



Cambridge International AS & A Level

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FURTHER MATHEMATICS

9231/14

Paper 1 Further Pure Mathematics 1

May/June 2025

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 (a) Use the List of formulae (MF19) to find $\sum_{r=1}^n (2r+1)$ in terms of n , simplifying your answer. [2]

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- (b) Show that $\frac{2r+1}{(r^2+1)(r^2+2r+2)} = \frac{1}{r^2+1} - \frac{1}{r^2+2r+2}$. [1]

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[illegible]

$$\frac{d^n}{dx^n}(x \ln x) = (-1)^n (n-2)! x^{1-n}. \quad [6]$$

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$$2\mathbf{j} + 3\mathbf{k}, \quad -5\mathbf{i} + 3\mathbf{j} + \mathbf{k} \quad \text{and} \quad \mathbf{i} + 2\mathbf{j} + 5\mathbf{k}$$

respectively, relative to the origin O .

- (a) Find the equation of the plane ABC , giving your answer in the form $ax + by + cz = d$. [5]

[illegible]

- (b) Find the perpendicular distance from O to the plane ABC . [2]

[illegible]



[3]

[illegible]

- 4 The cubic equation $x^3 + bx^2 + cx - 1 = 0$, where b and c are constants, has roots α, β, γ .

It is given that the matrix $\begin{pmatrix} 1 & \alpha & \beta \\ \alpha & 1 & \gamma \\ \beta & \gamma & 1 \end{pmatrix}$ is singular.

- (a) Show that $\alpha^2 + \beta^2 + \gamma^2 = 3$.

[4]



[6]

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[3]

[illegible]

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[3]

[illegible]



(d) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **MN**. [5]

[illegible]

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[3]

[4]



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

[3]

(e) Sketch the graph with equation $y = \frac{|x|^2 + |x| - 4}{|x|^2 + |x| + 2}$ and find the set of values of x for which

$$\frac{|x|^2 + |x| - 4}{|x|^2 + |x| + 2} < -\frac{1}{2}.$$

[5]

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[illegible]

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