

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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MATHEMATICS

9709/22

Paper 2 Pure Mathematics 2

February/March 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 **16** pages. Any blank pages are indicated.

1 Find the exact value of $\int_0^{\frac{1}{2}\pi} 2 \tan^2(\frac{1}{2}x) \, dx$.

[4]

[illegible]

- 2** Solve the equation $\tan(\theta - 60^\circ) = 3 \cot \theta$ for $-90^\circ < \theta < 90^\circ$. [5]

[illegible]

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

$$p(x) = ax^3 - ax^2 + ax + b,$$

where a and b are constants. It is given that $(x + 2)$ is a factor of $p(x)$, and that the remainder is 35 when $p(x)$ is divided by $(x - 3)$.

(a) Find the values of a and b .

[5]

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- (b)** Hence factorise $p(x)$ and show that the equation $p(x) = 0$ has exactly one real root. [3]

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- 4 (a) Sketch, on the same diagram, the graphs of $y = |2x - 11|$ and $y = 3x - 3$. [2]

- (b) Solve the inequality $|2x - 11| < 3x - 3$. [3]

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- (c) Find the smallest integer N satisfying the inequality $|2 \ln N - 11| < 3 \ln N - 3$. [2]

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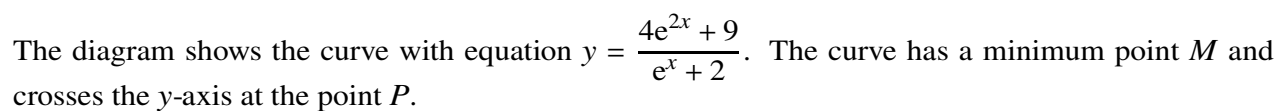
5 It is given that $\int_1^a \left(\frac{4}{1+2x} + \frac{3}{x} \right) dx = \ln 10$, where a is a constant greater than 1.

(a) Show that $a = \sqrt[3]{90(1+2a)^{-2}}$. [5]

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- (b) Use an iterative formula, based on the equation in (a), to find the value of a correct to 3 significant figures. Use an initial value of 1.7 and give the result of each iteration to 5 significant figures. [3]

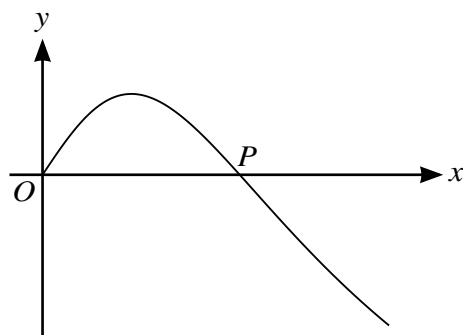
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- [illegible]

[4]

[illegible]



The diagram shows the curve with parametric equations

$$x = k \tan t, \quad y = 3 \sin 2t - 4 \sin t,$$

for $0 < t < \frac{1}{2}\pi$. It is given that k is a positive constant. The curve crosses the x -axis at the point P .

- (a) Find the value of $\cos t$ at P , giving your answer as an exact fraction. [3]

This image shows a full page of white paper with horizontal dashed 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) Express $\frac{dy}{dx}$ in terms of k and $\cos t$. [4]

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- (c) Given that the normal to the curve at P has gradient $\frac{9}{10}$, find the value of k , giving your answer as an exact fraction. [3]

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