



Cambridge International AS & A Level

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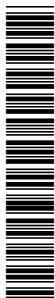
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MATHEMATICS

9709/13

Paper 1 Pure Mathematics 1

October/November 2021

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.

- 1 The graph of $y = f(x)$ is transformed to the graph of $y = 3 - f(x)$.

Describe fully, in the correct order, the two transformations that have been combined. [4]

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- 2 (a) Find the first three terms, in ascending powers of x , in the expansion of $(1 + ax)^6$. [1]

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- (b) Given that the coefficient of x^2 in the expansion of $(1 - 3x)(1 + ax)^6$ is -3 , find the possible values of the constant a . [4]

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- 3 (a) Express $5y^2 - 30y + 50$ in the form $5(y + a)^2 + b$, where a and b are constants. [2]

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- (b) The function f is defined by $f(x) = x^5 - 10x^3 + 50x$ for $x \in \mathbb{R}$.

Determine whether f is an increasing function, a decreasing function or neither. [3]

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4 The first term of an arithmetic progression is 84 and the common difference is -3 .

(a) Find the smallest value of n for which the n th term is negative. [2]

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It is given that the sum of the first $2k$ terms of this progression is equal to the sum of the first k terms.

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

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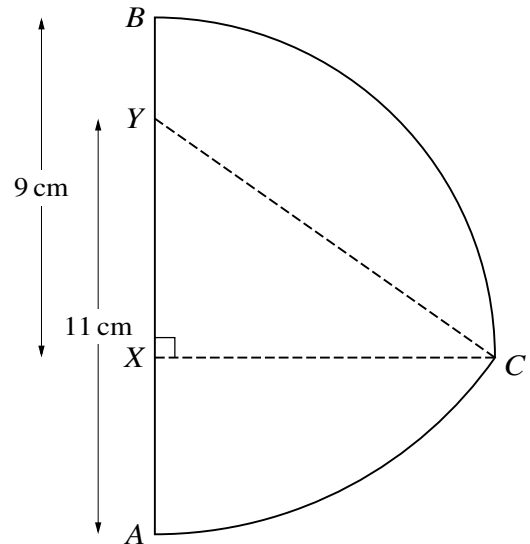
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In the diagram, X and Y are points on the line AB such that $BX = 9\text{ cm}$ and $AY = 11\text{ cm}$. Arc BC is part of a circle with centre X and radius 9 cm , where CX is perpendicular to AB . Arc AC is part of a circle with centre Y and radius 11 cm .

(a) Show that angle $XYC = 0.9582$ radians, correct to 4 significant figures. [1]

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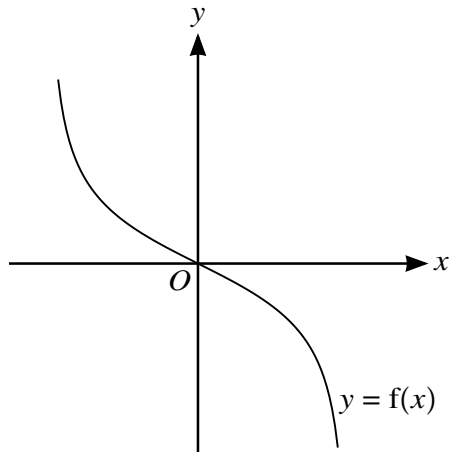
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The diagram shows the graph of $y = f(x)$.

(a) On this diagram sketch the graph of $y = f^{-1}(x)$. [1]

It is now given that $f(x) = -\frac{x}{\sqrt{4-x^2}}$ where $-2 < x < 2$.

(b) Find an expression for $f^{-1}(x)$. [4]

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The function g is defined by $g(x) = 2x$ for $-a < x < a$, where a is a constant.

- (c) State the maximum possible value of a for which fg can be formed. [1]

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- (d) Assuming that fg can be formed, find and simplify an expression for $fg(x)$. [2]

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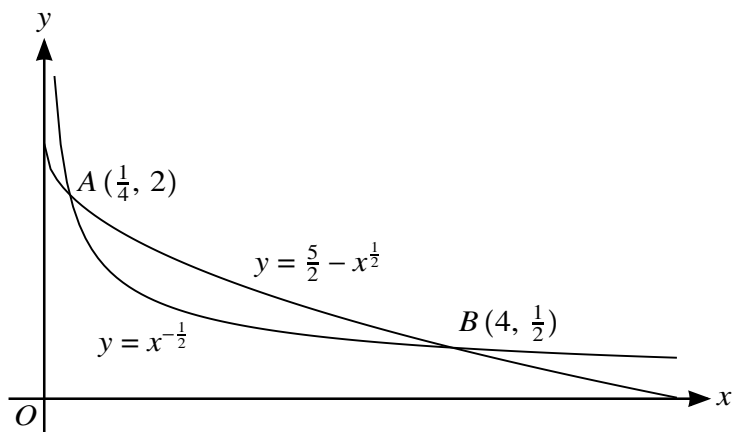
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The diagram shows the curves with equations $y = x^{-\frac{1}{2}}$ and $y = \frac{5}{2} - x^{\frac{1}{2}}$. The curves intersect at the points $A(\frac{1}{4}, 2)$ and $B(4, \frac{1}{2})$.

(a) Find the area of the region between the two curves. [6]

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(b) The normal to the curve $y = x^{-\frac{1}{2}}$ at the point $(1, 1)$ intersects the y -axis at the point $(0, p)$.

Find the value of p .

[4]

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10 A curve has equation $y = f(x)$ and it is given that

$$f'(x) = \left(\frac{1}{2}x + k\right)^{-2} - (1 + k)^{-2},$$

where k is a constant. The curve has a minimum point at $x = 2$.

(a) Find $f''(x)$ in terms of k and x , and hence find the set of possible values of k . [3]

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It is now given that $k = -3$ and the minimum point is at $(2, 3\frac{1}{2})$.

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

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- (c) Find the coordinates of the other stationary point and determine its nature. [4]

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