



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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9709/22

February/March 2024

1 hour 15 minutes

You will need: List of formulae (MF19)

- 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.

- 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]

[illegible]

- 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 $p(x)$ is defined by

$$p(x) = 6x^3 + ax^2 + 3x - 10,$$

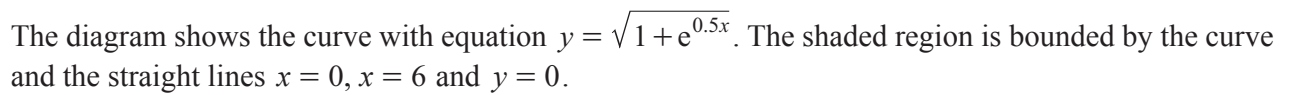
where a is a constant. It is given that $(2x-1)$ is a factor of $p(x)$.

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

[illegible]

(b) Solve the equation $\text{p}(\text{cosec } \theta) = 0$ for $-90^\circ < \theta < 90^\circ$. [2]

[illegible]



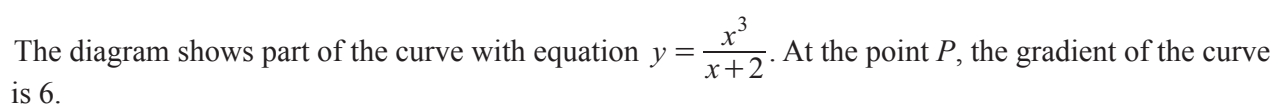
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- This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice. There are no margins, text, or other markings on the page.

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

Find the exact volume of the solid produced.

[4]

This image shows a full page of a handwriting practice sheet. It consists of multiple rows of horizontal dotted 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.



- [illegible]

- (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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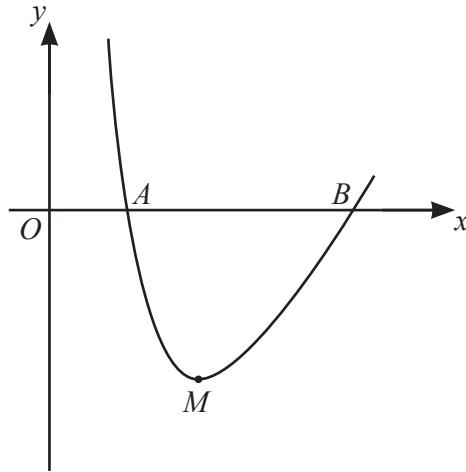
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The diagram shows the curve with parametric equations

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

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 $\frac{dy}{dx} = \frac{4 \ln t - 2}{\sqrt{t}}$. [4]

[illegible]

(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]

[illegible]

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

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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

[illegible]

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