



## Cambridge International AS & A Level

CANDIDATE  
NAME

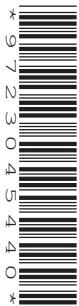


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### MATHEMATICS

9709/33

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

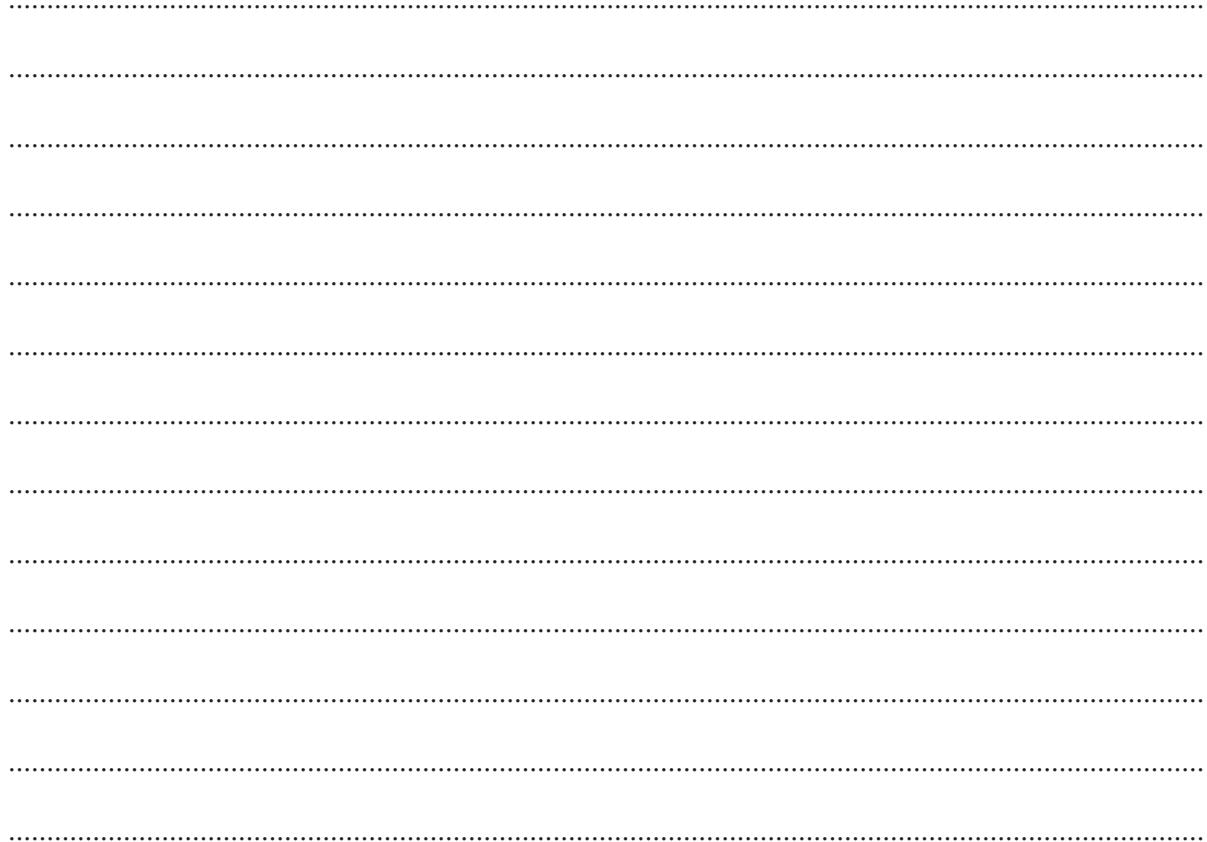
- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].

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



- 1 (a) Sketch the graph of  $y = |3x - 2a|$ , where  $a$  is a positive constant. [1]

(b) Hence or otherwise solve the inequality  $|3x - 2a| < x + 5a$ . [3]





- 2** Solve the equation  $2 \ln(2x + 3) - \ln(2x + 5) = \ln(3x)$ . [4]





- 3 Find the exact value of  $\int_{\frac{1}{5}\pi}^{\frac{1}{4}\pi} 3 \cos^2 5x \, dx$ . [4]





**4 (a)** It is given that  $z_1 = r_1 e^{i\theta_1}$  and  $z_2 = r_2 e^{i\theta_2}$ .

Show that  $(z_1 z_2)^* = z_1^* z_2^*$ .

[3]

(b)  $z = 3e^{\frac{1}{4}\pi i}$  is a root of the equation  $z^2 + bz + c = 0$ , where  $b$  and  $c$  are real.

State the other root and hence find the values of  $b$  and  $c$ .

[3]





- 5** The equation of a curve is  $xy + y^2 e^{-x} = 4$ .

(a) Show that  $\frac{dy}{dx} = \frac{y^2 - ye^x}{xe^x + 2y}$ .

[4]

(b) Find the gradients of the tangents to the curve when  $x = 0$ .

[2]





- 6 Find the complex numbers  $z$  for which  $\frac{z+4}{z+4i}$  is real and  $|z|=\sqrt{10}$ . Give your answers in the form  $z = x + iy$ , where  $x$  and  $y$  are real. [6]





- 7 Let  $f(x) = \frac{3a - 5x}{(3a + 2x)(2a - x)}$ , where  $a$  is a positive constant.

- (a)** Express  $f(x)$  in partial fractions.

[3]





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

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

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- 8 (a)** Prove the identity  $\cot^2\theta - \tan^2\theta \equiv 4 \cot 2\theta \cosec 2\theta$ .

[4]





- (b) Hence solve the equation  $\cot^2 x - \tan^2 x = 5 \sec 2x$  for  $0^\circ < x < 90^\circ$ .

[4]





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

$$\overrightarrow{OA} = \mathbf{i} + 2\mathbf{j}, \quad \overrightarrow{OB} = \mathbf{i} + 3\mathbf{j} - 2\mathbf{k} \quad \text{and} \quad \overrightarrow{OC} = 2\mathbf{i} - \mathbf{j} + 3\mathbf{k}.$$

The line  $l$  passes through  $B$  and  $C$ .

- (a) Find a vector equation for  $l$ .

[2]

- (b) The point  $P$  is the foot of the perpendicular from  $A$  to  $l$ .

Find the position vector of  $P$ .

[4]





- (c) The point  $D$  is the reflection of  $A$  in  $l$ .

Find the position vector of  $D$ .

[2]





**10** The variables  $x$  and  $y$  satisfy the differential equation

$$\sin 4y \frac{dy}{dx} = x \sin 2y \sin 3x.$$

It is given that  $y = \frac{1}{12}\pi$  when  $x = \frac{1}{2}\pi$ .

- (a) Solve the differential equation, obtaining a relation between  $x$  and  $y$ .

[8]



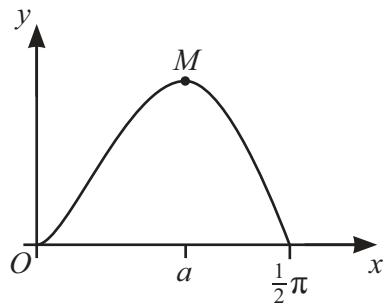


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**(b)** Given that  $0 < y < \frac{1}{2}\pi$ , find the values of  $y$  when  $x = 0$ .

[2]





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

- (a) Show that  $\tan 2a = -4a$  [4]

- (b) Show by calculation that  $0.9 < a < 0.95$ . [2]

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$$x_{n+1} = \frac{1}{2}\left(\pi - \tan^{-1}(4x_n)\right)$$

converges, then it converges to  $a$ .

[2]

(d) Use the iterative formula in part (c) to calculate  $a$  correct to 4 decimal places. Give the result of each iteration to 6 decimal places. [3]





Additional page

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