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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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MATHEMATICS **9709/32**

Paper 3 Pure Mathematics 3 **October/November 2025**

1 hour 50 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 75.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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1 **(a)** Sketch the graph of $y = |x + 3a|$, where a is a positive constant. [1]

(b) Hence or otherwise solve the inequality $|x + 3a| > a - 2x$. [2]

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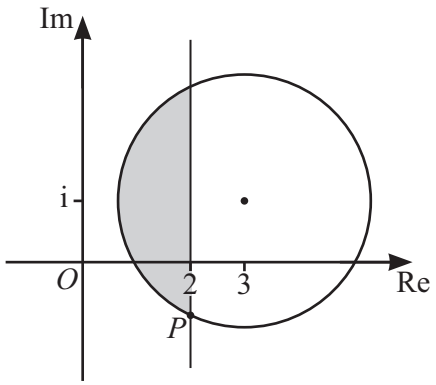
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2 Solve the equation $3 \times 2^{x+1} = 4 \times 3^{2x-3}$. Give your answer correct to 3 significant figures. [4]

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The shaded region in the Argand diagram, bounded by a line and a circle, represents the complex numbers z satisfying

$$\mathrm{Re}\, z \leqslant 2 \text{ and } |z-(3+\mathrm{i})| \leqslant 2.$$

The point P shown on the diagram is one of the points of intersection of the line and the circle.

(a) Find the complex number represented by the point P. Give your answer in the form $x+\mathrm{i}y$, where x and y are real and exact. [2]

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(b) Find the greatest value of $\arg z$ for points in the shaded region. [3]

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4 Find the exact value of $\int_0^1 x \tan^{-1} x \, \mathrm{d}x$. [6]

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5 **(a)** It is given that $f(x) = (x-a)^2 g(x)$, where $f(x)$ and $g(x)$ are polynomials.

Show that $(x-a)$ is a factor of $f'(x)$. [2]

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(b) It is given that $(x-3)^2$ is a factor of $2x^3 - 4x^2 + px + q$, where p and q are constants.

Find the values of p and q. [5]

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6 **(a)** By sketching a suitable pair of graphs, show that the equation $\cot 2x = 2\sin 2x - 1$ has exactly one root in the interval $0 < x < \frac{1}{2}\pi$. [2]

(b) Show by calculation that the root is in the interval $0.4 < x < 0.6$. [2]

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(c) Use the iterative formula $x_{n+1} = \frac{1}{2}\tan^{-1}\left(\frac{1}{2\sin 2x_n - 1}\right)$ to calculate the root correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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7 The equation of a curve is $2y^3 - 3x^2y - x^3 = 16$.

(a) Show that $\frac{dy}{dx} = \frac{x^2 + 2xy}{2y^2 - x^2}$. [4]

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(b) Hence find the coordinates of the points on the curve at which the normal is parallel to the y-axis. [4]

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8 **(a)** Prove the identity $\sin 4x \equiv 4\sin x\left(2\cos^3 x - \cos x\right)$. [3]

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(b) Hence find the exact value of $\int_0^{\frac{1}{4}\pi} \cos^3 x \sin 4x \, \mathrm{d}x$. [5]

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9 Let $f(x) = \dfrac{x^2 + 4ax + 6a^2}{(x+2a)(x+3a)}$, where a is a positive constant.

(a) Express $f(x)$ in partial fractions. [5]

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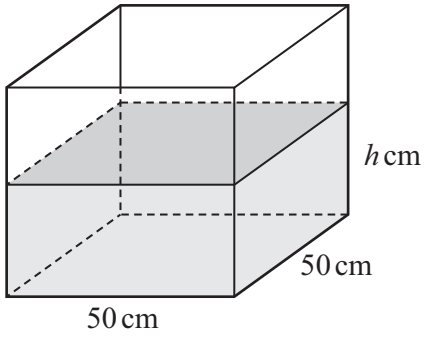
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(b) Hence find the exact value of $\int_{-a}^{a} \mathrm{f}(x)\,\mathrm{d}x$. Give your answer in the form $a(p+\ln q)$, where p and q are rational. [4]

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The diagram shows a tank for holding water. The tank is in the shape of a cube of side 50 cm. At time t seconds, the depth of water in the tank is h cm. Water is poured into the tank at a rate of $5000\,\text{cm}^3\,\text{s}^{-1}$. Water pours out of the tank through a hole in the bottom at a rate proportional to h^2.

When $h = 20$, the depth of the water is increasing at a rate of $0.4\,\text{cm}\,\text{s}^{-1}$.

(a) Show that $\frac{\mathrm{d}h}{\mathrm{d}t} = \frac{500 - h^2}{250}$. [4]

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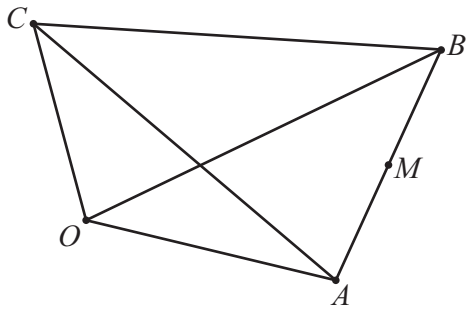
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(b) Given that $h = 0$ when $t = 0$, find the time taken for the depth of the water in the tank to reach 20 cm. [5]

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Relative to the origin O, the position vectors of the points A, B and C are

$$\overrightarrow{OA} = 4\mathbf{i} - 2\mathbf{j},\ \overrightarrow{OB} = 2\mathbf{i} + 8\mathbf{j} + 4\mathbf{k}, \text{ and } \overrightarrow{OC} = -2\mathbf{i} + 6\mathbf{k}.$$

The midpoint of AB is M, as shown in the diagram.

(a) Find the vectors $\overrightarrow{MB}$ and $\overrightarrow{MC}$. [2]

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(b) Calculate the exact value of the cosine of angle CMB. [3]

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(c) Hence or otherwise find the exact area of triangle ABC. [4]

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