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JC MATHEMATICS (H2)

STUDY TIPS

A COMMON PITFALL IN SUMMATION TRANSFORMATIONS: DO NOT LET THE BOUNDARIES FOOL YOU

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JC_H2Maths_049

5. Miscellaneous Questions

It is given that $\sum_{r=1}^{n} \frac{1}{4r^2-1} = \frac{n}{2n+1}$. Express the followings into single fractions:

(i) $\sum_{r=1}^{n-1} \frac{1}{4r^2-1}$,

$= \frac{n-1}{2(n-1)+1} = \frac{n-1}{2n-1}$ #

(ii) $\sum_{r=2}^{n} \frac{1}{4r^2-1}$,

$= \sum_{r=1}^{n} \frac{1}{4r^2-1} - \frac{1}{4(1)^2-1} = \frac{n}{2n+1} - \frac{1}{3} = \frac{3n-2n-1}{3(2n+1)} = \frac{n-1}{3(2n+1)}$ #

(iii) $\sum_{r=10}^{20} \frac{1}{4r^2-1}$,

$= \sum_{r=1}^{20} \frac{1}{4r^2-1} - \sum_{r=1}^{9} \frac{1}{4r^2-1} = \frac{20}{40+1} - \frac{9}{18+1} = \frac{20}{41} - \frac{9}{19} = \frac{11}{779}$ #

(iv) $\sum_{r=3}^{n} \frac{1}{(2r-3)(2r-5)}$.

$= \sum_{r+2=3}^{r+2=n} \frac{1}{[2(r+2)-3][2(r+2)-5]}$

$= \sum_{r=1}^{n-2} \frac{1}{(2r+1)(2r-1)} = \sum_{r=1}^{n-2} \frac{1}{4r^2-1} = \frac{n-2}{2(n-2)+1} = \frac{n-2}{2n-3}$ #

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Explanation

Referring to part (iv), a common pitfall when the internal expression closely resembles but does not exactly match the given baseline formula is that students immediately focus on altering the boundary limits of the summation.

Instead of pausing to consider how the core algebraic term can be rewritten, expanded, or factored to expose the required structure, they instinctively try to force a fit by shifting the starting and ending points. This fixation on the boundaries often complicates the problem or leads to mistakes in index substitution because the real challenge is an algebraic disguise within the term itself.

To avoid this error, students should dedicate more thought to manipulating and transforming the inner expression first, as revealing the familiar pattern within the core term naturally makes any necessary boundary adjustments clear and straightforward.

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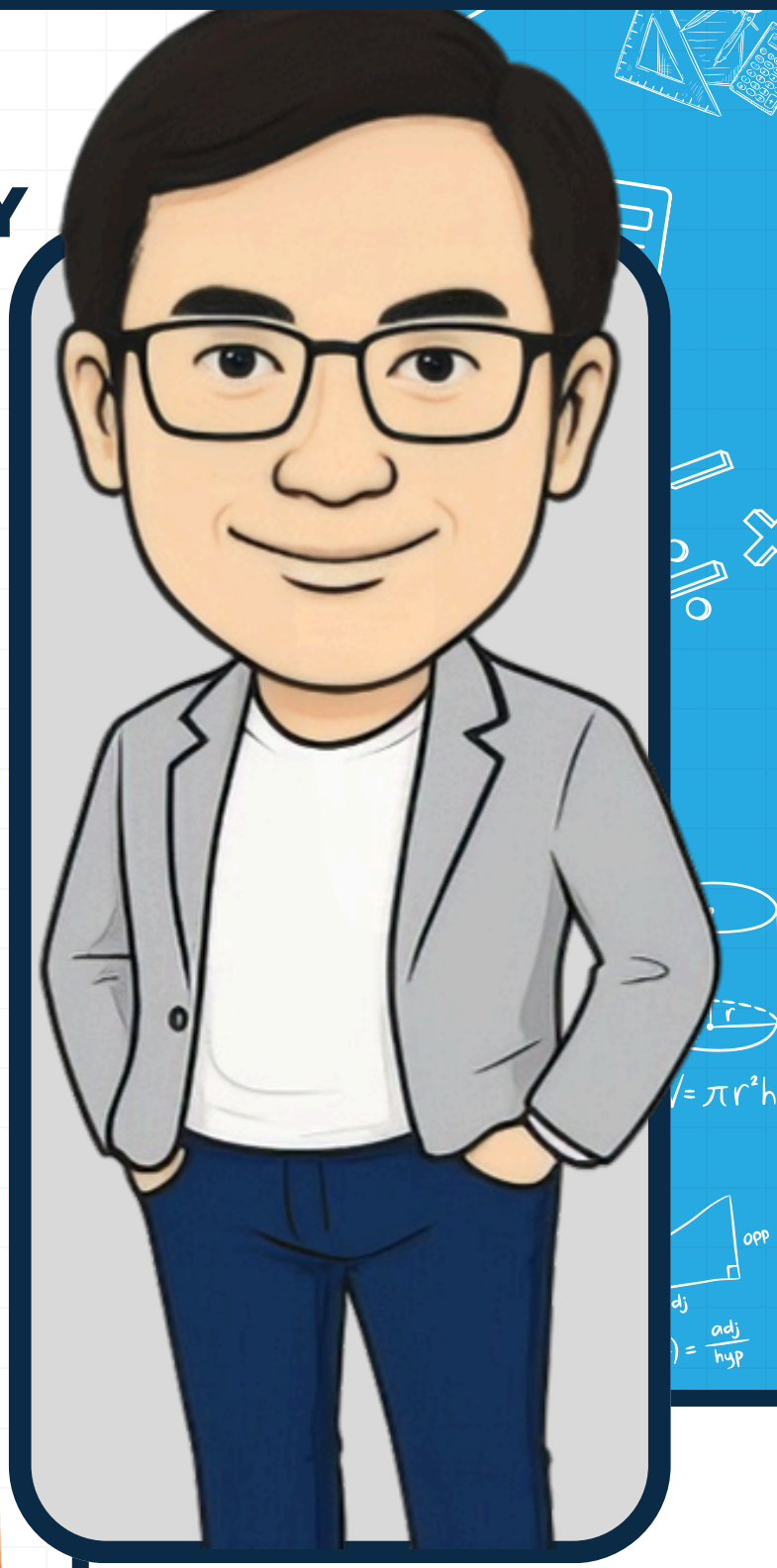
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