

$$f\left(\frac{2}{3}\right) = 0.5 \times \frac{2}{3} = 0.5 \times \frac{2}{3} = \frac{1}{3}$$

$$f \circ f\left(\frac{2}{3}\right), f\left(f\left(\frac{2}{3}\right)\right), f\left(\frac{1}{3}\right), \sqrt{3+1}, \dots \checkmark$$

$$\text{الف) } g\left(\frac{2}{3}\right) = 2 \cdot \sin\left(\frac{2}{3}\right) = 2 \cdot \left(\frac{1}{2}\right)^2 = 2 \times \frac{1}{4} = \frac{1}{2}$$

$$\Rightarrow \log\left(\frac{2}{3}\right), f\left(g\left(\frac{2}{3}\right)\right), f\left(\frac{1}{2}\right) = \sqrt{\frac{3}{4}}, \frac{\sqrt{3}}{2} \checkmark$$

$$\text{ب) } g(\sqrt{2}) = \frac{\sqrt{2}}{1-\sqrt{2}} \rightarrow \log(\sqrt{2}), f(g(\sqrt{2})), f\left(\frac{\sqrt{2}}{1-\sqrt{2}}\right)$$

$$\frac{\sqrt{2}}{1-\sqrt{2}} = \frac{\sqrt{2}(1+\sqrt{2})}{1-\sqrt{2}(1+\sqrt{2})} = -2-\sqrt{2} \sim f(-2-\sqrt{2}), [-2-\sqrt{2}], [-3, \dots] = -4 \checkmark$$

$$f\left(\frac{\pi}{2}\right) = \sin \frac{\pi}{2} = \frac{\sqrt{2}}{2}$$

$$g \circ f\left(\frac{\pi}{2}\right), g\left(f\left(\frac{\pi}{2}\right)\right), g\left(\frac{\sqrt{2}}{2}\right), \frac{\sqrt{2}}{2} \times \sqrt{1-\left(\frac{\sqrt{2}}{2}\right)^2} = \frac{\sqrt{2}}{2} \times \sqrt{\frac{1}{2}}$$

$$= \frac{\sqrt{2}}{2} \times \frac{1}{\sqrt{2}} = \frac{1}{2} \checkmark$$

$$\text{الف) } \log(a), \{(4,5), (2,5), (9,12), (8,12)\} \checkmark$$

$$\text{ب) } g \circ f(a) \Rightarrow D_{g \circ f} = \{a \in D_f \mid f(a) \in D_g\} \Rightarrow D_{g \circ f} = \emptyset \Rightarrow g \circ f(a) = \emptyset \checkmark$$

$$\text{ج) } f \circ f(a) \Rightarrow D_{f \circ f} = \{a \in D_f \mid f(a) \in D_f\} \Rightarrow D_{f \circ f} = \emptyset \Rightarrow f \circ f(a) = \emptyset \checkmark$$

$$\text{د) } g \circ f(a) = \{(4,8), (2,4), (9,10)\} \checkmark$$

$$\log(4), f(g(4)) = 2 \xrightarrow{f(3)=2} g(2) = 3 \Rightarrow (a,3) = (4,3) \Rightarrow a = 4 \checkmark$$

$$g \circ f(4) = g(f(4)) = 1 \xrightarrow{f(5)=1} g(5) = 1 \Rightarrow (b,1), (5,1) \Rightarrow b = 5 \checkmark$$

$$\Rightarrow (a,b) = (4,5) \checkmark$$

$$f(a), a \mapsto b \Rightarrow f(f(a)): f(a \mapsto b) = a(a \mapsto b) + b = a^2 a + a b + b$$

$$\Rightarrow a^2 a + a b + b = f a + 3 \Rightarrow a^2 = f, b(a+1) = 3 \Rightarrow \begin{cases} a=f \Rightarrow b=1 \Rightarrow f(a) = f_{a+1} \\ a=-f \Rightarrow b=-3 \Rightarrow f(a) = -f_{a+1} \end{cases}$$

$$g(a) = b a + d \Rightarrow g(f a + 3), g(f a + 3) + d = f a + f c + d = f a - f$$

$$\Rightarrow f c = 3 \Rightarrow c = \frac{3}{f} \quad f c + d = -f \xrightarrow{c = \frac{3}{f}} f(\frac{3}{f}) + d = -f \Rightarrow d = -\frac{13}{f} \Rightarrow g(a) = \frac{3}{f} a - \frac{13}{f}$$

$$f_{(-1)} \left\langle \begin{matrix} f(a), f_{a+1} \rightarrow f_{(-1)}, -1 \\ f(a), -f_{a+1} \rightarrow f_{(-1)}, -1 \end{matrix} \right. \Rightarrow g(f_{(-1)}) = g(-1) = \frac{3}{f}(-1) - \frac{13}{f} = -\frac{16}{f} = -\frac{16}{f} \checkmark$$

$$g \circ f: \{a \in D_f \mid f(a) \in D_g\}$$

$$\Rightarrow D_f: a + |a| \geq 0 \Rightarrow a \geq -|a| \checkmark \Rightarrow a \in \mathbb{R}$$

$$D_g: a^2 - f a \neq 0 \Rightarrow a(a - f) \neq 0 \Rightarrow a \neq 0, f$$

$$\Rightarrow f(a) \neq 0, f \Rightarrow \sqrt{a + |a|} \neq 0, f \Rightarrow a + |a| \neq 0, 1 \checkmark$$

$$\Rightarrow a > 0, a \neq 1 \Rightarrow D_{g \circ f}: (0, +\infty) - \{1\} \checkmark$$

$$(f+g) \circ h = f \circ h + g \circ h \Rightarrow D_{f+g}: \{a \in D_f \mid f(a) \in D_g\}$$

$$\Rightarrow D_h: 1 \geq a^2 \Rightarrow [-1, 1], f(a) \in D_g \Rightarrow 1 \geq (\sqrt{1-a^2})^2 \Rightarrow 1 \geq 1-a^2 \Rightarrow a^2 \geq 0$$

$$\Rightarrow 0 \leq a^2 \leq 1 \Rightarrow -1 \leq a \leq 1 \xrightarrow{\text{ناتك}} D_{f+g}: [-1, 1]$$

$$D_{g \circ h}: \{a \in D_g \mid h(a) \in D_g\} \Rightarrow D_h: [-1, 1], h(a) \in D_g \Rightarrow \sqrt{1-a^2} \geq 0 \text{ بيقول انت}$$

$$\Rightarrow D_{g \circ h}: [-1, 1] \xrightarrow{\text{ناتك}} D_{f+g} \cap D_{g \circ h} = D_{(f+g) \circ h} = [-1, 1] \checkmark$$

$$a), f(\frac{f a + 1}{a - f}) = f a + \omega \rightarrow \frac{f a + 1}{a - f} = z \Rightarrow z(a - f) = f a + 1$$

$$\Rightarrow f(z), f(\frac{f z + 1}{z - f}) + \omega \Rightarrow f(a), \frac{1 a + f}{a - f} + \omega \checkmark$$

$$b), f(a + \frac{1}{a}): a^2 + \frac{1}{a^2} \rightarrow a + \frac{1}{a} = z \Rightarrow z^2 = a^2 + \frac{1}{a^2} + 2 \Rightarrow a^2 + \frac{1}{a^2} = z^2 - 2$$

$$= a^2 + \frac{1}{a^2} + 2 \Rightarrow a^2 + \frac{1}{a^2} = z^2 - 2 \Rightarrow f(z), z^2 - 2 \Rightarrow f(a), a^2 - f a \checkmark$$

$$g \circ f(a) = 0 \Rightarrow g(f(a)) = 0$$

$$\Rightarrow f(a) \left\langle \begin{matrix} 1 \Rightarrow a \sqrt{a} = 1 \Rightarrow a = 1 \\ \sqrt{2} \Rightarrow a \sqrt{a} = \sqrt{2} \Rightarrow a = 2 \end{matrix} \right.$$

$$\Rightarrow a_1, a_2 = 1, 2 \text{ سنج } \checkmark$$