

$$12a - 10 \leq a^2 - 4$$

$$\rightarrow a^2 - 12a + 14 \geq 0 \rightarrow \text{صفتی پیدا} \rightarrow a = 2 \rightarrow (a-2)(a^2 + 2a - 1) \quad a \in [-4, +\infty) \quad ۲$$

$$\rightarrow (a-2)(a+2) \geq 0 \quad \begin{array}{c} -2 \quad 2 \\ - \quad + \quad + \end{array}$$

$$f(x) = 3x + k \rightarrow 3f^{-1}(x) + k = x \rightarrow f^{-1}(x) = \frac{x-k}{3}$$

$$\xrightarrow{x=2} 2-k = 12 \rightarrow k = -10 \rightarrow f(x) = 3x - 10 \rightarrow \boxed{f(4) = 11} \quad \checkmark$$

$$\rightarrow f^{-1}(x) = \frac{x+10}{3} \rightarrow f \circ f^{-1}(x) = 3\left(\frac{x+10}{3}\right) - 10 = x \quad \checkmark$$

$$\boxed{f(x) = 3x - 10} \quad \checkmark \quad ۲$$

$$(2, a) \in f^{-1}(x) \rightarrow (a, 2a) \in f(x)$$

$$\rightarrow \frac{a^2}{a-1} = 2a \rightarrow a^2 = 2a^2 - 2a \rightarrow a^2 - 2a = 0 \rightarrow a(a-2) = 0 \rightarrow a = 0 \text{ or } a = 2$$

$$\boxed{a = 2} \quad \checkmark \quad ۲$$

$$f^{-1}: \{(5, 2), (7, 4), (2, 5), (4, 9)\} \quad g^{-1}: \{(2, 3), (3, 1), (6, 9)\}$$

الف) $\{(0, 0), (7, 7), (2, 2), (4, 9)\} \quad \checkmark$ ب) $\{(3, 3), (4, 4), (7, 7), (9, 9)\} \quad \checkmark$

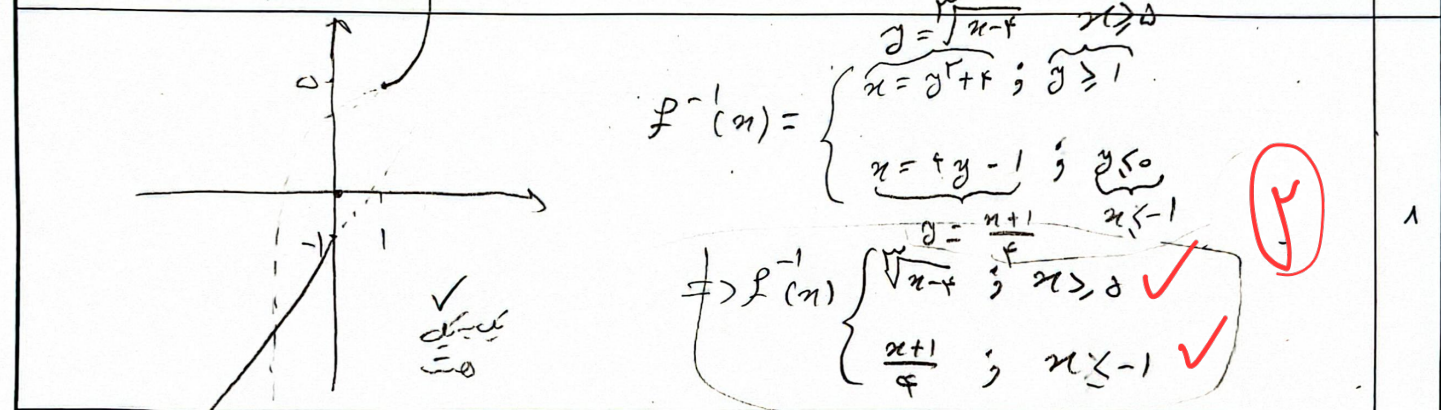
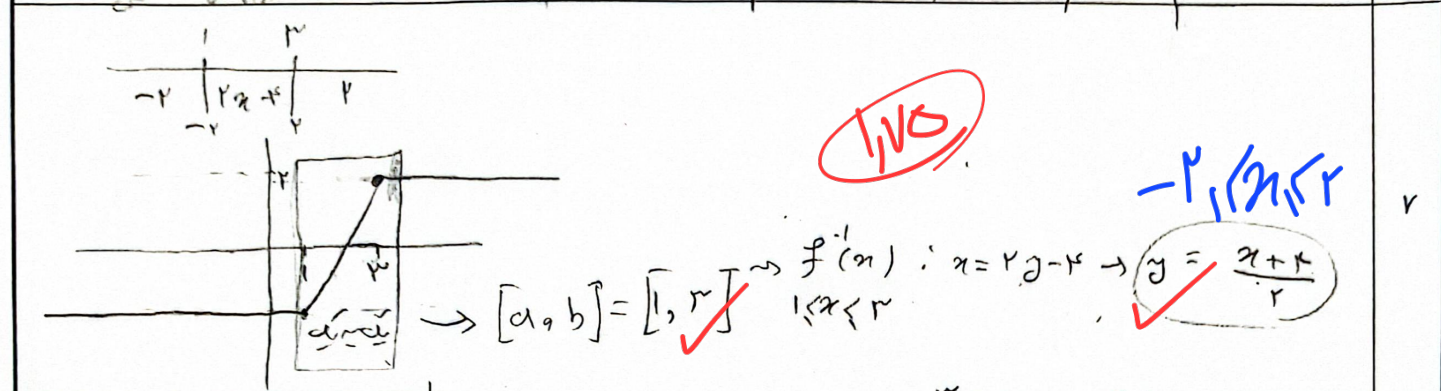
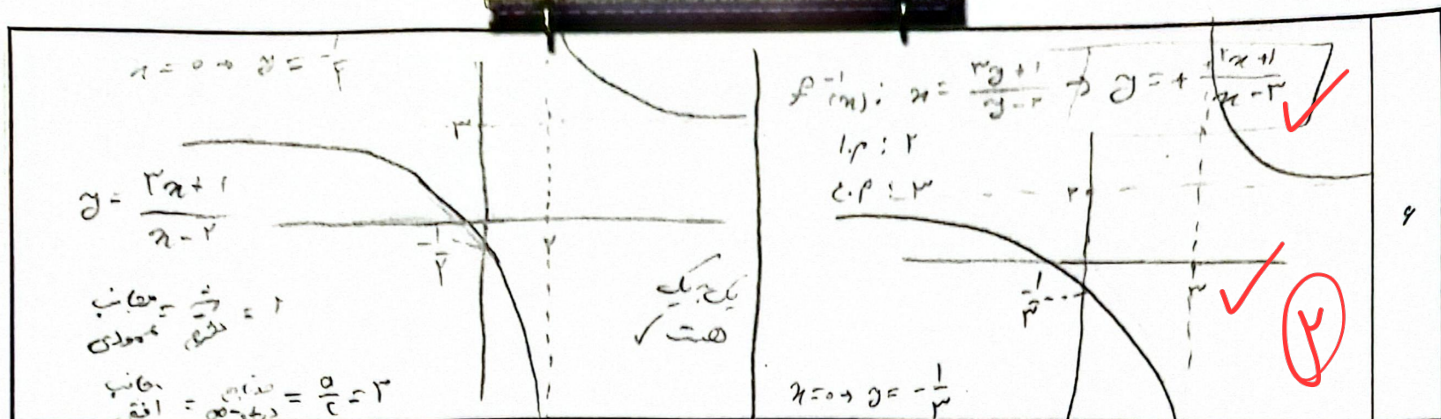
ج) $\{(2, 0), (0, 9)\} \quad \checkmark$ د) $\{(3, 9), (7, 3), (9, 1)\} \quad \checkmark$

$$\boxed{۲}$$

$$\frac{h}{f \circ g^{-1}} \rightarrow h: \{(1, 2), (3, 4), (4, 1), (5, 1)\}$$

$$g^{-1} = \{(1, 2), (3, 4), (5, 9)\} \rightarrow f \circ g^{-1}: \{(1, 4), (3, 1), (5, 0)\}$$

$$\rightarrow \frac{h}{f \circ g^{-1}} = \{(1, \frac{2}{4}), (3, \frac{4}{1}), (5, \frac{1}{0})\} \quad \checkmark \quad \boxed{۲}$$



$f^{-1}(n): x = y^r - \frac{(y+1)^r}{y+r} = \frac{-ry-1}{y+r} \rightarrow f^{-1}(n): y = -\frac{rx+1}{x+r} = \frac{-9x-2}{2x+9}$

$f^{-1}(h) = \frac{-9(-2)-2}{2(-2)+9} = \frac{10}{1} = 0$ ✓

$f^{-1}(n): x = \frac{y}{y^2+1} \rightarrow xy^2 - y + x = 0 \Rightarrow y = \frac{1 \pm \sqrt{1-4x^2}}{2x}$ ✓

$y = \frac{1 + \sqrt{1-4x^2}}{2x}$ ✓

$y = \frac{1 - \sqrt{1-4x^2}}{2x}$ ✓

نیازی به قسمة نیست