

الف) $y = x^3 - 3x^2 + 3x - 1 + 1 = (x-1)^3 + 1 \Rightarrow y-1 = (x-1)^3 \Rightarrow x-1 = \sqrt[3]{y-1}$
 $\Rightarrow x = \sqrt[3]{y-1} + 1 \Rightarrow R_f = \mathbb{R}$

ب) $y = \frac{1}{x^2 - 2x} \Rightarrow yx^2 - 2yx - 1 = 0 \Rightarrow x = \frac{2y \pm \sqrt{4y^2 + 4y}}{2y}$

لی هلیو قوت صفر نیست
 چون صورت $\frac{1}{x^2 - 2x}$ می‌باشد و
 صفر نمی‌شود

$\Delta = 4y^2 + 4y$
 $\Rightarrow 4y^2 + 4y \geq 0 \Rightarrow y^2 + y \geq 0 \Rightarrow y(y+1) \geq 0$

$\begin{array}{ccc} -1 & 0 & \\ +1 & -1 & + \end{array}$

$R_f = (-\infty, -1] \cup (0, +\infty)$

الف) $y = x^2 - 2x + 1$ $\min \left| \frac{-b}{2a} = \frac{1}{1} = 1 \right.$ $R_f = [1, +\infty)$
 $K - 1 + 1 = 0$

ب) $y = -x^2 + 4x + 3$ $\max \left| \frac{-b}{2a} = \frac{-4}{-2} = 2 \right.$ $R_f = (-\infty, 12]$
 $-9 + 16 + 3 = 10$

ج) $y = \sqrt{x^2 - 2x - 3}$ $\min \left| \frac{-b}{2a} = \frac{1}{1} = 1 \right.$ $\sqrt{[-4, +\infty)} \rightarrow R_f = [0, +\infty)$
 $K - 1 - 3 = -4$

د) $y = \sqrt{-x^2 + 4x}$ $\max \left| \frac{-b}{2a} = \frac{-4}{-2} = 2 \right.$ $\sqrt{(-\infty, 4]} \rightarrow R_f = [0, 3]$
 $-9 + 16 = 7$

الف) $y = x^3 - 6x^2 + 9x + 1 \rightarrow R_f = \mathbb{R}$

ب) $y = x^3 - 4x^2 + 3x + 2 \rightarrow R_f = \mathbb{R}$

ج) $y = \sqrt{x^3 - 4x^2 + 3x + 1} \sim \sqrt{(-\infty, +\infty)} \rightarrow R_f = [0, +\infty)$

د) $y = (x^3 - 2x^2 + 3x + 1)^2 \sim [(-\infty, +\infty)]^2 \rightarrow R_f = [0, +\infty)$

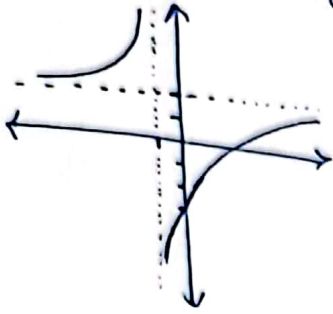
الف) $y = \frac{3x+1}{x-2} \rightarrow R_f = \mathbb{R} - \{2\}$

ب) $y = \frac{2x+1}{x+1} \rightarrow R_f = \mathbb{R} - \{1\}$

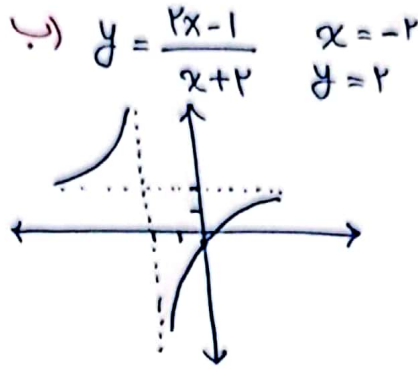
الف) $y = \sqrt{\frac{2x+1}{x+1}} \sim \sqrt{\mathbb{R} - \{1\}} \rightarrow R_f = [0, +\infty) - \{\sqrt{2}\}$

ب) $y = \sqrt{\frac{3x+1}{-x+2}} \sim \sqrt{\mathbb{R} - \{-3\}} \rightarrow R_f = [0, +\infty)$

الف) $y = \frac{2x-2}{x+1}$ $x = -1$
 $y = 2$



ب) $y = \frac{c}{a}$: $x =$ $y =$ $x =$ $y =$



الف) $y = \sin x + \frac{1}{\sin x}$ $-1 \leq \sin x \leq 1$ $\rightarrow R_f = (-\infty, -2] \cup [2, +\infty)$

ب) $y = \frac{x^2+1}{x^2} = x^2 + \frac{1}{x^2} \rightarrow R_f = (-\infty, -2] \cup [2, +\infty)$

ج) $y = \frac{\sqrt[3]{x^2+1}}{\sqrt[3]{x}} = \sqrt[3]{x} + \frac{1}{\sqrt[3]{x}} \rightarrow R_f = (-\infty, -2] \cup [2, +\infty)$

د) $y = \sqrt{x} + \frac{1}{\sqrt{x}} \xrightarrow{\sqrt{x} \geq 0} R_f = [2, +\infty)$

الف) $y = x^2 + \frac{1}{x^2+2} + 2 - 2 = x^2 + 2 + \frac{1}{x^2+2} - 2 \xrightarrow{x^2+2 \geq 2} R_f = [\frac{1}{2} - 2, +\infty)$
 $2 + \frac{1}{2} = \frac{5}{2} = 2.5$ $=$ $\frac{1}{2}$ $=$ $[\frac{1}{2}, +\infty)$

ب) $y = \frac{x^2+2}{\sqrt{x^2+2}} = \sqrt{x^2+2} + \frac{1}{\sqrt{x^2+2}} \rightarrow R_f = [\frac{2}{\sqrt{2}}, +\infty)$

$2 + \frac{1}{2} = \frac{5}{2} = 2.5$ $\xleftarrow{x=0}$ $\frac{1}{2} = \frac{1}{2}$

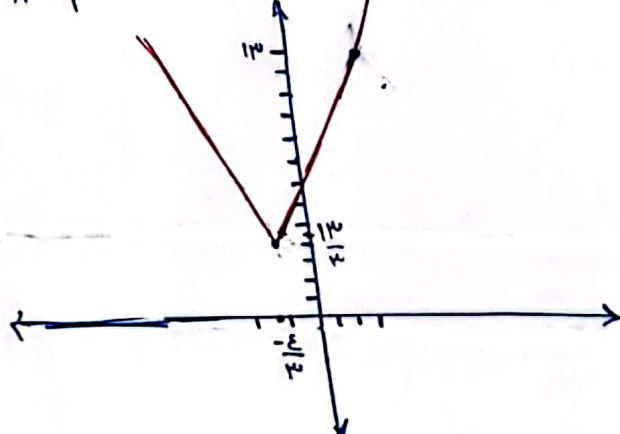
$y = |x-1| + |3x+1|$

$\downarrow$
 $\frac{1}{3}$

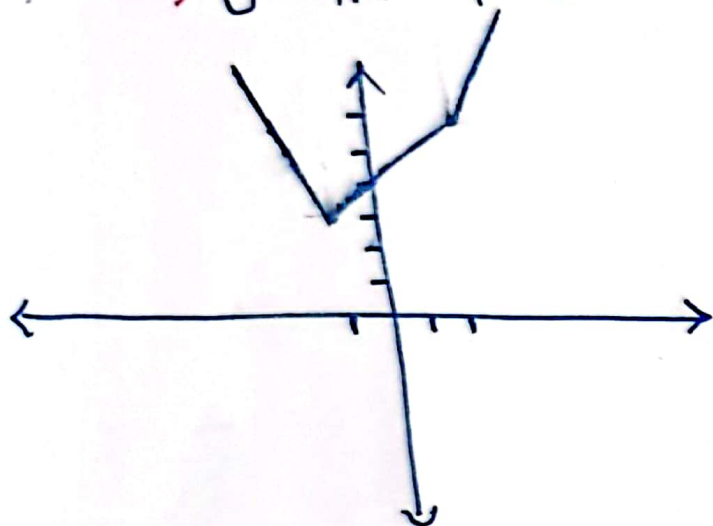
$\downarrow$
 $\frac{-1}{3}$

$\frac{-1}{3}$ $\frac{1}{3}$

$-x+1-3x-1$	$-x+1+3x+1$	$x-1+3x+1$
$= -4x$	$= 2x+2$	$= 4x$



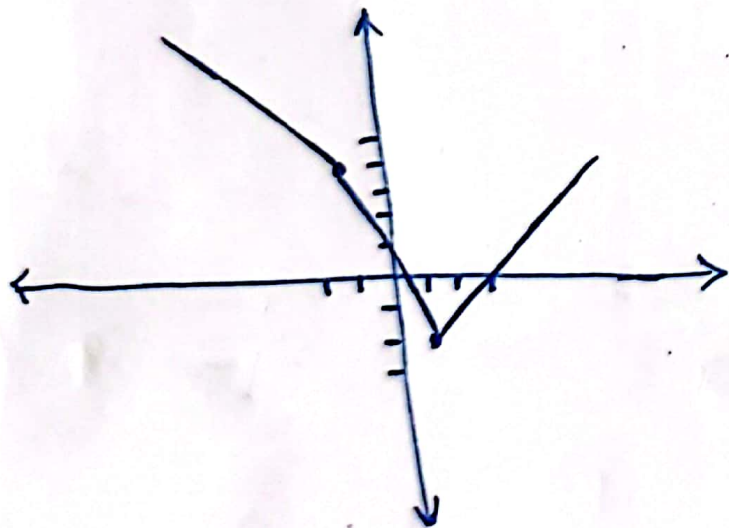
الف) $y = |x-2| + |2x+2|$



$$\begin{array}{ccc} & -1 & 2 \\ \hline -x+2-2x-2 & -x+2+2x+2 & x-2+2x+2 \\ =-3x & =x+4 & =3x \end{array}$$

$$R_f = [3, +\infty)$$

ب) $y = |2x-2| - |x+1|$



$$\begin{array}{ccc} & -1 & 1 \\ \hline -2x+2+x+1 & -2x+2-x-1 & 2x-2-x-1 \\ =-x+3 & =-3x+1 & =x-3 \end{array}$$

$$R_f = [-3, +\infty)$$