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9709/22

February/March 2024

1 hour 15 minutes

You must answer on the question paper.

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

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

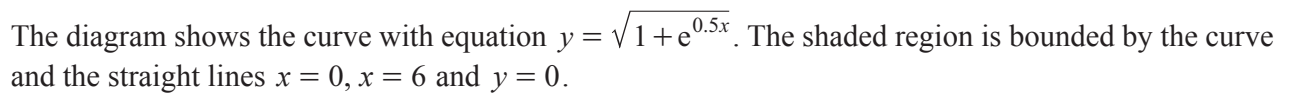
where a is a constant. It is given that $(2x - 1)$ is a factor of $p(x)$.

(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]



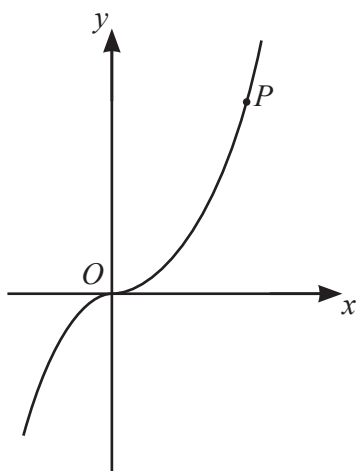
- [illegible]

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

Find the exact volume of the solid produced.

[4]

[illegible]



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

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

- [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]

[illegible]

(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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