



CANDIDATE
NAME

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CENTRE
NUMBER

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NUMBER

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9709/12

May/June 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 **20** pages. Any blank pages are indicated.

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- 1** The coefficient of x^2 in the expansion of $(1-4x)^6$ is 12 times the coefficient of x^2 in the expansion of $(2+ax)^5$.

Find the value of the positive constant a .

[3]

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.

- 2** The curve $y = x^2$ is transformed to the curve $y = 4(x-3)^2 - 8$.

Describe fully a sequence of transformations that have been combined, making clear the order in which the transformations have been applied. [5]

[illegible]

- 3 (a)** Show that the equation $\frac{7 \tan \theta}{\cos \theta} + 12 = 0$ can be expressed as

$$12 \sin^2 \theta - 7 \sin \theta - 12 = 0. \quad [3]$$

This image shows a full page of a handwriting practice worksheet. It consists of ten sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- (b)** Hence solve the equation $\frac{7 \tan \theta}{\cos \theta} + 12 = 0$ for $0^\circ \leq \theta \leq 360^\circ$. [3]

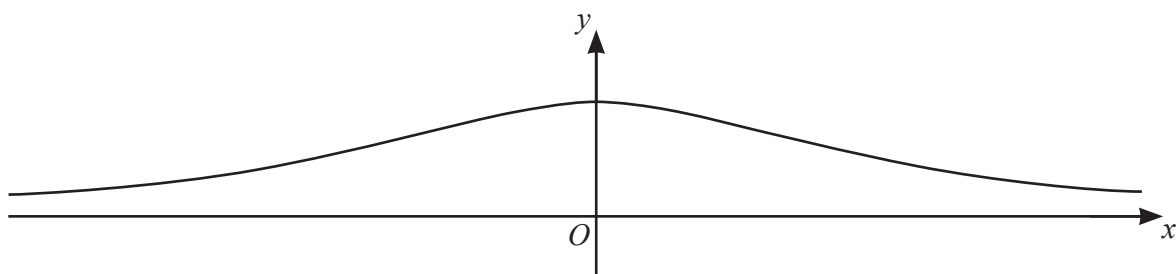
This image shows a full page of a handwriting practice worksheet. It consists of ten sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

4 The function f is defined as follows:

$$f(x) = \sqrt{x} - 1 \text{ for } x > 1.$$

(a) Find an expression for $f^{-1}(x)$.

[1]



The diagram shows the graph of $y = g(x)$ where $g(x) = \frac{1}{x^2 + 2}$ for $x \in \mathbb{R}$.

(b) State the range of g and explain whether g^{-1} exists.

[2]

[illegible]

The function h is defined by $h(x) = \frac{1}{x^2 + 2}$ for $x \geq 0$.

- (c) Solve the equation $hf(x) = f\left(\frac{25}{16}\right)$. Give your answer in the form $a + b\sqrt{c}$, where a , b and c are integers. [4]

[illegible]

- 5 The first and second terms of an arithmetic progression are $\tan \theta$ and $\sin \theta$ respectively, where $0 < \theta < \frac{1}{2}\pi$.

- (a) Given that $\theta = \frac{1}{4}\pi$, find the exact sum of the first 40 terms of the progression. [4]

[illegible]

The first and second terms of a geometric progression are $\tan \theta$ and $\sin \theta$ respectively, where $0 < \theta < \frac{1}{2}\pi$.

- (b) (i) Find the sum to infinity of the progression in terms of θ . [2]

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- (ii) Given that $\theta = \frac{1}{3}\pi$, find the sum of the first 10 terms of the progression. Give your answer correct to 3 significant figures. [3]

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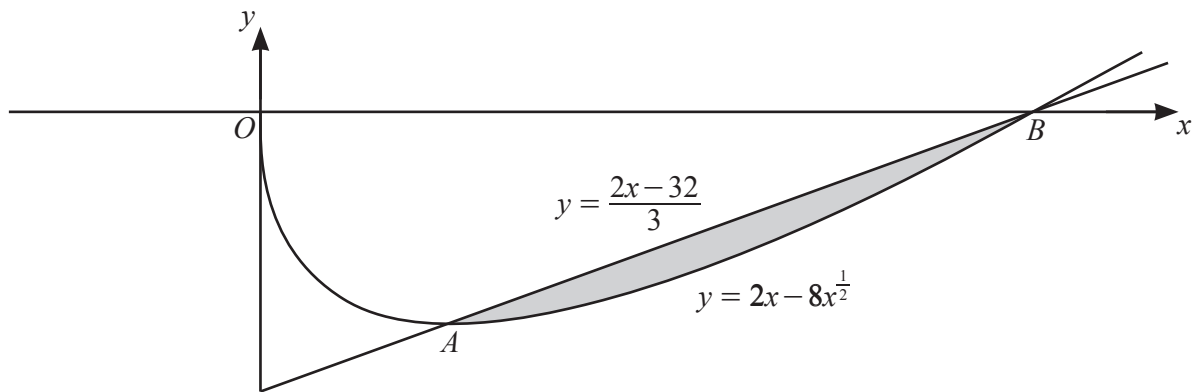
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- 6** The curve with equation $y = 2x - 8x^{\frac{1}{2}}$ has a minimum point at A and intersects the positive x -axis at B .
- (a)** Find the coordinates of A and B . [4]

[illegible]

(b)



The diagram shows the curve with equation $y = 2x - 8x^{\frac{1}{2}}$ and the line AB . It is given that the equation of AB is $y = \frac{2x-32}{3}$.

Find the area of the shaded region between the curve and the line.

[5]

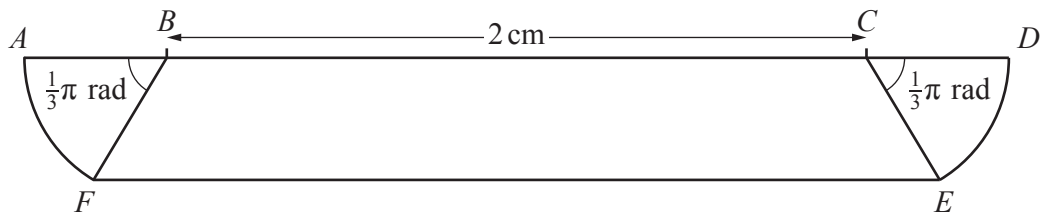
This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- 7 The equation of a circle is $(x-6)^2 + (y+a)^2 = 18$. The line with equation $y = 2a - x$ is a tangent to the circle.
- (a) Find the two possible values of the constant a . [5]

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.

- (b)** For the greater value of a , find the equation of the diameter which is perpendicular to the given tangent. [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.



The diagram shows a symmetrical plate $ABCDEF$. The line $ABCD$ is straight and the length of BC is 2 cm. Each of the two sectors ABF and DCE is of radius r cm and each of the angles ABF and DCE is equal to $\frac{1}{3}\pi$ radians.

(a) It is given that $r = 0.4$ cm.

(i) Show that the length $EF = 2.4$ cm. [2]

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(ii) Find the area of the plate. Give your answer correct to 3 significant figures. [4]

[illegible]

- Find the value of r . Give your answer correct to 3 significant figures. [4]

Find the value of r . Give your answer correct to 3 significant figures.

[4]

[illegible]

- 9** A function f is such that $f'(x) = 6(2x-3)^2 - 6x$ for $x \in \mathbb{R}$.

- (a)** Determine the set of values of x for which $f(x)$ is decreasing.

[4]

[illegible]

(b) Given that $f(1) = -1$, find $f(x)$.

[4]

[illegible]

- 10** The equation of a curve is $y = (5 - 2x)^{\frac{3}{2}} + 5$ for $x < \frac{5}{2}$.

- (a) A point P is moving along the curve in such a way that the y -coordinate of point P is decreasing at 5 units per second.

Find the rate at which the x -coordinate of point P is increasing when $y = 32$. [4]

[illegible]

[illegible]

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