

الف) $g = x^3 - 2x^2 + 3x + 1 - 1$

$g = (x-1)^3 + 1$

$g-1 = (x-1)^3 \Rightarrow (g-1)^3 = x-1 \Rightarrow x = (g-1)^3 + 1 \Rightarrow R = R$

ب) $g = \frac{1}{x^2 - 2x}$ $\Rightarrow x^2 - 2x \neq 0 \rightarrow x(x-2) \neq 0 \rightarrow x \neq 0$
 $\rightarrow x \neq 2$

$g x^2 - 2g x = 1 \rightarrow g x^2 - 2g x - 1 = 0$ $\Delta = 4g^2 - 4 \times g \times (-1) = 4g^2 + 4g > 0$
 $1 \quad 0 \quad 4g(g+1) > 0$
 $\frac{1}{+} \quad \frac{0}{-} \quad \frac{4g(g+1)}{+}$

$R = (-\infty, -1] \cup (0, \infty)$
 $x \neq 0 \leftarrow$

الف) $g = x^2 - 4x + 10$

$x_5 = \frac{-b}{2a} = \frac{4}{2} = 2$
 $g_5 = \frac{-\Delta}{4a}$

$R = [4, +\infty)$

$\rightarrow g = x^2 + 2x + 2$

$\begin{vmatrix} 2 \\ 1 \end{vmatrix}$
 $R = (-\infty, +2]$

ج) $g = \sqrt{x^2 - 4x - 20}$

$\begin{vmatrix} 2 \\ -2 \end{vmatrix}$
 $\sqrt{[-2, +\infty)}$
 $R = [0, +\infty)$

د) $g = \sqrt{4x - x^2}$

$\begin{vmatrix} 2 \\ 0 \end{vmatrix}$ $\sqrt{(-\infty, 4]}$
 $R = [0, 2]$

الف) $g = x^3 - 6x^2 + 9x + 1$

$R = R$

$\rightarrow g = x^3 - 6x^2 + 9x + 2$

$R = R$

ج) $g = \sqrt{x^3 - 6x^2 + 9x + 1}$

$x^3 - 6x^2 + 9x + 1$

$R = R \Rightarrow \sqrt{R} = [0, +\infty)$
 $R = [0, +\infty)$

د) $g = (x^3 - 6x^2 + 9x + 1)^2$

$x^3 - 6x^2 + 9x + 1$

$R = R$
 $Rg = [0, +\infty)$

الف) $g = \frac{cx+1}{x-2}$

$\Rightarrow ad \neq cb, c \neq 0$

$-4 \neq 1, 1 \neq 0$

$R = R - \{2\}$

$\rightarrow g = \frac{2x+1}{x+1}$

$R = R - \{1\}$

$$\text{الف) } g = \frac{\sqrt{x+2}}{x+1}$$

$$g = \frac{\sqrt{x+2}}{x+1} \rightarrow yx + y = \sqrt{x+2}$$

$$\rightarrow yx - \sqrt{x+2} = -y \rightarrow x(y-1) = -y \rightarrow x = \frac{-y}{y-1}$$

$$\Rightarrow y = \sqrt{1R - \sqrt{y}} \Rightarrow 1R = [0, +\infty) - \{\sqrt{y}\}$$

$$\text{ب) } g = \frac{\sqrt{x+1}}{x-1}$$

$$g = \frac{\sqrt{x+1}}{x-1} \rightarrow x = \frac{-y+1}{-y-1}$$

$$R = \mathbb{R} - \{y\}$$

$$\sqrt{R - \sqrt{y}} = [0, +\infty) - \{\sqrt{y}\}$$

$$R = [0, +\infty) \quad \sqrt{y}$$

(3)

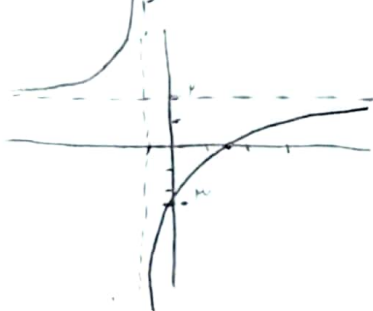
$$\text{الف) } g = \frac{x-1}{x+1}$$

$$x = -1 \rightarrow g = -1$$

$$x = 0 \rightarrow g = -1$$

$$y = 0 \rightarrow x = 1 \rightarrow x = 1$$

$$R = \mathbb{R} - \{1\}$$



$$\text{ب) } g = \frac{x-1}{x+1}$$

$$x = -1 \rightarrow g = -1$$

$$x = 0 \rightarrow g = -1$$

$$R = \mathbb{R} - \{1\}$$



(4)

$$\text{الف) } g = \sin x + \frac{1}{\sin x}$$

$$a + \frac{1}{a}$$

$$-1 \leq \sin x \leq 1$$

$$-1 + (-1) = -2$$

$$R = (-\infty, -2] \cup [2, +\infty)$$

$$\text{ب) } g = \frac{x^4+1}{x^2}$$

$$x^4 + \frac{1}{x^2}$$

$$R = (-\infty, -2] \cup [2, +\infty)$$

(5)

$$\text{ج) } g = \frac{\sqrt{x^2+1}}{\sqrt{x}}$$

$$\sqrt{x^2+1} + \frac{1}{\sqrt{x}}$$

$$R = (-\infty, -2] \cup [2, +\infty)$$

$$\text{د) } g = \sqrt{x} + \frac{1}{\sqrt{x}}$$

$$R = [2, +\infty)$$

$$\text{الف) } g = x^4 + \frac{1}{x^4}$$

$$x^4 + \frac{1}{x^4}$$

$$R = [1, +\infty)$$

$$\Rightarrow (x^4 + \frac{1}{x^4}) + \frac{1}{(x^4 + \frac{1}{x^4})} = 2$$

$$x_{min} = 0 \rightarrow 4 + \frac{1}{4} = 2 = \frac{1}{4}$$

$$\text{ب) } g = \frac{x^4+1}{\sqrt{x^2+1}}$$

$$x^4 + \frac{1}{x^2} + 1$$

$$\sqrt{x^2+1}$$

$$\Rightarrow x^4 + 1 + \frac{1}{\sqrt{x^2+1}}$$

$$x = 0 \rightarrow \sqrt{1} = 1$$

$$R = [2, +\infty)$$

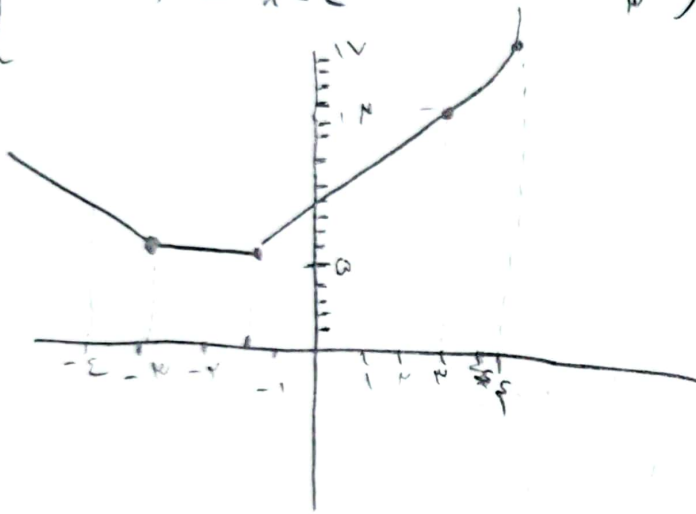
(6)

$$g = |x - \mu| + |x + \frac{\epsilon}{\mu}|$$

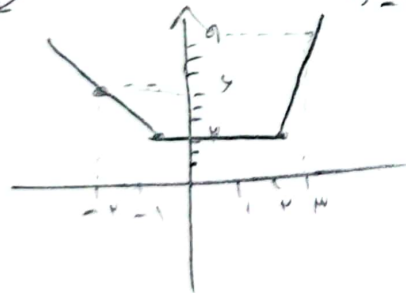
9

$$\left\{ \begin{array}{l} x - \mu + \mu + \epsilon \\ -x + \mu + \mu + \epsilon \\ -x + \mu - \mu - \epsilon \end{array} \right. \begin{array}{l} x > \mu \\ -\frac{\epsilon}{\mu} \leq x \leq \mu \\ x < -\frac{\epsilon}{\mu} \end{array} \rightarrow \left\{ \begin{array}{l} x + 1 \\ x + \mu \\ -x - \mu \end{array} \right. \begin{array}{l} x > \mu \\ -\frac{\epsilon}{\mu} \leq x \leq \mu \\ x < -\frac{\epsilon}{\mu} \end{array}$$

$$R = [\frac{1}{\mu}, +\infty)$$



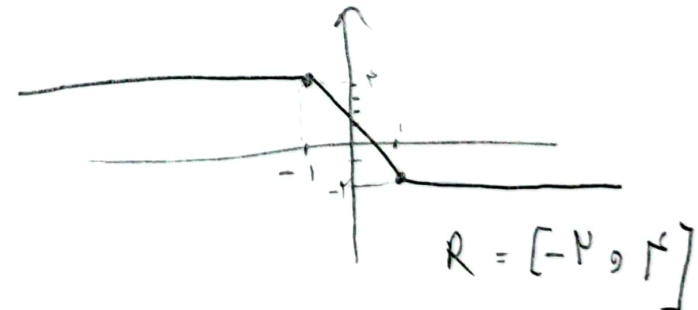
$$f(x) = |x - \mu| + |x + \frac{\epsilon}{\mu}|$$



$$R = [\mu, +\infty)$$

$$g(x) = |x - \mu| - |x + \frac{\epsilon}{\mu}|$$

10



$$R = [-\mu, \mu]$$