

$$x f(x) \geq 0$$

$$x \times y \geq 0$$

$$\begin{cases} + + \rightarrow + \\ 0 + \rightarrow 0 \\ - \rightarrow + \end{cases}$$

	-5	0	2	5	
$f(x)$	+	0	-	0	+
x	-	-	0	+	+
نتیجه	-	+	-	+	

$$\rightarrow [-5, 0] \cup [2, 5]$$

۱

$$y = \sqrt{\frac{-x}{f(x)}} \quad f(x) \neq 0 \quad \frac{-x}{f(x)} \geq 0 \Rightarrow f(x) \leq 0 \rightarrow f(x) < 0$$

f(x)	-	0	+	0	-	+	0
-x	+	+	0	-	-	-	-
نتیجه	-	+	+	-	-	-	-

$$\rightarrow (-3, 0) \cup (0, 2) \rightarrow (-2, -1) \cup (1, 2)$$

۲

$$f(x) - 2f(2) = x^2 - 2x + 4 \rightarrow f(2) - 2f(2) = 4 - 8 + 4 \rightarrow -f(2) = +2$$

$$\Rightarrow f(2) = -4 \quad \text{جای کناری} \quad f(x) - 4 = x^2 - 2x + 4$$

$$f(-2) - 4 = (-2)^2 - (2 \times -2) + 4 = 4 + 4 + 4 = (2 \times 4) = 10 \rightarrow f(-2)$$

۳

$$f(f(5)) + f(f(1))$$

$$f(x) = \begin{cases} x - \sqrt{x+4} & x > 2 \\ 2x+3 & x \leq 2 \end{cases}$$

$$\begin{cases} f(5) = 5 - \sqrt{5+4} = 2 \rightarrow f(2) = (2 \times 2) + 3 = 7 \\ f(1) = (2 \times 1) + 3 = 5 \rightarrow f(5) = 5 - \sqrt{5+4} = 2 \end{cases} \quad \begin{cases} 2+7=9 \end{cases}$$

۴

$$f(0) = 0a - 0b + 2 \Rightarrow f(0) = 2$$

$$f(x-1) - f(x) = 4x+2 \rightarrow f(0) - f(1) = (4 \times 1) + 2 = 6 \Rightarrow -f(1) = 4$$

$$f(1) = -6$$

۵

$$f(1) = a \times 1 - b \times 1 + 2 = -6 \Rightarrow a - b + 2 = -6 \Rightarrow a - b = -8$$

$$\frac{2f(2) + f(-1)}{f^2(2)} = \frac{(2 \times 1) + 5}{(-1)^2} = \frac{2+5}{1} = \boxed{\frac{7}{1}} = 7$$

6

$$f(2) = (2)^2 + (-2 \times 3) + 1 = 1 \quad f(2) = (2)^2 + (-\frac{4}{2 \times 2}) + 1 = -1$$

$$f(-1) = (-1)^2 + (-2 \times -1) + 1 = 5$$

$$\frac{2f(2) - 2f(-2)}{f(2)} \rightarrow \frac{(2 \times 1) - (2 \times 4)}{7} = \frac{2 - 8}{7} = \frac{-6}{7}$$

7

$$f(4) = (4 \times 3) + 1 = 13$$

$$f(-2) = (-2)^2 = 4$$

$$f(2) = (2 \times 2) + 1 = 5$$

$$\frac{f(f(4)) - f(f(2))}{f(1) - 2} \rightarrow \frac{9 - 4}{4 - 2} = \frac{5}{2} = 2.5$$

$$f(f(4)) \rightarrow f(4) = 13 \rightarrow f(1) = \boxed{4}$$

$$f(f(2)) \rightarrow f(2) = 5 \rightarrow f(2) = \boxed{9}$$

$$f(1) = \boxed{4}$$

8

$$f(x) = \frac{x^2 + 4x + 9}{x^2 + 4x + 5} = f(f(\sqrt{x-2}))$$

$$\frac{(\sqrt{x-2})^2 + (4 \times (\sqrt{x-2})) + 9}{(\sqrt{x-2})^2 + (4 \times (\sqrt{x-2})) + 5} = \frac{3 + 4 - 4\sqrt{x-2} + 4\sqrt{x-2} - 4 + 9}{3 + 4 - 4\sqrt{x-2} + 4\sqrt{x-2} - 4 + 5} = \frac{1}{1} = 1$$

$$f(2) = \frac{2^2 + (4 \times 2) + 9}{2^2 + (4 \times 2) + 5} = \frac{4 + 8 + 9}{4 + 8 + 5} = \frac{21}{17} = f(f(\sqrt{x-2}))$$

9

$$f(\sqrt{x}) = (\sqrt{x})^2 + \frac{1}{(\sqrt{x})^2} = x + \frac{1}{x} \rightarrow \left(x + \frac{1}{x}\right)^2 = x^2 + \frac{1}{x^2} + 2$$

$$f(x) = x^2 + \frac{1}{x^2} \quad \left(x^2 + \frac{1}{x^2} + 2\right) - \left(x^2 + \frac{1}{x^2}\right) = \boxed{2}$$

10