

الف) $y = x^2 - \omega$ $x^2 = y + \omega$
 $x = \sqrt{y + \omega} \Rightarrow y \geq -\omega$ $R_f = [-\omega, +\infty)$

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

الف) $y = x^2 - 2x + 2$ $x^2 - 2x + (2 - y) = 0 \Rightarrow \Delta \geq 0$ $R_f = [1, +\infty)$
 $b^2 - 4ac$
 $(-2)^2 - 4(1)(2 - y) = 4y - 4$
 $4y - 4 \geq 0 \Rightarrow y \geq 1$

ب) $y = x^2 - \omega x + 1$ $\Delta = b^2 - 4ac$ $R_f = \left[-\frac{\omega}{2}, +\infty\right)$
 $x^2 - \omega x + (1 - y) = 0$ $\omega^2 - 4(1)(1 - y) \geq 0$
 $\omega^2 - 4 + 4y \geq 0 \Rightarrow y \geq 1 - \frac{\omega^2}{4}$

الف) $y = \frac{x^2 + 2}{x^2 - 2}$ $y(x^2 - 2) = x^2 + 2$ $b^2 - 4ac \Rightarrow 4 - 4(y - 1)(-2)$
 $y x^2 - 2x = x^2 + 2$ $4 - 4(y - 1)(-2) \geq 0$
 $y x^2 - x^2 - 2x - 2 = 0$ $4 - 4(y - 1)(-2) \geq 0$
 $x^2(y - 1) - 2x - 2 = 0$ $4y - 4 \geq 0 \Rightarrow y \geq 1$

ب) $y = \frac{x|x| + 1}{|x| - 1}$ $y|x| - 1 = x|x| + 1$ $|x|(y - 1) = x|x| + 1$
 $y|x| - 2|x| = 1$ $|x|(y - 2) = 1$
 $|x| = \frac{1}{y - 2} \Rightarrow y > 2$

$y x^2 - 2x y = 1$ $14y + 2 = -8$ $R_f = [1, +\infty)$
 $x^2(y) - 2xy - 1 = 0$ $14y = -8$
 $x = \frac{-b \pm \sqrt{\Delta}}{2a}$ $\Delta = b^2 - 4ac$ $14y + 2 = -8$
 $(-2y)^2 - 4(y)(-1)$ $14y + 2 = -8$

الف) $y = x^2 - 4x + 2$ $\min \left\{ \frac{-b}{2a} = \frac{4}{2} = 2 \right\}$ $R_f = [2, +\infty)$
 $x^2 - 4x + 2 = 0$ $2^2 - 4(2) + 2 = -2$

ب) $y = -x^2 + 4x + 2$ $\max \left\{ \frac{-b}{2a} = \frac{-4}{-2} = 2 \right\}$ $R_f = (-\infty, 2]$
 $-x^2 + 4x + 2 = 0$ $-(2)^2 + 4(2) + 2 = 6$

$$\text{الف) } y = \sqrt{x^2 - 6x + 2} \quad \begin{cases} \frac{-b}{2a} = \frac{6}{2} = 3 \\ \frac{9 - 12 + 2}{1} = -1 \end{cases} \quad R_f = \sqrt{[-1, +\infty)} \rightarrow R_f = [0, +\infty)$$

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$$\text{ب) } y = \sqrt{-x^2 + 4x + 10} \quad \begin{cases} \frac{-b}{2a} = \frac{-4}{-2} = 2 \\ \frac{-1 + 16 + 10}{-1} = 15 \end{cases} \quad R_f = \sqrt{(-\infty, 15]} \rightarrow R_f = [0, \sqrt{15}]$$

$$\text{ج) } y = x^4 + 13x^2 + 2x + 1 \Rightarrow R_f = (-\infty, +\infty) = \mathbb{R}$$

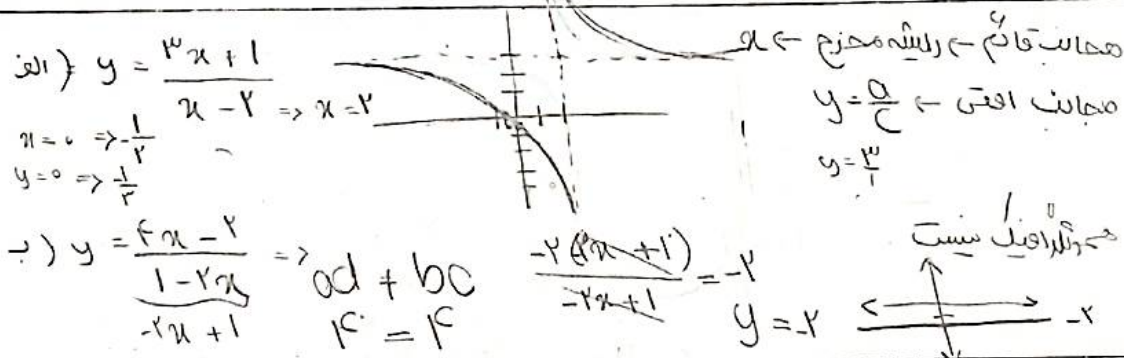
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$$\text{د) } y = \sqrt{x^4 + 4x^2 + 6x + 1} \Rightarrow R_f = \sqrt{\mathbb{R}} \Rightarrow [0, +\infty)$$

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

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



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$$\text{الف) } y = \frac{\cos^2 x}{\cos^2 x} \Rightarrow [1, +\infty)$$

$$\text{ب) } y = \sqrt{\frac{x^2+1}{x}} \Rightarrow \sqrt{\frac{x^2}{x} + \frac{1}{x}} \Rightarrow \sqrt{x + \frac{1}{x}} \Rightarrow x > 0 \Rightarrow [1, +\infty)$$

$$x < 0 \Rightarrow (-\infty, \sqrt{-1}]$$

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