



Cambridge International AS & A Level

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MATHEMATICS

9709/22

Paper 2 Pure Mathematics 2

October/November 2024

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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1 Use logarithms to show that the equation $5^{8y} = 6^{7x}$ can be expressed in the form $y = kx$. Give the value of the constant k correct to 3 significant figures. [3]





2 Let $f(x) = 4 \sin^2 3x$.

(a) Find the value of $f'\left(\frac{1}{4}\pi\right)$.

[3]

(b) Find $\int f(x) dx$.

[3]





3 A curve has equation $6e^{-x}y^2 + e^{2x} - 12y + 7 = 0$.

Find the gradient of the curve at the point $(\ln 3, 2)$.

[6]

Find the gradient of the curve at the point $(\ln 3, 2)$. [6]





4 (a) Sketch the graphs of $y = 1 + e^{2x}$ and $y = |x - 4|$ on the same diagram.

(b) The two graphs meet at the point P .

Show that the x -coordinate of P satisfies the equation $x = \frac{1}{2} \ln(3 - x)$.





(c) Use an iterative formula, based on the equation in part (b), to find the x -coordinate of P correct to 3 significant figures. Use an initial value of 0.45 and give the result of each iteration to 5 significant figures. [3]





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

$$p(x) = ax^3 + bx^2 - ax + 8,$$

where a and b are constants. It is given that $(x+2)$ is a factor of $p(x)$, and that the remainder is 24 when $p(x)$ is divided by $(x-2)$.

(a) Find the values of a and b .

[4]





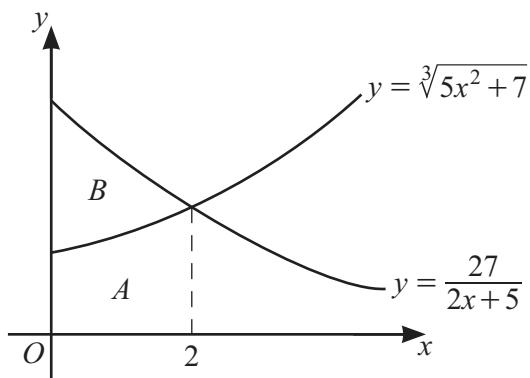
(b) Factorise $p(x)$ and hence show that the equation $p(x) = 0$ has exactly one real root.

[3]

(c) Solve the equation $p\left(\frac{1}{2}\operatorname{cosec}\theta\right)=0$ for $-90^\circ < \theta < 90^\circ$.

[3]





The diagram shows the curves with equations $y = \sqrt[3]{5x^2 + 7}$ and $y = \frac{27}{2x+5}$ for $x \geq 0$.

The curves meet at the point $(2, 3)$.

Region A is bounded by the curve $y = \sqrt[3]{5x^2 + 7}$ and the straight lines $x = 0$, $x = 2$ and $y = 0$.

Region B is bounded by the two curves and the straight line $x = 0$.

(a) Use the trapezium rule with two intervals to find an approximation to the area of region A. Give your answer correct to 3 significant figures. [3]





(b) Find the exact total area of regions A and B . Give your answer in the form $k \ln m$, where k and m are constants. [3]

(c) Deduce an approximation to the area of region B . Give your answer correct to 3 significant figures. [1]

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.....

(d) State, with a reason, whether your answer to part (c) is an over-estimate or an under-estimate of the area of region B . [2]





7 (a) Express $4 \sin \theta \sin(\theta + 60^\circ)$ in the form

$$a + R \sin(2\theta - \alpha),$$

where a and R are positive integers and $0^\circ < \alpha < 90^\circ$.

[6]

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(b) Hence find the smallest positive value of θ satisfying the equation

$$\frac{1}{5} + 4 \sin \theta \sin(\theta + 60^\circ) = 0.$$

[3]

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