

Cambridge International AS & A Level

Mathematics

9709

Paper 1 Pure Mathematics 1

Topic 2-Functions

Question No (22)

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Functions f and g are defined by

$$f: x \rightarrow 3x + 2, \text{ for } x \in \mathbb{R},$$

$$g: x \rightarrow 4x - 12, \text{ for } x \in \mathbb{R}.$$

Solve the equation $f^{-1}(x) = gf(x)$.

Solution

$$f: x \rightarrow 3x + 2, \quad x \in \mathbb{R}$$

$$\Rightarrow f(x) = 3x + 2$$

and

$$g: x \rightarrow 4x - 12, \quad x \in \mathbb{R}$$

$$g(x) = 4x - 12$$

$$\text{As } f(x) = 3x + 2$$

$$y = 3x + 2$$

$$\because f(x) = y$$

$$y - 2 = 3x$$

$$3x = y - 2$$

$$x = \frac{y - 2}{3}$$

(making x as subject)

$$f^{-1}(y) = \frac{y - 2}{3}$$

$$= x = f^{-1}(y)$$

replacing y by x

$$f^{-1}(x) = \frac{x - 2}{3}$$

By given condition

$$f^{-1}(x) = g(f(x))$$

$$\frac{x - 2}{3} = g(3x + 2)$$

$$\because f(x) = 3x + 2$$

$$\frac{x - 2}{3} = 4(3x + 2) - 12$$

$$\frac{x-2}{3} = 12x + 8 - 12$$

$$\frac{x-2}{3} = 12x - 4$$

$$x-2 = 3(12x-4)$$

$$x-2 = 36x-12$$

$$-2+12 = 36x-x$$

$$10 = 35x$$

$$x = \frac{10}{35}$$

$$x = \frac{2}{7}$$