



Cambridge International AS & A Level

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MATHEMATICS**9709/33**

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.



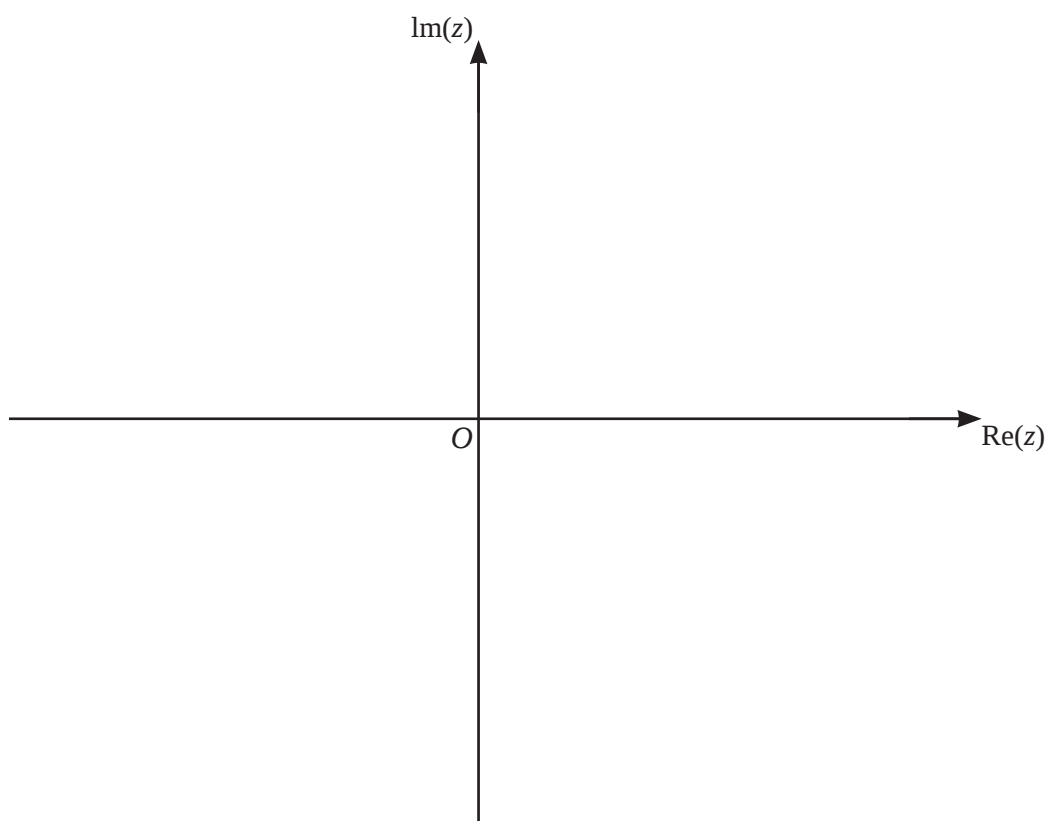
1 The complex number z satisfies $|z| = 2$ and $0 \leq \arg z \leq \frac{1}{4}\pi$.

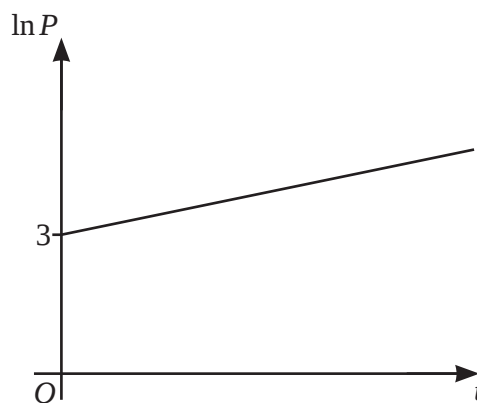
(a) On the Argand diagram below, sketch the locus of the points representing z .

[2]

(b) On the **same diagram**, sketch the locus of the points representing z^2 .

[2]





The number of bacteria in a population, P , at time t hours is modelled by the equation $P = ae^{kt}$, where a and k are constants. The graph of $\ln P$ against t , shown in the diagram, has gradient $\frac{1}{20}$ and intersects the vertical axis at $(0, 3)$.

- (a) State the value of k and find the value of a correct to 2 significant figures. [3]

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- (b) Find the time taken for P to double. Give your answer correct to the nearest hour. [2]

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4 Find the complex number z satisfying the equation

$$\frac{z-3i}{z+3i} = \frac{2-9i}{5}.$$

Give your answer in the form $x + iy$, where x and y are real.

[5]

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5 (a) Show that $\cos^4\theta - \sin^4\theta - 4\sin^2\theta\cos^2\theta \equiv \cos^2 2\theta + \cos 2\theta - 1$. [3]

This image shows a full page of a worksheet designed for handwriting practice. It consists of multiple rows of horizontal dashed lines spaced evenly across the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.



(b) Solve the equation $\cos^4 \alpha - \sin^4 \alpha = 4 \sin^2 \alpha \cos^2 \alpha$ for $0^\circ \leq \alpha \leq 180^\circ$. [3]

[illegible]



6 The lines l and m have vector equations

$$l: \mathbf{r} = 2\mathbf{i} + \mathbf{j} - 3\mathbf{k} + \lambda(-\mathbf{i} + 2\mathbf{k}) \quad \text{and} \quad m: \mathbf{r} = 2\mathbf{i} + \mathbf{j} - 3\mathbf{k} + \mu(2\mathbf{i} - \mathbf{j} + 5\mathbf{k}).$$

Lines l and m intersect at the point P .

(a) State the coordinates of P . [1]

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(b) Find the exact value of the cosine of the acute angle between l and m . [3]

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(c) The point A on line l has coordinates $(0, 1, 1)$. The point B on line m has coordinates $(0, 2, -8)$.

Find the exact area of triangle APB .

[3]

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7 The parametric equations of a curve are

$$x = 3 \sin 2t, \quad y = \tan t + \cot t,$$

for $0 < t < \frac{1}{2}\pi$.

(a) Show that $\frac{dy}{dx} = \frac{-2}{3 \sin^2 2t}$. [5]

[illegible]



- (b)** Find the equation of the normal to the curve at the point where $t = \frac{1}{4}\pi$. Give your answer in the form $py + qx + r = 0$, where p , q and r are integers. [3]

[illegible]



[3]

[illegible]



- (b)** Hence obtain the expansion of $f(x)$ in ascending powers of x , up to and including the term in x^2 . [4]

[illegible]

- (c) State the set of values of x for which the expansion in part (b) is valid. [1]

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9 (a) Find the quotient and remainder when $x^4 + 16$ is divided by $x^2 + 4$. [3]

[illegible]



(b) Hence show that $\int_2^{2\sqrt{3}} \frac{x^4 + 16}{x^2 + 4} dx = \frac{4}{3}(\pi + 4)$.

[5]





- (a) Show that $200 \frac{dh}{dt} = 250 - 3h$. [3]

[illegible]



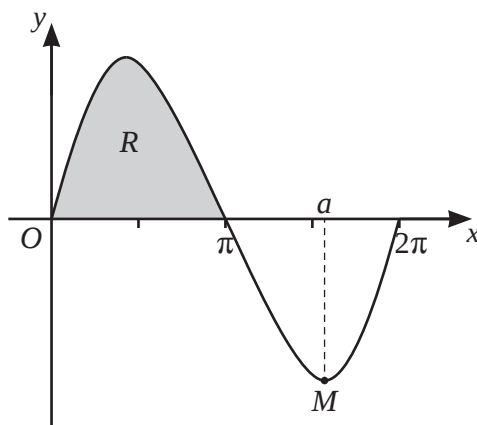
(b) It is given that when $t = 0$, $h = 50$.

Find the time taken for the depth of water in the tank to reach 80 cm. Give your answer correct to 2 significant figures. [5]

[illegible]



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(b) Use the substitution $u = 2 + \cos x$ to find the exact area of the shaded region R .

[6]

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