

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
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MATHEMATICS

9709/23

Paper 2 Pure Mathematics 2

May/June 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.

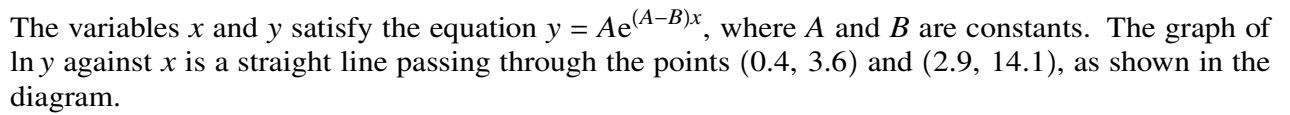
1 Solve the equation

$$\sec^2 \theta + 5 \tan^2 \theta = 9 + 17 \sec \theta$$

for $0^\circ < \theta < 360^\circ$.

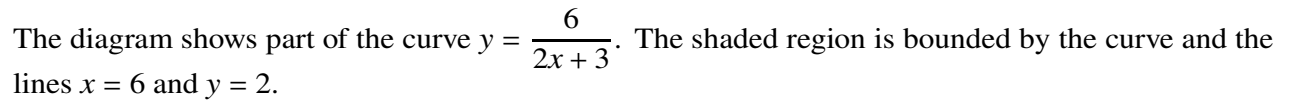
[5]

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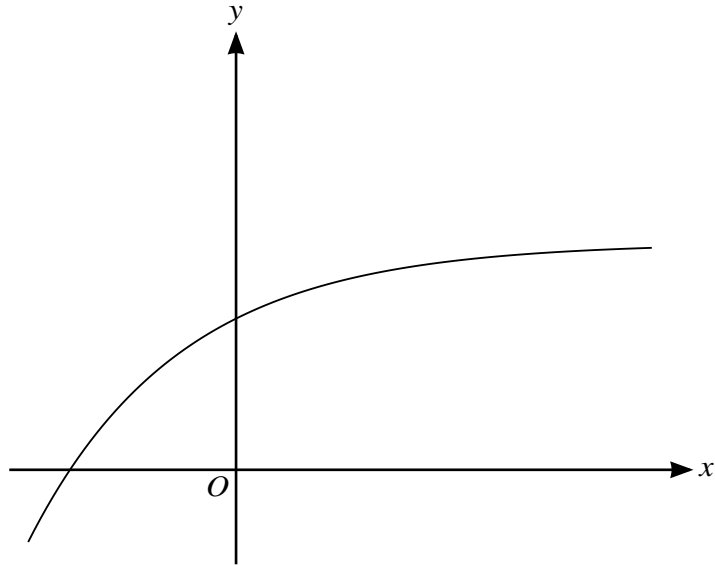
[5]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

4 (a)



The diagram shows the graph of $y = 3 - e^{-\frac{1}{2}x}$.

On the diagram, sketch the graph of $y = |5x - 4|$, and show that the equation $3 - e^{-\frac{1}{2}x} = |5x - 4|$ has exactly two real roots. [2]

It is given that the two roots of $3 - e^{-\frac{1}{2}x} = |5x - 4|$ are denoted by α and β , where $\alpha < \beta$.

(b) Show by calculation that α lies between 0.36 and 0.37. [2]

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(c) Use the iterative formula $x_{n+1} = \frac{1}{5}(7 - e^{-\frac{1}{2}x_n})$ to find β correct to 4 significant figures. Give the result of each iteration to 6 significant figures. [3]

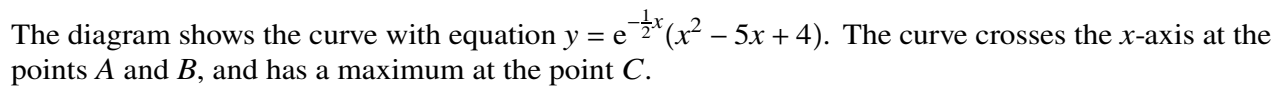
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- This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(b) Find the exact coordinates of C .

[4]

[illegible]

- 6 (a)** Show that $4 \sin\left(\theta + \frac{1}{3}\pi\right) \cos\left(\theta - \frac{1}{3}\pi\right) \equiv \sqrt{3} + 2 \sin 2\theta$. [4]

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- (b)** Find the exact value of $4 \sin \frac{17}{24}\pi \cos \frac{1}{24}\pi$. [2]

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[Turn over

where a is a constant. It is given that, at the point P on the curve, the gradient is 1.

(a) Show that the value of t at P satisfies the equation

$$2t^3 + (a+8)t^2 + (4a+8)t + 4a-1 = 0. \quad [4]$$

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- (b) It is given that $(t + 1)$ is a factor of

$$2t^3 + (a + 8)t^2 + (4a + 8)t + 4a - 1.$$

Find the value of a .

[2]

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- (c) Hence show that P is the only point on the curve at which the gradient is 1.

[3]

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[illegible]

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