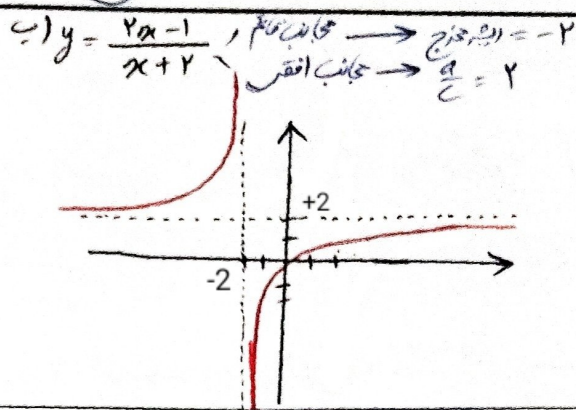
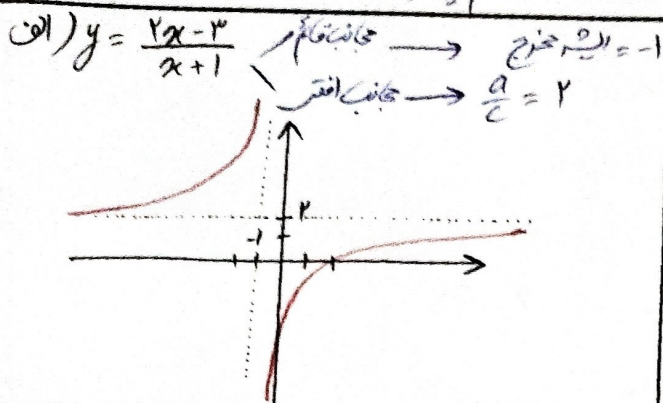


الف) $y = x^3 - 3x^2 + 3x$ $\xrightarrow{\text{فاکتورگیری}} x(x^2 - 3x + 3) = y$ $\xrightarrow{x \neq 0} x = \frac{y}{x^2 - 3x + 3}$ $\xrightarrow{\text{داده تغییرات}} x = \frac{y}{3 \pm \sqrt{9-12}}$ $\rightarrow \frac{y}{3}$ $\xrightarrow{\text{در } x=0} \frac{y}{3} \neq 0$ $\Rightarrow \mathbb{R} \setminus \{0\}$ ب) $y = \frac{1}{x^2 - 2x}$ $\xrightarrow{\text{ضرب در مخرج}} 1 = yx^2 - 2yx \rightarrow yx^2 - 2yx - 1 = 0 \rightarrow \begin{cases} x = \frac{-b \pm \sqrt{\Delta}}{2a} \\ x = \frac{2y \pm \sqrt{4y^2 + 4y}}{2y} \end{cases}$ $\xrightarrow{\text{در } y=0} \frac{1}{0}$ $\Rightarrow \begin{cases} 2y \neq 0 \rightarrow y \neq 0 \\ 4y^2 + 4y \geq 0 \rightarrow y(y+1) \geq 0 \end{cases}$ $\Rightarrow R_f = (-\infty, -1] \cup (0, +\infty)$				1
الف) $y = x^2 - 4x + 10$ $\text{ext} \begin{cases} -\frac{b}{2a} = 2 \\ -\frac{\Delta}{4a} = 9 \end{cases}$ $\Rightarrow R_f = [9, +\infty)$	ب) $-x^2 + 4x + 3$ $\text{ext} \begin{cases} -\frac{b}{2a} = -\frac{4}{-2} = 2 \\ -\frac{\Delta}{4a} = 12 \end{cases}$ $\Rightarrow R_f = (-\infty, 12]$	ج) $y = \sqrt{x^2 - 4x - 3}$ $\text{ext} \begin{cases} -\frac{b}{2a} = 2 \\ -\frac{\Delta}{4a} = -1 \end{cases}$ $\Rightarrow y = \sqrt{[-1, +\infty)}$ $\Rightarrow R_f = [0, +\infty)$	د) $y = \sqrt{4x - x^2}$ $\text{ext} \begin{cases} -\frac{b}{2a} = 2 \\ -\frac{\Delta}{4a} = 9 \end{cases}$ $\Rightarrow y = \sqrt{(-\infty, 4]}$ $\Rightarrow R_f = [0, 2]$	2
الف) $y = x^3 - 5x^2 + 2x + 1$ $\rightarrow$ چندجمله‌ای درجه فرد $\Rightarrow R_y = \mathbb{R}$ ب) $y = x^5 - 4x^4 + 3x^3 + 2$ $\rightarrow$ چندجمله‌ای درجه فرد $\Rightarrow R_y = \mathbb{R}$ ج) $y = \sqrt{x^5 - 4x^4 + 5x^3 + 1}$ $\rightarrow$ چندجمله‌ای درجه فرد $\Rightarrow y = \sqrt{\mathbb{R}}$ $\Rightarrow R_y = [0, +\infty)$ د) $y = (x^5 - 4x^4 + 3x^3 + 1)^2$ $\rightarrow$ چندجمله‌ای درجه زوج $\Rightarrow y = \mathbb{R}^+$ $\Rightarrow R_y = \mathbb{R}$				3
الف) $y = \frac{2x+1}{x-2}$ $\xrightarrow{\text{تابع صورتی/مخرجی}} \begin{cases} C \neq 0 \\ ad \neq bc \end{cases} \Rightarrow R_f = \mathbb{R} - \left\{ \frac{a}{c} \right\} \rightarrow \mathbb{R} - \{2\}$				4
ب) $y = \frac{2x+1}{x+1}$ $\xrightarrow{\text{تابع صورتی/مخرجی}} \begin{cases} C \neq 0 \\ ad \neq bc \end{cases} \Rightarrow R_f = \mathbb{R} - \left\{ \frac{a}{c} \right\} \rightarrow \mathbb{R} - \{2\}$				5

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الف) $y = \frac{5x+1}{5x} \xrightarrow{a+\frac{b}{c} \frac{p}{q}} \begin{cases} 5x \rightarrow \oplus \textcircled{1} \\ 5x \rightarrow \ominus \textcircled{2} \end{cases} \rightarrow R_f = (-\infty, -\frac{1}{5}] \cup [\frac{1}{5}, +\infty)$

ب) $y = \frac{x^4+1}{x^3} \xrightarrow{\text{مخرج}} x^3 + \frac{1}{x^3} \xrightarrow{a+\frac{b}{c} \frac{p}{q}} \begin{cases} \oplus \textcircled{1} \\ \ominus \textcircled{2} \end{cases} \rightarrow R_f = (-\infty, -\frac{1}{3}] \cup [\frac{1}{3}, +\infty)$

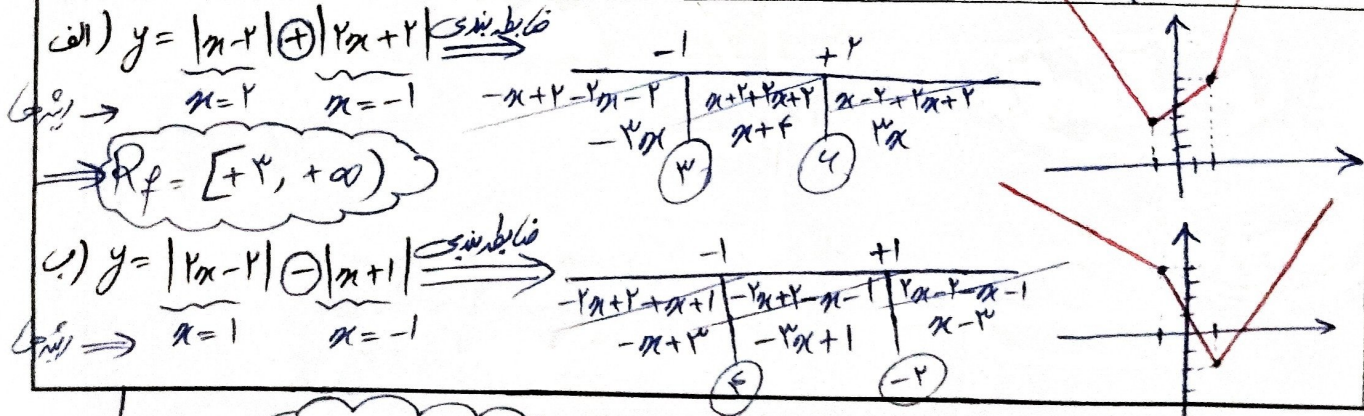
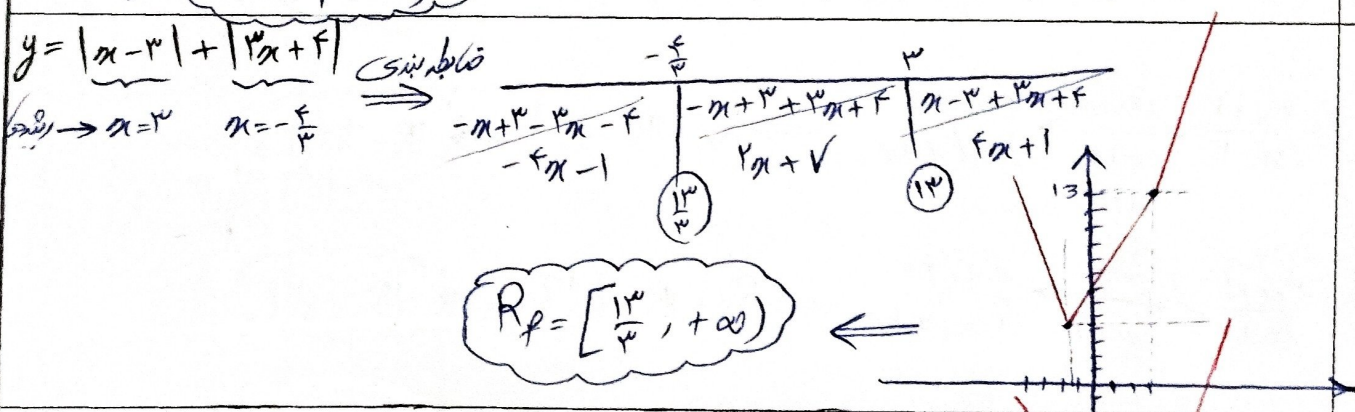
ج) $y = \frac{\sqrt[3]{x^3+1}}{\sqrt[3]{x}} \xrightarrow{\text{مخرج}} \sqrt[3]{x} + \frac{1}{\sqrt[3]{x}} \xrightarrow{a+\frac{b}{c} \frac{p}{q}} \begin{cases} \oplus \textcircled{1} \\ \ominus \textcircled{2} \end{cases} \rightarrow R_f = (-\infty, -\frac{1}{3}] \cup [\frac{1}{3}, +\infty)$

د) $y = \sqrt{x} + \frac{1}{\sqrt{x}} \xrightarrow{a+\frac{b}{c} \frac{p}{q}} \begin{cases} \oplus \textcircled{1} \\ \ominus \textcircled{2} \end{cases} \rightarrow R_f = [\frac{1}{2}, +\infty)$

الف) $y = x^2 + \frac{1}{x^2+3} \xrightarrow{y+3 = x^2+3 + \frac{1}{x^2+3}} \begin{cases} \oplus \textcircled{1} \\ \ominus \textcircled{2} \end{cases} \xrightarrow{\text{مخرج}} \frac{1}{x^2+3} \rightarrow R_f = [\frac{1}{3}, +\infty)$

ب) $y = \frac{x^2+5}{\sqrt{x^2+4}} \xrightarrow{\frac{x^2+4+1}{\sqrt{x^2+4}}} \frac{x^2+4}{\sqrt{x^2+4}} + \frac{1}{\sqrt{x^2+4}} = \sqrt{x^2+4} + \frac{1}{\sqrt{x^2+4}} \rightarrow R_f = [\frac{1}{2}, +\infty)$

$\frac{1}{2} \leftarrow x=0 \text{ مخرج}$



$R_f = [-1, +\infty)$