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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5870113572

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 [ ].

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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]

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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]

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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]

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

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

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

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(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]

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5 The polynomial $\mathrm{p}(x)$ is defined by

$$\mathrm{p}(x) = ax^3 + bx^2 - ax + 8,$$

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

(a) Find the values of a and b. [4]

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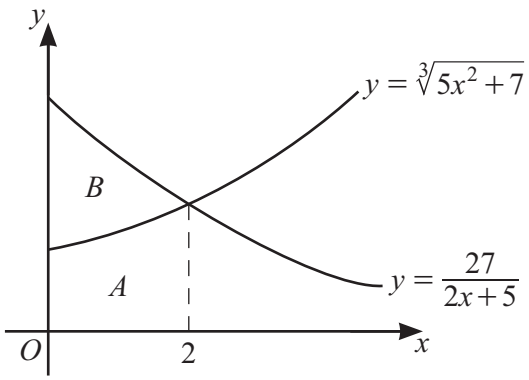
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(b) Factorise $\mathrm{p}(x)$ and hence show that the equation $\mathrm{p}(x) = 0$ has exactly one real root. [3]

(c) Solve the equation $\mathrm{p}\left(\frac{1}{2}\operatorname{cosec}\theta\right) = 0$ for $-90° < \theta < 90°$. [3]

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

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(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]

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(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]

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7 **(a)** Express $4\sin\theta\sin(\theta+60°)$ in the form

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

where a and R are positive integers and $0° < \alpha < 90°$. [6]

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

$$\tfrac{1}{5} + 4\sin\theta\sin(\theta + 60°) = 0.$$ [3]

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