Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

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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1 Solve the inequality $|2x - 5| > x$. [4]

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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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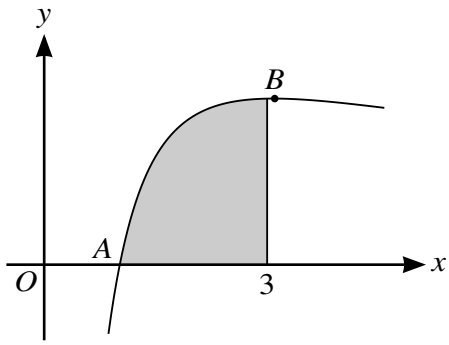

The diagram shows the curve with equation $y = \dfrac{2\ln x}{3x+1}$. The curve crosses the x-axis at the point A and has a maximum point B. The shaded region is bounded by the curve and the lines $x = 3$ and $y = 0$.

(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 α correct to 4 significant figures. [5]

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(b) Find the smallest positive value of θ 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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