

الف) $\frac{(u-1)^2 - u^2}{u(u-1)} \geq 0 \rightarrow \frac{u^2 - 2u + 1 - u^2}{u(u-1)} \geq 0 \rightarrow \frac{1-2u}{u(u-1)} \geq 0$ ①

$+ \frac{0}{+} - \frac{1}{+} + \frac{1}{-}$ $D = (-\infty, \frac{1}{2}) \cup [\frac{1}{2}, 1)$

ب) $u \neq -1, u \neq 0, u \neq 1, u \neq -2, \frac{u}{u-1} + \frac{1}{u+2} \neq 0$

$\rightarrow \frac{u(u+2) + u - 1}{(u-1)(u+2)} \neq 0 \rightarrow \frac{u^2 + 3u - 1}{(u-1)(u+2)} \neq 0 \rightarrow u \neq \frac{-3 \pm \sqrt{17}}{2}$

$\rightarrow D = \mathbb{R} - \left\{ -1, 0, 1, -2, \frac{-3 \pm \sqrt{17}}{2} \right\}$

الف) $\left(\left(\frac{1}{3} \right)^u - 9 \right) (3^u - 9) \geq 0 \rightarrow (3^{-u} - 3^2) (3^u - 3^2) \geq 0$ ②

$\rightarrow \frac{-2}{+} \frac{2}{-} \frac{5}{+} \rightarrow D = (-\infty, -2] \cup [2, 5, +\infty)$

ب) $u-1 \geq 0 \rightarrow u \geq 1$ $\sqrt{u-1} - 3 = -\sqrt{u+1}$ ③

$\rightarrow \sqrt{u-1} - 3 \leq 0 \rightarrow \sqrt{u-1} \leq 3 \rightarrow u-1 \leq 9 \rightarrow u \leq 10 \rightarrow D = [1, 10]$

$u^2 - u - 2 \geq 0 \rightarrow (u-2)(u+1) \geq 0 \rightarrow \frac{-1}{+} \frac{2}{-} \frac{2}{+} \rightarrow (-\infty, -1] \cup [2, +\infty)$ ④

$u^2 - 1 \geq 0 \rightarrow u \geq 1 \rightarrow u \geq 1$ $\frac{0}{+} \frac{1}{-} \frac{1}{+} \rightarrow D = (-\infty, -1] \cup [1, +\infty)$

$u = -2 \rightarrow 3 - 2u - 5 = 0 \rightarrow u = -1$ ⑤

$\rightarrow -u^2 - \frac{1}{4}u + 3 \geq 0 \rightarrow -(u+2)(u-\frac{3}{4}) \geq 0 \rightarrow \frac{-2}{-} \frac{3}{+} \frac{3}{-}$

$D = [-2, \frac{3}{4}] \rightarrow b = \frac{3}{4}$ $a+b = -\frac{1}{4} + \frac{3}{4} = 1$

$$f(u) = u, 0 \rightarrow f(u), u$$

(3)

$$u > 1 \rightarrow \sqrt{u} - \sqrt{u}, u \rightarrow u, 1 \quad \text{disproves } \checkmark$$

$$u < 1 \rightarrow \sqrt{u} + \sqrt{u}, u \rightarrow u, -\sqrt{u} \rightarrow -\sqrt{u}, u < 1$$

$$\rightarrow D_g = [-\sqrt{u}, +\infty)$$

(3)

$$\sin \frac{\pi}{\sqrt{x}} + C.S. \sqrt{x} = \frac{\sqrt{x} + \sqrt{x}}{\sqrt{x}} \rightarrow f\left(\frac{\sqrt{x} + \sqrt{x}}{\sqrt{x}}\right) = \sqrt{x}(\sqrt{x} + \sqrt{x}) - \frac{\pi}{\sqrt{x}}(\frac{\sqrt{x} + \sqrt{x}}{\sqrt{x}})$$

$$= \frac{\sqrt{x}}{\sqrt{x}} + \sqrt{x}\sqrt{x} - \sqrt{x}\sqrt{x} - \pi = \frac{-1}{\sqrt{x}}$$

(4)

$$f(f(a))' = \frac{\frac{a+1}{a-1} + 1}{\frac{a+1}{a-1} - 1} = \frac{\frac{2a}{a-1}}{\frac{2}{a-1}} = a$$

$$a = \{1, 2, 3\}$$

(5)

$$f(u) = -\pi \rightarrow u^2 - \pi u = -\pi \rightarrow u^2 - \pi u + \pi = 0 \rightarrow u = \pi$$

$$(u - \pi)^2 = 0$$

(6)

$$g(a) = \pi \rightarrow \sqrt{a^2 - 1} = \pi \rightarrow a^2 - 1 = \pi^2 \rightarrow a = \pm \sqrt{\pi^2 + 1}$$

(7)

$$f(u + \pi) = (u - \pi)(u - \pi)$$

(8)

$$u + \pi = \pi \rightarrow u = 0 \rightarrow f(\pi) = (-1) \times (-\pi) = \pi$$

$$u + \pi = -\pi \rightarrow u = -2\pi \rightarrow f(-\pi) = (-1) \times (-\pi) = \pi$$

$$\rightarrow f(\pi) \times (-\pi) = \pi \times \pi = \pi^2$$

(9)

$$\pi C.S. u + \pi C.S. u = \frac{\pi}{\sqrt{x}} = 0$$

(10)

$$C.S. u + \pi C.S. u - \pi = 0$$

$$(C.S. u + \pi)(C.S. u - \pi) = 0$$

$$(C.S. u + \pi)(C.S. u - \frac{1}{\sqrt{x}}) = 0$$

$$\rightarrow C.S. u = \frac{\pi}{\sqrt{x}} \times \frac{1}{\sqrt{x}}, \cos u = \frac{1}{\sqrt{x}} \checkmark$$

$$u = \pm \frac{\pi}{\sqrt{x}} \rightarrow \tan u = \pi$$

(11)