

الف) $y = x^2 - 5 \Rightarrow x^2 = y + 5 \Rightarrow x = \pm \sqrt{y+5}$ $y+5 \geq 0 \Rightarrow y \geq -5 \Rightarrow R_f = [-5, +\infty]$ ①

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

الف) $y = x^2 - 4x + 7 \Rightarrow y = x^2 - 4x + 4 + 3 = (x-2)^2 + 3 \Rightarrow y - 3 = (x-2)^2 \Rightarrow x - 2 = \pm \sqrt{y-3} \Rightarrow x = \pm \sqrt{y-3} + 2$ $y - 3 \geq 0 \Rightarrow y \geq 3 \Rightarrow R_f = [3, +\infty]$ ②

ب) $y = x^2 - 5x + 1 \Rightarrow x^2 - 5x + 1 - y = 0 \Rightarrow \Delta = (-5)^2 - 4(1-y) \Rightarrow 25 - 4 + 4y \geq 0$
 $21 + 4y \geq 0 \Rightarrow \frac{-5, 25}{-4+} \Rightarrow y \geq -5, 25 \Rightarrow R_f = [-5, 25, +\infty)$ ③

الف) $y = \frac{x^2 + 3}{x^2 - 2} \Rightarrow yx^2 - 2y = x^2 + 3 \Rightarrow x^2 - yx^2 + 3 + 2y = 0 \Rightarrow (1-y)x^2 + 3 + 2y = 0$ ③

$\Delta = 0^2 - 4(1-y)(3+2y) \Rightarrow +4(2y^2 + y - 3) \Rightarrow 4(y^2 + y - 6) = 4(y+3)(y-2) \begin{matrix} < 0 & -1, 5 \\ & +1 \end{matrix}$
 $\Rightarrow \frac{-1, 5}{+4-} \Rightarrow -4(1-y)(3+2y) \geq 0 \Rightarrow y = \mathbb{R} - (-1, 5, 1] \Rightarrow R_f = \mathbb{R} - (-1, 5, 1]$ ④

ب) $y = \frac{2|x| + 1}{|x| - 4} \Rightarrow y|x| - 4y = 2|x| + 1 \Rightarrow y|x| - 2|x| = 1 + 4y \Rightarrow (y-2)|x| = 1 + 4y$
 $|x| = \frac{1+4y}{y-2} \Rightarrow \frac{1+4y}{y-2} \geq 0 \Rightarrow \frac{-2, 5}{+4-} \Rightarrow y = \mathbb{R} - (-2, 5, 2]$
 $\Rightarrow R_f = \mathbb{R} - (-2, 5, 2]$ ⑤

$$y = \frac{1}{x^2 - 4x} \Rightarrow yx^2 - 4yx = 1 \Rightarrow yx^2 - 4yx - 1 = 0$$

$$\Delta = (-4y)^2 - 4(-y)$$

$$14y^2 + 4y \geq 0 \Rightarrow 4y(4y + 1) \geq 0 \Rightarrow \frac{-1 \pm \sqrt{17}}{8}$$

$$\Rightarrow y = R - (-1/17, 0) \Rightarrow R_f = R - (-1/17, 0) \checkmark$$

الف) $y = x^2 - 6x + 2 \Rightarrow \min \left| \frac{y}{x} \right| = 3$ $y = 3^2 - 18 + 2 = -7$
 $y \rightarrow -7 \Rightarrow R_f = [-7, +\infty) \checkmark$

ب) $y = -x^2 + 4x + 2 \Rightarrow \max \left| \frac{-y}{x} \right| = 2$ $y = -4 + 8 + 2 = 6$
 $\Rightarrow R_f = (-\infty, 6] \checkmark$

الف) $y = \sqrt{x^2 - 4x + 2}$ $\min \left| \frac{y}{x} \right| = 3$ $y = 9 - 18 + 2 = -7 \Rightarrow R = [-7, +\infty)$
 $\Rightarrow R_f = \sqrt{[-7, +\infty)} = [0, +\infty) \checkmark$

ب) $\sqrt{-x^2 + 4x + 10}$ $\max \left| \frac{-y}{x} \right| = 2$ $y = -4 + 8 + 10 = 14 \Rightarrow R = (-\infty, 14]$
 $\Rightarrow R_f = \sqrt{(-\infty, 14]} = [0, \sqrt{14}] \checkmark$

الف) $y = x^2 + 3x^2 + 2x + 1 \Rightarrow R_f = R \checkmark$

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

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

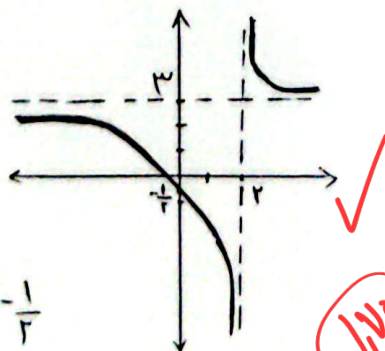
ب) $y = \sqrt{\frac{4x+1}{x+3}} \Rightarrow R_f = \sqrt{R - \{4\}} = [0, +\infty) - \{2\} \checkmark$

الف) $y = \frac{3x+1}{x-2}$

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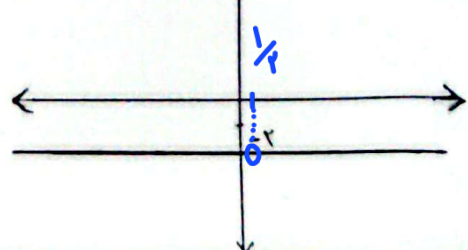
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عرض از سب: $\frac{0+1}{-2} = -\frac{1}{2}$



ب) $y = \frac{4x-2}{1-2x} \Rightarrow \frac{-2(-2x+1)}{1-2x} = -2$

$x \neq \frac{1}{2}$



$$a) y = \cos^r x + \frac{1}{\cos^r x} \Rightarrow \cos^r x > 0 \Rightarrow R_f = [r, +\infty) \checkmark$$

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$$b) y = \sqrt[r]{\frac{x^r + 1}{x}} \rightarrow \frac{x^r}{x} + \frac{1}{x} = x + \frac{1}{x} \Rightarrow \begin{cases} x > 0 \Rightarrow [r, +\infty) \\ x < 0 \Rightarrow (-\infty, -r] \end{cases}$$

$$\Rightarrow R_f = \sqrt[r]{(-\infty, -r)} \cup \sqrt[r]{[r, +\infty)} = (-\infty, \sqrt[r]{-r}] \cup [\sqrt[r]{r}, +\infty) \checkmark$$