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JC MATHEMATICS (H2) STUDY TIPS

NAVIGATING A QUADRATIC EQUATION WITH UNREAL COEFFICIENTS

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Quick Practice

Do not use a calculator in answering this question.

Given that $2+i$ is a root of the equation

$$z^2 + (-4+i)z + c = 0,$$

find the value of c and the other root, in the form of $a+bi$ where a and b are real.

$$\begin{aligned} (2+i)^2 + (-4+i)(2+i) + c &= 0 \\ 4 + 4i + \underbrace{i^2}_{-1} - 8 - 4i + 2i + \underbrace{i^2}_{-1} + c &= 0 \\ (4-1-8-1) + (4-4+2)i + c &= 0 \\ -6 + 2i + c &= 0 \\ c &= 6-2i \end{aligned}$$

$$\begin{aligned} z^2 + (-4+i)z + 6-2i &= [z-(2+i)][z-(a+bi)] \\ &= z^2 - (a+bi+2+i)z + (2+i)(a+bi) \end{aligned}$$

Comparing the coefficient of z : $-4+i = -(a+2) - (b+1)i$

$$\begin{aligned} -4 &= -a-2 & \text{and} & & 1 &= -b-1 \\ a &= 2 & & & b &= -2 \end{aligned}$$

$\therefore$ The other root is $2-2i$.



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Explanation

When a quadratic equation has unreal coefficients, the standard rule about complex roots always appearing in matching pairs no longer applies. The main consideration is that you cannot simply flip the sign of the imaginary part to find the second root.

Instead, you must solve the problem by substituting the known root directly into the equation to calculate the missing values.

Ultimately, this requires a much higher level of algebraic caution. Success depends entirely on being meticulous with your signs and expansions, rather than relying on the shortcuts used for standard real equations.

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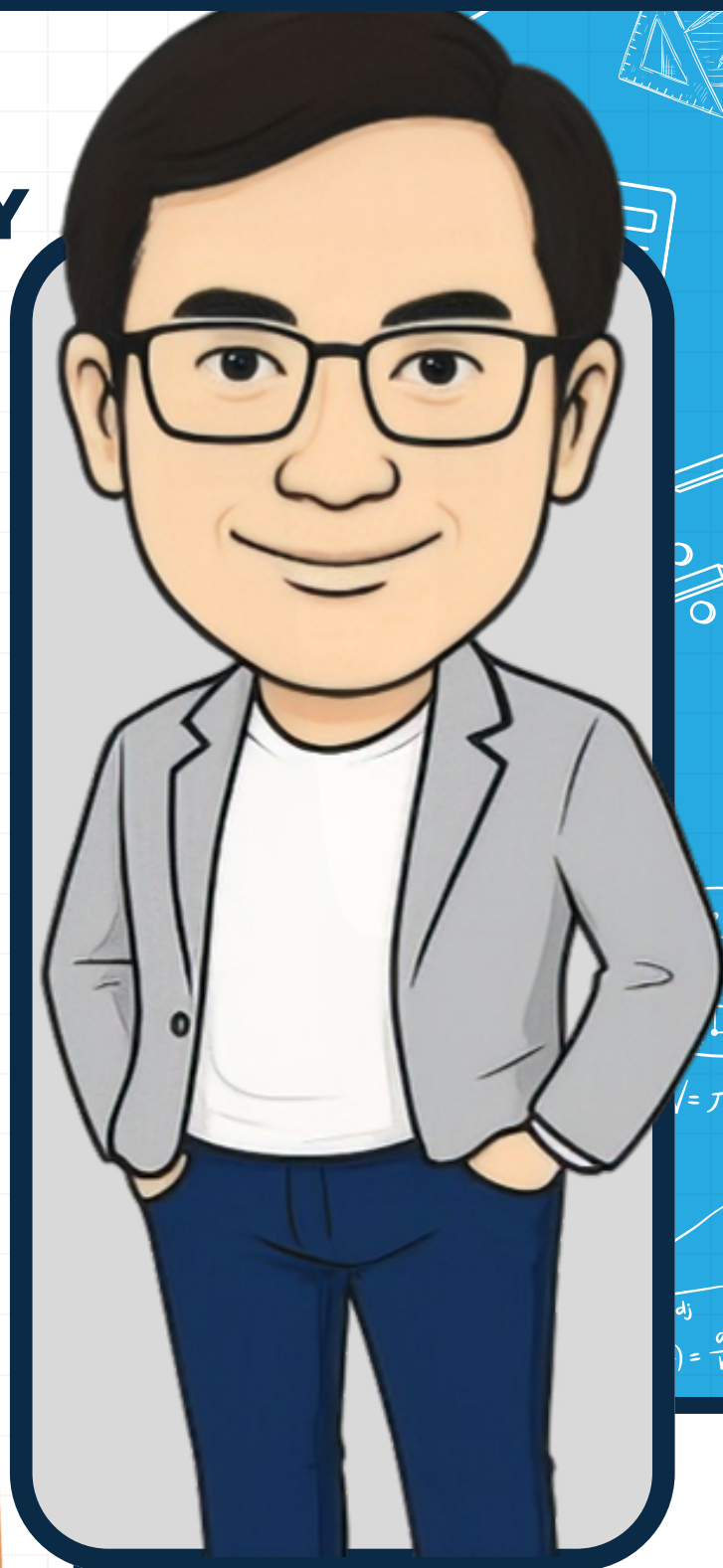
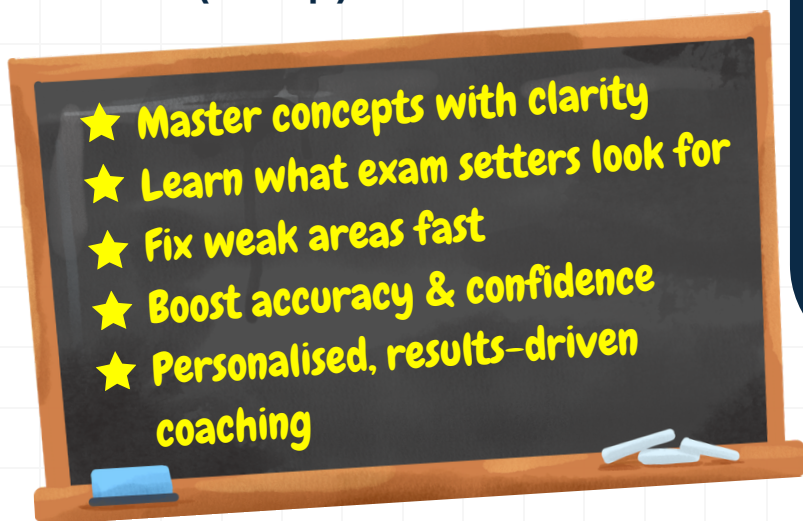
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