Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0894090447

MATHEMATICS **9709/22**

Paper 2 Pure Mathematics 2 **February/March 2024**

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 Use logarithms to solve the equation $3^{4x+3} = 5^{2x+7}$. Give your answer correct to 3 significant figures. [4]

2 **(a)** Sketch the graph of $y = |3x - 7|$, stating the coordinates of the points where the graph meets the axes. [2]

(b) Hence find the set of values of the constant k for which the equation $|3x - 7| = k(x - 4)$ has exactly two real roots. [2]

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3 The polynomial $\mathrm{p}(x)$ is defined by

$$\mathrm{p}(x) = 6x^3 + ax^2 + 3x - 10,$$

where a is a constant. It is given that $(2x-1)$ is a factor of $\mathrm{p}(x)$.

(a) Find the value of a and hence factorise $\mathrm{p}(x)$ completely. [5]

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(b) Solve the equation $\mathrm{p}(\mathrm{cosec}\,\theta) = 0$ for $-90° < \theta < 90°$. [2]

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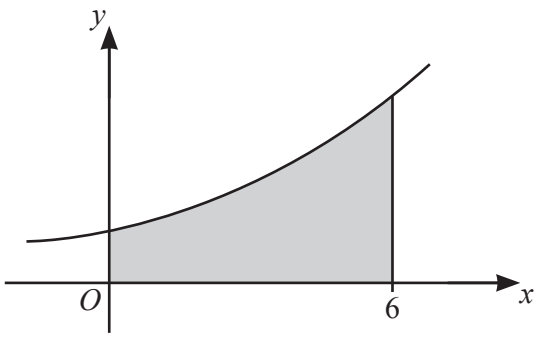
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4



The diagram shows the curve with equation $y = \sqrt{1 + e^{0.5x}}$. The shaded region is bounded by the curve and the straight lines $x = 0$, $x = 6$ and $y = 0$.

(a) Use the trapezium rule with three intervals to find an approximation to the area of the shaded region. Give your answer correct to 3 significant figures. [3]

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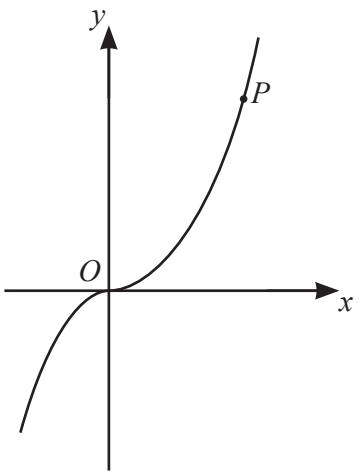
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(b) The shaded region is rotated completely about the x-axis.

Find the exact volume of the solid produced. [4]

5



The diagram shows part of the curve with equation $y = \frac{x^3}{x+2}$. At the point P, the gradient of the curve is 6.

(a) Show that the x-coordinate of P satisfies the equation $x = \sqrt[3]{12x+12}$. [4]

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(b) Show by calculation that the x-coordinate of P lies between 3.8 and 4.0 . [2]

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(c) Use an iterative formula, based on the equation in part **(a)**, to find the x-coordinate of P correct to 3 significant figures. Show the result of each iteration to 5 significant figures. [3]

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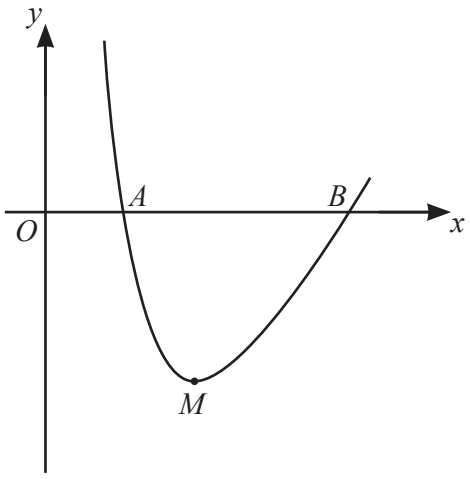
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The diagram shows the curve with parametric equations

$$x = 1 + \sqrt{t}, \qquad y = (\ln t + 2)(\ln t - 3),$$

for $0 < t < 25$. The curve crosses the x-axis at the points A and B and has a minimum point M.

(a) Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{4\ln t - 2}{\sqrt{t}}$. [4]

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(b) Find the exact gradient of the curve at B. [2]

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(c) Find the exact coordinates of M. [3]

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7 **(a)** Prove that

$$\sin 2\theta(a\cot\theta + b\tan\theta) \equiv a + b + (a - b)\cos 2\theta,$$

where a and b are constants. [4]

(b) Find the exact value of $\int_{\frac{1}{12}\pi}^{\frac{1}{6}\pi} \sin 2\theta(5\cot\theta + 3\tan\theta)\,\mathrm{d}\theta$. [3]

(c) Solve the equation $\sin\frac{2}{3}\alpha\left(2\cot\frac{1}{3}\alpha + 7\tan\frac{1}{3}\alpha\right) = 11$ for $-\pi < \alpha < \pi$. [3]

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

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