



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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9709/11

May/June 2024

1 hour 50 minutes

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.

- 1 (a) Express $3y^2 - 12y - 15$ in the form $3(y + a)^2 + b$, where a and b are constants. [2]

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- (b) Hence find the exact solutions of the equation $3x^4 - 12x^2 - 15 = 0$. [3]

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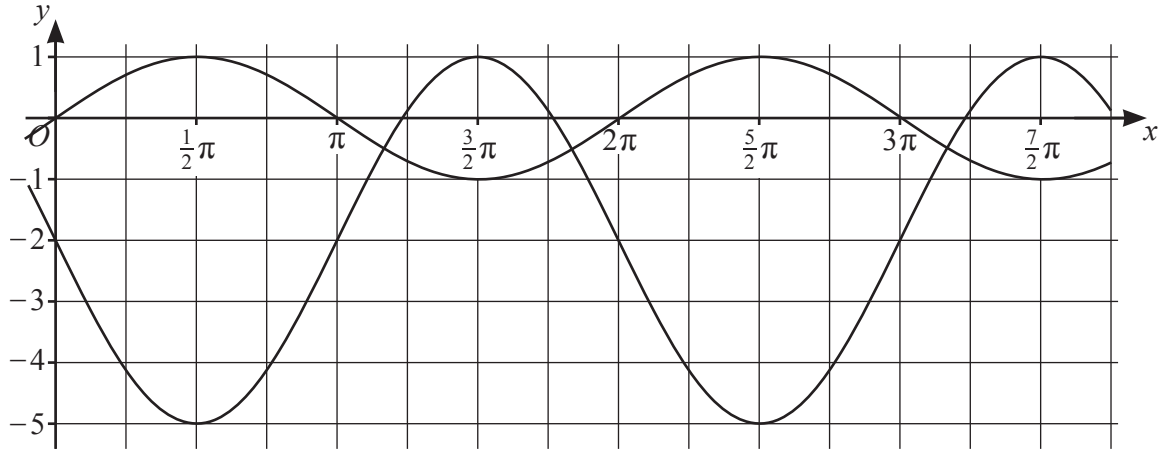
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The diagram shows two curves. One curve has equation $y = \sin x$ and the other curve has equation $y = f(x)$.

- (a) In order to transform the curve $y = \sin x$ to the curve $y = f(x)$, the curve $y = \sin x$ is first reflected in the x -axis.

Describe fully a sequence of two further transformations which are required.

[4]

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- (b) Find $f(x)$ in terms of $\sin x$.

[2]

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3 The coefficient of x^3 in the expansion of $(3 + ax)^6$ is 160.

(a) Find the value of the constant a .

[2]

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(b) Hence find the coefficient of x^3 in the expansion of $(3 + ax)^6(1 - 2x)$.

[3]

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- 4 The equation of a curve is $y = f(x)$, where $f(x) = (2x - 1)\sqrt{3x - 2} - 2$. The following points lie on the curve. Non-exact values have been given correct to 5 decimal places.

$A(2, 4)$, $B(2.0001, k)$, $C(2.001, 4.00625)$, $D(2.01, 4.06261)$, $E(2.1, 4.63566)$, $F(3, 11.22876)$

- (a) Find the value of k . Give your answer correct to 5 decimal places. [1]

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The table shows the gradients of the chords AB , AC , AD and AF .

Chord	AB	AC	AD	AE	AF
Gradient of chord	6.2501	6.2511	6.2608		7.2288

- (b) Find the gradient of the chord AE . Give your answer correct to 4 decimal places. [1]

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- (c) Deduce the value of $f'(2)$ using the values in the table. [1]

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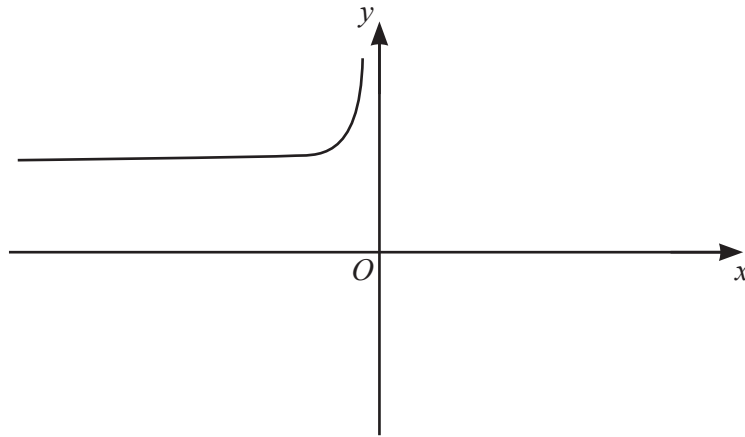
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- 5 (a)** Prove the identity $\frac{\sin^2 x - \cos x - 1}{1 + \cos x} \equiv -\cos x$. [3]

[illegible]

- (b)** Hence solve the equation $\frac{\sin^2 x - \cos x - 1}{2 + 2 \cos x} = \frac{1}{4}$ for $0^\circ \leq x \leq 360^\circ$. [3]

[illegible]



The function f is defined by $f(x) = \frac{2}{x^2} + 4$ for $x < 0$. The diagram shows the graph of $y = f(x)$.

- (a) On this diagram, sketch the graph of $y = f^{-1}(x)$. Show any relevant mirror line. [2]
- (b) Find an expression for $f^{-1}(x)$. [3]

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- (c) Solve the equation $f(x) = 4.5$. [1]

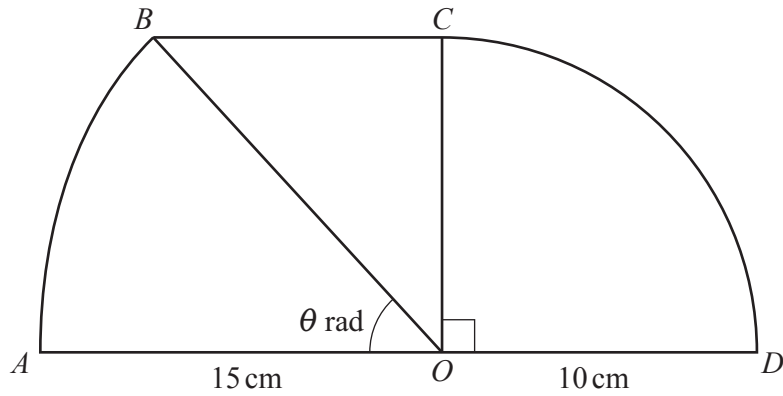
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- (d) Explain why the equation $f^{-1}(x) = f(x)$ has no solution. [1]

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In the diagram, AOD and BC are two parallel straight lines. Arc AB is part of a circle with centre O and radius 15 cm. Angle $BOA = \theta$ radians. Arc CD is part of a circle with centre O and radius 10 cm. Angle $COD = \frac{1}{2}\pi$ radians.

- (a) Show that $\theta = 0.7297$, correct to 4 decimal places. [1]

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- (b) Find the perimeter and the area of the shape $ABCD$. Give your answers correct to 3 significant figures. [7]

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- 8 (a)** The first three terms of an arithmetic progression are 25 , $4p - 1$ and $13 - p$, where p is a constant.

Find the value of the tenth term of the progression.

[4]

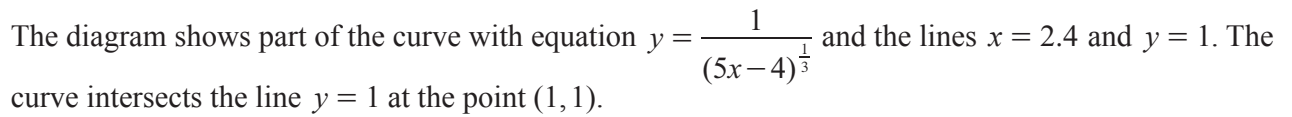
[illegible]

- (b) The first three terms of a geometric progression are 25 , $4q - 1$ and $13 - q$, where q is a positive constant.

Find the sum to infinity of the progression.

[4]

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.

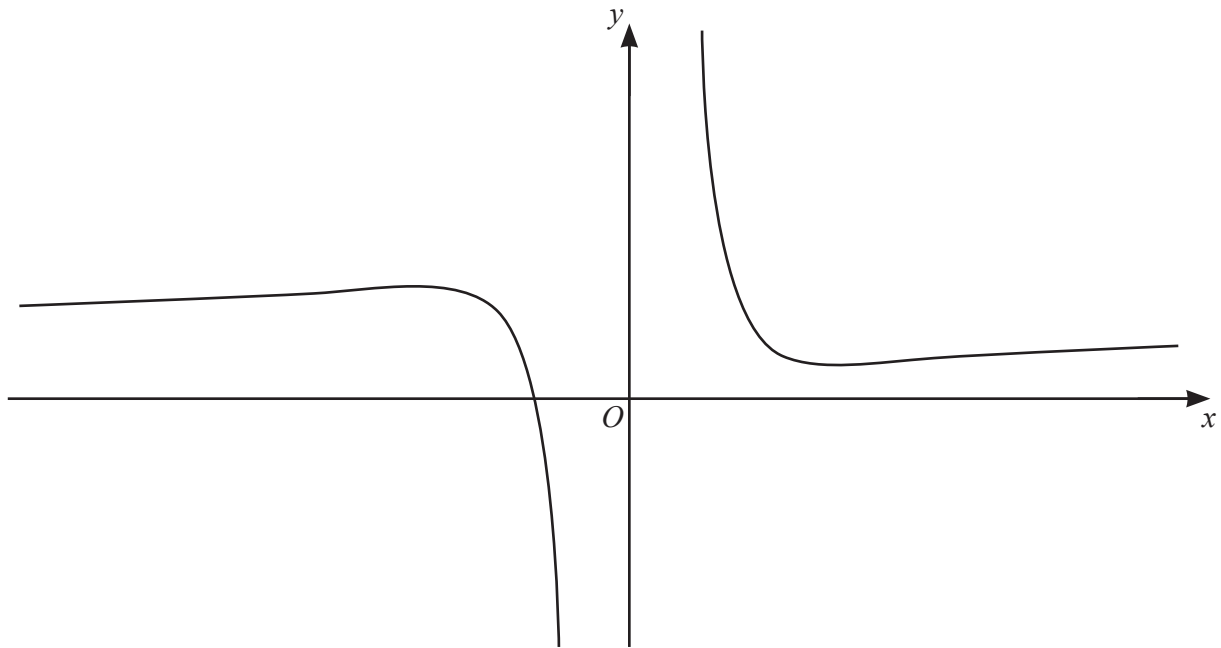


This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 10** The equation of a circle is $(x-3)^2 + y^2 = 18$. The line with equation $y = mx + c$ passes through the point $(0, -9)$ and is a tangent to the circle.

Find the two possible values of m and, for each value of m , find the coordinates of the point at which the tangent touches the circle. [8]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



A function is defined by $f(x) = \frac{4}{x^3} - \frac{3}{x} + 2$ for $x \neq 0$. The graph of $y = f(x)$ is shown in the diagram.

- (a) Find the set of values of x for which $f(x)$ is decreasing. [5]

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- (b) A triangle is bounded by the y -axis, the normal to the curve at the point where $x = 1$ and the tangent to the curve at the point where $x = -1$.

Find the area of the triangle. Give your answer correct to 3 significant figures.

[8]

This image shows a full page of a worksheet designed for handwriting practice. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The entire page is otherwise blank, with no text or other markings.

[illegible]

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CANDIDATE
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9709/12

May/June 2024

1 hour 50 minutes

You will need: List of formulae (MF19)

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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]

[illegible]

- 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]

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dotted 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.

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

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

[illegible]

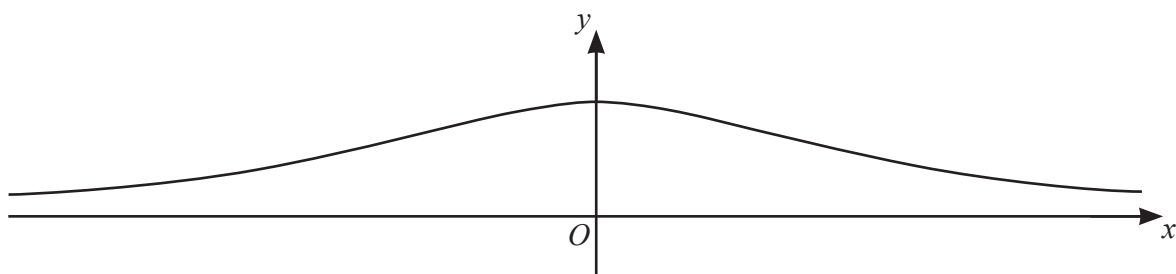
- (b)** Hence solve the equation $\frac{7 \tan \theta}{\cos \theta} + 12 = 0$ for $0^\circ \leq \theta \leq 360^\circ$. [3]

[illegible]

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]

This image shows a full page of a handwriting practice worksheet. It consists of ten sets of horizontal dotted 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.

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]

This image shows a full page of a worksheet designed for handwriting practice. It consists of multiple rows of horizontal dotted 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.

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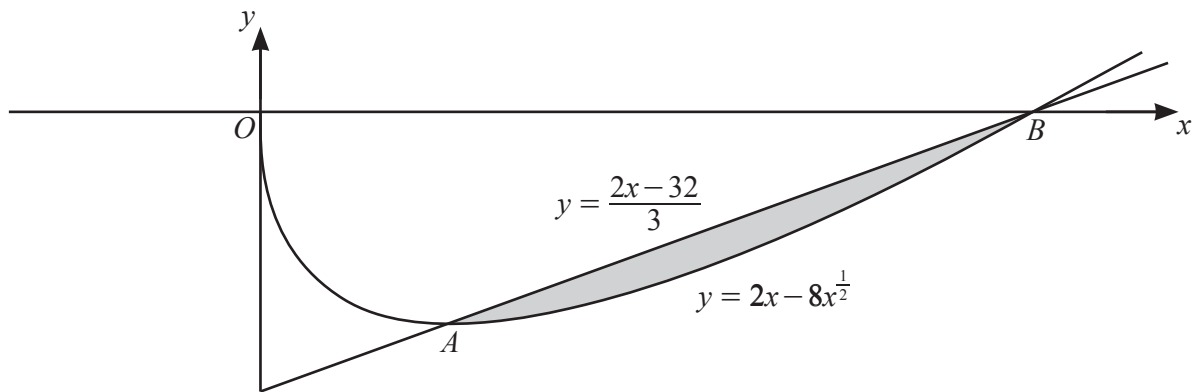
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- 6** The curve with equation $y = 2x - 8x^{\frac{1}{2}}$ has a minimum point at A and intersects the positive x -axis at B .
- (a)** Find the coordinates of A and B . [4]

[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]

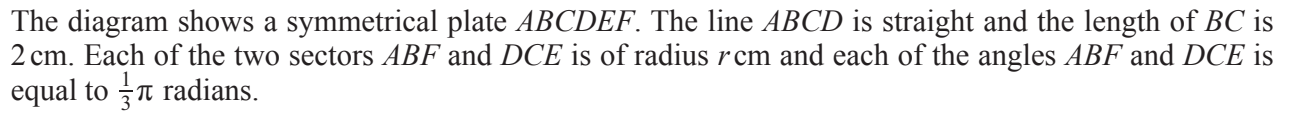
This image shows a full page of a worksheet designed for handwriting practice. It features 18 evenly spaced, horizontal dotted lines across the entire width of the page. The background is plain white, providing a clear guide for letter height and placement. There are no margins, text, or other markings present.

- 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]

[illegible]

- (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 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.



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

- [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.

[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]

- (b) Point A on the curve has y -coordinate 32. Point B on the curve is such that the gradient of the curve at B is -3 .

Find the equation of the perpendicular bisector of AB . Give your answer in the form $ax + by + c = 0$, where a, b and c are integers. [6]

[illegible]

[illegible]

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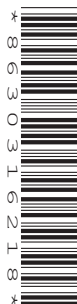
Cambridge International AS & A Level

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**MATHEMATICS****9709/13**

Paper 1 Pure Mathematics 1

May/June 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.
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- 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 [].

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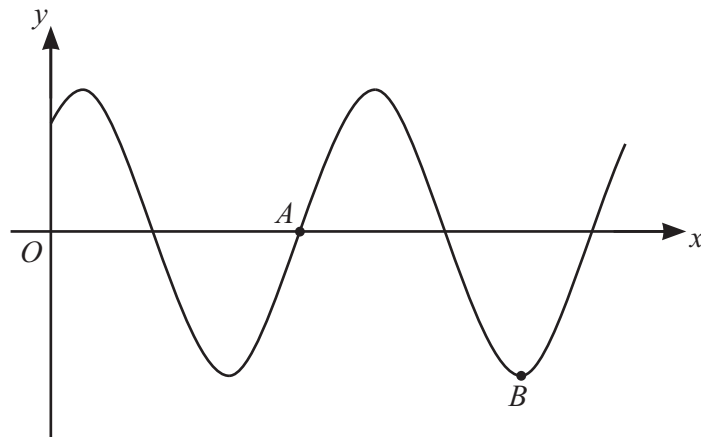
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[4]

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.



2 (a)



The diagram shows the curve $y = k \cos\left(x - \frac{1}{6}\pi\right)$ where k is a positive constant and x is measured in radians. The curve crosses the x -axis at point A and B is a minimum point.

Find the coordinates of A and B .

[3]

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(b) Find the exact value of t that satisfies the equation

$$3 \sin^{-1}(3t) + 2 \cos^{-1}\left(\frac{1}{2}\sqrt{2}\right) = \pi.$$

[2]

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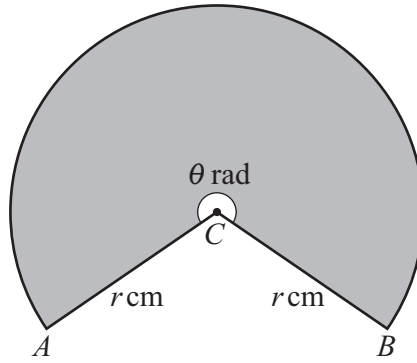
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The diagram shows a sector of a circle with centre C . The radii CA and CB each have length r cm and the size of the reflex angle ACB is θ radians. The sector, shaded in the diagram, has a perimeter of 65 cm and an area of 225 cm^2 .

- (a)** Find the values of r and θ . [4]

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)** Find the area of triangle ACB . [2]





- 4 (a) Show that the equation $\cos \theta (7 \tan \theta - 5 \cos \theta) = 1$ can be written in the form $a \sin^2 \theta + b \sin \theta + c = 0$, where a , b and c are integers to be found. [3]

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- (b) Hence solve the equation $\cos 2x (7 \tan 2x - 5 \cos 2x) = 1$ for $0^\circ < x < 180^\circ$. [3]

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5 The equation of a curve is $y = 2x^2 - \frac{1}{2x} + 3$.

(a) Find the coordinates of the stationary point.

[3]

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(b) Determine the nature of the stationary point.

[2]

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(c) For positive values of x , determine whether the curve shows a function that is increasing, decreasing or neither. Give a reason for your answer.

[2]

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(a) Find the equation of the curve.

[4]

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the paper.

(b) The curve is transformed by a stretch in the x -direction with scale factor $\frac{1}{2}$ followed by a translation of $\begin{pmatrix} 2 \\ 10 \end{pmatrix}$.

Find the equation of the new curve.

[3]

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- [2]

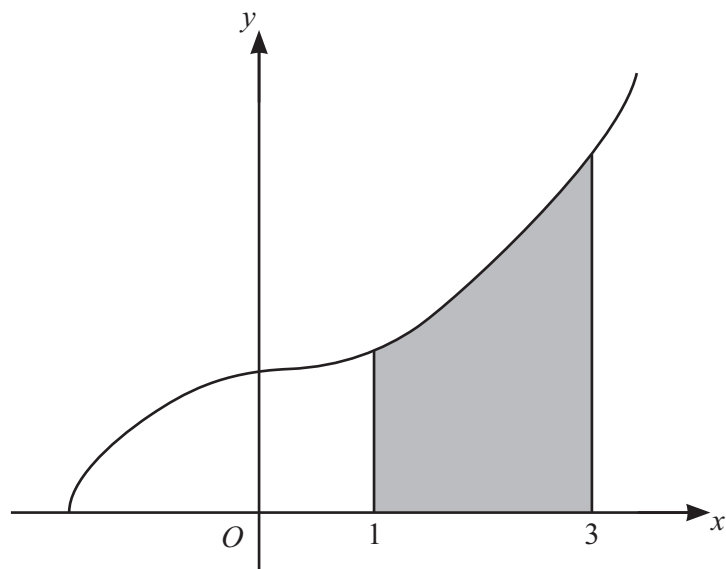
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- [5]

[illegible]

[illegible]

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 the curve with equation $y = \sqrt{2x^3 + 10}$.

- (a) Find the equation of the tangent to the curve at the point where $x = 3$. Give your answer in the form $ax + by + c = 0$ where a , b and c are integers. [5]

This image shows a single sheet of white paper with horizontal ruling lines. 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

[3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.



- 10 The geometric progression $a_1, a_2, a_3, \dots$ has first term 2 and common ratio r where $r > 0$.
It is given that $\frac{9}{2}a_5 + 7a_3 = 8$.

(a) Find the value of r . [3]

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(b) Find the sum of the first 20 terms of the geometric progression. Give your answer correct to 4 significant figures. [2]

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[3]

[illegible]

(a) By completing the square, find the range of f . [3]

[illegible]



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- Determine the coordinates of P .

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If you use the following page to complete the answer to any question, the question number must be clearly shown.

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