

Answer all the questions.

Section A (37 marks)

- 1 (a) By considering $(r+1)^3 - r^3$, find $\sum_{r=1}^n (3r^2 + 3r + 1)$. [3]
- (b) Use this result to find $\sum_{r=1}^n r(r+1)$, expressing your answer in fully factorised form. [4]
- 2 In this question you must show detailed reasoning.
- Find the exact value of $\int_2^{\infty} \frac{1}{x^2 - 4x + 5} dx$. [5]
- 3 In this question you must show detailed reasoning.
- Solve the equation $3 \cosh x = 2 \sinh^2 x$, giving your solutions in exact logarithmic form. [6]
- 4 (a) A transformation with associated matrix $\begin{pmatrix} w & 2 & 1 \\ 0 & 1 & -2 \\ 2 & 0 & 3 \end{pmatrix}$, where w is a constant, maps the vertices of a cube to points that all lie in a plane.
- Find w . [3]
- (b) The transformations S and T of the plane have associated matrices M and N respectively, where $M = \begin{pmatrix} k & 1 \\ -3 & 4 \end{pmatrix}$ and the determinant of N is $3k + 1$. The transformation U is equivalent to the combined transformation consisting of S followed by T.
- Given that U preserves orientation and has an area scale factor 2, find the possible values of k . [4]
- 5 (a) Sketch the polar curve $r = a(1 - \cos \theta)$, $0 < \theta < 2\pi$, where a is a positive constant. [2]
- (b) Determine the exact area of the region enclosed by the curve. [5]
- 6 Prove by mathematical induction that $\begin{pmatrix} 2 & 0 \\ -1 & 1 \end{pmatrix}^n = \begin{pmatrix} 2^n & 0 \\ 1 - 2^n & 1 \end{pmatrix}$ for all positive integers n . [5]

Mathematics Level Question Paper

Ensheng Dong



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In an electronic era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Mathematics Level Question Paper**," compiled by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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