

Cambridge International AS & A Level

CANDIDATE
NAME

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MATHEMATICS

9709/12

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.

- 1** Solve the equation $2 \cos \theta = 7 - \frac{3}{\cos \theta}$ for $-90^\circ < \theta < 90^\circ$. [4]

[illegible]

2 The graph of $y = f(x)$ is transformed to the graph of $y = f(2x) - 3$.

- (a) Describe fully the two single transformations that have been combined to give the resulting transformation. [3]

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The point $P(5, 6)$ lies on the transformed curve $y = f(2x) - 3$.

- (b) State the coordinates of the corresponding point on the original curve $y = f(x)$. [2]

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- 3** The function f is defined as follows:

$$f(x) = \frac{x+3}{x-1} \text{ for } x > 1.$$

- (a)** Find the value of $ff(5)$. [2]

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- (b)** Find an expression for $f^{-1}(x)$. [3]

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- 4** A curve is such that $\frac{dy}{dx} = \frac{8}{(3x+2)^2}$. The curve passes through the point $(2, 5\frac{2}{3})$.

Find the equation of the curve.

[4]

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- 5 The first, third and fifth terms of an arithmetic progression are $2 \cos x$, $-6\sqrt{3} \sin x$ and $10 \cos x$ respectively, where $\frac{1}{2}\pi < x < \pi$.

(a) Find the exact value of x . [3]

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(b) Hence find the exact sum of the first 25 terms of the progression. [3]

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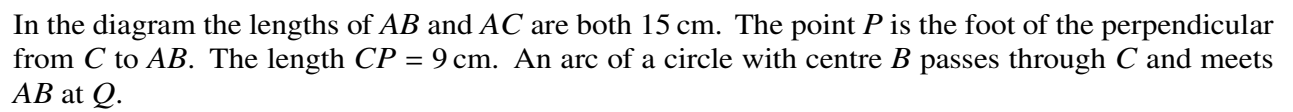
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- 6** The second term of a geometric progression is 54 and the sum to infinity of the progression is 243. The common ratio is greater than $\frac{1}{2}$.

Find the tenth term, giving your answer in exact form.

[5]

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- [illegible]

This image shows a full page of white paper with horizontal dotted 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.

- 8 (a)** It is given that in the expansion of $(4 + 2x)(2 - ax)^5$, the coefficient of x^2 is -15 .

Find the possible values of a .

[4]

[illegible]

- (b)** It is given instead that in the expansion of $(4 + 2x)(2 - ax)^5$, the coefficient of x^2 is k . It is also given that there is only one value of a which leads to this value of k .

Find the values of k and a .

[4]

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.

- 9 The volume $V \text{ m}^3$ of a large circular mound of iron ore of radius $r \text{ m}$ is modelled by the equation $V = \frac{3}{2}\left(r - \frac{1}{2}\right)^3 - 1$ for $r \geq 2$. Iron ore is added to the mound at a constant rate of 1.5 m^3 per second.

(a) Find the rate at which the radius of the mound is increasing at the instant when the radius is 5.5 m .
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[illegible]

- 10** The function f is defined by $f(x) = x^2 + \frac{k}{x} + 2$ for $x > 0$.

- (a) Given that the curve with equation $y = f(x)$ has a stationary point when $x = 2$, find k . [3]

[illegible]

- (b) Determine the nature of the stationary point. [2]

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- (c) Given that this is the only stationary point of the curve, find the range of f . [2]

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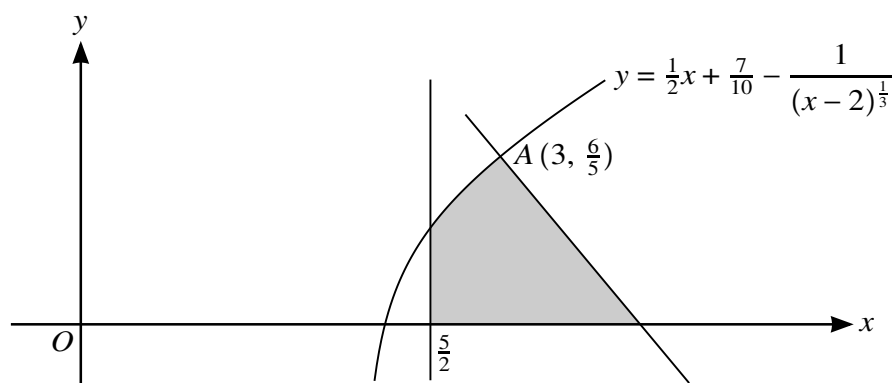
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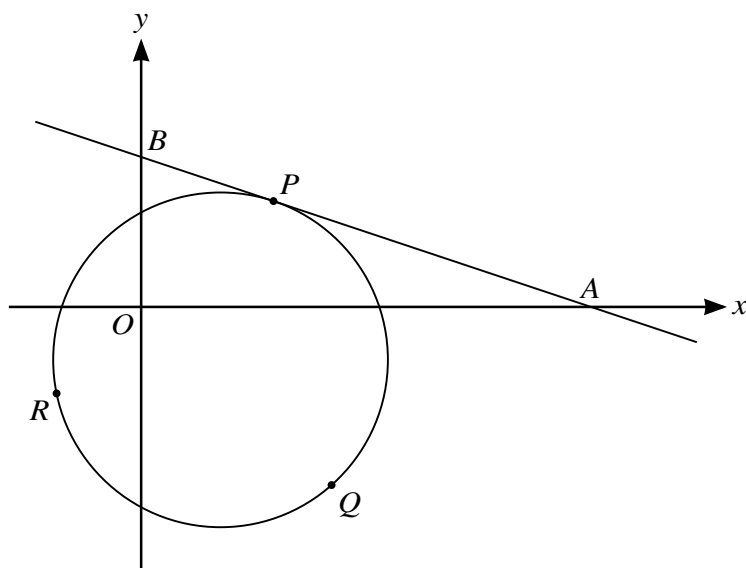
The diagram shows the line $x = \frac{5}{2}$, part of the curve $y = \frac{1}{2}x + \frac{7}{10} - \frac{1}{(x-2)^{\frac{1}{3}}}$ and the normal to the curve at the point A $(3, \frac{6}{5})$.

- (a) Find the x -coordinate of the point where the normal to the curve meets the x -axis. [5]

[illegible]

- (b)** Find the area of the shaded region, giving your answer correct to 2 decimal places. [6]

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(a) The tangent to the circle at P meets the x -axis at A and the y -axis at B .

[5]

[illegible]

[3]

[illegible]

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