



Cambridge International AS & A Level

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MATHEMATICS**9709/21**

Paper 2 Pure Mathematics 2

October/November 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.

- (a)** Use logarithms to show that the gradient of the straight line is $\frac{3}{2 \ln a}$. [1]

[illegible]

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- 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.



[4]

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The paper is otherwise blank, with no margins, text, or other markings.

(a) Find the exact value of $f'\left(\frac{2}{3}\pi\right)$. [3]

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.



[4]

[illegible]



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

$$p(x) = ax^3 - ax^2 - 15x + 18,$$

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

(a) Find the value of a . [2]

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(b) Hence factorise $p(x)$ completely. [3]

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[3]

[illegible]

(a) Show that $a = \sqrt[3]{0.5e^{1.4}(2a+1) - 0.5}$. [5]

[illegible]

[illegible]

$$x = \frac{e^{2t} - 2}{e^{2t} + 1}, \quad y = e^{3t} + 1.$$

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[3]

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

[illegible]



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

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.



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MATHEMATICS

9709/22

Paper 2 Pure Mathematics 2

October/November 2024

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

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[illegible]



2 Let $f(x) = 4 \sin^2 3x$.

(a) Find the value of $f'\left(\frac{1}{4}\pi\right)$. [3]

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(b) Find $\int f(x) dx$. [3]

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[6]

[illegible]

[2]

(b) The two graphs meet at the point P .

[2]

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



This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting or typing. There are no margins, text, or other markings on the page.

$$p(x) = ax^3 + bx^2 - ax + 8,$$

(a) Find the values of a and b . [4]

[illegible]



(b) Factorise $p(x)$ and hence show that the equation $p(x) = 0$ has exactly one real root. [3]

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(c) Solve the equation $p\left(\frac{1}{2}\operatorname{cosec}\theta\right) = 0$ for $-90^\circ < \theta < 90^\circ$. [3]

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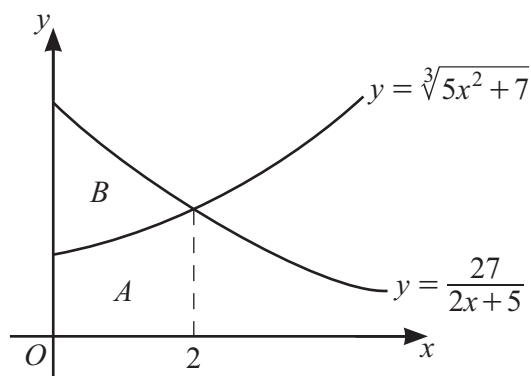
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The diagram shows the curves with equations $y = \sqrt[3]{5x^2 + 7}$ and $y = \frac{27}{2x+5}$ for $x \geq 0$.

The curves meet at the point $(2, 3)$.

Region A is bounded by the curve $y = \sqrt[3]{5x^2 + 7}$ and the straight lines $x = 0$, $x = 2$ and $y = 0$.

Region B is bounded by the two curves and the straight line $x = 0$.

- (a) Use the trapezium rule with two intervals to find an approximation to the area of region A . Give your answer correct to 3 significant figures. [3]

[illegible]



- (b) Find the exact total area of regions A and B . Give your answer in the form $k \ln m$, where k and m are constants. [3]

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- (c) Deduce an approximation to the area of region B . Give your answer correct to 3 significant figures. [1]

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- (d) State, with a reason, whether your answer to part (c) is an over-estimate or an under-estimate of the area of region B . [2]

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$$a + R \sin(2\theta - \alpha),$$

where a and R are positive integers and $0^\circ < \alpha < 90^\circ$. [6]

[illegible]



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Additional page

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

Lined area for writing answers, consisting of multiple horizontal dotted lines.

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[illegible][illegible]



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[illegible]



[3]

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[illegible]

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



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(c) Show that the exact value of $\cos 20^\circ \cos 50^\circ + \cos 40^\circ \cos 70^\circ$ is $\frac{1}{2}\sqrt{3}$. [3]

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