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Cambridge Assessment
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER





MATHEMATICS **9709/21**

Paper 2 Pure Mathematics 2 **May/June 2025**

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 Given that $y = 6x\cos\left(x^2 + 1\right)$, find an expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$. [2]

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2 **(a)** Use logarithms to solve the inequality $4^x < 0.05$. Give your answer in the form $x < a$, where the value of a is correct to 3 significant figures. [2]

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(b) Solve the inequality $|3x + 8| < 9$. [3]

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(c) Hence state the integers that satisfy both of the inequalities in parts **(a)** and **(b)**. [1]

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3 **(a)** Sketch, on a single diagram, the graphs of $y = 3e^{-2x}$ and $y = \sec x$ for values of x such that $0 \leqslant x < \frac{1}{2}\pi$. [2]

(b) Show that the x-coordinate of the point of intersection of the two graphs satisfies the equation $x = \frac{1}{2}\ln(3\cos x)$. [2]

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(c) Use an iterative formula, based on the equation in part **(b)**, to find the x-coordinate of the point of intersection correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

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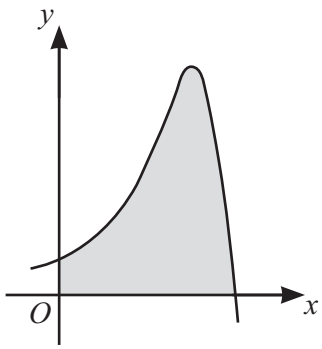

The diagram shows the curve with equation $y = 6e^{2x} - e^{3x}$. The shaded region is bounded by the axes and the curve.

(a) Find the exact x-coordinate of the maximum point. [3]

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(b) Find the area of the shaded region. Give your answer in the form $\frac{p}{q}$, where p and q are integers. [4]

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

$$\mathrm{p}(x) = ax^3 + bx^2 - ax - 24,$$

where a and b are constants. It is given that $(2x-3)$ is a factor of $\mathrm{p}(x)$ and that the remainder is -15 when $\mathrm{p}(x)$ is divided by $(x+1)$.

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

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(b) Hence factorise $\mathrm{p}(x)$ completely. [3]

(c) Hence solve the equation $\mathrm{p}(3\mathrm{cosec}\,\theta) = 0$ for $90° < \theta < 270°$. [2]

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6 The parametric equations of a curve are

$$x = \frac{2t+1}{3t+4}, \qquad y = 2\ln(3t+4),$$

where $t > -\frac{4}{3}$.

(a) Show that $\frac{\mathrm{d}y}{\mathrm{d}x}$ can be expressed in the form $c(3t+4)$ and state the value of the constant c. [5]

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(b) It is given that the gradient of the curve at the point $(a, \ln 100)$ is m.

Find the values of a and m. [4]

(c) State whether the curve represents a decreasing function or an increasing function or neither. Give a reason for your answer. [1]

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7 **(a)** Prove that $\sin^2 2x + 4\cos^2 x \cos 2x \equiv 4\cos^4 x$. [3]

(b) Find the set of possible values of the constant k for which the equation

$$\sin^2 2x + 4\cos^2 x \cos 2x + 5 = k$$

has no real solutions. [2]

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(c) Find the exact value of $\int_{-\frac{1}{3}\pi}^{\frac{1}{3}\pi} \sqrt{\sin^2 t + 4\cos^2\left(\frac{1}{2}t\right)}\cos t \, \mathrm{d}t$. [4]

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