



Cambridge International AS & A Level

 CANDIDATE
NAME


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FURTHER MATHEMATICS

9231/24

Paper 2 Further Pure Mathematics 2

May/June 2026
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. Do **not** use correction fluid or tape.
- 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) Find the set of values of k for which the system of equations

$$3x + ky + 7z = 1,$$

$$8x + y + 2z = 2,$$

$$8x + 2y + 4z = 3,$$

has a unique solution and interpret this situation geometrically.

[4]

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- (b) Given that $k = \frac{7}{2}$, show that the system of equations in part 1(a) is inconsistent and interpret this situation geometrically.

[2]

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2 Let $\mathbf{A} = \begin{pmatrix} a & -1 \\ 5 & 1 \end{pmatrix}$, where a is a constant. It is given that 2 is an eigenvalue of $\mathbf{A}$.

(a) Find a and the other eigenvalue of $\mathbf{A}$.

[4]

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 entire page is otherwise blank, with no margins, text, or other markings.



(b) Find a matrix $\mathbf{P}$ and a diagonal matrix $\mathbf{D}$ such that $\mathbf{A}^5 = \mathbf{P}\mathbf{D}\mathbf{P}^{-1}$.

[5]

[illegible]



3 Find the particular solution of the differential equation

$$\frac{dy}{dx} + y = e^{\frac{1}{2}x},$$

given that $y = 3$ when $x = 0$. Give your answer in the form $y = f(x)$.

[7]

[illegible]



4 The curve C has parametric equations

$$x = 2 \cosh 2t + 3t, \quad y = \frac{3}{2} \cosh 2t - 4t, \quad \text{for } 0 \leq t \leq 1.$$

(a) Find, in terms of e , the length of C .

[5]

[illegible]



(b) Show that

$$\frac{d^2y}{dx^2} = \frac{a \cosh 2t}{(b \sinh 2t + c)^n},$$

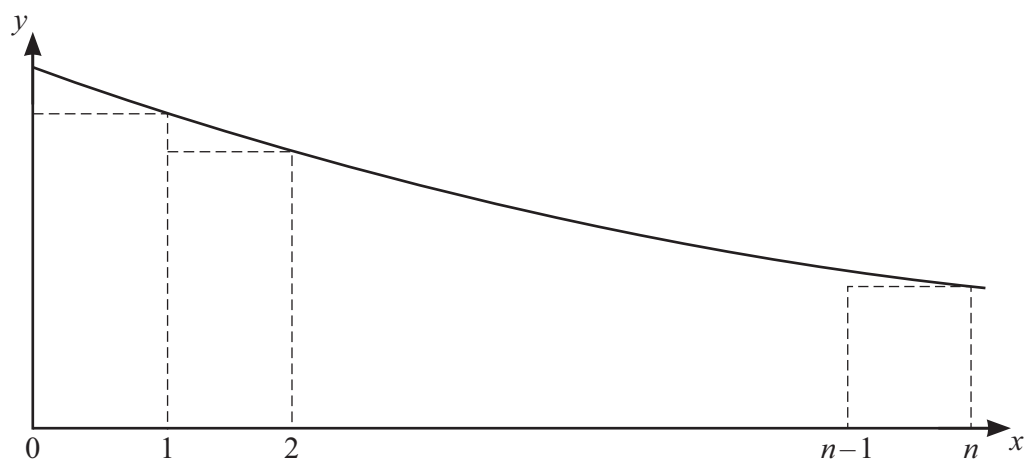
where a, b, c and n are integers to be determined.

[5]





5



The diagram shows the curve $y = \frac{1}{\sqrt{4x^2 + 4x + 3}}$ for $x \geq 0$, together with a set of n rectangles of unit width. By considering the sum of the areas of these rectangles, show that

$$\sum_{r=1}^n \frac{1}{\sqrt{4r^2+4r+3}} < \frac{1}{2} \ln \left(\frac{1+2n+\sqrt{4n^2+4n+3}}{1+\sqrt{3}} \right). \quad [9]$$

[illegible]

[illegible]



6 Let $I_n = \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} e^x \cos^n x \, dx$, where n is a non-negative integer.

(a) Show that, for $n \geq 2$,

$$I_n = n(n-1) \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} e^x \cos^{n-2} x \sin^2 x \, dx - nI_n,$$

and deduce the reduction formula

$$(n^2 + 1)I_n = n(n - 1)I_{n-2}. \quad [6]$$

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



(b) Find the exact value of I_4 .

This image shows a full page of a worksheet designed for handwriting practice. It features approximately 20 horizontal dashed lines spaced evenly across the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.





$$\sec 7\theta = \frac{\sec^7 \theta}{64 - 112 \sec^2 \theta + 56 \sec^4 \theta - 7 \sec^6 \theta}. \quad [6]$$

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.





(b) Hence obtain the roots of the equation

$$x^7 - 14x^6 + 112x^4 - 224x^2 + 128 = 0$$

in the form $\sec q\pi$, where q is rational.

[5]

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8 It is given that $v = xy^3$ and

$$xy^2 \frac{d^2y}{dx^2} + 2xy \left(\frac{dy}{dx} \right)^2 + (3x+2)y^2 \frac{dy}{dx} + (x+1)y^3 = x+5.$$

(a) Show that

$$\frac{1}{3} \frac{d^2v}{dx^2} + \frac{dv}{dx} + v = x+5. \quad [4]$$

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(b) Find the general solution for y in terms of x . [7]

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(c) Deduce that, for large positive values of x and for any initial conditions,

$$y \approx \sqrt[3]{a + \frac{b}{x}},$$

where the constants a and b are to be determined. [2]

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