

# Exercícios

1)

a)  $3 - x < 5 + 3x$

$$+3 - 3 - x < 5 - 3 + 3x \quad (-3) \text{ de ambos os lados}$$

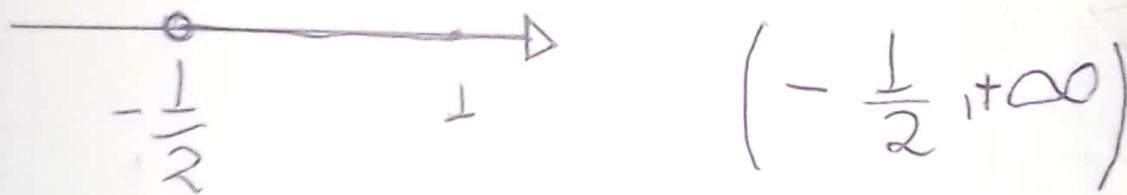
$$-x < 2 + 3x \quad (-3x) \text{ de ambos os lados}$$

$$-x - 3x < 2 + 3x - 3x \quad \text{voltar para}$$

$$-4x < 2 \quad x(-1) \text{ multiplicar}$$

$$4x > -2$$

$$x > -\frac{2}{4} \Rightarrow x = -\frac{1}{2}$$



b)  $2x - 5 < \frac{1}{3} + \frac{3x}{4} + \frac{1-x}{3}$

mmc

$$\begin{array}{r|l} 3 & 4 \\ 3 & 2 \\ 3 & 1 \\ \hline 1 & 1 \end{array} \quad | \quad \begin{array}{l} 2 \\ 2 \\ 3 \\ 12 \end{array}$$

$$2x \cdot 12 - 5 \cdot 12 < \frac{1}{3} \cdot 12 + \frac{3x}{4} \cdot 12 + \frac{1-x}{3} \cdot 12$$

$$24x - 60 < 4 + 9x + 4(1-x)$$

$$24 - 60 < 4 + 9x \quad 4 - 9x$$

$$24x - 60 + 60 < 8 + 5x \quad +60$$

$$24x < 8 + 5x + 60$$

$$24x - 5x < 68$$

$$19x < 68 \quad \div 19$$

$$\frac{19}{19}x < \frac{68}{19}$$

$$x < \frac{68}{19} \quad \left(-\infty, \frac{68}{19}\right)$$

$$c) 27 - 3 - 3x \geq -7$$

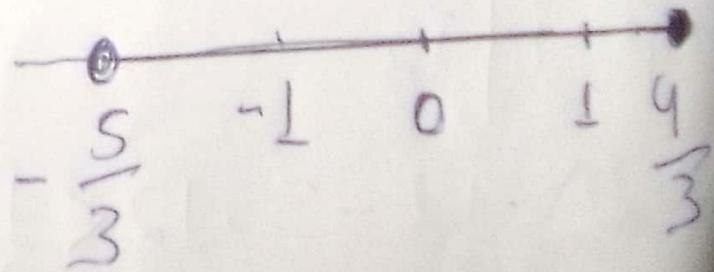
$$3 + 27 - 3 + 3 - 3x \geq -7 + 3 \quad (+3)$$

$$57 - 3x \geq -4 \quad \cdot (-1)$$

$$-5 < +3x \geq +4 \quad (\div 3)$$

$$-\frac{5}{3} < \frac{+3x}{3} \leq \frac{+4}{3}$$

$$-\frac{5}{3} < x \leq \frac{4}{3}$$
$$\left(-\frac{5}{3}, \frac{4}{3}\right]$$



$$d) \frac{5}{x} < \frac{3}{4}$$

$$\frac{5}{x} - \frac{3}{4} < 0 \quad \frac{20 - 3x}{4x} < 0$$

1º Equação

$$20 - 3x < 0$$

$$-3x < -20 \quad \cdot (-1)$$

$$3x > 20$$

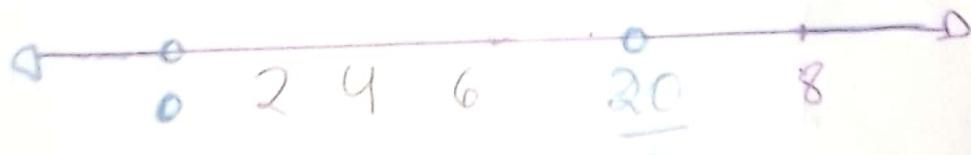
$$x > \frac{20}{3}$$

2º Equação

$$4x < 0$$

$$x < \frac{0}{4}$$

$$x < 0$$



$$(-\infty, 0) \cup \left( \frac{20}{3}, +\infty \right)$$

$$e) x^2 \leq 9$$

$$x \leq \pm \sqrt{9}$$

$$x \leq \pm 3$$

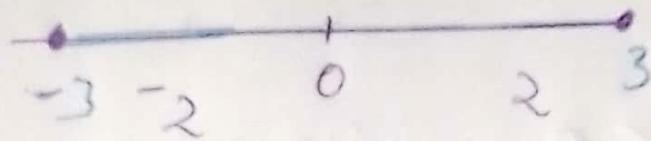
$$\sqrt{x^2} = |x| \quad \boxed{\text{Resposta}}$$

$$\sqrt{x^2} \leq \sqrt{9}$$

$$|x| \leq 3$$

$$-3 \leq x \leq +3$$

$$[-3, 3]$$



$$8) x^2 - 3x + 2 > 0$$

$$x^2 - 3x + 2 = 0$$

$$\begin{aligned} S &= -\frac{b}{a} \\ P &= \frac{c}{a} \end{aligned}$$

$$S = -\frac{(-3)}{1} \rightarrow 3$$

$$P = \frac{2}{1} \rightarrow 2$$

1 e 2



$$x < 0$$

$$(-\infty, 1) \cup (2, +\infty)$$

$$9) 1 - x - 2x^2 \geq 0$$

$$1 - x - 2x^2 = 0$$

$$\boxed{\Delta = b^2 - 4ac}$$

$$\begin{aligned} \Delta &= 1^2 - 4(-2) \cdot 1 \\ \Delta &= 1 + 8 \end{aligned}$$

$$\frac{-b \pm \sqrt{\Delta}}{2 \cdot a}$$

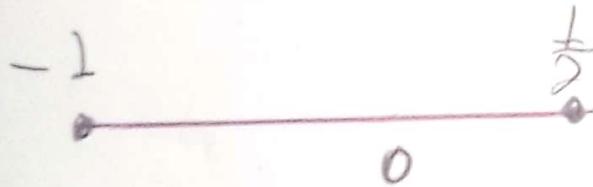
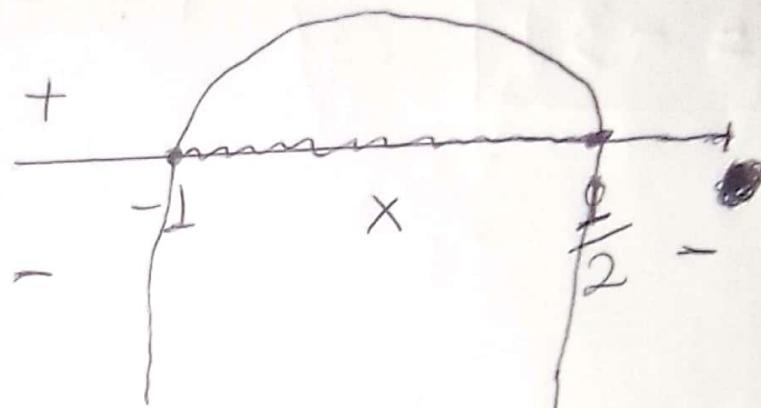
$$\frac{-(1) \pm \sqrt{9}}{2(-2)} = \frac{1+3}{-4} = \frac{4}{-4} = -1 \quad x,$$

$$x^1 = -1 \quad \frac{1-3}{-4} = \frac{-2}{-4} = \frac{1}{2} \quad \cancel{x}$$

$$x^2 = \frac{1}{2}$$

$$[-1, \frac{1}{2}]$$

$$-1 \leq x \leq \frac{1}{2}$$



$$\text{h) } \frac{x+1}{2-x} < \frac{x}{3+x}$$

$$\frac{3x+3+x^2+1-2x+x^2}{3x+3(2-x)(3+x)}=0$$

$$\frac{x+1}{2-x} - \frac{x}{3+x} < 0$$

$$\frac{2x^2+x+4}{(2-x)(3+x)} = 0$$

$$\frac{x+1}{2-x} - \frac{x}{3+x} = 0$$

$$\frac{(3+x)(x+1)-x(2-x)}{(2-x)(3+x)} = 0$$

$$2x^2 + x + 4 = 0$$

$$\Delta = b^2 - 4 \cdot a \cdot c$$

$$\Delta = 1^2 - 4 \cdot 2 \cdot 4$$

$$\Delta = 1 - 32$$

$$\boxed{\Delta = -31}$$

$$(2-x), (3+x) = 0$$

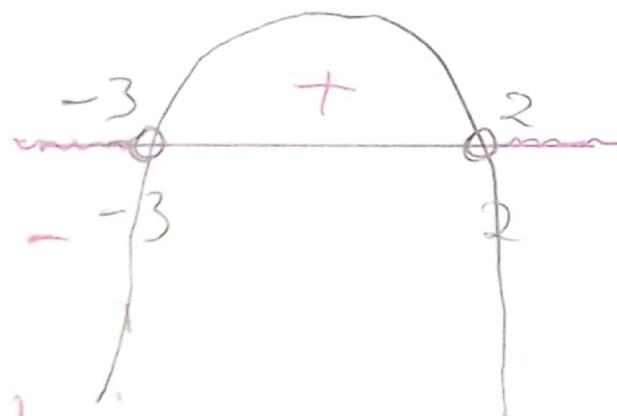
$$2-x = 0$$

$$-x = -2 \quad (-1) \quad x_1 = -3$$

$$\boxed{x = 2}$$

$$3+x = 0$$

$$\boxed{x = -3}$$



$$(-\infty, -3) \cup (2, +\infty)$$



$$i) x^3 + 1 > x^2 + x \quad a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

$$\begin{matrix} 3 \\ x+1 > x^2 - x > 0 \end{matrix}$$

$$\begin{aligned} & x^3 + 1^3 - x^2 - x \\ & (x+1)(x^2 - x + 1) - x^2 - x > 0 \end{aligned}$$

$$(x+1) \cdot (x^2 - x + 1) - x(x+1)$$

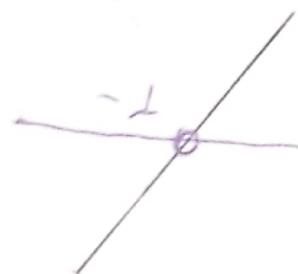
$$(x+1) \cdot [(x^2 - x + 1) - x] > 0$$

$$(x+1) \cdot (x^2 - x + 1 - x) > 0$$

$$\underbrace{(x+1)}_{g(x)} \cdot \underbrace{(x^2 - 2x + 1)}_{g(x)} > 0$$

$$x+1=0$$

$$\boxed{x = -1}$$

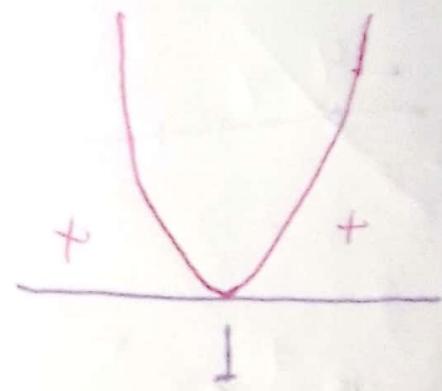


$$x^2 - 2x + 1$$

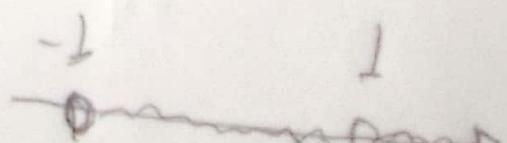
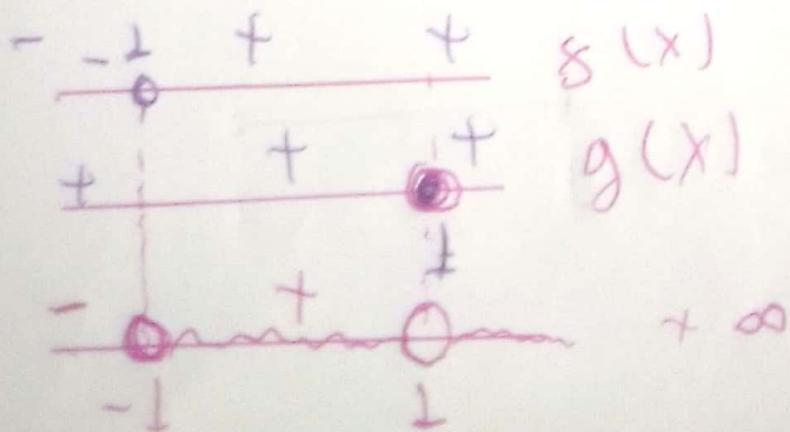
$$S = \frac{-b}{a}$$

$$P = \frac{c}{a}$$

$$S = \frac{-(-2)}{2} = 1$$
$$P = \frac{1}{1} = 1$$



$$(-1, 1) \cup (1, +\infty)$$



$$2) \underbrace{(x^2 - 1)}_{s(x)} \underbrace{(x + 4)}_{g(x)} \leq 0$$

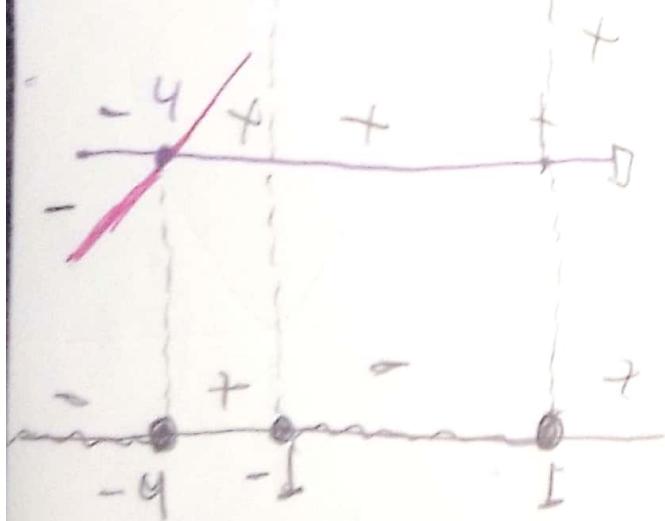
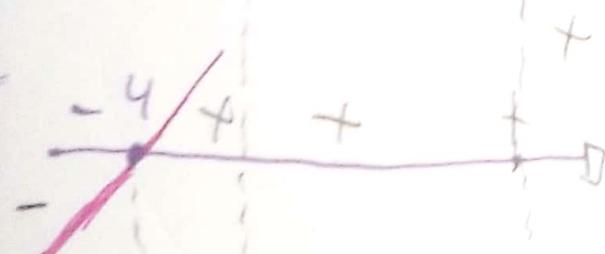
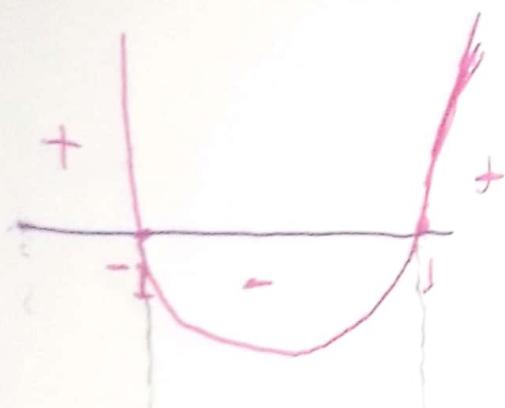
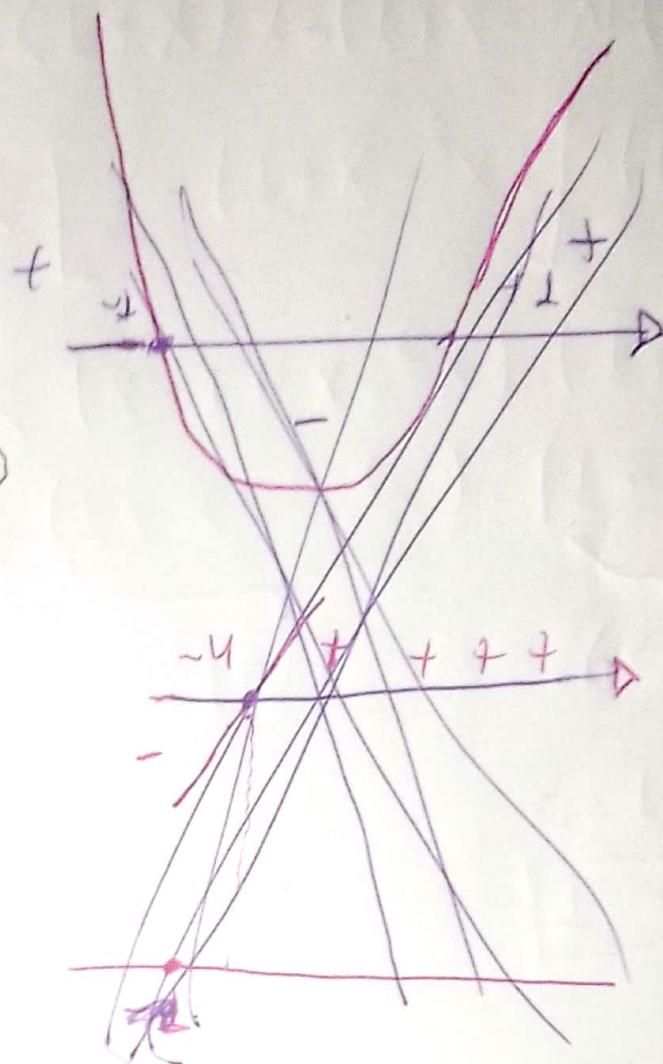
$$x^2 = 1$$

$$x = \sqrt{1}$$

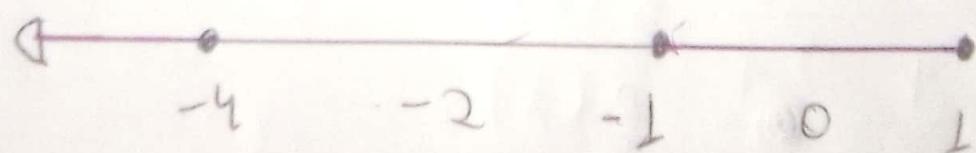
$$(x = \pm 1)$$

$$x + 4 = 0$$

$$(x = -4)$$



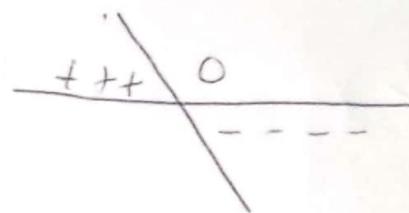
$$(-\infty, -4] \cup [-1, 1]$$



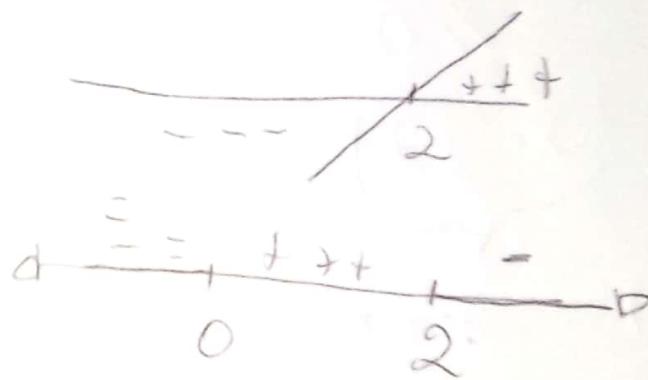
$$K) \frac{2}{x-2} \leq \frac{x+2}{x-2} \leq 1$$

$$\frac{2}{x-2} - \left( \frac{x+2}{x-2} \right) \leq 0$$

$$\frac{2-x-2}{x-2} \leq 0$$

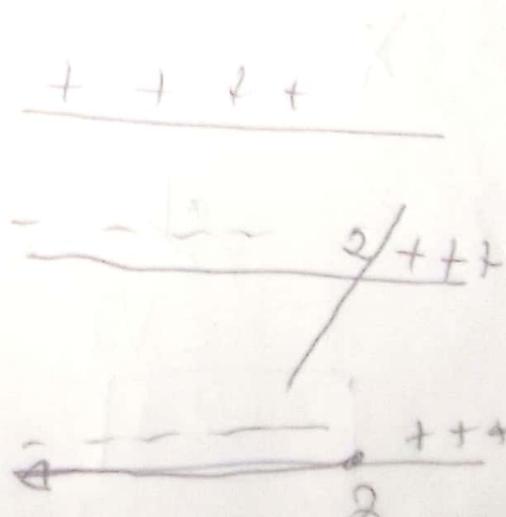


$$\frac{-x}{-x-2} \leq 0$$



$$\frac{x+2}{x-2} - 1 \leq 0$$

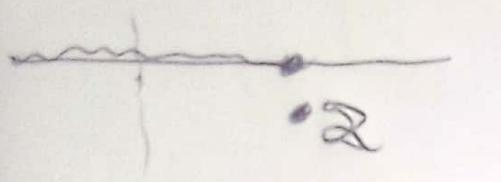
$$\frac{x+2-x+2}{x-2} \leq 0$$



$$\frac{4}{x-2} \leq 0$$



$$(-\infty, 0]$$



$$x^0 \leq 0$$

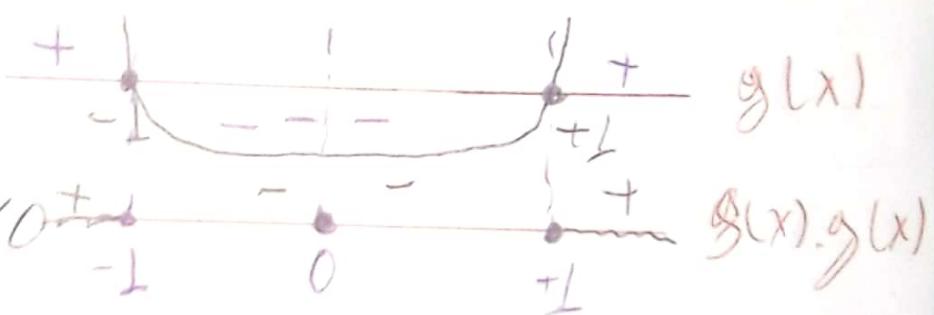
$$\ell) x^4 \geq x^2$$

$$x^4 - x^2 \geq 0$$

$$x^2(x^2 - 1) \geq 0$$

$$S(x)$$

$$S(g)$$



$$(-\infty, -1] \cup [1, +\infty) \cup \{0\}$$

$$x^2 = 0 \quad \left\{ \begin{array}{l} x^2 - 1 \\ x^2 = 1 \end{array} \right.$$

$$x = 0$$

$$x^2 = 1$$

$$x = \pm \sqrt{1}$$

$$x = \pm 1$$



$$m) \frac{x}{x-3} < 4$$

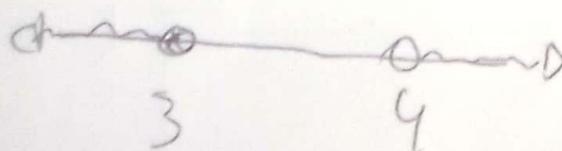
$$\frac{x}{x-3} - 4 < 0$$

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

$$\frac{x-4x+12}{(x-3)} < 0$$

$$\frac{-3x+12}{(x-3)} \begin{matrix} s(x) \\ g(x) \end{matrix} < 0$$

$$\boxed{(-\infty, 3) \cup (4, +\infty)}$$



$$-3x + 12 = 0$$

$$-3x = -12 \quad (-1)$$

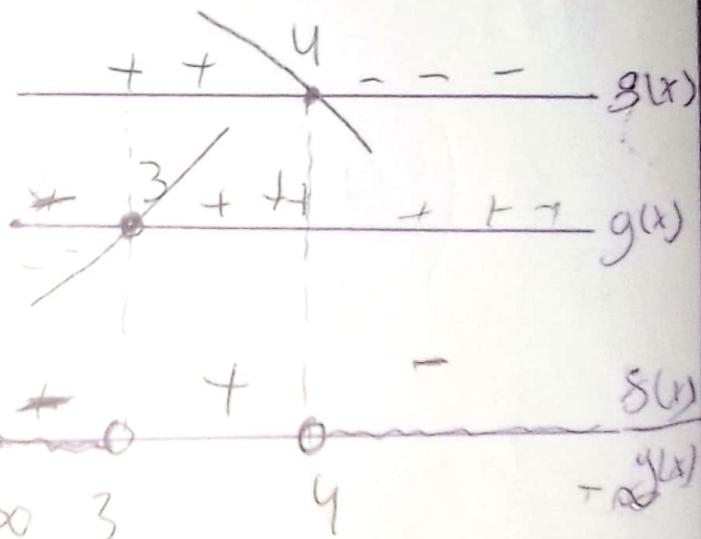
$$3x = 12$$

$$x = \frac{12}{3} \quad s(x)$$

$$\boxed{x = 4}$$

$$x - 3 = 0$$

$$\boxed{x = 3} \quad g(x)$$



$$m) \frac{\frac{1}{2}x - 3}{4+x} > 1$$

$$\frac{x}{2} - 3 > 1 \\ \frac{-6}{4+x}$$

$$\frac{x-6}{2} > 1 \\ \frac{-6}{4+x}$$

$$\frac{x-6}{2} + \frac{1}{4+x} > 1$$

$$\frac{x-6}{2(4+x)} > 1$$

$$\frac{x-6}{8+2x} > 1$$

$$\frac{x-6}{8+2x} - 1 > 0$$

$$\frac{x-6-1(8+2x)}{8+2x} > 0$$

$$\frac{x-6-8-2x}{8+2x} > 0$$

$$\frac{-x-14}{8+2x} > 0$$

$$-x - 14 = 0$$

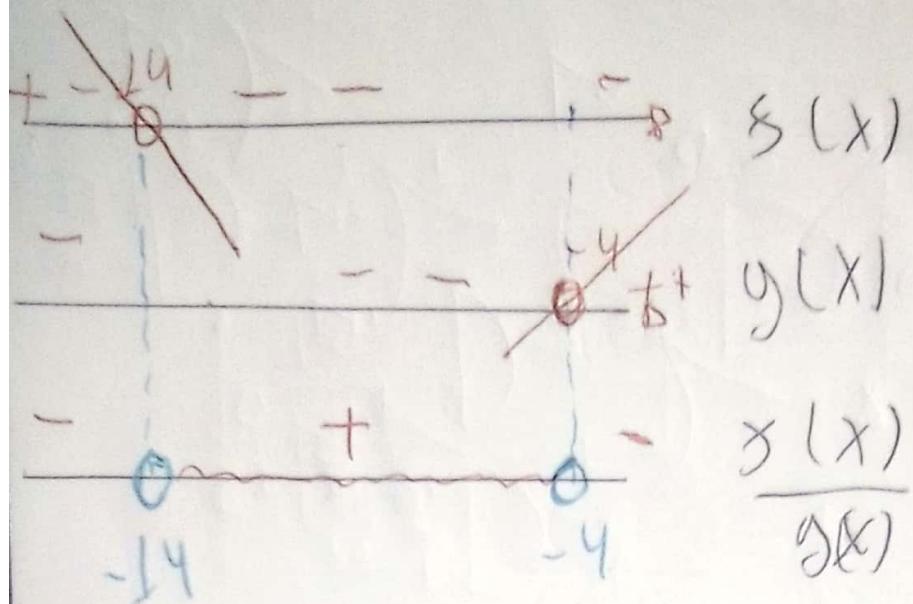
$$\begin{aligned} -x &= 14 \\ x &= -14 \end{aligned}$$

$$8+2x = 0$$

$$2x = -8$$

$$x = \frac{-8}{2} = -4$$

$$x = -4$$



$(-14, -4)$

$\dots$   $-14$   $-4$

$$9) \frac{3}{x-5} \leq 2$$

$$\frac{3}{x-5} - 2 \leq 0$$

$$\frac{3 - 2(x-5)}{(x-5)}$$

$$\frac{3 - 2x + 10}{x-5} \leq 0$$

$$\frac{-2x + 13}{x-5} \leq 0$$

$$-2x + 13 = 0$$

$$-2x = 13$$

$$-x = \frac{13}{2} \quad (-1)$$

$$x = \frac{13}{2}$$

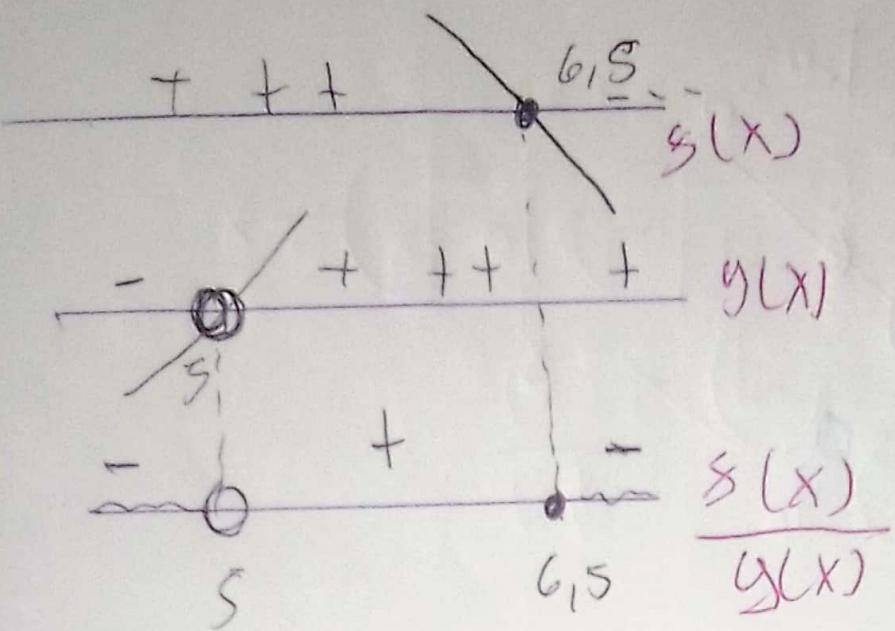
$x = 6,5$

$$x-5=0$$

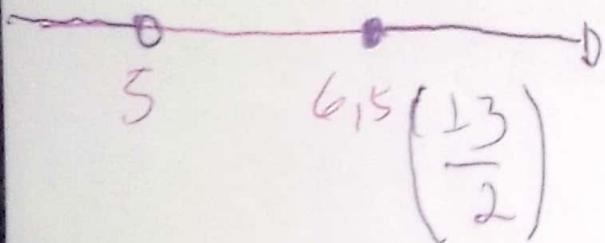
$x=5$

$$x-5 \neq 0$$

$$x \neq 5$$



$$(-\infty, 5) \cup [6,5, +\infty)$$



$$\text{P}) x^3 - x^2 - x - 2 > 0$$

$$x^3 - x^2 - x - 1 - 1 > 0$$

$$x^3 - x^2 - x - 1 > 0$$

$$x^3 - x^2 - x - 1 > 0$$

$$(x-1) \cdot (x^2 + x + 1) - 1(x^2 + x + 1) > 0$$

$$(x^2 + x + 1)[(x-1) - 1] > 0$$

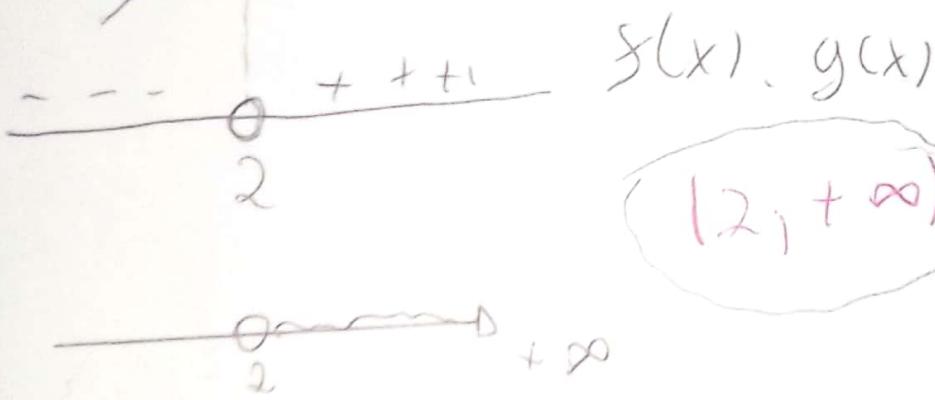
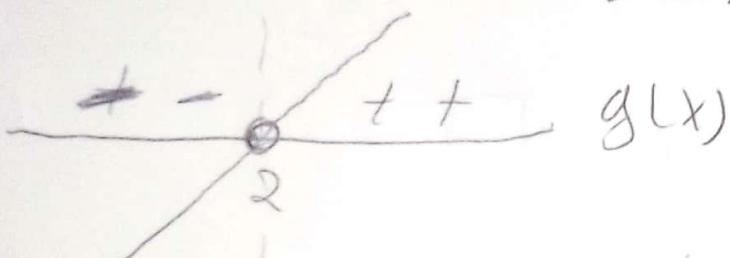
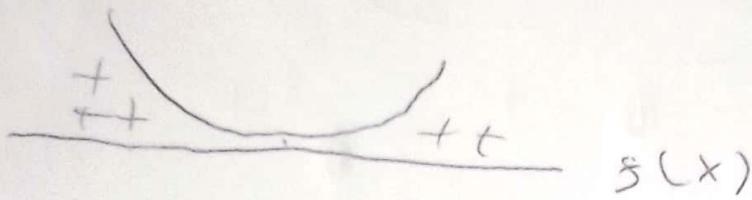
$$(x^2 + x + 1) \cdot (x - 2) > 0$$

$$(x^2 + x + 1)(x - 2) > 0$$

$$\left. \begin{array}{l} x-2=0 \\ x=2 \end{array} \right\} \quad \left. \begin{array}{l} x^2+x+1=0 \\ \Delta=b^2-4ac \end{array} \right.$$

$$\Delta = 1 - 4 \cdot 1 \cdot 1$$

$$\boxed{\Delta = -3}$$



$$q) x^3 - 3x + 2 \leq 0$$

$$x^3 - 3x + 2 + 1 - 1 \leq 0$$

$$x^3 - 3x + 3 - 1 \leq 0$$

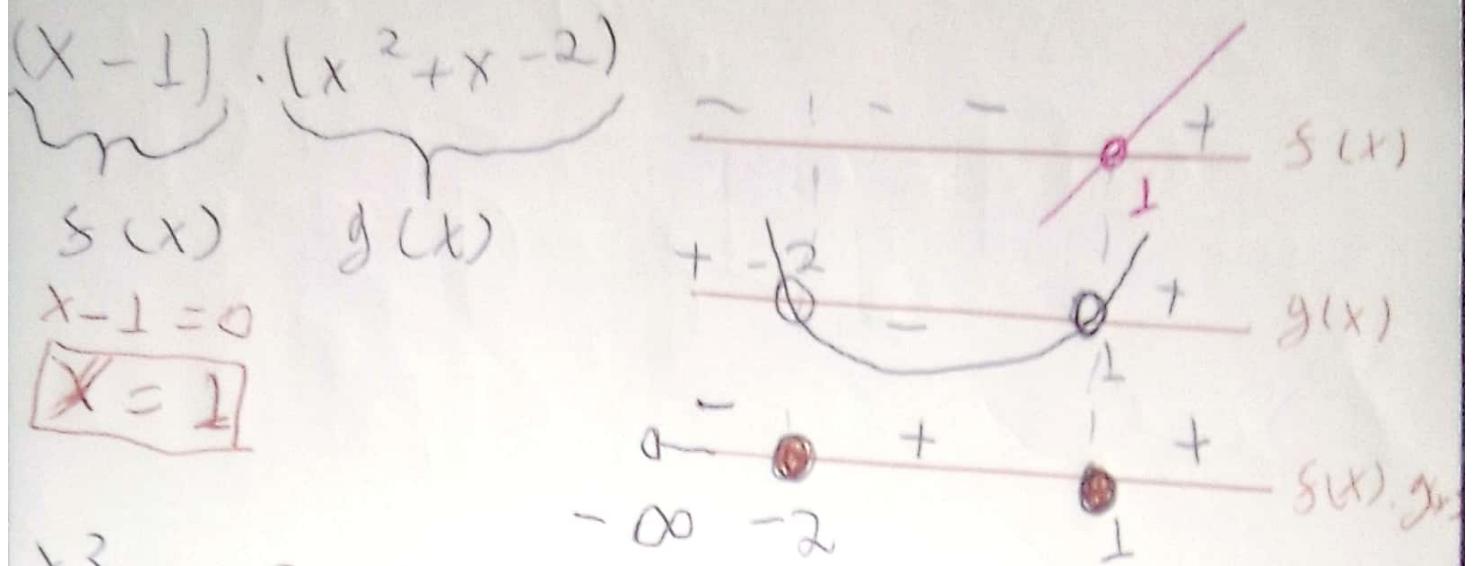
$$x^3 - 1 + 3 - 1 \leq 0$$

$$\underbrace{x^3 - 1^3 - 3x + 3}_{(x-1)(x^2+x+1)} \leq 0$$

$$(x-1) \cdot (x^2+x+1) - 3(x-1) \leq 0$$

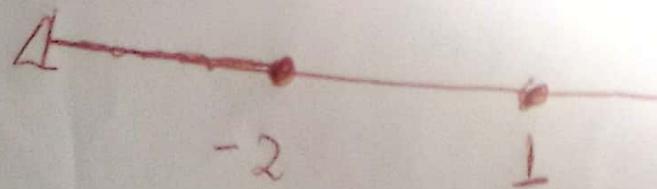
$$(x-1) [(x^2+x+1) - 3] \leq 0$$

$$(x-1) \cdot (x^2+x+1-3) \leq 0$$



$$\Delta = \boxed{B^2 - 4ac}$$
$$\Delta = (+1)^2 - 4 \cdot 1 \cdot -2$$
$$\Delta = 1 + 8$$
$$\Delta = 9$$
$$-B \pm \sqrt{\Delta}$$
$$2 \cdot a$$
$$\frac{-1 \pm \sqrt{9}}{2}$$
$$\frac{-1 \pm 3}{2} = x^1 = \frac{-1 + 3}{2} = \frac{2}{2}$$

$$[-\infty, -2] \cup \{1\}$$



$$x^1 = \frac{3}{2} = 1.5$$

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

$$x^2 = -2$$

$$\text{7)} \frac{1}{x+1} \geq \frac{3}{x-2}$$

$$-2x - 5 = 0$$

$$-2x = 5$$

$$-x = 5 \quad |(-1)$$

$$\frac{1}{x+1} - \frac{3}{x-2} \geq 0$$

2

$$x = \frac{5}{2}$$

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

$$x^2 - x - 2 = 0$$

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

$$S = \frac{-B}{a} = \frac{-(\text{-}1)}{1} = 1$$

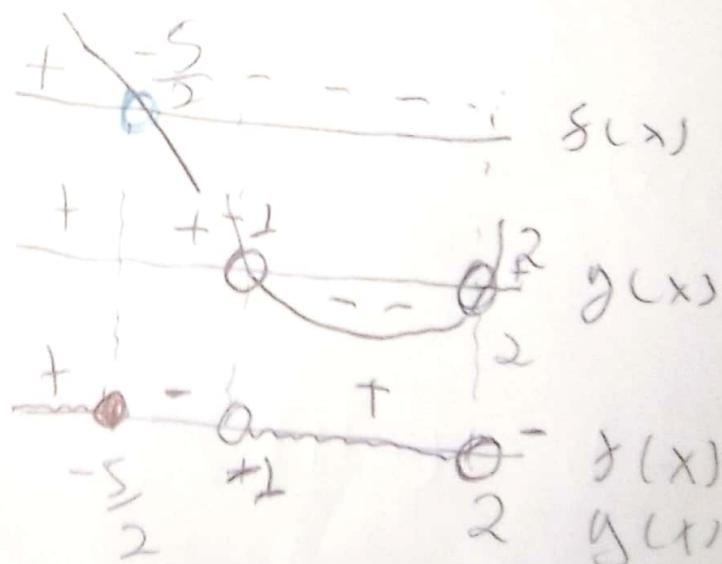
$$P = \frac{C}{a} = \frac{(-2)}{1} = -2$$

$$\frac{x-2 - 3x - 3}{x^2 - x - 2} \geq 0$$

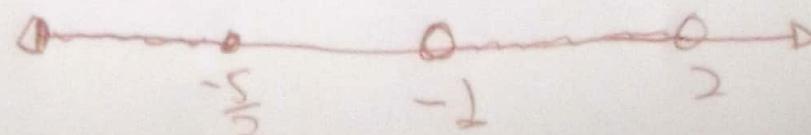
$$x_1 = -1 \\ x_2 = 2$$

$$\frac{-2x - 5}{x^2 - x - 2} \geq 0$$

$$\frac{8(x)}{y(x)} \geq 0$$



$$(-\infty, -\frac{5}{2}] \cup (-1, 2)$$



$$D) 8x^3 - 4x^2 - 2x + 1 < 0$$

$$(2x)^3 - (2x)^2 - 2x + 1 < 0$$

$$(2x)^3 + 1^3 - (2x)^3 - 2x - 1 < 0$$

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

$$(2x+1)[(2x)^2 - 2x + 1 - 2x] < 0$$

$$(2x+1)[(2x)^2 - 4x + 1] < 0$$

$$(2x+1)[4x^2 - 4x + 1] < 0$$

$$S(x)$$

$$g(x)$$

$$2x+1=0$$

$$2x = -1$$

$$S(x) \left\{ \begin{array}{l} x = -\frac{1}{2} \\ \end{array} \right.$$

$$4x^2 - 4x + 1 = 0$$

$$\Delta = (-4)^2 - 4 \cdot 4 \cdot 1$$

$$\Delta = 16 - 16$$

$$\Delta = 0$$

$$-\frac{b}{2a} - \frac{(-4)}{2 \cdot 4} = \frac{4}{8} = \frac{1}{2}$$

$$g(x) = \frac{1}{2}$$

$$\begin{array}{r} \cancel{-\frac{1}{2}} + ++ \quad ++ \quad s(x) \\ + \quad + \quad \text{U} \quad ++ \quad g(x) \end{array}$$

$$\begin{array}{r} -\frac{1}{2} \quad ++ \quad | \quad \frac{1}{2} \quad + \quad s(x) \quad g(x) \\ -\frac{1}{2} \quad \quad \quad | \quad \frac{1}{2} \end{array}$$

$$(-\infty, -\frac{1}{2}) \quad \text{---} \quad \frac{1}{2}$$

II)  $12x^3 - 20x^2 \geq -11x + 2$

$$12x^3 - 20x^2 + 11x - 2 \geq 0$$

$$(2x)^3 + 4x^3 - 20x^2 + 11x - 2 \geq 0$$

$$(2x)^3 - 1 + 4x^3 - 20x^2 + 11x - 2 \geq 0$$

$$(2x-1)(4x^2+2x+1) + 4x^3 - 20x^2 + 11x - 1 \geq 0$$

$$\begin{array}{r} 4x^3 - 20x^2 + 11x - 1 \quad | \quad \underline{2x-1} \\ -4x^3 + 2x^2 \quad \quad \quad 2x^2 - 9x + 1 \\ \hline -18x^2 + 11x - 1 \\ 18x^2 - 9x \\ \hline + 2x - 1 \end{array}$$

$$(2x-1) \cdot (4x^2 + 2x + 1) + (2x+1) \cdot (2x^2 - 3x + 1)$$

$$(2x-1) \cdot (4x^2 + 2x + 1 + 2x^2 - 3x + 1)$$

$$(2x-1) \cdot (6x^2 - 7x + 2) \geq 0$$

$$g(x) = 8x$$

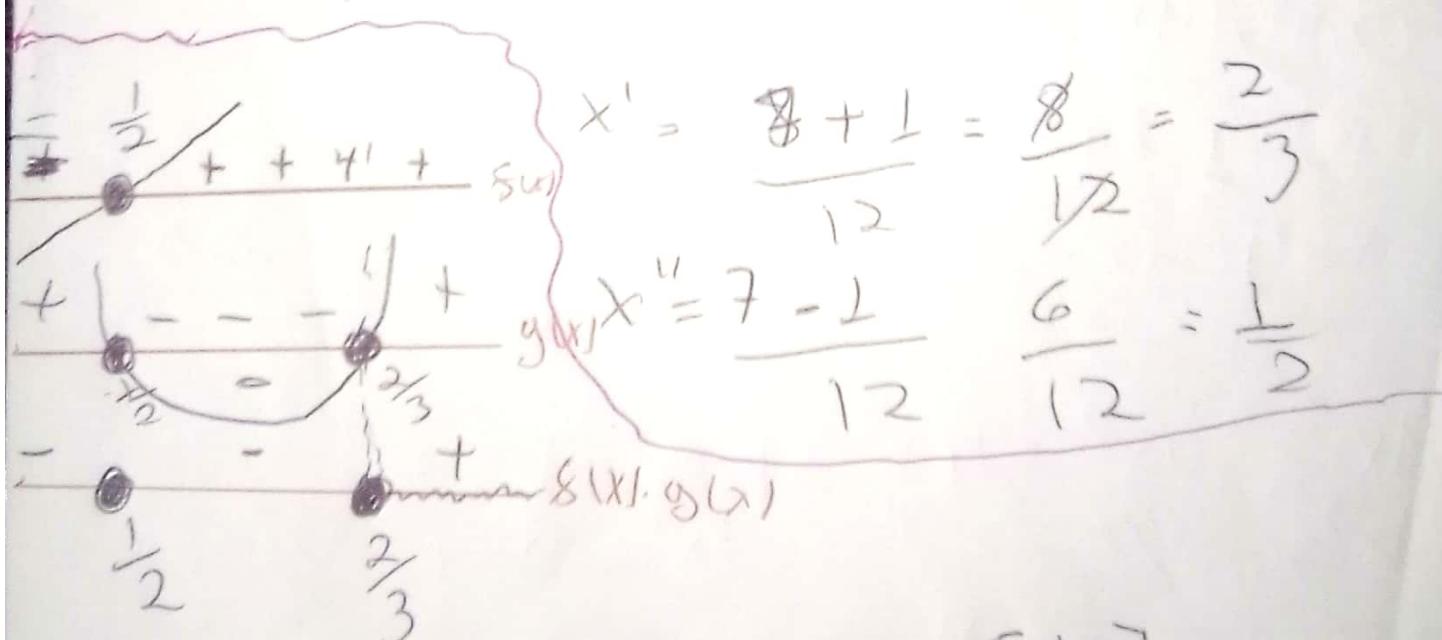
$$2x-1=0 \quad \left\{ \begin{array}{l} 6x^2 - 7x + 2 = 0 \\ D = b^2 - 4 \cdot a \cdot c \end{array} \right.$$

$$2x = 1 \quad \left\{ \begin{array}{l} D = (-7)^2 - 4 \cdot 6 \cdot 2 \\ D = 49 - 48 \end{array} \right.$$

$$x = \frac{1}{2} \quad \left\{ \begin{array}{l} D = 1 \\ 48 \end{array} \right.$$

$$D = 1$$

$$\frac{-b \pm \sqrt{D}}{2 \cdot a}, \quad \frac{-(-7) \pm \sqrt{1}}{2 \cdot 6} = \frac{+7 \pm 1}{12}$$



$$[\frac{2}{3}, +\infty) \cup \{\frac{1}{2}\}$$

$$\begin{array}{c} \cancel{\text{---}} \cancel{-} \cancel{\frac{1}{2}} + \cancel{++} \cancel{; \cancel{++}} \quad s(x) \\ + \quad + \quad \backslash \quad + + \quad g(x) \\ -\frac{1}{2} \quad + ++ \quad 0 \quad + \quad s(x) \quad g(x) \\ -\frac{1}{2} \quad \frac{1}{2} \end{array}$$

$$(-\infty, -\frac{1}{2}) \quad \text{---} \textcircled{+} \text{---}$$

$$+1) 12x^3 - 20x^2 \geq -11x + 2$$

$$12x^3 - 20x^2 + 11x - 2 \quad 710$$

$$(2x)^3 + 4x^3 - 20x^2 + 11x - 27/0$$

$$(2x)^3 - 1 + 4x^3 - 20x^2 + 11x - 2710$$

$$(2x-1)(4x^2+2x+1) + 9x^3 - 20x^2 + 11x - 1 \geq 0$$

$$\begin{array}{r} 4x^3 - 20x^2 + 11x - 1 \quad | \quad 2x - 1 \\ -4x^3 + 2x^2 \\ \hline -18x^2 + 11x - 1 \\ 18x^2 - 9x \\ \hline +2x - 1 \\ 0 \end{array}$$

$$2 \cdot a) |5x - 3| = 12$$

$$\begin{aligned} 5x - 3 &= 12 & 5x - 3 &= -12 \\ 5x &= 12 + 3 & 5x &= -12 + 3 \\ 5x &= 15 & 5x &= -9 \\ x &= \frac{15}{5} & x &= \frac{-9}{5} \\ x &= 3 \end{aligned} \quad \left. \begin{array}{l} 5x - 3 = 12 \\ 5x = -12 + 3 \\ 5x = -9 \\ x = -\frac{9}{5} \end{array} \right\}$$

Solução  $\{-\frac{9}{5}, 3\}$

$$b) |-4 + 12x| = 7$$

$$\begin{aligned} -4 + 12x &= 7 & -4 + 12x &= -7 \\ 12x &= +4 + 7 & 12x &= -7 + 4 \\ 12x &= 11 & 12x &= -3 \\ x &= \frac{11}{12} & x &= -\frac{3}{12} = \frac{1}{4} \end{aligned} \quad \left. \begin{array}{l} -4 + 12x = 7 \\ 12x = -7 + 4 \\ 12x = -3 \\ x = -\frac{3}{12} = \frac{1}{4} \end{array} \right\}$$

Solução  $\{-\frac{1}{4}, \frac{11}{12}\}$

$$c) |2x - 3| = |7x - 5|$$

$$\begin{aligned} 2x - 3 &= 7x - 5 \\ 2x - 7x &= -5 + 3 \\ -5x &= -2 \end{aligned} \quad \begin{array}{l} (-1) \\ \rightarrow \end{array} \quad x = \frac{2}{5}$$

$$\begin{aligned}
 -(2x-3) &= 7x-5 \\
 -2x+3 &= 7x-5 \\
 -2x-7x &= -5-3 \\
 -9x &= -8 \quad (-1) \\
 9x &= 8 \\
 x &= \frac{8}{9}
 \end{aligned}$$

d)  $\left| \frac{x+2}{x-2} \right| = 5$

$$\left\{
 \begin{array}{l}
 \frac{x+2}{x-2} = -5, \quad x \neq 2 \\
 x+2 = -5(x-2) \\
 x+2 = -5x + 10 \\
 x + 5x = +10 - 2 \\
 6x = 8 \\
 x = \frac{8}{6} = \frac{4}{3} \\
 x = \frac{4}{3}
 \end{array}
 \right.$$

$x = 3$

Solução:  $\left\{ \frac{4}{3}, 3 \right\}$

$$2) \left| \frac{3x+8}{2x-3} \right| = 4$$

$$\frac{3x+8}{2x-3} = 4 \quad x \neq 3/2$$

$$3x+8 = 4(2x-3)$$

$$3x+8 = 8x - 12$$

$$3x - 8x = -12 - 8$$

$$-5x = -20 \quad .(-1)$$

$$5x = 20$$

$$x = \frac{20}{5}$$

$$x = 4$$

$$\frac{3x+8}{2x-3} = -4 \quad x \neq 3/2$$

$$3x+8 = -4(2x-3)$$

$$3x+8 = -8x + 12$$

$$3x+8x = +12 - 8$$

$$11x = +4$$

$$x = \frac{4}{11}$$

Solução  $\left\{ \frac{4}{11}, 4 \right\}$

$$8) |3x+2| = 5-x$$

$$3x+2 = 5-x \quad \left\{ \begin{array}{l} 3x+2 = -(5-x) \\ 3x+2 = -5+x \\ 3x-x = -5-2 \\ 2x = -7 \\ x = -\frac{7}{2} \end{array} \right.$$

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

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

$$4x = 3$$

$$x = \frac{3}{4}$$

Soluções  $\left\{ -\frac{7}{2}, \frac{3}{4} \right\}$

$$g) |9x| - 11 = x$$

$$x > 0$$

$$9x - 11 = x$$

$$9x + x = +11$$

$$8x = 11$$

$$x = \frac{11}{8}$$

$$x < 0$$

$$-9x - 11 = x$$

$$-9x - x = 11$$

$$-10x = 11 \quad (-1)$$

$$x = -\frac{11}{10}$$

$$\text{Solução} = \left\{-\frac{11}{10}, \frac{11}{8}\right\}$$

$$h) 2x - 7 = |x| + 1$$

$$(x < 0)$$

$$2x - 7 = x + 1$$

$$(x > 0)$$

$$2x - x = +1 + 7$$

$$x = 8$$

$$2x - 7 = -x + 1$$

$$2x + x = +1 + 7$$

$$3x = 8$$

$$x = \frac{8}{3}$$

$$\text{Solução} \{8\}$$

$$3) a) |x+12| < 7$$

$$-7 < x+12 < 7$$

$$-7 + 12 < x < 7$$

$$-19 < x < 7 - 12$$

$$-19 < x < 5$$

$$x \in (-19, -5)$$

$$0) |3x - 4| \leq 2$$

$$-2 \leq 3x - 4 \leq 2$$

$$-2 + 4 < 3x + 4 - 4 \leq 2 + 4$$

$$+2 \leq 3x \leq 2 + 4$$

$$+\frac{2}{3} \leq 3x \leq 6$$

$$x \in \left[ \frac{2}{3}, 2 \right]$$

$$+\frac{2}{3} \leq x \leq 2$$

$$c) |5 - 6x \geq 9|$$

$$5 - 6x \geq 9 \quad \left\{ \begin{array}{l} 5 - 6x \leq -9 \\ -6x \geq 9 - 5 \end{array} \right.$$

$$-6x \geq 4 \quad \left\{ \begin{array}{l} -6x \leq -9 - 5 \\ -6x \leq -14 \end{array} \right.$$

$$\begin{aligned} -6x &\geq 4 \\ -x &\geq \frac{4}{6} \quad (-1) \end{aligned} \quad \left\{ \begin{array}{l} -x \leq -\frac{14}{6} \quad (-1) \\ x \geq \frac{14}{6} \end{array} \right.$$

$$x \geq -\frac{4}{6} \quad \left\{ \begin{array}{l} x \geq -\frac{2}{3} \\ x \leq -\frac{2}{3} \end{array} \right.$$

$$x \geq \frac{14}{6}$$

$$x \geq \frac{7}{3}$$

$$x \leq -\frac{2}{3}$$

$$\left( -\infty, -\frac{2}{3} \right] \cup \left[ \frac{7}{3}, +\infty \right)$$

$$d) |2x - 5| > 3$$

$$\begin{aligned} 2x - 5 &> 3 & 2x - 5 &< -3 \\ 2x &> 3 + 5 & 2x &< -3 + 5 \\ 2x &> 8 & 2x &< +2 \\ x &> \frac{8}{2} & x &< \frac{2}{2} \\ x &> 4 & x &< 1 \end{aligned}$$

$$(-\infty, 1) \cup (4, +\infty)$$

$$e) |6+2x| < |4-x|$$

$$|6+2x|^2 < |4-x|^2$$

$$36 + 24x + 4x^2 < 16 - 8x + x^2$$

$$3x^2 + 32x + 20 < 0$$

$$(3x+2)(x+10) < 0$$

$$3\left(x + \frac{2}{3}\right)(x+10) < 0$$

$$x \in (-10, -\frac{2}{3})$$

$$8|1x+4| \leq |2x-6|$$

$$x^2 + 8x + 16 \leq 4x^2 - 24x + 36$$

$$-3x^2 + 32x - 20 \leq 0$$

$$3x^2 - 32x + 20 \geq 0$$

$$(x-10)(3x-2) \geq 0$$

$$3(x-10)(x-\frac{2}{3}) \geq 0$$

$$\text{Solução } (-\infty, \frac{2}{3}] \cup [10, +\infty]$$

$$g) |3x| > |5-2x|$$

$$9x^2 > 25 - 4x^2 - 20x$$

$$5x^2 + 20x - 25 > 0$$

$$(x-1)(x+5) > 0$$

$$x \in (-\infty, -5) \cup (1, +\infty)$$

$$h) \left| \frac{7-2x}{5+3x} \right| \leq \frac{1}{2}$$

$$\frac{7-2x}{5+3x} \leq \frac{1}{2}$$

$$2|7-2x| \leq |5+3x|$$

$$\dots \rightarrow 2(7-2x)^2 \leq (5+3x)^2$$

$$196 - 112x + 46x^2 \leq 25 + 30x + 3x^2$$

$$7x^2 - 142x + 171 \leq 0$$

$$(x-19)(7x-9) \leq 0$$

$$7(x-19)\left(x-\frac{9}{7}\right) \leq 0$$

Solução  $\left[\frac{9}{7}, 19\right]$

$$\text{i) } |x-1| + |x+2| \geq 4$$

$$x \geq 1$$

$$x < -2$$

$$\begin{cases} x-1+x+2 \geq 4 \\ 2x+1 \geq 4 \\ 2x \geq 3 \\ x \geq \frac{3}{2} \end{cases} \quad \begin{cases} -x+1-x-2 \geq 4 \\ -2x-1 \geq 4 \\ -2x \geq 5 \\ x \geq -\frac{5}{2} \end{cases}$$

$$-2 \leq x < 1$$

$$-x+1+x+2 \geq 4$$

$$3 \geq 4$$

Solução

$$\left[\frac{3}{2}, +\infty\right) \cup \left(-\infty, -\frac{5}{2}\right]$$

$$2) 1 < |x+2| < 4$$

$$1^{\circ} \text{ caso } x+2 \geq 0 \quad x \geq -2$$

$$1 < x+2 < 4$$

$$-1 < x < +2$$

$$(-1, 2)$$

$$2^{\circ} \text{ caso } x+2 < 0 \quad x < -2$$

$$1 < -x-2 < 4$$

$$3 < -x < 6 \quad (-1)$$

$$-6 < x < 3$$

$$(-6, -3)$$

$$(-6, -3) \cup (-1, 2)$$

$$K \cdot \left| \frac{2+x}{3-x} \right| > 4$$

$$\left| \frac{2+x}{3-x} \right| > 4, \quad x \neq 3$$

$$|2+x| > 4|3-x|$$

$$4+4x+x^2 > 16(9-6x+x^2)$$

$$4+4x+x^2 > 144-96x+16x^2$$

$$15x^2 + 100x - 140 > 0$$

$$(x-2)(3x-14) < 0$$

$$3(x-2)\left(x-\frac{14}{3}\right) < 0$$

Solução  $(2, \frac{14}{3}) - \{3\}$

$$\ell \left| \frac{5}{2x-1} \right| \geq \left| \frac{1}{x-2} \right|$$

$$\frac{5}{|2x-1|} \geq \frac{1}{|x-2|}$$

$$5|x-2| \geq |2x-1|$$

$$25(x^2 - 4x + 4) \geq 4x^2 - 4x + 1$$

$$25x^2 - 100x + 100 \geq 4x^2 - 4x + 1$$

$$21x^2 - 96x + 99 \geq 0$$

$$(x-3)(7x-11) \geq 0$$

$$(x=3)$$

$$(x = \frac{11}{7})$$

$$(-\infty, 11/7] \cup [3, +\infty) - \{\frac{11}{7}\}$$

$$n) |x|+1 \leq x$$

$$\begin{cases} 1^{\circ} \text{ caso } x \geq 0 \\ x+1 \geq x \end{cases}$$

$$x-x \leq -1$$

$$0 \leq -1$$

Solução: 0

$$\begin{cases} 2^{\circ} \text{ caso } x < 0 \\ -x+1 < x \end{cases}$$

$$-x-x < -1$$

$$-2x < -1$$

Educação  
Básica

(-1)

$$x-1+x-3 < 4x$$

$$2x - 4x - 4 < 0$$

$$-2x < 4$$

$x \geq 3$  ou  $[3, +\infty)$

$$x > -\frac{4}{2}$$

$$x > -2$$

2º caso  $-1 < x < 3$

$$x+1-x-3 < 4x$$

$$2 < 4x$$

$$\left( x > \frac{1}{2} \right)$$

$(-1, 3)$

3º caso  $0 \leq x < 1$

$$-x+1-x+3 < 4x$$

$$-2x+4 < 4x$$

$$4 < 6x$$

$\left(\frac{2}{3}, 1\right)$

$$x > \frac{2}{3}$$

4º caso  $x < 0$

$$-x+1-x+3 < -4x$$

$$-2x+4 < -4$$

$$2x < -4$$

$$x < -2$$

SF  $(-\infty, -2)$

7)  $|3(x-1)| + |x| < 1$

1º caso  $x > 1$

$$\left. \begin{array}{l} 3(x-1) + x < 1 \\ 3x - 3 + x < 1 \end{array} \right\} \quad \left. \begin{array}{l} x-1 < 0 \quad \text{e } x \leq 0, x < 1 \\ 3(-x+1) + (-x) < 1 \\ -3x + 3 - x < 1 \\ -4x < -2 \quad (-1) \\ x > \frac{1}{2} \end{array} \right.$$

$$4x < 1 + 3$$

$$4x < 4$$

$$x < \frac{4}{4} = 1$$

$S = x < 1$

Solução ①

$\boxed{x > \frac{1}{2}}$

Solução 0

Final = 0

8)  $|2x^2 + 3x + 3| \leq 3$

1º caso

$$2x^2 + 3x + 3 \neq 0 \quad \text{Solução Fim}$$

$$x \in \mathbb{R}$$

$$[-\frac{3}{2}, 0]$$

2º caso  $< 0$

$$2x^2 + 3x + 3 \leq 0$$

$$2x^2 + 3x \leq 0$$

$$x = -\frac{3}{2}$$

PJ  $|x-1| + |x-3| < 14N$

1º caso  $x \geq 3$

$$4) \frac{1}{|x+1||x-3|} \geq \frac{1}{5}$$

$$5 \geq |x+1||x-3|$$

caso  $x > 3$

$$5 \geq (x+1)(x-3)$$

$$5 \geq x^2 - 3x + 3 + x$$

$$x^2 - 2x - 8 \leq 0$$

$$(x-4)(x+2) \leq 0$$

$$[-2, 4]$$

$$\text{caso } (-1, 3)$$

$$5 \geq (x+1)(x+3)$$

$$5 \geq -x^2 + 3x - x + 3$$

$$x^2 - 2x + 2 \geq 0$$

$$x \in \mathbb{R}$$

$$S \in \{-1\}$$

$$3^{\circ} \text{ caso } x < -1$$

$$5 \geq (-x-1)(-x+3)$$

$$S \not\in [-2, 4] - \{-\frac{1}{2}\}$$

$$5 \geq x^2 - 3x + 3 + x$$

$$x^2 - 2x - 8 \leq 0$$

$$[-2, 4 \cup)$$

$$k \left| \frac{x - \frac{1}{2}}{x + \frac{1}{2}} \right| < 1$$

$$\left| x - \frac{1}{2} \right| < \left| x + \frac{1}{2} \right| \quad x \neq -\frac{1}{2}$$

$$x^2 - x + \frac{1}{4} < x^2 + 1 \quad x + \frac{1}{4}$$

$$-2x < 0$$

$$2x > 0 \quad (0, +\infty)$$

$$x > 0$$

$$5) \left| \frac{3-2x}{1+x} \right| \leq 4$$

$$|3-2x| \leq 4|1+x|, \quad x \neq -1$$

$$9 - 12x + 4x^2 \leq 16(1 + 2x + x^2)$$

$$9 - 12x + 4x^2 \leq 16 + 32x + 16x^2$$

$$-12x - 44x - 7 \leq 0$$

$$12x^2 + 44x + 7 \geq 0$$

$$(6x+1)(2x+7) \geq 0$$

$$(-\infty, -\frac{1}{2}] \cup [-\frac{1}{6}, +\infty)$$