



Cambridge International AS & A Level

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MATHEMATICS**9709/32**

Paper 3 Pure Mathematics 3

October/November 2024**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.

- [illegible]



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

- (b)** Show that if a sequence of real values given by the iterative formula

$$x_{n+1} = \frac{1}{2} \tan^{-1}(\cos x_n)$$

converges, then it converges to the root in part (a). [1]

[illegible]

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This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



5 (a) The complex number u is given by

$$u = \frac{(\cos \frac{1}{7}\pi + i \sin \frac{1}{7}\pi)^4}{\cos \frac{1}{7}\pi - i \sin \frac{1}{7}\pi}.$$

Find the exact value of $\arg u$.

[2]

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(b) The complex numbers u and u^* are plotted on an Argand diagram.

Describe the single geometrical transformation that maps u onto u^* and state the exact value of $\arg u^*$.

[2]

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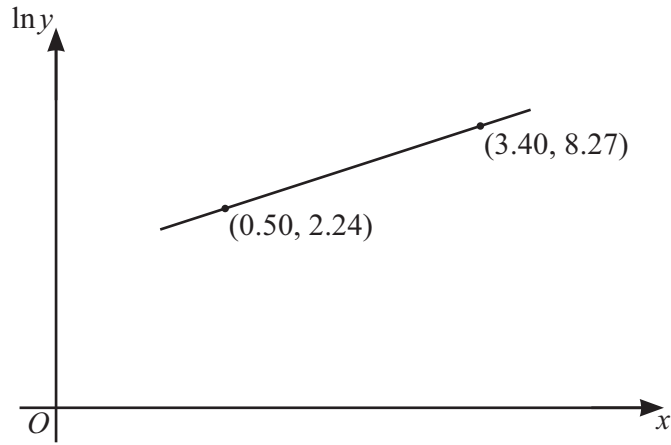
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The variables x and y satisfy the equation $ay = b^x$, where a and b are constants. The graph of $\ln y$ against x is a straight line passing through the points $(0.50, 2.24)$ and $(3.40, 8.27)$, as shown in the diagram.

Find the values of a and b . Give each value correct to 1 significant figure. [4]

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$$\tan^4 x - 2 \tan^2 x - 3 = 0$$

[3]

[illegible]



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$$x = \tan^2 2t, \quad y = \cos 2t,$$

(a) Show that $\frac{dy}{dx} = -\frac{1}{2}\cos^3 2t$.

[4]

[illegible]

[illegible]



9 With respect to the origin O , the points A , B and C have position vectors given by

$$\overrightarrow{OA} = \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}, \quad \overrightarrow{OB} = \begin{pmatrix} 0 \\ 4 \\ 1 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OC} = \begin{pmatrix} -3 \\ -2 \\ 2 \end{pmatrix}.$$

(a) The point D is such that $ABCD$ is a trapezium with $\overrightarrow{DC} = 3\overrightarrow{AB}$.

Find the position vector of D .

[2]

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(b) The diagonals of the trapezium intersect at the point P .

Find the position vector of P .

[5]

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(c) Using a scalar product, calculate angle ABC . [4]

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- 10 A balloon in the shape of a sphere has volume V and radius r . Air is pumped into the balloon at a constant rate of 40π starting when time $t = 0$ and $r = 0$. At the same time, air begins to flow out of the balloon at a rate of $0.8\pi r$. The balloon remains a sphere at all times.

(a) Show that r and t satisfy the differential equation

$$\frac{dr}{dt} = \frac{50-r}{5r^2}. \quad [3]$$

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(b) Find the quotient and remainder when $5r^2$ is divided by $50 - r$. [3]

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[illegible]

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(a) Find $f'(x)$ and hence find the exact coordinates of the stationary point of the curve with equation $y = f(x)$. [5]

[illegible]



1

[illegible]

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