



## Cambridge International AS & A Level

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**MATHEMATICS**

**9709/23**

Paper 2 Pure Mathematics 2

**October/November 2022**

**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 **16** pages. Any blank pages are indicated.

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2 Use logarithms to solve the equation  $14e^{-2x} = 5^{x+1}$ , giving your answer correct to 3 significant figures. [4]

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3 It is given that  $\sec \theta = \sqrt{17}$  where  $0 < \theta < \frac{1}{2}\pi$ .

Find the exact value of  $\tan(\theta + \frac{1}{4}\pi)$ . [4]

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- 4 (a) By sketching a suitable pair of graphs on the same diagram, show that the equation

$$e^{-\frac{1}{2}x} = x^5$$

has exactly one real root.

[2]

- (b) Use the iterative formula  $x_{n+1} = \sqrt[5]{e^{-\frac{1}{2}x_n}}$  to determine the root correct to 4 significant figures. Give the result of each iteration to 6 significant figures. [3]

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5 A curve has equation  $4e^{2x}y + y^2 = 21$ .

Find the gradient of the curve at the point  $(0, -7)$ .

[5]

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6 The polynomial  $p(x)$  is defined by

$$p(x) = 12x^3 - 9x^2 + 8x - 4.$$

- (a) Find the quotient when  $p(x)$  is divided by  $(4x - 3)$  and show that the remainder is 2. [3]

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- (b) Hence find  $\int_2^{12} \left( \frac{p(x)}{4x - 3} - 3x^2 \right) dx$ , giving your answer in the form  $a + \ln b$ . [6]

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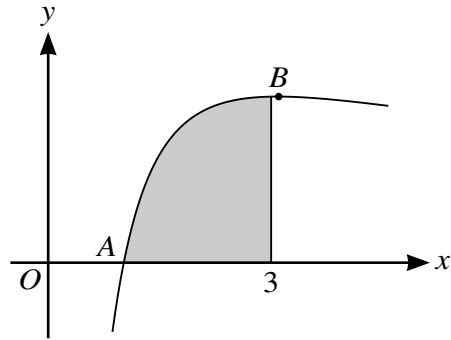
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The diagram shows the curve with equation  $y = \frac{2 \ln x}{3x + 1}$ . The curve crosses the  $x$ -axis at the point  $A$  and has a maximum point  $B$ . The shaded region is bounded by the curve and the lines  $x = 3$  and  $y = 0$ .

(a) Find the gradient of the curve at  $A$ . [3]

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(b) Show by calculation that the  $x$ -coordinate of  $B$  lies between 3.0 and 3.1. [3]

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(c) Use the trapezium rule with two intervals to find an approximation to the area of the shaded region. Give your answer correct to 2 decimal places. [3]

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8 The expression  $f(\theta)$  is defined by  $f(\theta) = 12 \sin \theta \cos \theta + 16 \cos^2 \theta$ .

- (a) Express  $f(\theta)$  in the form  $R \cos(2\theta - \alpha) + k$ , where  $R > 0$ ,  $0 < \alpha < \frac{1}{2}\pi$  and  $k$  is a constant. State the values of  $R$  and  $k$ , and give the value of  $\alpha$  correct to 4 significant figures. [5]

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- (b) Find the smallest positive value of  $\theta$  satisfying the equation  $f(\theta) = 17$ . [3]

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(c) Find  $\int f(\theta) d\theta$ . [2]

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**Additional Page**

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