

- 2 (a) Expand $(2 - x^2)^{-2}$ in ascending powers of x , up to and including the term in x^4 , simplifying the coefficients. [4]

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- (b) State the set of values of x for which the expansion is valid. [1]

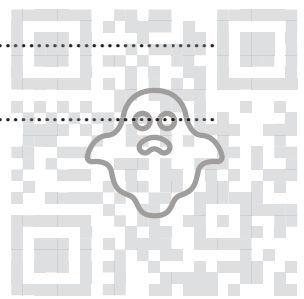
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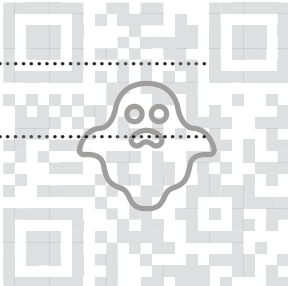
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6 Let $I = \int_0^3 \frac{27}{(9+x^2)^2} dx.$

(a) Using the substitution $x = 3 \tan \theta$, show that $I = \int_0^{\frac{1}{4}\pi} \cos^2 \theta d\theta.$ [4]

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It is now given that $a = 3$.

- (b) Express u in the form $re^{i\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$, giving the exact values of r and θ . [2]

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- (c) Using your answer to part (b), find the two square roots of u . Give your answers in the form $re^{i\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$, giving the exact values of r and θ . [3]

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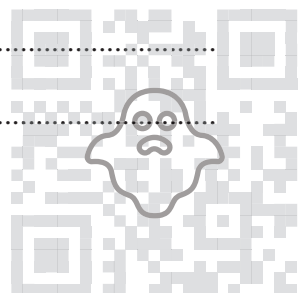
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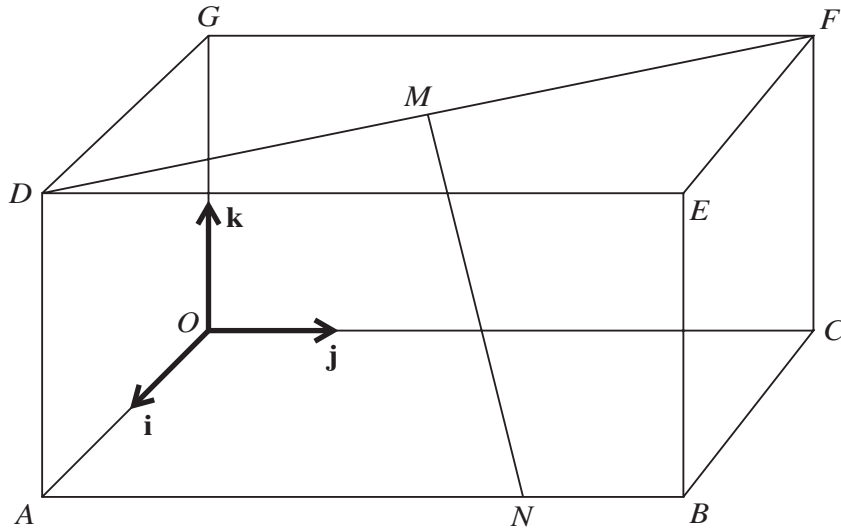
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In the diagram, $OABCDEFG$ is a cuboid in which $OA = 2$ units, $OC = 4$ units and $OG = 2$ units. Unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to OA , OC and OG respectively. The point M is the midpoint of DF . The point N on AB is such that $AN = 3NB$.

- (a) Express the vectors \vec{OM} and \vec{MN} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [3]

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- (b) Find a vector equation for the line through M and N . [2]

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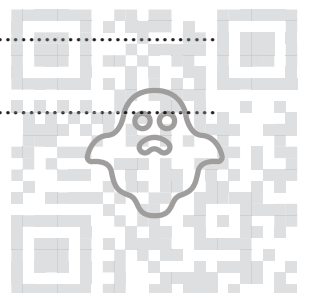
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(b) Verify by calculation that a lies between 2 and 2.5. [2]

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(c) Show that if a sequence of values in the interval $0 < x < \pi$ given by the iterative formula $x_{n+1} = \pi - \tan^{-1}(\frac{1}{2}x_n)$ converges, then it converges to a , the root of the equation in part (a). [2]

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(d) Use the iterative formula given in part (c) to determine a correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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