

Cambridge International AS & A Level

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MATHEMATICS

9709/21

Paper 2 Pure Mathematics 2

May/June 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.

- 1** A curve has equation $y = 2 \tan x - 5 \sin x$ for $0 \leq x < \frac{1}{2}\pi$.

Find the x -coordinate of the stationary point of the curve. Give your answer correct to 3 significant figures. [3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal lines each: a solid top line, a dashed middle line, and a solid bottom line. These lines are evenly spaced and run across the entire width of the page, providing a guide for letter formation and alignment. There is no text or other markings on the page.

2 A curve has equation $x^2 \ln y + y^2 + 4x = 9$.

Find the gradient of the curve at the point $(2, 1)$.

[5]

[illegible]

- 3 (a) Sketch on the same diagram the graphs of $y = |3x - 8|$ and $y = 5 - x$. [2]

- (b) Solve the inequality $|3x - 8| < 5 - x$. [4]

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- (c) Hence determine the largest integer N satisfying the inequality $|3e^{0.1N} - 8| < 5 - e^{0.1N}$. [2]

4 (a) Show that $3 \tan 2\theta + \tan(\theta + 45^\circ) \equiv \frac{\tan^2 \theta + 8 \tan \theta + 1}{1 - \tan^2 \theta}$. [4]

[illegible]

(b) Hence solve the equation $3 \tan 2\theta + \tan(\theta + 45^\circ) = 4$ for $0^\circ < \theta < 180^\circ$. [3]

[illegible]

- 5** A curve has equation $y = \frac{1+e^{2x}}{1+3x}$. The curve has exactly one stationary point P .

(a) Find $\frac{dy}{dx}$ and hence show that the x -coordinate of P satisfies the equation $x = \frac{1}{6} + \frac{1}{2}e^{-2x}$. [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) Show by calculation that the x -coordinate of P lies between 0.35 and 0.45 . [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. Give the result of each iteration to 5 significant figures. [3]

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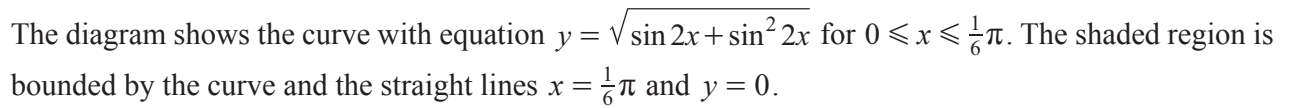
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- [illegible]

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

Find the exact volume of the solid produced.

[6]

[illegible]

- 7 The polynomial $p(x)$ is defined by

$$p(x) = 9x^3 + 6x^2 + 12x + k,$$

where k is a constant.

- (a) Find the quotient when $p(x)$ is divided by $(3x + 2)$ and show that the remainder is $(k - 8)$. [3]

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- (b) It is given that $\int_1^6 \frac{p(x)}{3x+2} dx = a + \ln 64$, where a is an integer.

Find the values of a and k . [6]

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[illegible]

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9709/22

May/June 2024

1 hour 15 minutes

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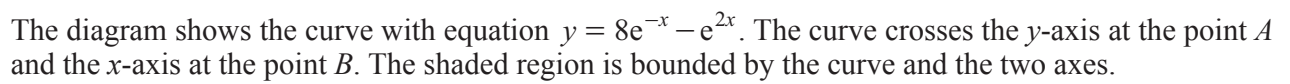
1 Solve the inequality $|5x + 7| > |2x - 3|$.

[4]

[illegible]

- 2 Use logarithms to solve the equation $6^{2x-1} = 5e^{3x+2}$. Give your answer correct to 4 significant figures. [4]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice 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.



- [illegible]

- (b)** Show that the x -coordinate of B is $\ln 2$ and hence find the area of the shaded region. [5]

[illegible]

4 A curve is defined by the parametric equations

$$x = 4 \cos^2 t, \quad y = \sqrt{3} \sin 2t,$$

for values of t such that $0 < t < \frac{1}{2}\pi$.

Find the equation of the normal to the curve at the point for which $t = \frac{1}{6}\pi$. Give your answer in the form $ax + by + c = 0$ where a , b and c are integers. [7]

5 The polynomial $p(x)$ is defined by $p(x) = 9x^3 + 18x^2 + 5x + 4$.

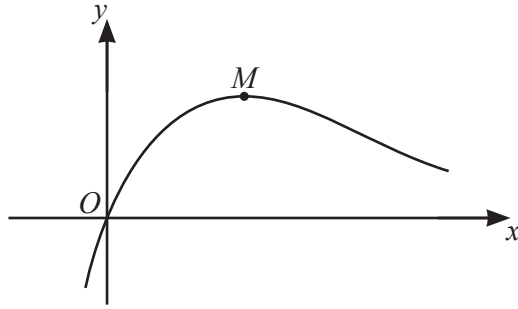
(a) Find the quotient when $p(x)$ is divided by $(3x+2)$, and show that the remainder is 6. [3]

[illegible]

(b) Find the value of $\int_0^2 \frac{p(x)}{3x+2} dx$, giving your answer in the form $a + \ln b$ where a and b are integers. [5]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no margins, text, or other markings.

6



The diagram shows the curve with equation $y = \frac{\ln(2x+1)}{x+3}$. The curve has a maximum point M .

- (a) Find an expression for $\frac{dy}{dx}$. [2]

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- (b) Show that the x -coordinate of M satisfies the equation $x = \frac{x+3}{\ln(2x+1)} - 0.5$. [2]

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- (c) Show by calculation that the x -coordinate of M lies between 2.5 and 3.0 . [2]

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- (d) Use an iterative formula based on the equation in part (b) to find the x -coordinate of M correct to 4 significant figures. Give the result of each iteration to 6 significant figures. [3]

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7 (a) Prove that $2 \sin \theta \operatorname{cosec} 2\theta \equiv \sec \theta$.

[2]

This image shows a single 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.

(b) Solve the equation $\tan^2 \theta + 7 \sin \theta \operatorname{cosec} 2\theta = 8$ for $-\pi < \theta < \pi$.

[5]

This image shows a full page of primary-ruled paper. It features ten sets of horizontal dashed lines, each set consisting of three parallel lines. These lines are evenly spaced vertically across the entire page, providing a guide for handwriting practice. The background is white, and there are no margins or additional markings.

- (c) Find $\int 8 \sin^2 \frac{1}{2} x \operatorname{cosec}^2 x \, dx$. [3]

[illegible]

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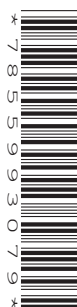
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MATHEMATICS
9709/23

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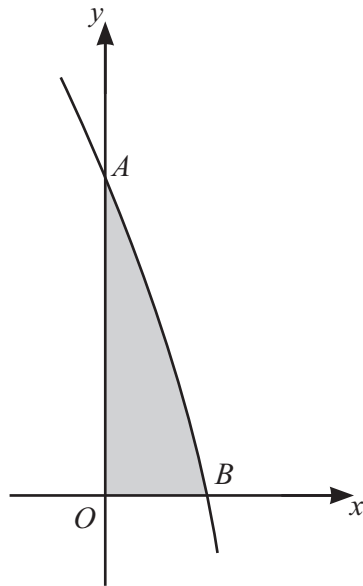
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[4]

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[illegible]



11

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dashed lines, creating a series of uniform gaps for letter height. The lines are evenly spaced across the entire page, providing a guide for consistent letter formation. There is no text or other markings on the page.

4

$$x = 4 \cos^2 t, \quad y = \sqrt{3} \sin 2t,$$

for values of t such that $0 < t < \frac{1}{2}\pi$.

Find the equation of the normal to the curve at the point for which $t = \frac{1}{6}\pi$. Give your answer in the form $ax + by + c = 0$ where a , b and c are integers. [7]

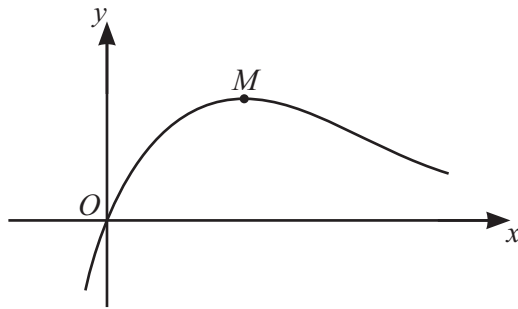
[illegible]

[illegible]

(a) Find the quotient when $p(x)$ is divided by $(3x+2)$, and show that the remainder is 6. [3]

[illegible]

[illegible]



The diagram shows the curve with equation $y = \frac{\ln(2x+1)}{x+3}$. The curve has a maximum point M .

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[2]

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[3]

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[2]

[illegible]

[5]

[illegible]



(c) Find $\int 8 \sin^2 \frac{1}{2}x \operatorname{cosec}^2 x \, dx$.

[3]



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

[illegible]

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