) = y^2 + 3y - 10$
18. $S(z) = -12z^2 + 19z - 4$
19. $P(z) = z^2 + 2z - 2$
20. $R(y) = y^2 + 10y$
21. $R(z) = -80z^2 - 86z - 21$
22. $R(t) = -t^2 + 5t + 4$
23. $R(y) = 490y^2 + 140y + 10$
24. $R(t) = t^2 + 2t$
25. $Q(t) = 21t^2 + 34t + 9$
26. $Q(t) = -t^2 + 8t + 3$
27. $S(t) = t^2 + 15t + 50$
28. $Q(y) = 70y^2 + 73y + 9$
29. $S(z) = -z^2 + 5z + 5$
30. $S(z) = z^2 - z - 20$
31. $S(y) = 10y^2 + 9y - 1$
32. $Q(z) = z^2 + 4z + 2$

Second degré - Exercices complémentaires : Solutions

Résoudre les équations suivantes :

1. $x^2 + 12x + 35 = 0$

$\Delta = 144 - 140 = 4$ $\quad x_{1,2} = \frac{-12 \pm 2}{2} \begin{cases} -5 \\ -7 \end{cases}$

$S : \{-7, -5\}$

2. $-48x^2 + 80x - 25 = 0$

$\Delta = 6400 - 4800 = 1600$ $\quad x_{1,2} = \frac{-80 \pm 40}{-96} \begin{cases} \frac{5}{12} \\ \frac{5}{4} \end{cases}$

$S : \{\frac{5}{12}, \frac{5}{4}\}$

3. $x^2 + 7x + 9 = 0$

$\Delta = 49 - 36 = 7$ $\quad x_{1,2} = -\frac{7 \pm \sqrt{7}}{2}$

$S : \{-\frac{7-\sqrt{7}}{2}, -\frac{7+\sqrt{7}}{2}\}$

4. $x^2 + 11x + 10 = 0$

$\Delta = 121 - 40 = 81$ $\quad x_{1,2} = \frac{-11 \pm 9}{2} \begin{cases} -1 \\ -10 \end{cases}$

$S : \{-10, -1\}$

5. $-27x^2 + 30x - 7 = 0$

$\Delta = 900 - 756 = 144$ $\quad x_{1,2} = \frac{-30 \pm 12}{-54} \begin{cases} \frac{1}{3} \\ \frac{7}{9} \end{cases}$

$S: \left\{ \frac{1}{3}, \frac{7}{9} \right\}$

6. $-x^2 + 7x - 9 = 0$

$\Delta = 49 - 36 = 7$ $\quad x_{1,2} = \frac{-7 \pm \sqrt{7}}{-2}$

$S: \left\{ \frac{7-\sqrt{7}}{2}, \frac{7+\sqrt{7}}{2} \right\}$

7. $x^2 - x - 42 = 0$

$\Delta = 1 + 168 = 169$ $\quad x_{1,2} = \frac{1 \pm 13}{2} \begin{cases} 7 \\ -6 \end{cases}$

$S: \{-6, 7\}$

8. $-x^2 + 5x + 14 = 0$

$\Delta = 25 + 56 = 81$ $\quad x_{1,2} = \frac{-5 \pm 9}{-2} \begin{cases} -2 \\ 7 \end{cases}$

$S: \{-2, 7\}$

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

$\Delta = 36$ $\quad x_{1,2} = \frac{0 \pm 6}{-2} \begin{cases} -3 \\ 3 \end{cases}$

$S: \{-3, 3\}$

10. $x^2 + 15x + 54 = 0$

$\Delta = 225 - 216 = 9$ $\quad x_{1,2} = \frac{-15 \pm 3}{2} \begin{cases} -6 \\ -9 \end{cases}$

$S: \{-9, -6\}$

11. $-4x^2 - 11x - 6 = 0$

$\Delta = 121 - 96 = 25$ $\quad x_{1,2} = \frac{11 \pm 5}{-8} \begin{cases} -2 \\ \frac{3}{4} \end{cases}$

$S: \{-2, \frac{3}{4}\}$

12. $x^2 + 5x - 3 = 0$

$\Delta = 25 + 12 = 37$ $\quad x_{1,2} = \frac{-5 \pm \sqrt{37}}{2}$

$S: \left\{\frac{-5-\sqrt{37}}{2}, \frac{-5+\sqrt{37}}{2}\right\}$

13. $x^2 - x - 20 = 0$

$\Delta = 1 + 80 = 81$ $\quad x_{1,2} = \frac{1 \pm 9}{2} \begin{cases} 5 \\ -4 \end{cases}$

$S: \{-4, 5\}$

14. $33x^2 - 113x + 10 = 0$

$\Delta = 12769 - 1320 = 11449$ $\quad x_{1,2} = \frac{113 \pm 107}{66} \begin{cases} \frac{10}{3} \\ \frac{1}{11} \end{cases}$

$S: \left\{\frac{1}{11}, \frac{10}{3}\right\}$

15. $x^2 + 6x + 3 = 0$

$\Delta = 36 - 12 = 24$ $\quad x_{1,2} = \frac{-6 \pm 2\sqrt{6}}{2} = \frac{-\cancel{2}(3 \pm \sqrt{6})}{\cancel{2}}$

$S: \{-3 - \sqrt{6}, -3 + \sqrt{6}\}$

16. $x^2 - 16x + 63 = 0$

$\Delta = 256 - 252 = 4$ $\quad x_{1,2} = \frac{16 \pm 2}{2} \begin{cases} 9 \\ 7 \end{cases}$

$S: \{7, 9\}$

17. $11x^2 + 59x + 20 = 0$

$\Delta = 3481 - 880 = 2601$ $\quad x_{1,2} = \frac{-59 \pm 51}{22} \begin{cases} -\frac{4}{11} \\ -5 \end{cases}$

$S: \{-\frac{4}{11}, -5\}$

18. $x^2 + 4x - 10 = 0$

$\Delta = 16 + 40 = 56$ $\quad x_{1,2} = \frac{-4 \pm 2\sqrt{14}}{2} = \frac{-\cancel{2}(2 \pm \sqrt{14})}{\cancel{2}}$

$S: \{-2 - \sqrt{14}, -2 + \sqrt{14}\}$

19. $x^2 + 4x - 21 = 0$

$\Delta = 16 + 84 = 100$ $\quad x_{1,2} = \frac{-4 \pm 10}{2} \begin{cases} 3 \\ -7 \end{cases}$

$S: \{-7, 3\}$

20. $-20x^2 + 9x + 18 = 0$

$D = 81 + 1440 = 1521$ $\quad x_{1,2} = \frac{-9 \pm 39}{-40} < \begin{matrix} -\frac{3}{4} \\ \frac{6}{5} \end{matrix}$

$S: \left\{ -\frac{3}{4}, \frac{6}{5} \right\}$

21. $x^2 + 2x - 10 = 0$

$D = 4 + 40 = 44$ $\quad x_{1,2} = \frac{-2 \pm 2\sqrt{11}}{2} = \frac{-2(1 \pm \sqrt{11})}{2}$

$S: \left\{ -1 - \sqrt{11}, -1 + \sqrt{11} \right\}$

22. $x^2 + 9x + 20 = 0$

$D = 81 - 80 = 1$ $\quad x_{1,2} = \frac{-9 \pm 1}{2} < \begin{matrix} -4 \\ -5 \end{matrix}$

$S: \{ -5, -4 \}$

23. $-27x^2 - 3x + 14 = 0$

$D = 9 + 1512 = 1521$ $\quad x_{1,2} = \frac{3 \pm 39}{54} < \begin{matrix} \frac{7}{9} \\ -\frac{2}{3} \end{matrix}$

$S: \left\{ -\frac{2}{3}, \frac{7}{9} \right\}$

24. $x^2 + 2x - 7 = 0$

$D = 4 + 28 = 32$ $\quad x_{1,2} = \frac{-2 \pm 4\sqrt{2}}{2} = \frac{-2(1 \pm 2\sqrt{2})}{2}$

$S: \left\{ -1 - 2\sqrt{2}, -1 + 2\sqrt{2} \right\}$

25. $x^2 + 5x = 0$

$\Delta = 25$ $\quad x_{1,2} = \frac{-5 \pm 5}{2} \begin{cases} 0 \\ -5 \end{cases}$

$S: \{-5, 0\}$

26. $-x^2 - 5x - 4 = 0$

$\Delta = 25 - 16 = 9$ $\quad x_{1,2} = \frac{5 \pm 3}{-2} \begin{cases} -4 \\ -1 \end{cases}$

$S: \{-4, -1\}$

27. $-x^2 + 9x = 0$

$\Delta = 81$ $\quad x_{1,2} = \frac{-9 \pm 9}{-2} \begin{cases} 0 \\ 9 \end{cases}$

$S: \{0, 9\}$

28. $x^2 - 6x + 9 = 0$

$\Delta = 36 - 36 = 0$ $\quad x_{1,2} = \frac{6}{2} = 3$

$S: \{3\}$

29. $-5x^2 + 49x - 36 = 0$

$\Delta = 2401 - 720 = 1681$ $\quad x_{1,2} = \frac{-49 \pm 41}{-10} \begin{cases} \frac{4}{5} \\ 9 \end{cases}$

$S: \{\frac{4}{5}, 9\}$

30. $x^2 + 6x - 4 = 0$

$\Delta = 36 + 16 = 52$ $\quad x_{1,2} = \dfrac{-6 \pm 2\sqrt{13}}{2} = \dfrac{-2(3 \pm \sqrt{13})}{2}$

$S : \{-3 - \sqrt{13}, -3 + \sqrt{13}\}$

Factoriser les trinômes suivants :

*MEE = mise en évidence

1. $Q(t) = t^2 - 7t$

$Q(t) = t(t-7)$ $\quad$ MEE

2. $P(x) = -33x^2 - 10x + 8$

$\Delta = 100 + 1056 = 1156$ $\quad x_{1,2} = \dfrac{10 \pm 34}{-66} < \begin{matrix} -\frac{2}{3} \\ \frac{4}{11} \end{matrix}$

$P(x) = -33\left(x + \frac{2}{3}\right)\left(x - \frac{4}{11}\right) = -(3x+2)(11x-4)$

3. $P(x) = -x^2 + 5x + 9$

$\Delta = 25 + 36 = 61$ $\quad x_{1,2} = \dfrac{-5 \pm \sqrt{61}}{2}$

$P(x) = -\left(x - \dfrac{-5+\sqrt{61}}{2}\right)\left(x - \dfrac{-5-\sqrt{61}}{2}\right)$
$= -\left(x + \dfrac{5-\sqrt{61}}{2}\right)\left(x + \dfrac{5+\sqrt{61}}{2}\right)$

4. $P(y) = y^2 - 15y + 56$

$\Delta = 225 - 224$ $\quad y_{1,2} = \dfrac{15 \pm 1}{2} < \begin{matrix} 8 \\ 7 \end{matrix}$

$P(y) = (x-8)(x-7)$

5. $P(y) = 10y^2 - y - 24$

$\Delta = 1 + 960 = 961$ $\quad y_{1,2} = \dfrac{1 \pm 31}{20} \begin{cases} \frac{8}{5} \\ -\frac{3}{2} \end{cases}$

$P(y) = 10\left(y - \frac{8}{5}\right)\left(y + \frac{3}{2}\right) = (5y - 8)(2y + 3)$

6. $Q(y) = y^2 + 3y - 3$

$\Delta = 9 + 12 = 21$ $\quad y_{1,2} = \dfrac{-3 \pm \sqrt{21}}{2}$

$Q(y) = \left(y - \frac{3+\sqrt{21}}{2}\right)\left(y - \frac{3-\sqrt{21}}{2}\right)$

7. $Q(z) = z^2 + 11z + 10$

$\Delta = 121 - 40 = 81$ $\quad z_{1,2} = \dfrac{-11 \pm 9}{2} \begin{cases} -1 \\ -10 \end{cases}$

$Q(z) = (z + 1)(z + 10)$

8. $R(y) = -33y^2 - 14y - 1$

$\Delta = 196 - 132 = 64$ $\quad y_{1,2} = \dfrac{14 \pm 8}{-66} \begin{cases} -\frac{1}{3} \\ -\frac{1}{11} \end{cases}$

$R(y) = -33\left(y + \frac{1}{3}\right)\left(y + \frac{1}{11}\right) = -(3y + 1)(11y + 1)$

9. $P(y) = y^2 + 2y + 6$

$\Delta = 4 - 24 = -20$

$P(y)$ n'est pas factorisable

10. $Q(x) = x^2 - 14x + 48$

$\Delta = 196 - 192 = 4$ $\quad x_{1,2} = \frac{+14 \pm 2}{2} \begin{cases} 8 \\ 6 \end{cases}$

$Q(x) = (x-8)(x-6)$

11. $Q(t) = 16t^2 + 40t + 9$

$\Delta = 1600 - 576 = 1024$ $\quad t_{1,2} = \frac{-40 \pm 32}{32} \begin{cases} -\frac{1}{4} \\ -\frac{9}{4} \end{cases}$

$Q(t) = 16\left(t + \frac{1}{4}\right)\left(t + \frac{9}{4}\right) = (4t+1)(4t+9)$

12. $S(z) = -z^2 + 5z + 4$

$\Delta = 25 + 16 = 41$ $\quad z_{1,2} = \frac{-5 \pm \sqrt{41}}{-2} \begin{cases} \frac{5-\sqrt{41}}{2} \\ \frac{5+\sqrt{41}}{2} \end{cases}$

$S(z) = -\left(z - \frac{5-\sqrt{41}}{2}\right)\left(z - \frac{5+\sqrt{41}}{2}\right)$

13. $S(y) = 405y^2 + 630y + 245$

$\Delta = 396900 - 396900 = 0$ $\quad y_{1,2} = \frac{-630}{810} = -\frac{7}{9}$

$S(y) = \underbrace{405}_{5 \cdot 81}\left(y + \frac{7}{9}\right)^2 = 5\left(9y + 7\right)^2$

14. $R(z) = z^2 + 2z - 15$

$\Delta = 4 + 60 = 64$ $\quad z_{1,2} = \frac{-2 \pm 8}{2} \begin{cases} 3 \\ -5 \end{cases}$

$R(z) = (z-3)(z+5)$

15. $P(t) = 28t^2 + 13t - 6$

$\Delta = 169 + 672 = 841$ $\quad t_{1,2} = \frac{-13 \pm 29}{56} \begin{cases} \frac{2}{7} \\ -\frac{3}{4} \end{cases}$

$P(t) = 28\left(t - \frac{2}{7}\right)\left(t + \frac{3}{4}\right) = (7t-2)(4t+3)$

16. $R(z) = -z^2 - 9$

$R(z) = -(z^2+9)$ $\quad (\Delta < 0)$

17. $Q(y) = y^2 + 3y - 10$

$\Delta = 9 + 40 = 49$ $\quad y_{1,2} = \frac{-3 \pm 7}{2} \begin{cases} 2 \\ -5 \end{cases}$

$Q(y) = (y-2)(y+5)$

18. $S(z) = -12z^2 + 19z - 4$

$\Delta = 361 - 192 = 169$ $\quad z_{1,2} = \frac{-19 \pm 13}{-24} \begin{cases} \frac{1}{4} \\ \frac{4}{3} \end{cases}$

$S(z) = -12\left(z - \frac{1}{4}\right)\left(z - \frac{4}{3}\right)$
$= -(4z-1)(3z-4)$

19. $P(z) = z^2 + 2z - 2$

$\Delta = 4 + 8 = 12$ $\quad z_{1,2} = \frac{-2 \pm 2\sqrt{3}}{2} \begin{cases} -1+\sqrt{3} \\ -1-\sqrt{3} \end{cases}$

$P(z) = (z + 1 - \sqrt{3})(z + 1 + \sqrt{3})$

20. $R(y) = y^2 + 10y$

$R(y) = y(y+10)$

21. $R(z) = -80z^2 - 86z - 21$

$\Delta = 7396 - 6720 = 676 \qquad z_{1,2} = \frac{86 \pm 26}{-160} \begin{cases} -\frac{7}{10} \\ -\frac{3}{8} \end{cases}$

$R(z) = -80\left(z + \frac{7}{10}\right)\left(z + \frac{3}{8}\right)$

$= -(10z+7)(8z+3)$

22. $R(t) = -t^2 + 5t + 4$

$\Delta = 25 + 16 = 41 \qquad t_{1,2} = \frac{-5 \pm \sqrt{41}}{-2} \begin{cases} \frac{5-\sqrt{41}}{2} \\ \frac{5+\sqrt{41}}{2} \end{cases}$

$R(t) = -\left(t - \frac{5-\sqrt{41}}{2}\right)\left(t - \frac{5+\sqrt{41}}{2}\right)$

23. $R(y) = 490y^2 + 140y + 10$

$\Delta = 19600 - 19600 = 0 \qquad y_{1,2} = \frac{-140}{980} = -\frac{1}{7}$

$R(y) = \underbrace{490}_{49 \cdot 10}\left(y + \frac{1}{7}\right)^2 = 10(7y+1)^2$

24. $R(t) = t^2 + 2t$

$R(t) = t(t+2)$

25. $Q(t) = 21t^2 + 34t + 9$

$\Delta = 1156 - 756 = 400$ $\quad t_{1,2} = \frac{-34 \pm 20}{42} \begin{cases} -\frac{9}{7} \\ -\frac{1}{3} \end{cases}$

$Q(t) = 21\left(t + \frac{9}{7}\right)\left(t + \frac{1}{3}\right)$

$= (7t + 9)(3t + 1)$

26. $Q(t) = -t^2 + 8t + 3$

$\Delta = 64 + 12 = 76$ $\quad t_{1,2} = \frac{-8 \pm 2\sqrt{19}}{-2} = 4 \pm \sqrt{19}$

$Q(t) = -(t - 4 - \sqrt{19})(t - 4 + \sqrt{19})$

27. $S(t) = t^2 + 15t + 50$

$\Delta = 225 - 200 = 25$ $\quad t_{1,2} = \frac{-15 \pm 5}{2} \begin{cases} -5 \\ -10 \end{cases}$

$S(t) = (y + 10)(y + 5)$

28. $Q(y) = 70y^2 + 73y + 9$

$\Delta = 5329 - 2520 = 2809$ $\quad y_{1,2} = \frac{-73 \pm 53}{140} \begin{cases} -\frac{1}{10} \\ -\frac{1}{7} \end{cases}$

$Q(y) = 70\left(y + \frac{1}{10}\right)\left(y + \frac{1}{7}\right) = (10y + 1)(7y + 1)$

29. $S(z) = -z^2 + 5z + 5$

$\Delta = 25 + 20 = 45$ $\quad z_{1,2} = \frac{-5 \pm 3\sqrt{5}}{-2} = \frac{5 \pm 3\sqrt{5}}{2}$

$S(z) = -\left(z - \frac{5 - 3\sqrt{5}}{2}\right)\left(z - \frac{5 + 3\sqrt{5}}{2}\right)$

30. $S(z) = z^2 - z - 20$

$D = 1 + 80 = 81$ $\qquad z_{1,2} = \frac{1 \pm 9}{2} \begin{cases} 5 \\ -4 \end{cases}$

$S(z) = (z - 5)(z + 4)$

31. $S(y) = 10y^2 + 9y - 1$

$D = 81 + 40 = 121$ $\qquad y_{1,2} = \frac{-9 \pm 11}{20} \begin{cases} \frac{1}{10} \\ -1 \end{cases}$

$S(y) = 10\left(y - \frac{1}{10}\right)(y + 1)$

$= (10y - 1)(y + 1)$

32. $Q(z) = z^2 + 4z + 2$

$D = 16 - 8 = 8$ $\qquad z_{1,2} = \frac{-4 \pm 2\sqrt{2}}{2} = -2 \pm \sqrt{2}$

$Q(z) = (z + 2 - \sqrt{2})(z + 2 + \sqrt{2})$

Résoudre les inéquations suivantes :

1. $\dfrac{8-x^3}{4x^2+12x+9} \leq 0$

zéros : N : $x^3 - 8 = 0 \iff x = 2$

D : $4x^2 + 12x + 9 = 0$

$\Delta = 144 - 144 = 0$

$x_1 = \dfrac{-12}{8} = -\dfrac{3}{2}$

x		$-\frac{3}{2}$		2	
$8-x^3$ (*)	+		+	0	−
$4x^2+12x+9$	+	0	+		+
I_n	+	‖	+	0	−

$S : [2, +\infty$

(*) Le comportement d'une expression du 3e degré est le même que celle du 1er degré (si celle-ci ne s'annule qu'une fois)

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

$$\Leftrightarrow \frac{x-3}{x^2-4} \ominus \frac{x}{x-2} \ominus \frac{x-1}{x+2} \geq 0$$

$x^2-4 = (x-2)(x+2)$

$$\Leftrightarrow \frac{x-3 \ominus x(x+2) \ominus (x-1)(x-2)}{(x-2)(x+2)} \geq 0$$

$$\Leftrightarrow \frac{x-3-(x^2+2x)-(x^2-2x-x+2)}{(x-2)(x+2)} \geq 0$$

$$\Leftrightarrow \frac{-2x^2+2x-5}{(x-2)(x+2)} \geq 0$$

Zéros: $N: -2x^2+2x-5 = 0$

$\Delta = 4 - 40 = -36 < 0$ —

$D: x = -2, \quad x = 2$

x		-2		2	
$-2x^2+2x-5$	$-$		$-$		$-$
$x-2$	$-$		$-$	0	$+$
$x+2$	$-$	0	$+$		$+$
I_x	$-$	‖	$+$	‖	$-$

$S:]-2, 2[$

3. $\dfrac{36x-47}{-2x^2+7x+9} > \dfrac{3x-5}{x+1} - \dfrac{-x+2}{-2x+9}$

$-2x^2+7x+9 \overset{\Delta}{=} (-2x+9)(x+1)$

$$\Leftrightarrow \frac{36x-47}{(-2x+9)(x+1)} - \frac{3x-5}{x+1} + \frac{-x+2}{-2x+9} > 0$$

$$\Leftrightarrow \frac{36x-47-(3x-5)(-2x+9)+(-x+2)(x+1)}{(-2x+9)(x+1)} > 0$$

$$\Leftrightarrow \frac{36x-47-(-6x^2+27x+10x-45)+(-x^2-x+1x+2)}{(-2x+9)(x+1)} > 0$$

$$\Leftrightarrow \frac{5x^2}{(-2x+9)(x+1)} > 0$$

Zeros: N : $x=0$

D : $x=-1$, $x=\frac{9}{2}$

x		-1		0		$\frac{9}{2}$	
$5x^2$	+		+	0	+		+
$-2x+9$	+		+		+	0	−
$x+1$	−	0	+		+		+
I_x	−	∄	+	0	+	∄	−

S. $]-1,0[\cup]0,\frac{9}{2}[$

(d) $\dfrac{2x-1}{4-x} < \dfrac{3-2x}{x+3}$

$$\frac{2x^2+5x-3-(12+2x^2-11x)}{(4-x)(x+3)} < 0$$

$$\frac{16x-15}{(4-x)(x+3)} < 0$$

x		-3		$\frac{15}{16}$		4	
$16x-15$	$-$		$-$	0	$+$		$+$
$4-x$	$+$		$+$		$+$	0	$-$
$x+3$	$-$	0	$+$		$+$		$+$
I_n	$+$	‖	$-$	0	$+$	‖	$-$

$S :]-3, \frac{15}{16}[\cup]4, +\infty[$

(e) $\dfrac{2x^2+x+5}{x^2-3x+3} < 1$

$$\frac{2x^2+x+5-x^2+3x-3}{x^2-3x+3} < 0$$

$$\frac{x^2+4x+2}{x^2-3x+3} < 0$$

Zeros: N: $\Delta = 16-8 = 8$ $\quad x_{1,2} = \dfrac{-4 \pm 2\sqrt{2}}{2}$

$= -2 \pm \sqrt{2}$

D: $\Delta = 9-12 < 0 \rightarrow D > 0$

		$-2-\sqrt{2}$		$-2+\sqrt{2}$	
x					
I_N		$+$	0	$-$	0 $+$
			$\times$		$\times$

S: $]-2-\sqrt{2}, -2+\sqrt{2}[$

(i) $\dfrac{3x-5}{-3x+15} > \dfrac{-x+3}{x+1}$

$\Leftrightarrow \dfrac{(3x-5)(x+1)-(-x+3)(-3x+15)}{(-3x+15)(x+1)} > 0$

$\Leftrightarrow \dfrac{3x^2-2x-5-(3x^2-21x+45)}{D} > 0$

$\Leftrightarrow \dfrac{22x-50}{(-3x+15)(x+1)} > 0$

x		-1		$\frac{25}{11}$		5	
N	$-$	‖	$-$	0	$+$	‖	$+$
D	$-$	‖	$+$	‖	$+$	0	$-$
I_n	$+$	‖	$-$	0	$+$	‖	$-$

$S. \;]-\infty, -1[\cup]\frac{25}{11}, 5[$

(k) $(x-1)(x-2)<1$

$\Leftrightarrow x^2 - 3x + 2 - 1 < 0$

$\Leftrightarrow x^2 - 3x + 1 < 0$

gesucht: $\Delta = 9 - 4 = 5$

$x_{1,2} = \frac{3 \pm \sqrt{5}}{2}$

		$\frac{3-\sqrt{5}}{2}$		$\frac{3+\sqrt{5}}{2}$	
x		1		1	
I_m	+	0	−	0	+

$\times$ ——— $\times$

S.: $\left]\frac{3-\sqrt{5}}{2}, \frac{3+\sqrt{5}}{2}\right[$

(o) $\dfrac{24-4x^2-20x}{4x^2-12x+9} \leq -1$

$\Leftrightarrow \dfrac{-4x^2-20x+24+(4x^2-12x+9)}{(2x-3)^2} \leq 0$

$\Leftrightarrow \dfrac{-32x+33}{(2x-3)^2} \leq 0$

x		$\frac{33}{32}$		$\frac{3}{2}$	
N	$+$	0	$-$		$-$
D	$+$		$+$	0	$+$
I_n	$+$	0	$-$	$\nexists$	$-$

$S = \left[\frac{33}{32}, \frac{3}{2}\right[\cup \left]\frac{3}{2}, +\infty\right[$

(p) $2 \geq \dfrac{x^2-2x}{x^2+2x} + \dfrac{x^2+2x}{x^2-2x}$

$\Leftrightarrow 2 \geq \dfrac{(x^2-2x)}{x(x+4)} + \dfrac{(x^2+2x)}{x(x-2)}$

$\Leftrightarrow \dfrac{2x(x-2)(x+2) - (x^2-2x)(x-2) - (x^2+2x)(x+2)}{x(x-2)(x+2)} \geq 0$

$\Leftrightarrow \dfrac{2x(x^2-4) - (x^3-2x^2-2x^2+4x) - (x^3+2x^2+2x^2+4x)}{D} \geq 0$

$\Leftrightarrow \dfrac{2x^3-8x-x^3+4x^2-4x-x^3-4x^2-4x}{D} \geq 0$

$\Leftrightarrow \dfrac{-16x}{x(x-2)(x+2)} \geq 0$ ⚠ C.E. : $x \neq 0$

x	$-\infty$		-2		0		2		$+\infty$
-16		$-$		$-$		$-$		$-$	
x^2-4		$+$	0	$-$		$-$	0	$+$	
I_x		$-$	‖	$+$	‖	$+$	‖	$-$	

$S. \;]-2, 0[\cup]0, 2[$