



Cambridge International AS & A Level

CANDIDATE
NAME



CENTRE
NUMBER

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FURTHER MATHEMATICS

9231/11

Paper 1 Further Pure Mathematics 1

October/November 2024

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.



- 1 The matrix $\mathbf{M}$ represents the sequence of two transformations in the x - y plane given by a stretch parallel to the x -axis, scale factor k ($k \neq 0$), followed by a shear, x -axis fixed, with $(0, 1)$ mapped to $(k, 1)$.

(a) Show that $\mathbf{M} = \begin{pmatrix} k & k \\ 0 & 1 \end{pmatrix}$. [4]

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- (b) The transformation represented by $\mathbf{M}$ has a line of invariant points.

Find, in terms of k , the equation of this line. [3]

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(c) Find, in terms of k , a matrix which transforms P onto S . [1]

(d) Given that the area of P is $3k^2$ units², find the possible values of k . [2]

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$$\frac{d^n}{dx^n}(\tan^{-1}x) = P_n(x)(1+x^2)^{-n},$$

[6]

[illegible]

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(a) Find a quartic equation whose roots are $\alpha^4, \beta^4, \gamma^4, \delta^4$ and state the value of $\alpha^4 + \beta^4 + \gamma^4 + \delta^4$. [5]

[illegible]



(b) Find the value of $\alpha^5 + \beta^5 + \gamma^5 + \delta^5$.

[3]

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(c) Find the value of $\alpha^8 + \beta^8 + \gamma^8 + \delta^8$.

[2]

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- [illegible]



It is given that $\sum_{r=1}^{\infty} \frac{5k}{(5r+k)(5r+5+k)} = \frac{1}{3}$.

(b) Find the value of k .

[2]

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(c) Hence find $\sum_{r=n}^{n^2} \frac{5k}{(5r+k)(5r+5+k)}$ in terms of n .

[2]

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- 5 (a) Show that the curve with Cartesian equation

$$(x^2 + y^2)^2 = 6xy$$

has polar equation $r^2 = 3 \sin 2\theta$.

[2]

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The curve C has polar equation $r^2 = 3 \sin 2\theta$, for $0 \leq \theta \leq \frac{1}{2}\pi$.

- (b) Sketch C and state the maximum distance of a point on C from the pole.

[3]



[2]

[illegible]

[6]

[illegible]



(c) Sketch C , stating the coordinates of any intersections with the axes.

[5]

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(d) Sketch the curve with equation $y = \left| \frac{4x^2 + x + 1}{2x^2 - 7x + 3} \right|$ and state the set of values of k for which $\left| \frac{4x^2 + x + 1}{2x^2 - 7x + 3} \right| = k$ has 4 distinct real solutions.

[2]



This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.



[7]

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dotted lines spaced evenly down the page, providing a guide for handwriting practice. The paper is otherwise blank, with no margins, text, or other markings.

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