



Cambridge International AS & A Level

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MATHEMATICS**9709/23**

Paper 2 Pure Mathematics 2

October/November 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.



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[illegible]

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[4]

[illegible]

6

4 (a) By sketching a suitable pair of graphs on the same diagram, show that the equation

$$e^{-\frac{1}{2}x} = x^5$$

has exactly one real root. [2]

(b) Use the iterative formula $x_{n+1} = \sqrt[5]{e^{-\frac{1}{2}x_n}}$ to determine the root correct to 4 significant figures. Give the result of each iteration to 6 significant figures. [3]

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[5]

[illegible]

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

$$p(x) = 12x^3 - 9x^2 + 8x - 4.$$

- (a)** Find the quotient when $p(x)$ is divided by $(4x - 3)$ and show that the remainder is 2. [3]

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- (b)** Hence find $\int_2^{12} \left(\frac{p(x)}{4x - 3} - 3x^2 \right) dx$, giving your answer in the form $a + \ln b$. [6]

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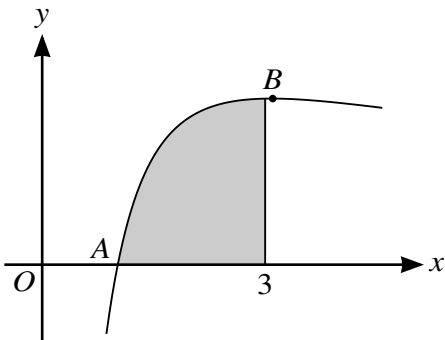
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The diagram shows the curve with equation $y = \frac{2 \ln x}{3x + 1}$. The curve crosses the x -axis at the point A and has a maximum point B . The shaded region is bounded by the curve and the lines $x = 3$ and $y = 0$.

(a) Find the gradient of the curve at A . [3]

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- (b) Show by calculation that the x -coordinate of B lies between 3.0 and 3.1. [3]

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- (c) Use the trapezium rule with two intervals to find an approximation to the area of the shaded region. Give your answer correct to 2 decimal places. [3]

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8 The expression $f(\theta)$ is defined by $f(\theta) = 12 \sin \theta \cos \theta + 16 \cos^2 \theta$.

- (a) Express $f(\theta)$ in the form $R \cos(2\theta - \alpha) + k$, where $R > 0$, $0 < \alpha < \frac{1}{2}\pi$ and k is a constant. State the values of R and k , and give the value of α correct to 4 significant figures. [5]

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- (b) Find the smallest positive value of θ satisfying the equation $f(\theta) = 17$. [3]

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(c) Find $\int f(\theta) \, d\theta$. [2]

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