

الف) $y = x^2 - 5 \rightarrow x^2 = y + 5 \xrightarrow{\text{دایره}} x = \pm \sqrt{y+5} \rightarrow y+5 \geq 0 \Rightarrow y \geq -5 \Rightarrow R_f = [-5, +\infty)$

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

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

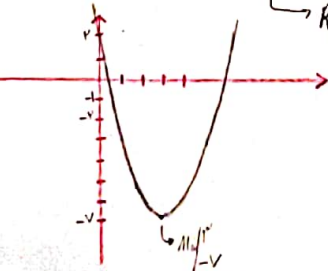
ب) $y = x^2 - 2(\frac{5}{4}x) + \frac{25}{4} - \frac{21}{4} \rightarrow y = (x - \frac{5}{4})^2 - \frac{21}{4} \rightarrow (x - \frac{5}{4})^2 = y + \frac{21}{4} \rightarrow x - \frac{5}{4} = \pm \sqrt{y + \frac{21}{4}} \rightarrow x = \pm \sqrt{y + \frac{21}{4}} + \frac{5}{4}$
 $\Rightarrow y + \frac{21}{4}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

الف) $x^2y - 2y = x^2 + 3 \rightarrow x^2y - x^2 = 2y + 3 \rightarrow x^2(y-1) = 2y+3 \rightarrow x^2 = \frac{2y+3}{y-1} \Rightarrow \frac{2y+3}{y-1} \geq 0$
 $\xrightarrow{\text{دایره}} (y = \frac{ay+b}{cy+d} \rightarrow x = \frac{-dy+b}{cy-a}) \rightarrow x^2 = \frac{2y+3}{y-1} \rightarrow x = \pm \sqrt{\frac{2y+3}{y-1}} \Rightarrow y \geq \frac{3}{2}$
 $\Rightarrow R_f = \mathbb{R} - (-\frac{3}{2}, 1] = (-\infty, -\frac{3}{2}] \cup (1, +\infty)$

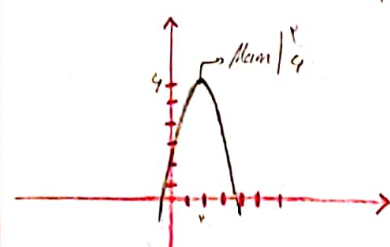
ب) $|x| = \frac{4y+1}{y-2} \rightarrow |x| \geq 0 \Rightarrow \frac{4y+1}{y-2} \geq 0 \Rightarrow y \leq -\frac{1}{4} \text{ یا } y > 2 \Rightarrow R_f = \mathbb{R} - (-\frac{1}{4}, 2] = (-\infty, -\frac{1}{4}] \cup (2, +\infty)$

$y = \frac{1}{x^2 - 4x + 4 - 4} = \frac{1}{(x-2)^2 - 4} \Rightarrow (x-2)^2y - 4y = 1 \rightarrow (x-2)^2y = 1 + 4y \rightarrow (x-2)^2 = \frac{4y+1}{y}$
 $x = \pm \sqrt{\frac{4y+1}{y}} + 2 \Rightarrow \frac{4y+1}{y} \geq 0 \Rightarrow y \leq -\frac{1}{4} \text{ یا } y > 0 \Rightarrow R_f = \mathbb{R} - (-\frac{1}{4}, 0] = (-\infty, -\frac{1}{4}] \cup (0, +\infty)$

الف) $\min \left| \frac{-b}{\sqrt{a}} \right| = \left| \frac{-3}{\sqrt{1}} \right| = 3 \Rightarrow R_f = [-3, +\infty)$



ب) $\max \left| \frac{-b}{\sqrt{a}} \right| = 4 \Rightarrow R_f = (-\infty, 4]$



الف) $\frac{a > 0}{\text{برای هر}} \rightarrow \lim_{x \rightarrow -\infty} \frac{-b}{2a} = \frac{-1}{-2} = \frac{1}{2}$ $\lim_{x \rightarrow +\infty} \frac{-b}{2a} = \frac{-1}{-2} = \frac{1}{2}$ برای هر x $\rightarrow$ $\lim_{x \rightarrow -\infty} \frac{-b}{2a} = \frac{1}{2}$ $\lim_{x \rightarrow +\infty} \frac{-b}{2a} = \frac{1}{2}$ حال باید $\sqrt{\text{ریشه آن اصل کنیم}}$ $R_f = \sqrt{[-1, +\infty)} = [0, +\infty)$ چون $a > 0$ $\rightarrow$ زیر x با y $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$ نقشه $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$ نقشه $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$	ب) $\frac{a < 0}{\text{برای هر}} \rightarrow \lim_{x \rightarrow -\infty} \frac{-b}{2a} = \frac{-1}{-2} = \frac{1}{2}$ $\lim_{x \rightarrow +\infty} \frac{-b}{2a} = \frac{-1}{-2} = \frac{1}{2}$ برای هر x $\rightarrow$ $\lim_{x \rightarrow -\infty} \frac{-b}{2a} = \frac{1}{2}$ $\lim_{x \rightarrow +\infty} \frac{-b}{2a} = \frac{1}{2}$ حال باید $\sqrt{\text{ریشه آن اصل کنیم}}$ $R_f = \sqrt{[-1, +\infty)} = [0, +\infty)$ چون $a < 0$ $\rightarrow$ زیر x با y $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$ نقشه $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$ نقشه $\rightarrow$ $y = \frac{1}{2}$ $\rightarrow$ $y = 3$
الف) $R_f = \mathbb{R}$ $\Rightarrow$ چند جمله‌ای درجه ۲ $\rightarrow$ $R_f = \mathbb{R}$ ب) $R_f = \mathbb{R}$ $\Rightarrow$ چند جمله‌ای درجه ۲ $\rightarrow$ $R_f = \mathbb{R}$	الف) $R_f = \mathbb{R}$ $\Rightarrow$ چند جمله‌ای درجه ۲ $\rightarrow$ $R_f = \mathbb{R}$ ب) $R_f = \mathbb{R}$ $\Rightarrow$ چند جمله‌ای درجه ۲ $\rightarrow$ $R_f = \mathbb{R}$
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