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JC MATHEMATICS (H2) STUDY TIPS

**A QUICK EXAMPLE TO SHOW
HOW TO HANDLE "REPETITIVE
SELF-COMPOSITE FUNCTION"**

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JC_H2Maths_032



Quick Practice

The function g is defined by

$$g: x \mapsto \frac{1}{1-x}, \quad x \in \mathbb{R}, x \neq 0, x \neq 1.$$

Find $g^2(x)$ and $g^3(x)$.

Hence, determine the value of $g^{2018}(2)$.

$$\begin{aligned} g^2(x) &= gg(x) = g\left(\frac{1}{1-x}\right) \\ &= \frac{1}{1 - \frac{1}{1-x}} = \frac{1-x}{1-x-1} = -\frac{1-x}{x} = \frac{x-1}{x}, \quad x \in \mathbb{R}, x \neq 0, x \neq 1. \end{aligned}$$

$$g^3(x) = gg^2(x) = g\left(\frac{x-1}{x}\right) = \frac{1}{1 - \frac{x-1}{x}} = \frac{x}{x-x+1} = x, \quad x \in \mathbb{R}, x \neq 0, x \neq 1.$$

$$\begin{aligned} g^{2018}(2) &= g^3 g^{2015}(2) \\ &= g^{2015}(2) \\ &= g^3 g^{2012}(2) \\ &= g^{2012}(2) \\ &= \dots \\ &= g^3 g^2(2) \\ &= g^2(2) \\ &= \frac{2-1}{2} = \frac{1}{2} \end{aligned}$$

$$\begin{array}{r} 672 \\ 3 \overline{) 2018} \\ \underline{18} \\ 21 \\ \underline{21} \\ 8 \\ \underline{6} \\ 2 \end{array}$$

$$\therefore 2018 = 3(672) + 2$$

$\frac{1}{1-x}$	$\frac{x-1}{x}$	x
g	g^2	g^3
g^4	g^5	g^6
g^7	g^8	g^9
$\vdots$	$\vdots$	$\vdots$
g^{2017}	g^{2018}	g^{2019}



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Explanation

To find the final value, the problem demonstrates that compounding the function with itself multiple times reveals a repeating cycle.

By calculating the second and third versions of the function sequentially, it becomes clear that applying the operation three times returns the input back to its original state.

Because this behaviour repeats in a consistent three-step loop, any high repetition number can be simplified by dividing it by three and looking at the remainder.

Since the requested number of repetitions leaves a remainder of two, the entire calculation simplifies down to just applying the operation twice, leading straight to the final answer.

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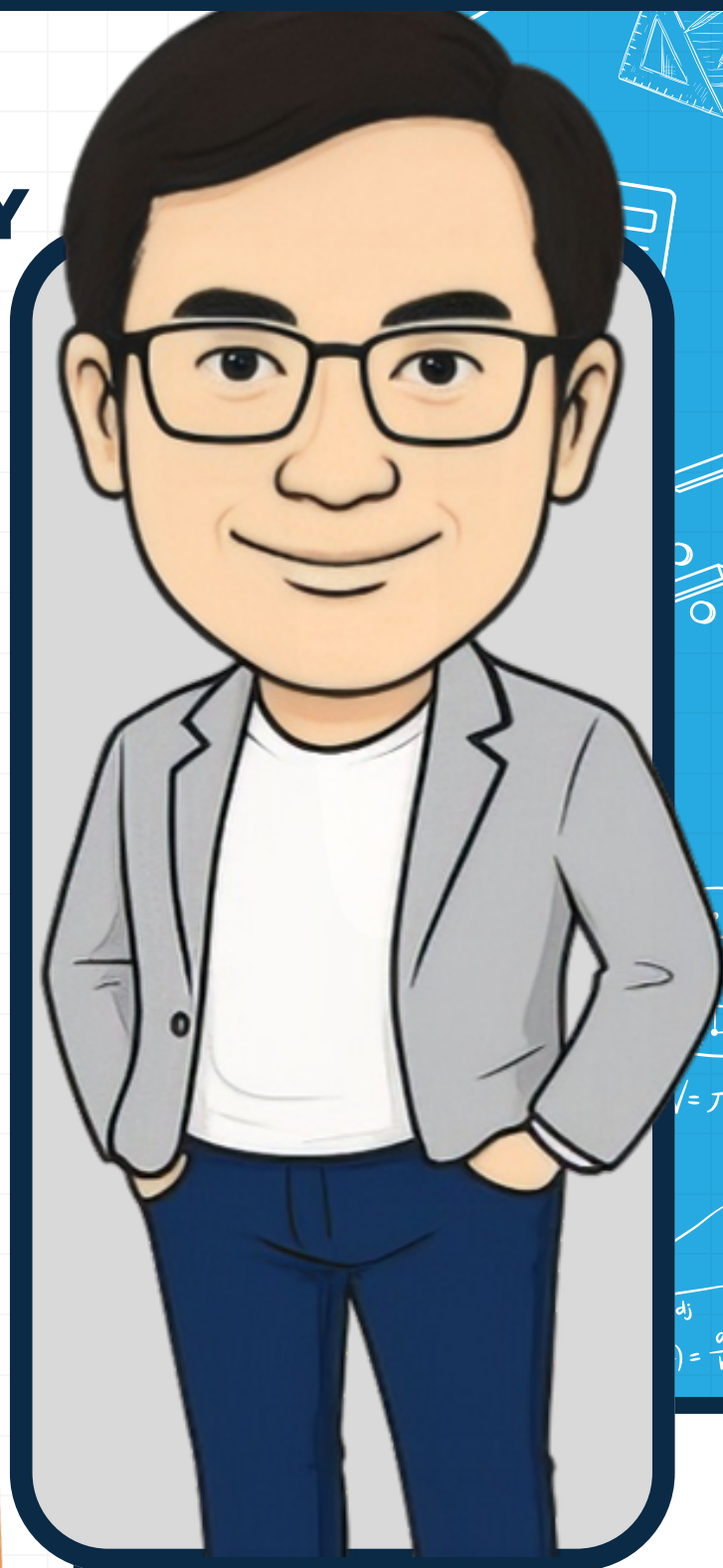
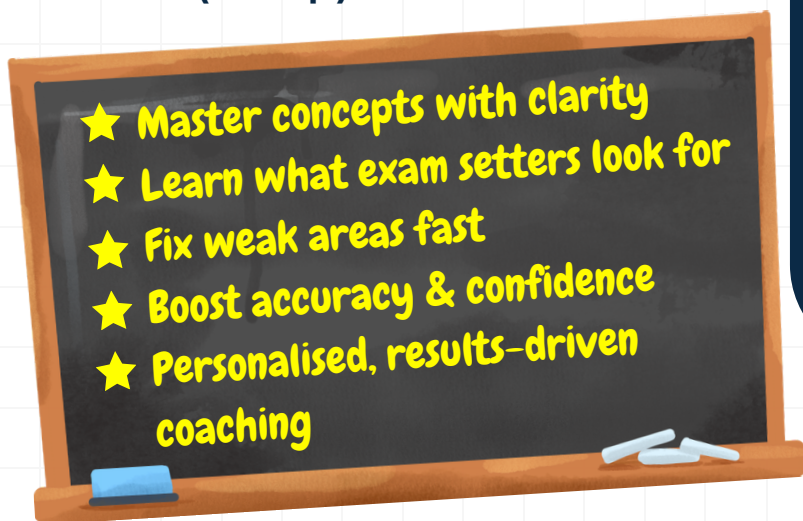
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