



# Cambridge International AS & A Level

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## FURTHER MATHEMATICS

9231/24

Paper 2 Further Pure Mathematics 2

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 **20** pages. Any blank pages are indicated.



- 1 (a) Find the values of  $k$  for which the system of equations

$$x + 2y + 3z = 1,$$

$$kx + 5y + 6z = 2,$$

$$7x + 2ky + 9z = 3,$$

does not have a unique solution.

[3]

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- (b) Given that  $k = 1$ , show that the system of equations in part (a) is consistent. Interpret this situation geometrically.

[3]

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[6]

[illegible]

3

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 13e^{3x}$$

given that  $y = 1$  and  $\frac{dy}{dx} = 0$  when  $x = 0$ .

[10]

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



$$x = t^3 - t^2 + t - 1 \quad \text{and} \quad y = te^t.$$

- (a) Show that 1 is the only real value of  $t$  for which  $x = 0$ . [1]

This image shows a blank sheet of white paper with ten horizontal dashed lines spaced evenly apart, resembling notebook paper. The lines are thin and black, extending across the width of the page. There is no handwriting or other markings on the paper.

- (b) Show that  $\frac{dy}{dx} = \frac{(t+1)e^t}{3t^2-2t+1}$ . [3]

[illegible]



[6]

This image shows a full page of white paper designed for handwriting practice. It features approximately 20 evenly spaced horizontal dotted lines running from left to right across the entire width of the page. There are no margins, text, or other markings present.

$$\sin 7\theta = -64 \sin^7 \theta + 112 \sin^5 \theta - 56 \sin^3 \theta + 7 \sin \theta. \quad [5]$$

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.




$$64x^6 - 112x^4 + 56x^2 - 7 = 0$$

[3]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The lines are evenly spaced across the entire page, providing a guide for consistent letter formation. There is no text or other markings on the page.

6

$$x \frac{dy}{dx} - y = 2x^2 \tan^{-1} x$$

for which  $y = \frac{1}{2}\pi$  when  $x = 1$ . Give your answer in the form  $y = f(x)$ .

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.

This image shows a full page of a document template designed for handwriting practice or general writing. It consists of approximately 20 evenly spaced, horizontal dotted lines extending across the entire width of the page. The background is plain white, and there are no margins, headers, footers, or other markings present.

$$\mathbf{A} = \begin{pmatrix} 1 & 7 & 11 \\ 0 & 2 & 5 \\ 0 & 0 & -3 \end{pmatrix}.$$

- (a) Find a matrix  $\mathbf{P}$  and a diagonal matrix  $\mathbf{D}$  such that  $\mathbf{A}^6 = \mathbf{P}\mathbf{D}\mathbf{P}^{-1}$ . [7]

[illegible]



where  $a$ ,  $b$  and  $c$  are integers to be determined. [4]

$$\mathbf{A}^6 = a\mathbf{A}^2 + b\mathbf{A} + c\mathbf{I},$$

where  $a, b$  and  $c$  are integers to be determined.

[4]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

(a) Sketch  $C$  and state the equation of the asymptote.

[2]

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$$\sum_{r=1}^N \tanh r > \ln(\cosh N). \quad [3]$$

[illegible]



- $$S = \pi \int_{\frac{5}{4}}^{\sqrt{2}} \frac{u^2}{u^2 - 1} du. \quad [7]$$

[illegible]

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## Additional page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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