



Cambridge International AS & A Level

CANDIDATE
NAME

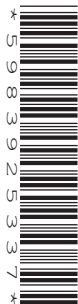
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CENTRE
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FURTHER MATHEMATICS

9231/12

Paper 1 Further Pure Mathematics 1

October/November 2021

2 hours

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

- 1 (a) Give full details of the geometrical transformation in the x - y plane represented by the matrix $\begin{pmatrix} 6 & 0 \\ 0 & 6 \end{pmatrix}$. [1]

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Let $\mathbf{A} = \begin{pmatrix} 3 & 4 \\ 2 & 2 \end{pmatrix}$.

- (b) The triangle DEF in the x - y plane is transformed by \mathbf{A} onto triangle PQR .

Given that the area of triangle DEF is 13 cm^2 , find the area of triangle PQR . [2]

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- (c) Find the matrix \mathbf{B} such that $\mathbf{AB} = \begin{pmatrix} 6 & 0 \\ 0 & 6 \end{pmatrix}$. [2]

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- (d) Show that the origin is the only invariant point of the transformation in the x - y plane represented by \mathbf{A} . [4]

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4 The cubic equation $x^3 + 2x^2 + 3x + 3 = 0$ has roots α , β , γ .

(a) Find the value of $\alpha^2 + \beta^2 + \gamma^2$. [2]

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(b) Show that $\alpha^3 + \beta^3 + \gamma^3 = 1$. [2]

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(c) Sketch C .

[2]

(d) (i) Sketch the graphs of $y = \left| \frac{x^2}{x-3} \right|$ and $y = |x| - 3$ on a single diagram, stating the coordinates of the intersections with the axes. [4]

(ii) Use your sketch to find the set of values of c for which $\left| \frac{x^2}{x-3} \right| \leq |x| + c$ has no solution. [1]

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