



Cambridge International AS & A Level

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FURTHER MATHEMATICS

9231/22

Paper 2 Further Pure Mathematics 2

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



[illegible]

2 The curve C has equation

$$4y^2 + 4 \ln(xy) = 1.$$

(a) Show that, at the point $\left(2, \frac{1}{2}\right)$ on C , $\frac{dy}{dx} = -\frac{1}{6}$. [3]

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 or typing. There are no margins, text, or other markings on the page.



[4]

[illegible]

$$x = \frac{1}{2}e^{2t} - \frac{1}{3}t^3 - \frac{1}{2}, \quad y = 2e^t(t-1), \quad \text{for } 0 \leq t \leq 1.$$

[7]

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.



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$$\cot 6\theta = \frac{\cot^6 \theta - 15 \cot^4 \theta + 15 \cot^2 \theta - 1}{6 \cot^5 \theta - 20 \cot^3 \theta + 6 \cot \theta}. \quad [6]$$
[illegible]



in the form $\cot(q\pi)$, where q is a rational number. [4]

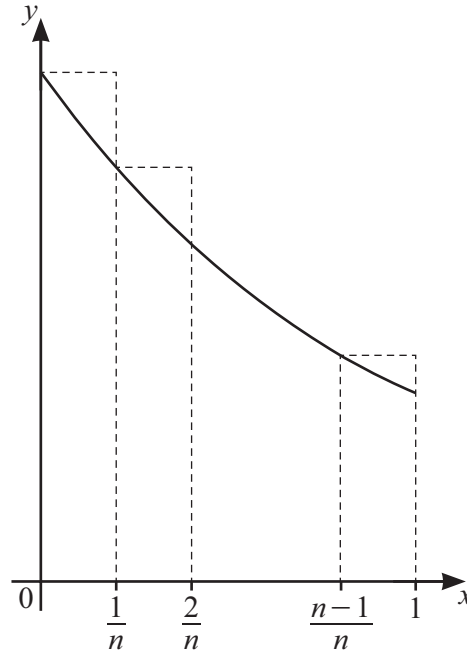
This image shows a full page of a worksheet designed for handwriting practice. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The entire page is otherwise blank, with no margins, text, or other markings.

$$3\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = x^2,$$

[10]

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

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.



The diagram shows the curve with equation $y = e^{1-x}$ for $0 \leq x \leq 1$, together with a set of n rectangles of width $\frac{1}{n}$.

- (a) By considering the sum of the areas of these rectangles, show that $\int_0^1 e^{1-x} dx < U_n$, where

$$U_n = \frac{e-1}{n(1-e^{-\frac{1}{n}})}. \quad [4]$$

[illegible]

[illegible][illegible]

- [illegible]

- [illegible]



for which $y = 5$ when $x = \ln 2$. Give your answer in an exact form. [7]

This image shows a full page of a worksheet designed for handwriting practice. It features approximately 20 horizontal rows, each defined by two parallel dotted lines. The lines are evenly spaced and extend across the entire width of the page, providing a guide for letter height and placement. There is no text or other markings on the page.

8 The matrix $\mathbf{A}$ is given by

$$\mathbf{A} = \begin{pmatrix} -2 & 0 & 0 \\ 0 & 7 & 9 \\ 4 & 1 & 7 \end{pmatrix}.$$

- (a) Show that the characteristic equation of $\mathbf{A}$ is $\lambda^3 - 12\lambda^2 + 12\lambda + 80 = 0$ and find the eigenvalues of $\mathbf{A}$. [4]

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where p , q and r are integers to be determined. [4]

[illegible]

[illegible]



1

[illegible]



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