

الف) $x^2 = y + a \xrightarrow{\text{جذر}} x = \pm \sqrt{y + a} \rightarrow y + a \geq 0 \rightarrow y \geq -a$

$R_f \rightarrow [-a, +\infty)$

ب) $x^3 = y - 1 \xrightarrow{\text{جذر}} x = \sqrt[3]{y - 1} \rightarrow R_f = \mathbb{R}$

الف) $y = (x + 2)^2 + 2 \rightarrow (x + 2)^2 = y - 2 \xrightarrow{\text{جذر}} x + 2 = \pm \sqrt{y - 2}$

$R_f = [2, +\infty) \quad y \geq 2 \rightarrow y - 2 \geq 0 \rightarrow x = \pm \sqrt{y - 2} + 2$

ب) $x^2 - 5x + 1 - y = 0 \rightarrow x = \frac{-b \pm \sqrt{\Delta}}{2a} \xrightarrow{b^2 - 4ac} \frac{5 \pm \sqrt{25 - 4 + 4y}}{2} \xrightarrow{\Delta \geq 0} \frac{5 \pm \sqrt{21 + 4y}}{2}$

$R_f = \left[\frac{-21}{4}, +\infty\right) \rightarrow 21 + 4y \geq 0 \rightarrow 4y \geq -21 \rightarrow y \geq -\frac{21}{4}$

الف) $yx^2 - 2y = x^2 + 3 \rightarrow yx^2 - x^2 = 3 + 2y \rightarrow x^2(y - 1) = 3 + 2y$

$R_f = \left(-\infty, -\frac{3}{2}\right] \cup (1, +\infty) \quad x^2 = \frac{3 + 2y}{y - 1} = x = \pm \sqrt{\frac{3 + 2y}{y - 1}}$

ب) $y|x| - 4y = 2|x| + 1 \rightarrow y|x| - 2|x| = 4y + 1 \xrightarrow{\text{تقسیم بر } |x|} \frac{y - 2}{1} = \frac{4y + 1}{|x|} \rightarrow |x| = \frac{4y + 1}{y - 2} \geq 0$

$\xrightarrow{\text{تقسیم بر } y} \frac{1}{y - 2} = \frac{4}{y - 2} + \frac{1}{y - 2} \rightarrow R_f = \left(-\infty, -\frac{1}{4}\right] \cup (2, +\infty)$

$yx^2 - 4yx = 1 \rightarrow yx^2 - 4yx - 1 = 0 \rightarrow x = \frac{-b \pm \sqrt{\Delta}}{2a}$

$\rightarrow x = \frac{4y \pm \sqrt{(4y)^2 + 4y}}{2y} \rightarrow 16y^2 + 4y \geq 0 \rightarrow 4y(4y + 1) \geq 0 \rightarrow \frac{-1}{4} \leq y \leq 0$
 $\rightarrow 4y \neq 0 \rightarrow y \neq 0$

$\xrightarrow{\text{حاصل}} R_f = \left(-\infty, -\frac{1}{4}\right) \cup (0, +\infty)$

الف) $\min_{\text{دارد}} \rightarrow \text{دست} = \frac{-b}{2a} \rightarrow \frac{4}{2} = 2 \xrightarrow{\text{بررسی}} y = -2$

$R_f = [-2, +\infty)$

ب) $\max_{\text{دارد}} \rightarrow \text{دست} = \frac{-b}{2a} \rightarrow \frac{-4}{-2} = 2 \rightarrow R_f = (-\infty, 2]$

$\text{عرض کلیدی} = 4$

الف) $\min_{x \in \mathbb{R}} \frac{-b}{2a} = \frac{4}{2} = 2$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = -1 \rightarrow R_f = [-1, +\infty)$

$\rightarrow \sqrt{[-1, +\infty)} \rightarrow R_f = [0, +\infty)$

ب) $\max_{x \in \mathbb{R}} \frac{-b}{2a} = \frac{-4}{-2} = 2$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = 1 \rightarrow R_f = (-\infty, 1] \rightarrow \sqrt{\quad}$

$\rightarrow R_f = [0, 1]$

الف) $R_f = \mathbb{R}$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = 1 \rightarrow R_f = \mathbb{R}$

ب) $R_f = \mathbb{R}$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = 0 \rightarrow R_f = [0, +\infty)$

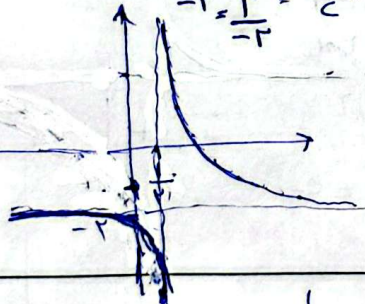
الف) $R_f = \mathbb{R} - \{3\}$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = 3 \rightarrow R_f = \mathbb{R} - \{3\}$

ب) $R_f = \mathbb{R} - \{4\}$ $\xrightarrow{\text{ملاحظه}}$ $\text{معرّف} = 4 \rightarrow R_f = \mathbb{R} - \{4\}$

$R_f = [0, +\infty) - \{4\}$

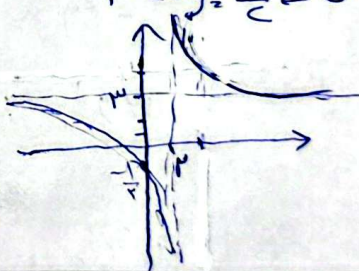
ب) بجانب قائم - رسمه صحیح: $\frac{1}{x}$

افقی - $\frac{a}{c} = \frac{4}{-2} = -2$



الف) بجانب قائم - رسمه صحیح: $\frac{1}{x}$

افقی - $\frac{a}{c} = \frac{4}{3} = \frac{4}{3}$



الف) $a + \frac{1}{a} \rightarrow R_f = [2, +\infty)$

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