

الف) $y = a^2 \cdot \omega \Rightarrow y \cdot \omega = a^2 \Rightarrow a = \sqrt{y \cdot \omega} \Rightarrow R_f = [-\omega, +\infty)$ ✓

ب) $y = a^3 \cdot 1 \Rightarrow a^3 = y \Rightarrow a = \sqrt[3]{y} \Rightarrow R_f = [0, +\infty)$ ✓

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الف) $y = a^2 - 2a \Rightarrow y = (a-1)^2 \Rightarrow y-1 = (a-1)^2 - 1 \Rightarrow a = \sqrt{y-1} + 1 \Rightarrow R_f = [1, +\infty)$ ✓

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ب) $y = a^2 - \omega a + 1 \Rightarrow a^2 - \omega a + 1 - y = 0 \Rightarrow a = \frac{\omega \pm \sqrt{\omega^2 - 4(1-y)}}{2} = \frac{\omega \pm \sqrt{4\omega - 4(1-y)}}{2}$

$4\omega - 4(1-y) \geq 0 \Rightarrow \omega - 1 + y \geq 0 \Rightarrow y \geq 1 - \omega$ ✓

الف) $y = \frac{a^2 + 3}{a^2 - 2} \Rightarrow y(a^2 - 2) = a^2 + 3 \Rightarrow y a^2 - 2y = a^2 + 3 \Rightarrow a^2(1-y) = -2y + 3 \Rightarrow a^2 = \frac{3-2y}{1-y}$

$\Rightarrow a = \pm \sqrt{\frac{3-2y}{1-y}} \Rightarrow R_f = (-\infty, -\frac{1}{\sqrt{2}}] \cup [\frac{1}{\sqrt{2}}, +\infty)$ ✓

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

$\Rightarrow R_f = (-\infty, -\frac{1}{2}) \cup (\frac{1}{2}, +\infty)$ ✓

$y = \frac{1}{a^2 - 4a} \Rightarrow y(a^2 - 4a) = 1 \Rightarrow \Delta \geq 0 \Rightarrow b^2 - 4ac \geq 0 \Rightarrow 16y^2 - 4y \geq 0 \Rightarrow 4y(4y-1) \geq 0$

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$4y^2 - y \geq 0 \Rightarrow y \geq \frac{1}{4} \Rightarrow R_f = [\frac{1}{4}, +\infty)$ ✓

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الف) $y = a^2 - 2a + 2 \Rightarrow \min |a = -\frac{b}{2a} = \frac{2}{2} = 1 \Rightarrow R_f = [-1, +\infty)$ ✓

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ب) $y = -a^2 + 4a + 2 \Rightarrow \max |a = \frac{b}{2a} = \frac{4}{2} = 2 \Rightarrow R_f = (-\infty, 6]$ ✓

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الف) $y = \sqrt{x^2 - 4x + 4}$ $\min \begin{cases} u = \frac{x}{y} = 1 \\ y = 1 \end{cases} R_f = \sqrt{[\frac{1}{2}, +\infty)} = [0, +\infty)$

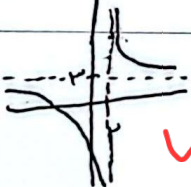
ب) $y = \sqrt{-x^2 + 4x + 10}$ $\max \begin{cases} u = \frac{x}{y} = 2 \\ y = 1 \end{cases} R_f = \sqrt{(-\infty, 14]} = [0, \sqrt{14}]$

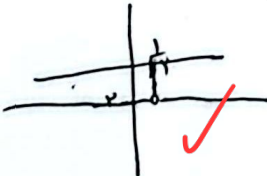
الف) $y = x^4 + 3x^2 + 2x + 1 \Rightarrow R_f = \mathbb{R}$

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

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

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

الف) $y = \frac{3x+1}{x-2}$ 

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

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

ب) $y = \sqrt{\frac{x^2+4}{x}}$ $\Rightarrow y = \sqrt{x + \frac{4}{x}}$ $R_f = \sqrt{(-\infty, -\frac{4}{3}] \cup [\frac{4}{3}, +\infty)}$

$\neq (-\infty, \sqrt{-2}] \cup [\sqrt{2}, +\infty)$