



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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9709/12

February/March 2024

1 hour 50 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

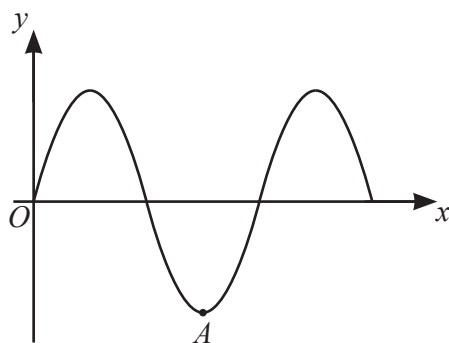
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction 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.

- 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 **16** pages.

1 Find the exact value of $\int_3^{\infty} \frac{2}{x^2} dx$. [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 entire width of the page. There are no margins, text, or other markings present.



(a) State the coordinates of A . [1]

[illegible]

- ### Reflection in the x -axis

[illegible]

- 3** A curve is such that $\frac{dy}{dx} = 3(4x+5)^{\frac{1}{2}}$. It is given that the points $(1, 9)$ and $(5, a)$ lie on the curve.

Find the value of a .

[5]

[illegible]

- 4 (a) Prove that $\frac{(\sin \theta + \cos \theta)^2 - 1}{\cos^2 \theta} \equiv 2 \tan \theta$. [3]

This image shows a blank sheet 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.

- (b)** Hence solve the equation $\frac{(\sin \theta + \cos \theta)^2 - 1}{\cos^2 \theta} = 5 \tan^3 \theta$ for $-90^\circ < \theta < 90^\circ$. [3]

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.

5 A curve has the equation $y = \frac{3}{2x^2 - 5}$.

Find the equation of the normal to the curve at the point $(2, 1)$, giving your answer in the form $ax + by + c = 0$, where a , b and c are integers. [6]

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.

- 6** It is given that the coefficient of x^3 in the expansion of

$$(2+ax)^4(5-ax)$$

is 432.

Find the value of the constant a .

[5]

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.

7 The straight line $y = x + 5$ meets the curve $2x^2 + 3y^2 = k$ at a single point P .

(a) Find the value of the constant k .

[4]

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(b) Find the coordinates of P .

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- 8 (a) An arithmetic progression is such that its first term is 6 and its tenth term is 19.5 .

Find the sum of the first 100 terms of this arithmetic progression.

[4]

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- (b) A geometric progression $a_1, a_2, a_3, \dots$ is such that $a_1 = 24$ and the common ratio is $\frac{1}{2}$.

The sum to infinity of this geometric progression is denoted by S . The sum to infinity of the even-numbered terms (i.e. $a_2, a_4, a_6, \dots$) is denoted by S_E .

Find the values of S and S_E .

[4]

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- 9** The functions f and g are defined for all real values of x by

$$f(x) = (3x-2)^2 + k \quad \text{and} \quad g(x) = 5x-1,$$

where k is a constant.

- (a) Given that the range of the function gf is $gf(x) \geq 39$, find the value of k . [4]

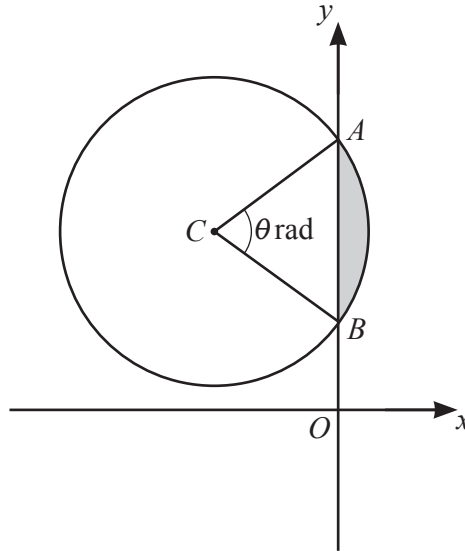
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- (b) For this value of k , determine the range of the function f g. [2]

[illegible]

- (c) The function h is defined for all real values of x and is such that $gh(x) = 35x + 19$.

Find an expression for $g^{-1}(x)$ and hence, or otherwise, find an expression for $h(x)$. [3]



The diagram shows the circle with centre $C(-4, 5)$ and radius $\sqrt{20}$ units. The circle intersects the y -axis at the points A and B . The size of angle ACB is θ radians.

- (a) Find the equation of the tangent to the circle at the point $(-6, 9)$. [3]

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- (b) Find the equation of the circle in the form $x^2 + y^2 + ax + by + c = 0$. [2]

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- (c) Find the value of θ correct to 4 significant figures.

[3]

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- (d) Find the perimeter and area of the segment shaded in the diagram.

[4]

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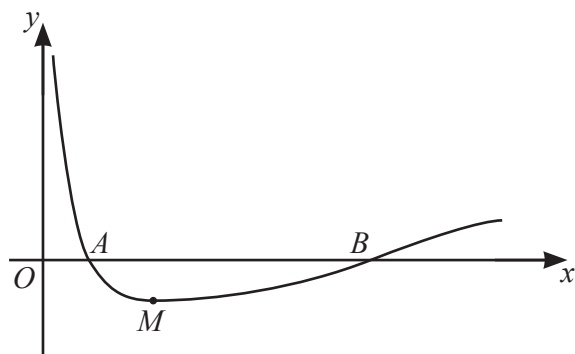
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(a) Find the exact coordinates of M . [4]

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[7]

[illegible]

[illegible]

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