

$$\left. \begin{aligned} f(x) &= \sqrt{x+2} \sqrt{x-2} = \sqrt{(\sqrt{x-2}+2)^2} \\ g(x) &= \sqrt{x-2} \sqrt{x+2} = \sqrt{(\sqrt{x+2}-2)^2} \end{aligned} \right\} x \geq 1 \rightarrow f(x) + g(x) = \sqrt{x-2} + 2 + \sqrt{x-2} - 2 = 2\sqrt{x-2}$$

$$f(x) + g(x) = a + b\sqrt{x+c} \quad \frac{a+b}{c} = \frac{2}{-2} = \left(-\frac{1}{2}\right)$$

$\downarrow$ $\downarrow$ $\downarrow$
 a b c

$$\frac{g}{f} = \left\{ \left(2, -\frac{1}{2}\right), \left(1, \frac{9}{2}\right), \left(3, \frac{5}{2}\right), \left(0, \frac{11}{2}\right) \right\}$$

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

$$f(x) = \left\{ (1, 2), (3, -1), (5, 2), (-1, 2) \right\} \quad g(x) = \left\{ (-2, 3), (1, -1), (3, 2), (-1, 0) \right\}$$

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

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

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

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

$$f(x) = \left\{ (2, 1), (3, 1), (5, 9), (-2, 0) \right\} \quad g(x) = \left\{ (2, 1), (2, 3), (-2, 2), (-1, 2), (3, 3) \right\}$$

$$h = 2f + g \rightarrow h = \left\{ (2, 5), (-2, 2), (3, 5) \right\}$$

$$f(x) = \frac{\sqrt{3x} - x}{x-2} \rightarrow D_f = 3x > 0 \rightarrow x > 0 \text{ و } \sqrt{3x} - x > 0$$

$$g(x) = [x] + [-x] \begin{cases} x \in \mathbb{Z} \rightarrow g(x) + 1 = 1 \\ x \notin \mathbb{Z} \rightarrow g(x) + 1 = 0 \end{cases}$$

$D_f = [0, 3] - \{2\}$ $\rightarrow 3x - x^2 > 0 \rightarrow 0 < x < 3$

$\left(\frac{f}{g+1}\right)(x) \rightarrow D = \{0, 1, 3\}$

$$f(x) = \sqrt{5x - x^2 - 4} \rightarrow 5x - x^2 - 4 \geq 0 \rightarrow -(x^2 + 4 - 5x) \geq 0$$

$$g(x) = \{(1, 2), (2, 2), (3, 4), (4, 1)\}$$

$$h(x) = \frac{f(x)}{g(x)} = \{(1, 0), (2, \frac{\sqrt{1}}{2}), (3, 0)\}$$

$$Dg = \{1, 2, 3, 4\}$$

$$Df = [1, 4]$$

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

$$x = 1 + \sqrt[3]{y-1}$$

$$R_f = \mathbb{R}$$

$$ب) y = \frac{1}{x^3 - 3x}$$

$$y(x^3 - 3x) = 1$$

$$x^3y - 3xy = 1$$

$$x^3y - 3xy - 1 = 0$$

$$y \neq 0 \rightarrow x = \frac{3y \pm \sqrt{9y^2 + 4y}}{2y}$$

$$y \neq 0 \rightarrow 0 \neq 1 \rightarrow y \neq 0$$

$$Df = (-\infty, -1] \cup (0, +\infty)$$

$$الف) y = x^3 - 3x + 1 \rightarrow x_{\min} = \frac{3}{2} = 1.5 \rightarrow y_{\min} = 1^3 - 1 + 1 = 1 \rightarrow R_f = [1, +\infty)$$

$$ب) y = x^3 + 4x + 3 \rightarrow x_{\max} = -\frac{4}{3} = -1.33 \rightarrow y_{\max} = -9 + 11 + 3 = 12 \rightarrow R_f = (-\infty, 12]$$

$$ج) y = \sqrt{x^3 - 3x - 3} \rightarrow x_{\min} = \frac{3}{2} = 1.5 \rightarrow y_{\min} = 1^3 - 1 - 3 = -3 \rightarrow R_f = [-3, +\infty)$$

$$د) y = \sqrt{4x - x^2} \rightarrow x_{\max} = \frac{4}{2} = 2 \rightarrow y_{\max} = 12 - 9 = 9 \rightarrow R_f = [0, 3]$$

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

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

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

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

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

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