

$$\begin{aligned}
 f(x) + g(x) &= \sqrt{x+4}\sqrt{x-4} + \sqrt{x-4}\sqrt{x-4} \xrightarrow{\text{می توان}} x+4\sqrt{x-4} + x-4\sqrt{x-4} \\
 &+ 2\sqrt{x^2-14x+44} \xrightarrow{x \geq 11} (f(x) + g(x))^2 = 2x + 2x - 14 = 4x - 14 \\
 &\quad (x-1)^2 \Rightarrow f(x) + g(x) = 2\sqrt{x-4} \rightarrow \begin{matrix} a=0 \\ b=2 \\ c=-4 \end{matrix} \\
 \Rightarrow \frac{a+b}{c} &= \frac{2}{-4} = -\frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 f(2) &= \frac{2+2}{(2-1)(2-3)} = -4 & f(1) &= \frac{1+1}{(1-1)(1-3)} \text{ تن } \nearrow & f(3) &= \frac{3+2}{(3-1)(3-3)} \text{ تن } \nearrow \\
 f(0) &= \frac{0+2}{(0-1)(0-3)} = \frac{2}{3}
 \end{aligned}$$

$$\frac{g}{f} = \left\{ \left(2, -\frac{1}{4} \right), \left(0, \frac{2}{3} \right) \right\}$$

$$\text{الف) } f(2x) = \left\{ \left(\frac{1}{2}, 2 \right), \left(\frac{3}{2}, -1 \right), (2, 2), \left(-\frac{1}{2}, 4 \right) \right\} \quad (3)$$

$$\text{ب) } f(x^2) = \left\{ (1, 2), (-1, 2), (\sqrt{3}, -1), (-\sqrt{3}, -1), (2, 2), (-2, 2) \right\}$$

$$\text{ج) } 2g^2(x) + 1 = \left\{ (-2, 9), (1, 3), (3, 9), (-1, 1) \right\}$$

$$\text{د) } \frac{2f}{g} = \left\{ (1, -4), (3, -1) \right\} \rightarrow \left(-1, \frac{12}{9} \right) \rightarrow \text{تعریف نشده است}$$

$$h = 2f + g = \left\{ \underbrace{(2, 0)}_{2 \times 1 + 3}, \underbrace{(3, 0)}_{2 \times 1 + 3}, \underbrace{(-2, 4)}_{2 \times 0 + 4} \right\} \quad (4)$$

$$\begin{aligned}
 \frac{f}{g+1}(x) &= \frac{\sqrt{3x-x}}{(x-2)([x]+[-x]+1)} \xrightarrow{3x \geq 0 \rightarrow x \geq 0} \sqrt{3x-x} \geq 0 \rightarrow 3x \geq x^2 \rightarrow x^2 - 3x \leq 0 \\
 &\quad \Rightarrow x = [0, 3] \\
 &\quad \left. \begin{matrix} \text{if } x \notin \mathbb{Z} \Rightarrow [x] + [-x] = -1 \\ \text{if } x \in \mathbb{Z} \Rightarrow [x] + [-x] = 0 \end{matrix} \right\} x \in \mathbb{Z} \\
 &\quad x \neq 2
 \end{aligned}$$

$$D_f = \{x \mid x \in \mathbb{Z}, x \in [0, 3], x \neq 2\} \rightarrow D_f = \{0, 1, 3\}$$

$$\left. \begin{aligned} \frac{f(1)}{g(1)} &= \frac{\sqrt{5-1-1}}{3} = 0 & \frac{f(2)}{g(2)} &= \frac{\sqrt{10-4-4}}{2} = \frac{\sqrt{2}}{2} \\ \frac{f(4)}{g(4)} &= \frac{\sqrt{20-16-4}}{4} = 0 & \frac{f(5)}{g(5)} &= \frac{\sqrt{25-25-4}}{1} = -2 \end{aligned} \right\} h(x) = \left\{ (1,0), (2, \frac{\sqrt{2}}{2}), (4,0), (5,-2) \right\}$$

الف) $x^3 - 3x^2 + 3x = y \rightarrow (x-1)^3 + 1 = y \rightarrow x = \sqrt[3]{y-1} + 1$ (✓)

ب) $y = \frac{1}{x^2 - 2x} \rightarrow yx^2 - 2yx - 1 = 0$ $\Rightarrow R_f = \mathbb{R}$
 $\Rightarrow 4y^2 + 4y \geq 0 \rightarrow 4y(y+1) \geq 0 \rightarrow R_f = \mathbb{R} - (-1, 0]$
← تابع امکان صف شدن ندارد .

الف) $y = x^2 - 4x + 10$ (✓)
 $\left. \begin{aligned} \frac{-b}{2a} &= \frac{4}{2} = 2 \\ y^2 - 4(2) + 10 &= 4 \end{aligned} \right\} \Rightarrow R_f = [4, +\infty)$

ب) $y = -x^2 + 4x + 3$ $R_f = (-\infty, 12]$
 $\left. \begin{aligned} \frac{-b}{2a} &= \frac{-4}{-2} = 2 \\ -(2)^2 + 4(2) + 3 &= 12 \end{aligned} \right\}$

ج) $y = \sqrt{x^2 - 4x - 3} = \sqrt{(x-2)^2 - 7} \rightarrow R_f = [0, +\infty)$
 $\min = (2-2)^2 - 7 = -7 \rightarrow [-7, +\infty)$

د) $y = \sqrt{-x^2 + 4x}$ $R_f = [0, 3]$
 $\left. \begin{aligned} \frac{-b}{2a} &= \frac{-4}{-2} = 2 \\ -(2)^2 + 4(2) &= 4 \rightarrow (-\infty, 4] \end{aligned} \right\}$

الف) $y = x^3 - 5x^2 + 2x + 1 \rightarrow R_f = \mathbb{R}$ (9)

ب) $y = x^3 - 4x^2 + 3x + 2 \rightarrow R_f = \mathbb{R}$

ج) $y = \sqrt{x^3 - 4x^2 + 5x + 1} \rightarrow R_f = \sqrt{\mathbb{R}} = [0, +\infty)$

د) $y = (x^3 - 4x^2 + 3x + 1)^2 \rightarrow R_f = (\mathbb{R})^2 = [0, +\infty)$

الف) $y = \frac{3x+1}{x-2} \rightarrow R_f = \mathbb{R} - \{3\}$ (10)

ب) $y = \frac{2x+1}{x+1} \rightarrow R_f = \mathbb{R} - \{2\}$