

$$a^3 - 4 \geq 12a - 2 \Rightarrow a^3 - 12a + 14 > 0 \Rightarrow \frac{a^3}{12} - \frac{1}{3} + \frac{7}{6} > 0$$

$$- \frac{1}{3} + \frac{7}{6} \Rightarrow \boxed{a > -\frac{1}{3}}$$

$$n_{x-1} = y + 1, n_x = y_{x-1} \Rightarrow n_x = 4 \Rightarrow y_x = 1 \Rightarrow f(1) = 1 = 12 + 1 < 0 \Rightarrow 1 < -1$$

$$f(1) = 3(1) - 1 = 2$$

$$f(f(1)) = 9(2) + 1 = 19 = 9(2) - 1$$

~~$$f(x) = \frac{a^x}{a-1} \Rightarrow f(a) = \frac{a^a}{a-1} = 2a$$~~

$$n_{x-1} = y + 1, n_x = y_{x-1} \Rightarrow f(a) = \frac{a^a}{a-1} = 2a$$

$$\Rightarrow 2a^a - 2a = a^a \Rightarrow a^a - 2a = 0 \Rightarrow \boxed{a = 0}$$

~~$$f^{-1} \circ f = \text{id}$$~~

$$f^{-1} \circ f = \{(0,0), (1,1), (2,2), (3,3)\}$$

$$f \circ g^{-1} = \{(3,9), (7,49), (9,81)\}$$

$$g^{-1} \circ f = \{(1,1), (2,4)\}$$

~~$$h = \{a, b, c, d\}$$~~

$$\Rightarrow \frac{h}{f \circ g^{-1}} = \{a, b, c, d\}$$

$$D \times g^{-1} = \{(a, c), (b, d)\}$$

$$D_h = \{(a, c), (b, d)\}$$

$$D \times g^{-1} \cap D_h = \{(a, c), (b, d)\}$$

$$\Rightarrow x = \frac{xy+1}{y-1} \Rightarrow y = \frac{xy+1}{x-1}$$

$$\Rightarrow b = \frac{x+1}{x-1}$$

$$f(x) = \begin{cases} x & x > 1 \\ x-1 & 1 \leq x \leq 1 \\ -1 & \end{cases} \Rightarrow y = x-1 \Rightarrow x = y+1$$

$$\Rightarrow y = \frac{x+1}{x}$$

$$\Rightarrow 1+y_1=y_2 \Rightarrow x_1=x_2$$

$$f^{-1}(x) = \begin{cases} \sqrt{x-1} & x \geq 1 \\ \frac{x+1}{x} & x \leq 1 \end{cases}$$

$$x^2 - \frac{(x+1)^2}{x+1} = \frac{x^2 + x^2 - x^2 - 2x - 1}{x+1} = \frac{-x-1}{x+1}$$

$$\Rightarrow x = \frac{-x-1}{y+1} \Rightarrow y = \frac{-x-1}{x-1} \Rightarrow b = -1$$

$$f^{-1}(-1) = \frac{4-1}{-2} = -1$$

$$y(x^2+1) = x \Rightarrow yx^2 - x + y = 0$$

$$\Rightarrow x = \frac{1 \pm \sqrt{1-4y^2}}{2y} \Rightarrow y = \frac{1 \pm \sqrt{1-4x^2}}{2x}$$