



Cambridge International AS & A Level

CANDIDATE
NAME

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MATHEMATICS

9709/22

Paper 2 Pure Mathematics 2

May/June 2022

1 hour 15 minutes

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 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

1 Given that $y = \frac{\ln x}{x^2}$, find the exact value of $\frac{dy}{dx}$ when $x = e$. [3]

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2 (a) Sketch, on the same diagram, the graphs of $y = |2x - 9|$ and $y = 5x - 3$. [2]

(b) Solve the equation $|2x - 9| = 5x - 3$. [2]

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3 A curve has equation $e^{2x} \cos 2y + \sin y = 1$.

Find the exact gradient of the curve at the point $(0, \frac{1}{6}\pi)$. [5]

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4 (a) Use the trapezium rule with three intervals to show that the value of $\int_1^4 \ln x \, dx$ is approximately $\ln 12$. [4]

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(b) Use a graph of $y = \ln x$ to show that $\ln 12$ is an under-estimate of the true value of $\int_1^4 \ln x \, dx$. [2]

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5 The polynomial $p(x)$ is defined by

$$p(x) = 2x^3 + ax^2 - 3x - 4,$$

where a is a constant. It is given that $(x - 4)$ is a factor of $p(x)$.

(a) Find the value of a and hence factorise $p(x)$. [4]

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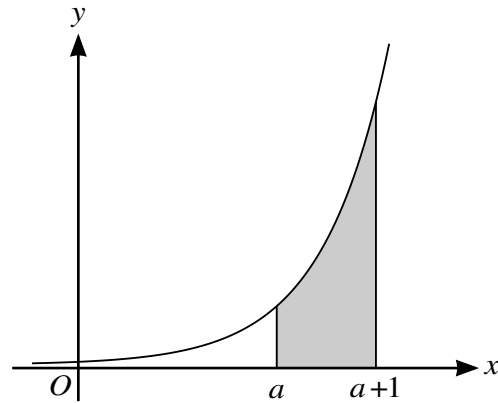
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(b) Show that the equation $p(e^{3y}) = 0$ has only one real root and find its exact value. [3]

A series of 24 horizontal dotted lines for writing the solution.

6



The diagram shows the curve $y = 3e^{2x-1}$. The shaded region is bounded by the curve and the lines $x = a$, $x = a + 1$ and $y = 0$, where a is a constant. It is given that the area of the shaded region is 120 square units.

- (a) Show that $a = \frac{1}{2} \ln(80 + e^{2a-1}) - \frac{1}{2}$. [5]

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(b) Use an iterative formula, based on the equation in part (a), to find the value of a correct to 3 significant figures. Give the result of each iteration to 5 significant figures. [3]

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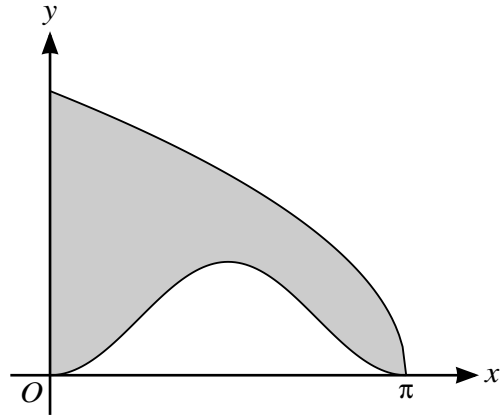
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The diagram shows the curves $y = \sqrt{2\pi - 2x}$ and $y = \sin^2 x$ for $0 \leq x \leq \pi$. The shaded region is bounded by the two curves and the line $x = 0$.

Find the exact area of the shaded region. [8]

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- 8 (a) Express $3 \sin 2\theta \sec \theta + 10 \cos(\theta - 30^\circ)$ in the form $R \sin(\theta + \alpha)$ where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the value of α correct to 2 decimal places. [6]

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Additional Page

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