



Cambridge International AS & A Level

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MATHEMATICS

9709/31

Paper 3 Pure Mathematics 3

May/June 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.

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2

1 (a) Sketch the graph of $y = |2x - 3|$.

[1]

(b) Solve the inequality $3x - 1 < |2x - 3|$.

[2]

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3

- 2** It is given that $2 \ln p + \ln(p-1) - \frac{1}{2} \ln(q+1) = 3$.

Find q in terms of p .

[3]

[illegible]



- [6]

[illegible]

[illegible]



4 The parametric equations of a curve are

$$x = e^{\tan t}, \quad y = 3 \tan^2 t.$$

Find the equation of the tangent to the curve at the point $(e, 3)$. Give your answer in the form $y = mx + c$, where m and c are exact. [6]

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- When $f(x)$ is divided by $(x+2a)$ the remainder is $-22a^3$. When $f(x)$ is divided by $(3x-a)$ the remainder is $-a^3$.

[5]

[illegible]



6 It is given that $z_1 = 3e^{\frac{1}{4}\pi i}$, $z_2 = \frac{3}{2}e^{\frac{1}{6}\pi i}$ and $\omega = 2e^{\frac{1}{2}\pi i}$.

- (a) State the values of ωz_1 and ωz_2 . Give your answers in the form $re^{i\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$. [2]

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- (b) On a sketch of an Argand diagram with origin O , show the points A , B , C and D representing the complex numbers z_1 , z_2 , ωz_1 and ωz_2 respectively. [2]

- (c) State the geometric effects of multiplying z_1 and z_2 by ω . [2]

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- [4]

[illegible]



- (b) Hence solve the equation $5 \sin\left(2\theta + \frac{1}{6}\pi\right) - 4 \cos 2\theta = \sqrt{7}$ for $0 \leq \theta \leq \pi$. Give your answers correct to 2 decimal places. [4]

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- 8 With respect to the origin O , the points A and B have position vectors $2\mathbf{i}+4\mathbf{k}$ and $5\mathbf{i}+\mathbf{j}+6\mathbf{k}$ respectively. The line l_1 passes through the points A and B .

(a) Find a vector equation for the line l_1 . [2]

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The line l_2 has equation $\mathbf{r} = 2\mathbf{i} + \mathbf{j} + 5\mathbf{k} + \mu(\mathbf{i} + 2\mathbf{j} + 3\mathbf{k})$.

(b) Show that l_1 and l_2 do **not** intersect. [4]

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- (c) Find the acute angle between the directions of l_1 and l_2 . [3]





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(b) Verify by calculation that a lies between 2 and 2.1.

[2]

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(c) Use an iterative formula based on the equation in part (a) to determine a correct to 2 decimal places. Give the result of each iteration to 4 decimal places.

[3]

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- 10 (a) Find the quotient and remainder when $x^3 + 5x^2 - 2x - 15$ is divided by $x^2 - 3$. [3]

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- (b) The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = \frac{x^3 + 5x^2 - 2x - 15}{6y(x^2 - 3)}.$$

It is given that $y = 2$ when $x = 2$.

Solve the differential equation to obtain an expression for y^2 in terms of x . [5]

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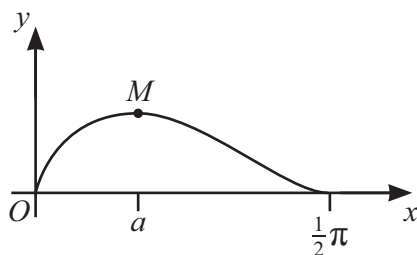
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The diagram shows the curve $y = \cos x \sqrt{\sin 2x}$ for $0 \leq x \leq \frac{1}{2}\pi$. The curve has a maximum point at M , where $x = a$.

- (a) Find the exact value of a .

[6]

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- (b) The region enclosed between the x -axis and the curve is rotated through 2π radians about the x -axis.

Find the exact volume of the solid generated.

[5]

[illegible]



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