



# Cambridge International AS & A Level

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## MATHEMATICS

9709/21

Paper 2 Pure Mathematics 2

October/November 2023

1 hour 15 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 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.



- 1** It is given that  $\theta$  is an acute angle in degrees such that  $\sin \theta = \frac{2}{3}$ .

Find the exact value of  $\sin(\theta + 60^\circ)$ .

[3]

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

**2** A curve has equation  $y = 3 \tan \frac{1}{2}x \cos 2x$ .

Find the gradient of the curve at the point for which  $x = \frac{1}{3}\pi$ . [5]

[illegible]

- 3 (a) Find  $\int_4^{10} \frac{4}{2x-5} dx$ , giving your answer in the form  $\ln a$ , where  $a$  is an integer. [4]

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- (b) Find the exact value of  $\int_4^{10} e^{2x-5} dx$ . [2]

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- 4 (a) Sketch, on the same diagram, the graphs of  $y = |3x - 5|$  and  $y = 2x + 7$ . [2]

- (b) Solve the equation  $|3x - 5| = 2x + 7$ . [3]

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- (c) Hence solve the equation  $|3^{y+1} - 5| = 2 \times 3^y + 7$ , giving your answer correct to 3 significant figures. [2]

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**5** The polynomial  $p(x)$  is defined by

$$p(x) = 6x^3 + ax^2 + bx - 20,$$

where  $a$  and  $b$  are constants. It is given that  $(x + 2)$  is a factor of  $p(x)$  and that the remainder is  $-11$  when  $p(x)$  is divided by  $(x + 1)$ .

**(a)** Find the values of  $a$  and  $b$ .

[5]

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- (b)** Hence factorise  $p(x)$ , and determine the exact roots of the equation  $p(3x) = 0$ . [4]

[illegible]

- 6 (a)** Show that  $\operatorname{cosec} \theta(3 \sin 2\theta + 4 \sin^3 \theta) \equiv 4 + 6 \cos \theta - 4 \cos^2 \theta$ . [3]

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- (b)** Solve the equation

$$\operatorname{cosec} \theta(3 \sin 2\theta + 4 \sin^3 \theta) + 3 = 0$$

for  $-\pi < \theta < 0$ .

[3]

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- (c) Find  $\int \operatorname{cosec} \theta (3 \sin 2\theta + 4 \sin^3 \theta) \, d\theta$ . [3]

- 7** The curve with equation  $e^{2x} - 18x + y^3 + y = 11$  has a stationary point at  $(p, q)$ .

(a) Find the exact value of  $p$ .

[4]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (b) Show that  $q = \sqrt[3]{2 + 18 \ln 3 - q}$ . [2]

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- (c) Show by calculation that the value of  $q$  lies between 2.5 and 3.0. [2]

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- (d) Use an iterative formula, based on the equation in (b), to find the value of  $q$  correct to 4 significant figures. Give the result of each iteration to 6 significant figures. [3]

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