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الف) $y = n^3 - 3n^2 + 3n - 1 + 1 = (n-1)^3 + 1$

$\rightarrow y-1 = (n-1)^3 \rightarrow n = \sqrt[3]{y-1} + 1 \rightarrow R_f = \mathbb{R}$

ب) $y = \frac{1}{n^2 - 2n} \rightarrow y n^2 - 2y n - 1 = 0 \rightarrow n = \frac{2y \pm \sqrt{4y^2 + 4y}}{2y} \text{ ① } \rightarrow y \neq 0$

$\rightarrow 4y^2 + 4y \geq 0 \rightarrow y^2 + y \geq 0 \rightarrow y(y+1) \geq 0$

-1	0
+	-

① ② $\rightarrow R_y = (-\infty, -1] \cup (0, +\infty)$ + | - | + $\rightarrow$ ②

الف) $y = n^2 - 2n + 10$ $\min \left| \frac{-b}{2a} = \frac{2}{2} = 1 \right|$
 $\varepsilon = 1 + 10 = 11 \rightarrow R_y = [11, +\infty)$

ب) $y = -n^2 + 4n + 3$ $\max \left| \frac{-b}{2a} = \frac{-4}{-2} = 2 \right|$
 $-9 + 16 + 3 = 10 \rightarrow R_y = (-\infty, 10]$

ج) $y = \sqrt{n^2 - 2n - 3}$ $\min \left| \frac{\varepsilon}{r} = 2 \right|$
 $\varepsilon = 1 - 3 = -2 \rightarrow \sqrt{[2, +\infty)} = [2, +\infty)$

د) $y = \sqrt{4n - n^2}$ $\max \left| \frac{-4}{-2} = 2 \right|$
 $-9 + 16 = 7 \rightarrow \sqrt{[-7, 9]} \rightarrow R_y = [0, 3]$

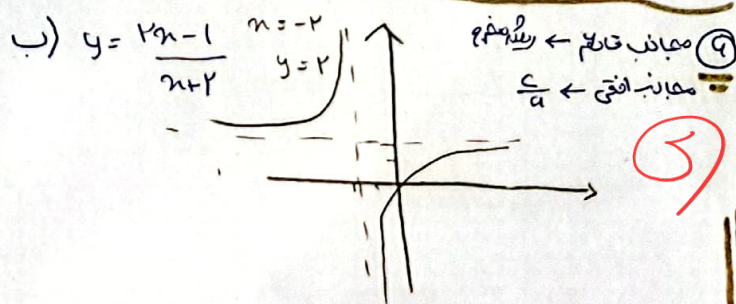
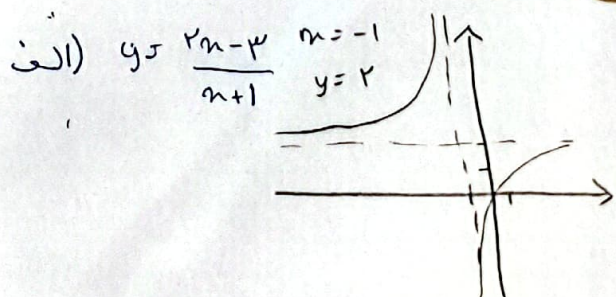
الف) $y = n^3 - 2n^2 + 2n + 1 \rightarrow R_y = \mathbb{R}$ د) $y = (n^2 - 2n^2 + 3n + 1)^2$ ⑤ ③

ب) $y = n^5 - 4n^2 + 3n + 2 \rightarrow R_y = \mathbb{R}$ $\hookrightarrow [(-\infty, +\infty)]^2 \rightarrow R_y = [0, +\infty)$

ج) $y = \sqrt{n^5 - 4n^2 + 2n + 1} \rightarrow \sqrt{(-\infty, +\infty)} = [0, +\infty)$

الف) $y = \frac{3n+1}{n^2} R_y = \mathbb{R} - \{3\}$ ب) $y = \frac{2n+1}{n+1} R_y = \mathbb{R} - \{2\}$ ⑤ ④

الف) $y = \sqrt{\frac{2n+1}{n+1}} \sqrt{\mathbb{R} - \{2\}} R_y = [0, +\infty) - \{\sqrt{2}\}$ ب) $y = \sqrt{\frac{3n+1}{n+2}} \sqrt{\mathbb{R} - \{3\}} \rightarrow R_y = [0, +\infty)$ ⑤ ⑤



④ معادله قائم ← شیب قائم
 معادله افقی ← شیب افقی

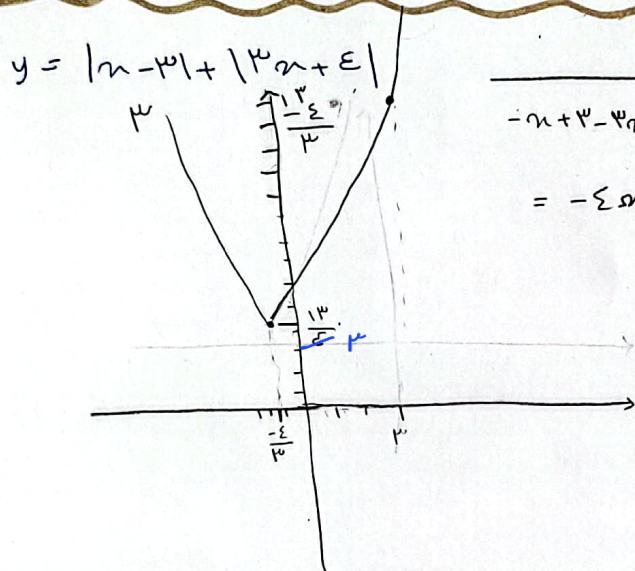
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الف) $y = \sin x + \frac{1}{x^2} \rightarrow (-\infty, -2] \cup [2, +\infty)$ $y = \frac{x^4 + 1}{x^2} = x^2 + \frac{1}{x^2} \rightarrow (-\infty, -2] \cup [2, +\infty)$ $\textcircled{U}$
 $1 \leq \sin x \leq 1$ $\leftarrow \textcircled{\sin x}$

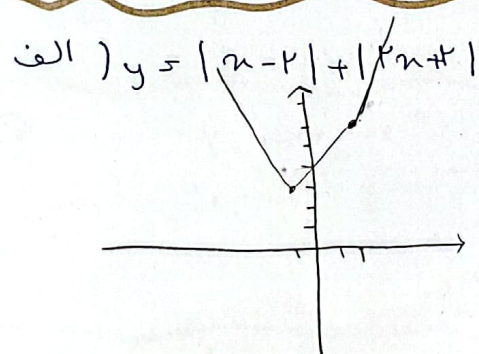
ج) $y = \frac{\sqrt[3]{x^3 + 1}}{\sqrt[3]{x^3}} \rightarrow (-\infty, -2] \cup [2, +\infty)$ $\sqrt{x+1} \rightarrow [2, +\infty)$
 $\mathbb{R} \leftarrow \sqrt[3]{x^3} \leftarrow \sqrt[3]{x^3}$

الف) $y = x^2 + \frac{1}{x^2} + 2 - 2 = x^2 + 2 + \frac{1}{x^2} - 2 \xrightarrow{x^2 + 2 \geq 2} R_y = [\frac{1}{2} - 2, +\infty)$ $\textcircled{A}$
 $x=0 \rightarrow \min = \frac{1}{2}$ $\leftarrow$ $\frac{1}{x^2} \rightarrow \frac{1}{2}$ $\rightarrow$ $[-\frac{1}{2}, +\infty)$ $\textcircled{5}$

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



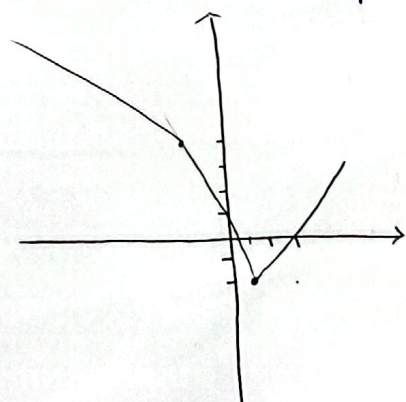
$-\frac{2}{3}$	3
$-x+3-3x-2$	$-x+3+3x+2$
$= -4x+1$	$= 2x+5$
$= -4x+1$	$= 4x+1$



-1	2
$-x+2-x-1$	$-x+2+x+1$
$= -2x+1$	$= x+3$
$= -2x+1$	$= 2x+3$

$R_y = [3, +\infty)$

ب) $y = |2x+1| - |x+1|$



-1	1
$-2x+1-x-1$	$-2x+1-x-1$
$= -3x-1$	$= -3x-1$
$= -3x-1$	$= x-1$

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