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JC MATHEMATICS (H2) STUDY TIPS

**A STRATEGIC GUIDE ON
SIMPLIFYING SUCCESSIVE
DIFFERENTIATION IN
MACLAURIN SERIES**

PREPARED BY
Mr Jackie Lee



www.h2maths.com

JC_H2Maths_013



3. Useful Techniques in Obtaining Maclaurin's Expansion

• Replacing by y

Good to know

Back to Section 2 Step 1, after every differentiation, try to replace certain term(s) by y (if possible) to enable subsequent differentiation(s) faster and easier. This could also enhance the chance of getting the correct answer.

Example 2

It is given that $y = \frac{1}{1 + \sin 2x}$. Show that, when $x = 0$, $\frac{d^2y}{dx^2} = 8$.

Find the first three terms in Maclaurin's series for y .

$$\textcircled{1} \quad \frac{dy}{dx} = -\frac{2\cos 2x}{(1 + \sin 2x)^2} = -2y^2 \cos 2x$$

$$\frac{1}{f(x)} \xrightarrow{d} -\frac{f'(x)}{(f(x))^2}$$

$$\frac{d^2y}{dx^2} = -2y^2(-2\sin 2x) + \cos 2x(-4y \frac{dy}{dx}) = 4y^2 \sin 2x - 4y \cos 2x \frac{dy}{dx}$$

$$\textcircled{2} \quad x = 0 \Rightarrow y = 1$$

$$\frac{dy}{dx} = -2(1)^2(1) = -2$$

$$\frac{d^2y}{dx^2} = 4(1)^2(0) - 4(1)(1)(-2) = 8 \quad (\text{shown})$$

$$\textcircled{3} \quad \therefore y = 1 - 2x + \frac{8}{2!}x^2 + \dots$$

$$= 1 - 2x + 4x^2 + \dots$$



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Explanation

Successfully navigating advanced mathematical expansions requires strategic shortcuts. Replacing complex algebraic parts with the variable after differentiation helps simplify your workload and streamline the entire process.

This powerful shortcut ensures that subsequent calculations stay perfectly clean and highly manageable. It converts bulky, expanding terms into a single, compact placeholder before you attempt any further steps. By keeping the algebraic expressions lightweight, you completely avoid repetitive, multi-layered rules that usually cause messy mistakes.

This general approach makes the overall workings significantly easier to settle while drastically cutting down on tracking errors.

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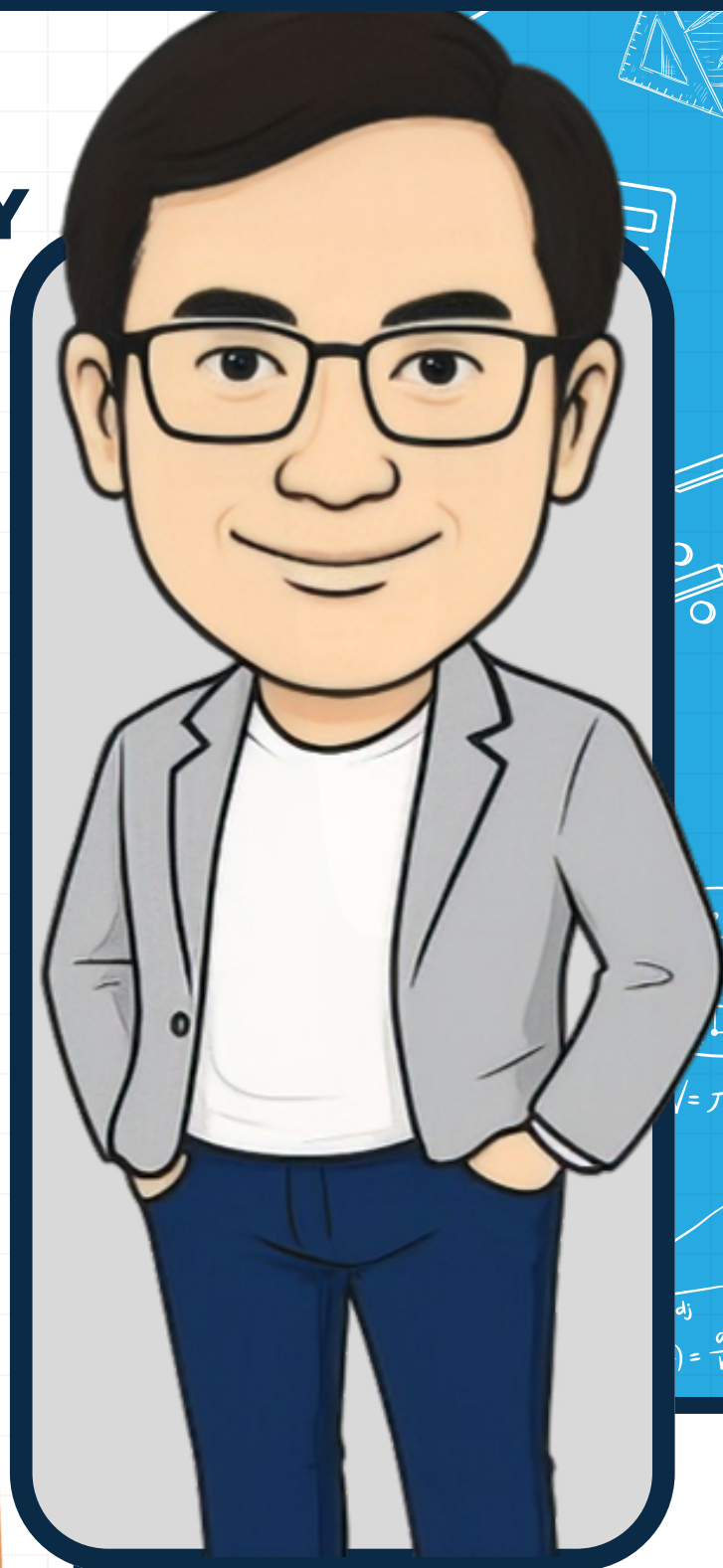
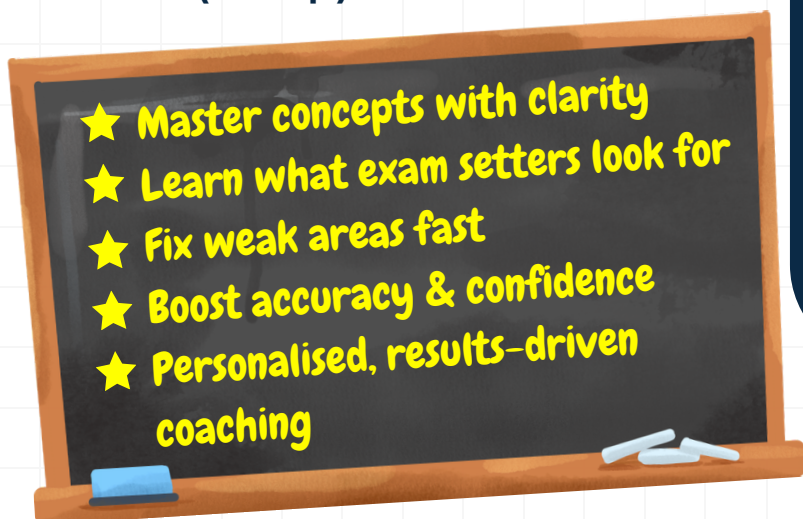
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- ✓ PGDE Qualification (NIE) with **Distinction in Mathematics**
- ✓ Former **School Maths Teacher** in
 - Nan Hua High School
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