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JC MATHEMATICS (H2) STUDY TIPS

PATTERN SHORTCUT RULES FOR NEGATIVE BINOMIAL EXPANSIONS

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JC_H2Maths_014



• Use of Binomial Expansions (Shortcut Results)

$$(1+x)^{-1} = 1 - x + x^2 - x^3 + \dots \qquad (1-x)^{-1} = 1 + x + x^2 + x^3 + \dots$$

$$(1+x)^{-2} = 1 - 2x + 3x^2 - 4x^3 + \dots \qquad (1-x)^{-2} = 1 + 2x + 3x^2 + 4x^3 + \dots$$

Given that x is sufficiently small for x^3 and higher powers of x to be neglected, obtain the series expansion for the following expressions:

Example 12

$$\begin{aligned} \tan\left(\frac{\pi}{3} - x\right) &= \frac{\tan\frac{\pi}{3} - \tan x}{1 + \tan\frac{\pi}{3} \tan x} \\ &\approx \frac{\sqrt{3} - x}{1 + \sqrt{3}x} \\ &= (\sqrt{3} - x)(1 + \sqrt{3}x)^{-1} \\ &= (\sqrt{3} - x)(1 - \sqrt{3}x + 3x^2 - \dots) \\ &= \sqrt{3} + (-3 - 1)x + (3\sqrt{3} + \sqrt{3})x^2 + \dots \\ &\approx \sqrt{3} - 4x + 4\sqrt{3}x^2 \end{aligned}$$

Quick Practice

$$\begin{aligned} \frac{1 - 2 \sin x}{5 - 3 \cos x} &\approx (1 - 2x) \left[5 - 3 \left(1 - \frac{1}{2}x^2 \right) \right]^{-1} \\ &= (1 - 2x) \left(2 + \frac{3}{2}x^2 \right)^{-1} \\ &= \frac{1}{2} (1 - 2x) \left(1 + \frac{3}{4}x^2 \right)^{-1} \\ &= \frac{1}{2} (1 - 2x) \left[1 - \frac{3}{4}x^2 + \left(\frac{3}{4}x^2 \right)^2 - \dots \right] \\ &\approx \frac{1}{2} \left(1 - 2x - \frac{3}{4}x^2 \right) \end{aligned}$$



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Explanation

These formulas provide a quick visual guide to expanding negative binomial expressions. When the outside power is negative one and the inside is plus, the terms alternate minus then plus, with the minus sign specifically attached to the odd power terms. If the inside is minus instead, every single term becomes plus.

Finally, when the outside power becomes negative two, you follow these exact same sign rules, but the coefficients steadily rise in sequence as one, two, three, and four.

Applying these structural patterns allows you to simplify complex fraction problems instantly.

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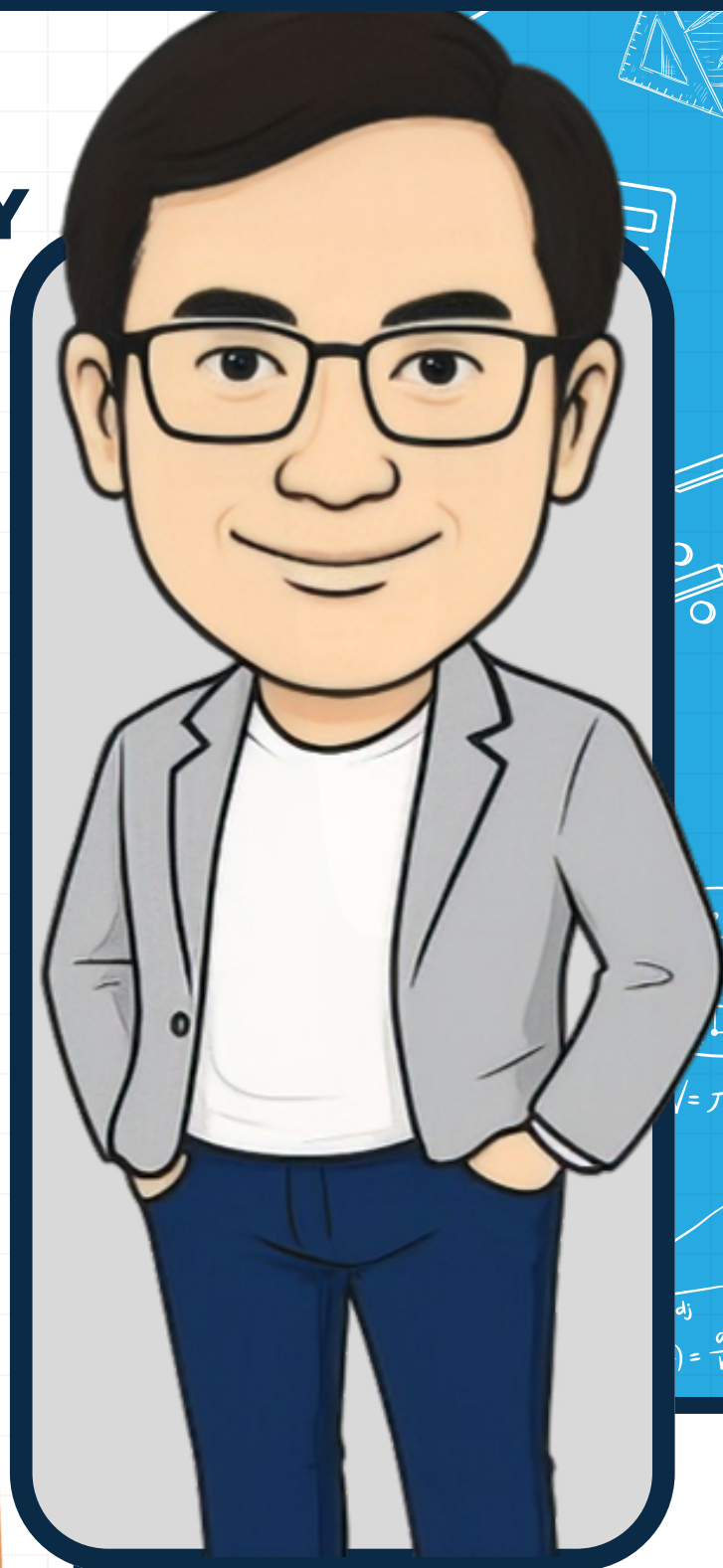
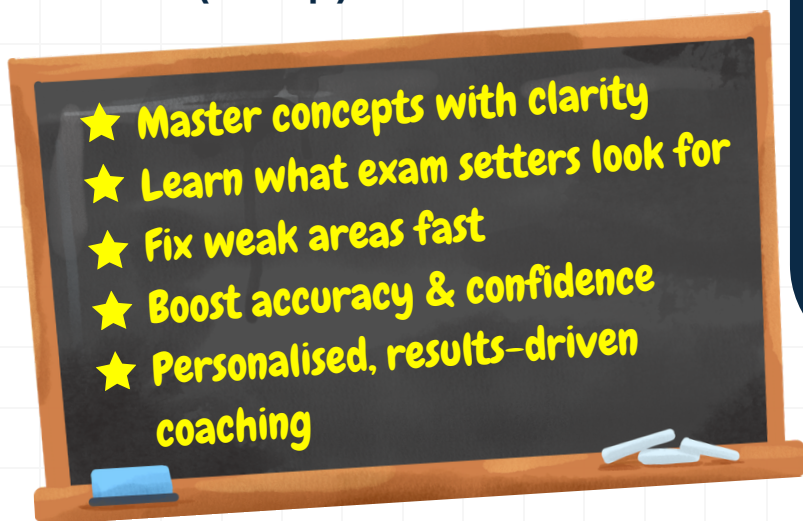
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