

الف) $x^2 = y + 0$ $x = \pm \sqrt{y+0} \Rightarrow R_f = [-\infty, \infty)$ ✓

ب) $x^2 = y - 1$ $x = \sqrt{y-1}$ $R_f = \mathbb{R}$ (۲) ✓

الف) $y = (x-2)^2 + 2$ $(x-2)^2 = y-2$ $x-2 = \pm \sqrt{y-2}$ (۱)

$x = \pm \sqrt{y-2} + 2$ $\Rightarrow \frac{y-2}{4} \geq 0 \Rightarrow y \geq 2 \Rightarrow R_f = [2, \infty)$ ✓

ب) $y = (x - \frac{2}{x})^2 + \frac{4}{x^2} \Rightarrow x - \frac{2}{x} = \pm \sqrt{y - \frac{4}{x^2}} \Rightarrow x = \pm \sqrt{y - \frac{4}{x^2}} + \frac{2}{x}$
 $y \geq \frac{4}{x^2}$ $R_f = [\frac{4}{x^2}, \infty)$ $R_f = [-\frac{1}{x}, +\infty)$ ✓

الف) $yx^2 - xy = x^2 + 3$ $x^2(y-1) = xy + 3 \Rightarrow$
 $x^2 = \frac{xy+3}{y-1}$ $x = \pm \sqrt{\frac{xy+3}{y-1}}$ $\frac{-1/2}{+1 - \frac{1}{2}} R_f = (-\infty, 1/2] \cup (1, \infty)$ ✓

ب) $y|x| - 4y = 2|x| + 1 \Rightarrow |x|(y-2) - 4y + 1 \Rightarrow |x| = \frac{4y+1}{y-2}$
 $\frac{-1/2}{+1 - \frac{1}{2}} R_f = (-\infty, -\frac{1}{2}] \cup (2, \infty)$ ✓ (۳)

$yx^2 - 4yx = 1 \Rightarrow yx^2 - 4yx - 1 = 0$ $\Delta = 16y^2 + 4y$
 $\frac{4y \pm \sqrt{16y^2 + 4y}}{2y} \rightarrow \begin{cases} 16y^2 + 4y \geq 0 \Rightarrow 4y(4y+1) \geq 0 \\ 2y \neq 0 \Rightarrow y \neq 0 \end{cases}$
 $R_f = (-\infty, -\frac{1}{4}] \cup (0, \infty)$ ✓ (۲)

الف) $\min$ $\min \begin{cases} x = \frac{b}{a} = 3 \\ y = 9 - x + 2 = -4 \end{cases} R_f = [-4, \infty)$ ✓

ب) $\max$ $\max \begin{cases} x = \frac{b}{a} = 3 \\ y = -x + 1 + 2 = 0 \end{cases} R_f = (-\infty, 0]$ (۲) ✓

الف) $\min \begin{cases} x = \frac{y}{2} = 3 \\ y = 9 - 11 + 2 = -6 \end{cases} \quad R_f = \sqrt{[-6, \infty)} = [0, \infty)$

ب) $\max \begin{cases} x = \frac{-4}{-2} = 2 \\ y = -2 + 1 + 10 = 9 \end{cases} \quad R_f = \sqrt{(-\infty, 9]} = [0, \sqrt{9}]$

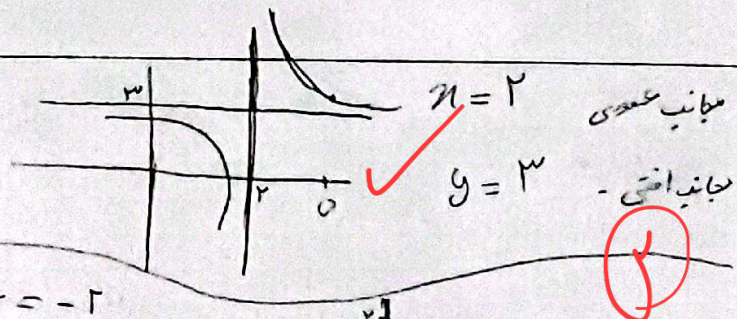
الف) $y = x^3 + 3x^2 + 2x + 1 \quad R_f = \mathbb{R}$

ب) $y = \sqrt{x^2 + 2x^2 + 4x + 1} \quad R_f = \sqrt{\mathbb{R}} = [0, \infty)$

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

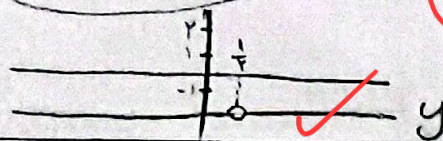
ب) $y = \sqrt{\frac{4x+1}{x+3}} \quad R_g = \mathbb{R} - \{4\} \Rightarrow R_f = [0, \infty) - \{2\}$

الف) $x=0$
مثلاً $y = \frac{3 \times 0 + 1}{0 - 2} = -\frac{1}{2}$



ب) $y = \frac{2(2x-1)}{-(2x-1)} = -\frac{2}{1} = -2$

$2x-1 \neq 0 \Rightarrow x \neq \frac{1}{2}$



الف) $y = \cos^2 x + \frac{1}{\cos^2 x} \quad \cos^2 x \geq 0 \quad \checkmark$

$R_f = [2, \infty)$

ب) $y = \sqrt{x + \frac{1}{x}}$

$R_f = (-\infty, \sqrt{-2}] \cup [\sqrt{2}, \infty)$