



Cambridge International AS & A Level

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MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1

October/November 2024

1 hour 50 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

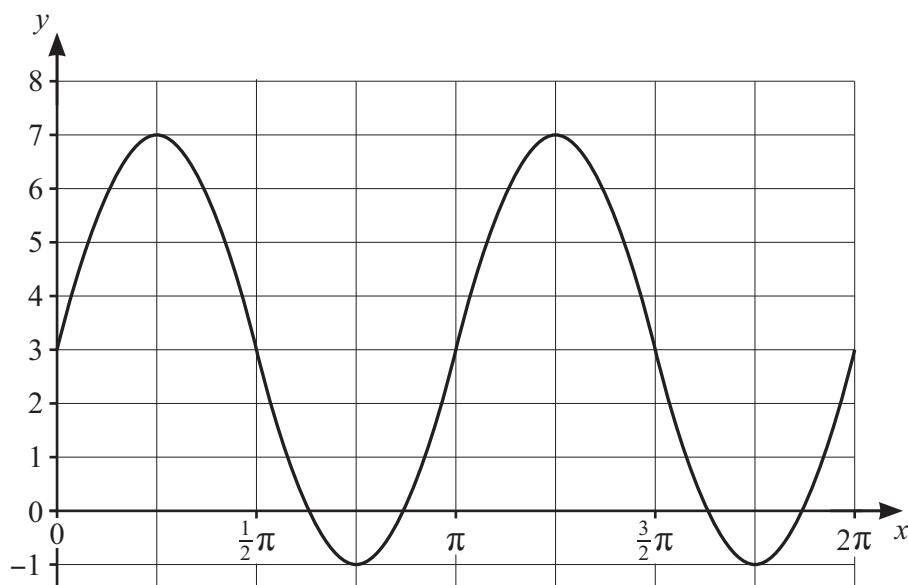
INSTRUCTIONS

- 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 75.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.



The diagram shows the curve with equation $y = a \sin(bx) + c$ for $0 \leq x \leq 2\pi$, where a , b and c are positive constants.

- (a) State the values of a , b and c . [3]

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- (b) For these values of a , b and c , determine the number of solutions in the interval $0 \leq x \leq 2\pi$ for each of the following equations:

(i) $a \sin(bx) + c = 7 - x$ [1]

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(ii) $a \sin(bx) + c = 2\pi(x - 1)$. [1]

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2 The first term of an arithmetic progression is -20 and the common difference is 5 .

(a) Find the sum of the first 20 terms of the progression. [2]

[illegible]

It is given that the sum of the first $2k$ terms is 10 times the sum of the first k terms.

(b) Find the value of k . [3]

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 practice. There are no margins, text, or other markings on the page.



- 3 The equation of a curve is $y = 2x^2 - 3$. Two points A and B with x -coordinates 2 and $(2 + h)$ respectively lie on the curve.

- (a) Find and simplify an expression for the gradient of the chord AB in terms of h . [3]

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- (b) Explain how the gradient of the curve at the point A can be deduced from the answer to part (a), and state the value of this gradient. [2]

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4 Find the term independent of x in the expansion of each of the following:

(a) $\left(x + \frac{3}{x^2}\right)^6$ [2]

[illegible]

$$\textbf{(b)} \quad (4x^3 - 5)\left(x + \frac{3}{x^2}\right)^6. \quad [4]$$

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5 The function f is defined by $f(x) = \frac{2x+1}{2x-1}$ for $x < \frac{1}{2}$.

(a) (i) State the value of $f(-1)$.

[1]

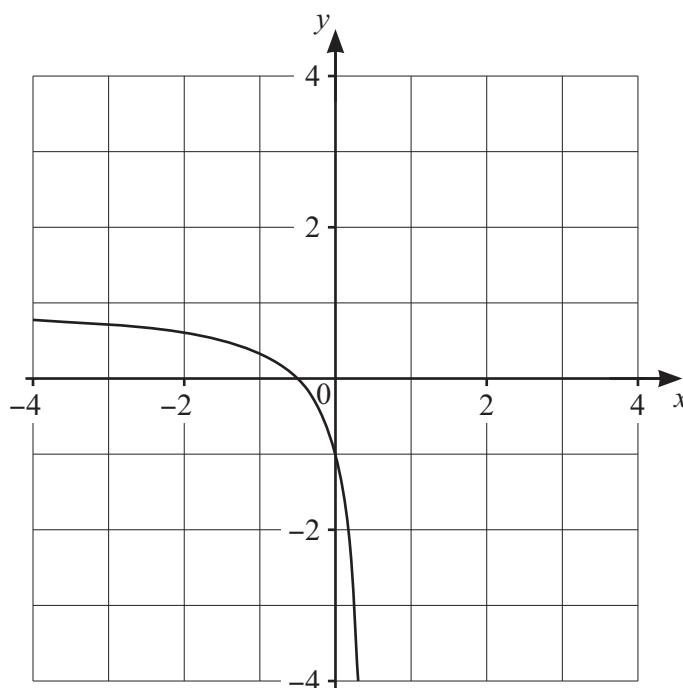
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(ii)



The diagram shows the graph of $y = f(x)$. Sketch the graph of $y = f^{-1}(x)$ on this diagram. Show any relevant mirror line. [2]

(iii) Find an expression for $f^{-1}(x)$ and state the domain of the function f^{-1} . [4]

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The function g is defined by $g(x) = 3x + 2$ for $x \in \mathbb{R}$.

(b) Solve the equation $f(x) = gf\left(\frac{1}{4}\right)$. [3]

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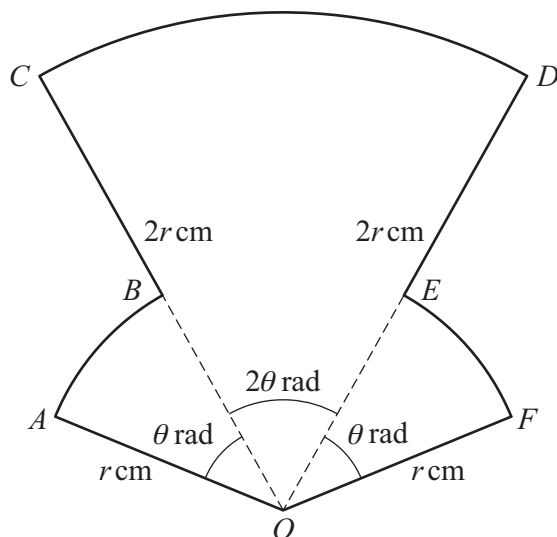
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The diagram shows a metal plate $OABCDEF$ consisting of sectors of two circles, each with centre O . The radii of sectors AOB and EOF are r cm and the radius of sector COD is $2r$ cm. Angle $AOB = \text{angle } EOF = \theta$ radians and angle $COD = 2\theta$ radians.

It is given that the perimeter of the plate is 14 cm and the area of the plate is 10 cm^2 .

Given that $r > \frac{3}{2}$ and $\theta < \frac{3}{4}$, find the values of r and θ . [6]

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[illegible]

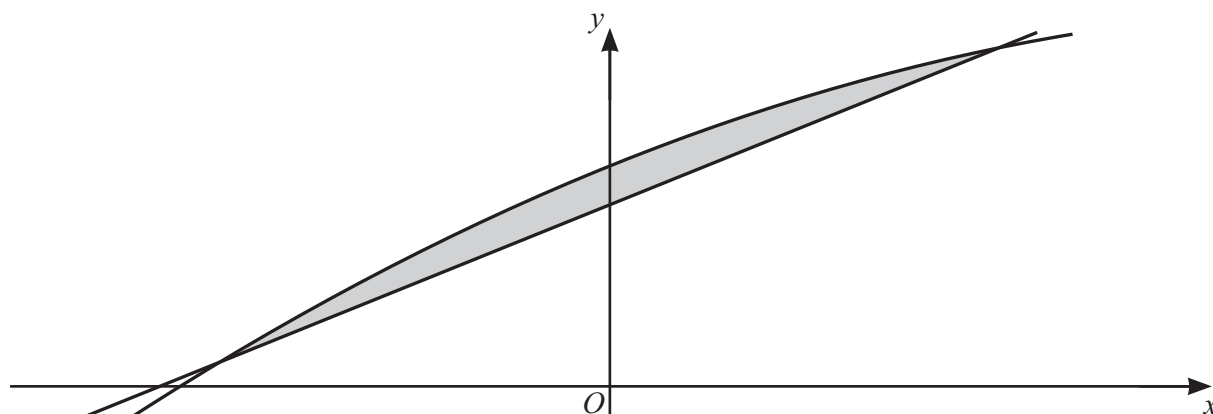


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- 7 (a) By expressing $-2x^2 + 8x + 11$ in the form $-a(x-b)^2 + c$, where a , b and c are positive integers, find the coordinates of the vertex of the graph with equation $y = -2x^2 + 8x + 11$. [3]

[illegible]

(b)



The diagram shows part of the curve with equation $y = -2x^2 + 8x + 11$ and the line with equation $y = 8x + 9$.

Find the area of the shaded region.

[illegible]



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[illegible]



- [2]

[illegible]

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- [3]

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(ii) Find the values of p and q .

[5]

[illegible]



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- (b) It is given instead that the line and the curve do **not** intersect.

Find the set of possible values of p .

[3]





- (a) Find the equation of the normal to the curve at the point $(1, 0)$. [3]

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- (b)** Find $f(x)$. [4]

[illegible]



It is given that the equation $f'(x) = 0$ can be expressed in the form

$$125x^2 - 128x + 192 = 0.$$

- (c) Determine, making your reasoning clear, whether f is an increasing function, a decreasing function or neither. [3]

[illegible]



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