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JC MATHEMATICS (H2)

STUDY TIPS

A QUICK AND EASY APPROACH TO SETTLE "COMPLETING SQUARE" OF A QUADRATIC FUNCTION

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JC_H2Maths_002

Quick Practice

(a) $\int \frac{1}{4x^2-1}\,dx$

$= \int \frac{1}{(2x)^2-1^2}\,dx$

$f(x)=2x$

$f'(x)=2$

$= \frac{1}{2}\int \frac{2}{(2x)^2-1^2}\,dx$

$= \frac{1}{\cancel{2}}\left(\frac{\cancel{1}}{2(1)}\right)\ln\left|\frac{2x-1}{2x+1}\right|+c$

$1/4$

(b) $\int \frac{1}{(3x-1)^2+4}\,dx$

$f(x)=3x-1$

$f'(x)=3$

$= \frac{1}{3}\int \frac{3}{(3x-1)^2+2^2}\,dx$

$= \frac{1}{\cancel{3}}\left(\frac{1}{2}\right)\tan^{-1}\left(\frac{3x-1}{2}\right)+c$

$\frac{1}{6}$

Good to know

The following is a guided method for "Completing Square". Many students like it ☺.

e.g. $4x^2-24x+28$

$= (2x+a)^2+b$

$= 4x^2+4ax+a^2+b$

$= (2x-6)^2-8$

$4a=-24 \Rightarrow a=-6$

$a^2+b=28 \Rightarrow 36+b=28 \Rightarrow b=-8$

Example 8

$\int \frac{1}{\sqrt{15-4x-4x^2}}\,dx$

$15-4x-4x^2 = b-(2x+a)^2$

$= b-(4x^2+4ax+a^2)$

$= b-a^2-4ax-4x^2$

$\Rightarrow -4a=-4 \Rightarrow a=1$

$\Rightarrow b-a^2=15 \Rightarrow b-1=15 \Rightarrow b=16$

$= \int \frac{1}{\sqrt{16-(2x+1)^2}}\,dx$

$= \frac{1}{2}\int \frac{2}{\sqrt{4^2-(2x+1)^2}}\,dx$

$f(x)=2x+1$

$f'(x)=2$

$= \frac{1}{2}\sin^{-1}\left(\frac{2x+1}{4}\right)+c$

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Explanation

Completing the square is a notorious stumbling block for many students in algebra. The traditional process of factoring out the leading coefficient, halving the middle coefficient, and carefully balancing added and subtracted terms often leads to persistent sign errors and arithmetic confusion. Because so many learners struggle to visualize or remember these standard algorithmic steps, finding a more intuitive alternative is crucial. This guided shortcut provides a highly structured, foolproof roadmap that replaces abstract manipulation with a clear, step-by-step framework to settle this task with confidence.

Instead of performing a complex algebraic balancing act, this alternative approach works backward by matching coefficients to a predetermined expansion template. For instance, given the expression $4x^2 - 24x + 28$ the method assumes a structured target form of $(2x + a)^2 + b$ which expands directly to $4x^2 + 4ax + a^2 + b$. By directly comparing corresponding terms, students set up two isolated, easy-to-solve equations: matching the x-

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coefficients
$(4a = -24)$ quickly isolates $a = -6$ while matching the constant terms $(a^2 + b = 28)$ reveals $b = -8$. Substituting these values straight back into the template yields the final answer, $(2x - 6)^2 - 8$, transforming a historically difficult procedure into simple, predictable arithmetic.

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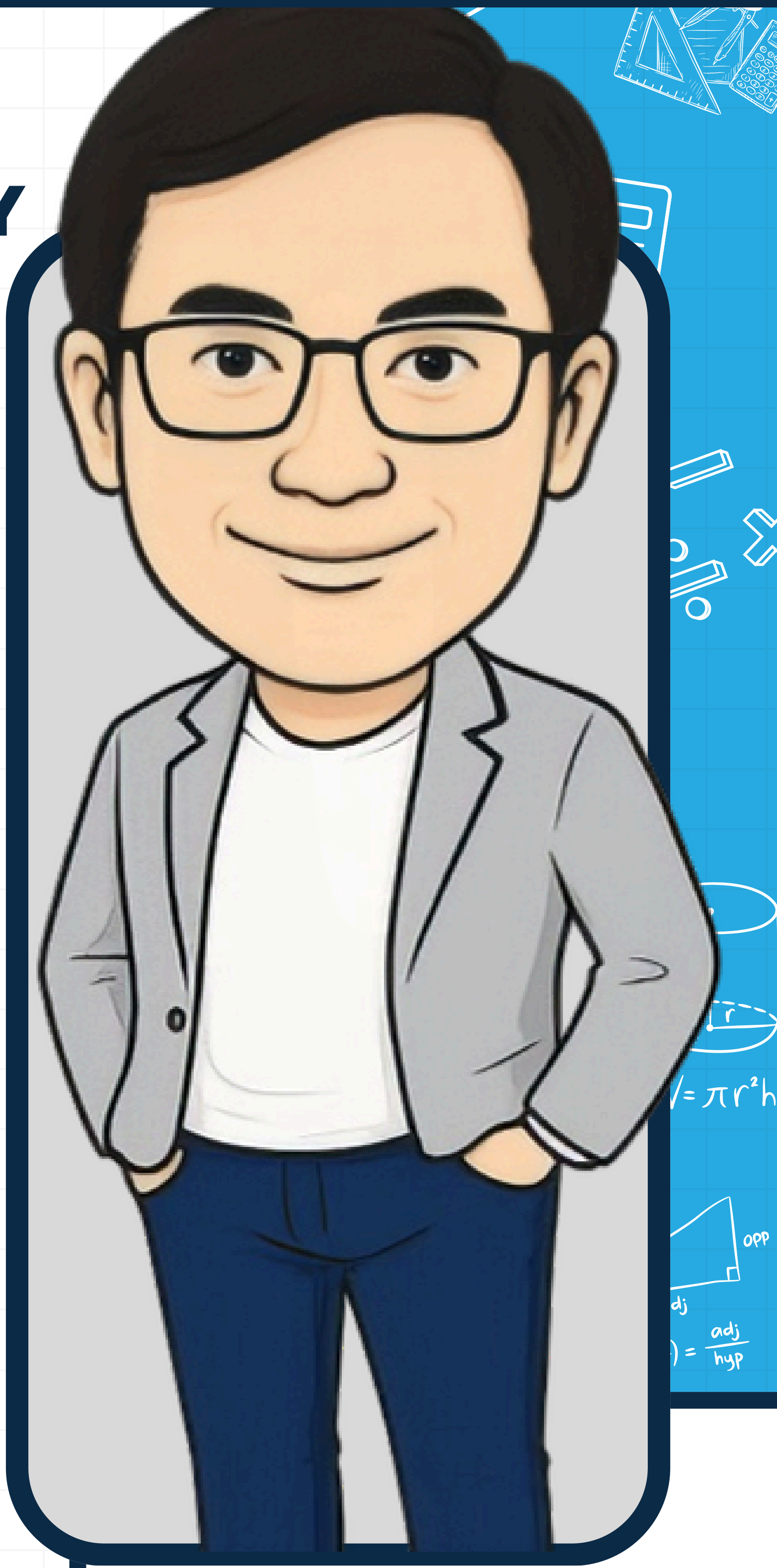

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