

الف) $y = x^2 - x + 10$

$x_{\min} = \frac{+1}{2} = \frac{1}{2} \quad y_{\min} = \left(\frac{1}{2}\right)^2 - \frac{1}{2} + 10 = 9 \rightarrow R = [9, +\infty)$

ب) $y = -x^2 + 4x + 3$

$x_{\max} = \frac{-4}{-2} = 2 \quad y_{\max} = -(2)^2 + 4(2) + 3 = 11 \rightarrow R = (-\infty, 11]$

ج) $y = \sqrt{x^2 - x}$

$x_{\min} = \frac{+1}{2} = \frac{1}{2} \quad y_{\min} = 0 \quad R = \sqrt{[-\frac{1}{4}, +\infty)} = [0, +\infty)$

د) $y = \sqrt{4x - x^2}$

$x_{\max} = \frac{-4}{-2} = 2 \quad y_{\max} = 2 \quad R = \sqrt{[0, 4]} = [0, 2]$

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

ب) $y = x^3 - 4x^2 + 3x + 1 \rightarrow R_f = \mathbb{R}$

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

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

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

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

$$f(x) + g(x) = \frac{\sqrt{x+4}\sqrt{x-4}}{\sqrt{(\sqrt{x-4}+2)^2}} + \frac{\sqrt{x-4}\sqrt{x-4}}{\sqrt{(\sqrt{x-4}-2)^2}} \xrightarrow{x \geq 4} \frac{\sqrt{x-4} + \sqrt{x-4}}{\sqrt{x-4} + 2} = \frac{2\sqrt{x-4}}{\sqrt{x-4} + 2}$$

$$\rightarrow a=0 \quad b=2 \quad c=-4 \quad \frac{a+b}{c} = \frac{0+2}{-4} = -\frac{1}{2}$$

$$f(x) = \frac{x+2}{(x-1)(x-3)} \rightarrow D_f = \mathbb{R} - \{1, 3\}$$

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

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

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

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

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

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$$h = xf + g = \left\{ (2, 0), (-2, 4), (2, 0) \right\}$$

$$g(x) \xrightarrow{x \in \mathbb{Z}} 0$$

$$x \in \mathbb{Z} \rightarrow -1$$

$$f(x) = \frac{\sqrt{x^2 - x}}{x-2} \xrightarrow{x \geq 2} \frac{0}{0} \rightarrow \frac{0}{0} = \frac{0}{0} = \frac{0}{0}$$

$$\left(\frac{f}{g+1} \right)(x) \xrightarrow{x \in \mathbb{Z}} \frac{0}{0} \rightarrow g \neq -1 \rightarrow x \notin \mathbb{Z}$$

$$\rightarrow D\left(\frac{f}{g+1}\right) = \{x \mid x \in \mathbb{Z}, x \geq 2, x \neq 0\}$$

$$f(x) = \sqrt{ax^2 + bx + c} = \sqrt{-(x-1)(x-4)} \rightarrow \frac{1}{-4+4-}$$

$$h(x) = \left\{ (1, 0), \left(2, \frac{\sqrt{3}}{2} \right), (4, 0) \right\}$$

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

$$\rightarrow R_f = \mathbb{R}$$

$$y = \frac{1}{x^2 - 2x} \rightarrow yx^2 - 2yx = 1 \rightarrow yx^2 - 2yx - 1 = 0 \rightarrow \frac{1}{y} - 2x + \frac{1}{y} = 0 \rightarrow \frac{1}{y} - 2x + \frac{1}{y} = 0$$

$$y(y+1) \geq 0 \rightarrow \frac{-1}{-1} \rightarrow R = [-1, 0] \cup [0, +\infty)$$