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MATHEMATICS

9709/11

Paper 1 Pure Mathematics 1

October/November 2025

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** Find the set of values of the constant k for which the quadratic equation

$$3kx^2 + (k+8)x + 3 = 0$$

has two distinct real roots.

[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 geometric progression has first term a and common ratio $\cos \theta$, where $0 < \theta < \frac{1}{2}\pi$. It is given that the second term is 8 and the fifth term is $\frac{1}{8}$.

(a) Find the value of θ . Give your answer correct to 3 significant figures. [3]

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(b) Find the exact value of the sum to infinity. [2]

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$$(px+3)^5 - \left(x^3 + \frac{p}{x}\right)^4,$$

Find the value of the positive constant p .

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- 4 (a) Express $1 - 6x - x^2$ in the form $a - (x + b)^2$, where a and b are constants. [3]

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- (b) The graph of $y = x^2$ is transformed to the graph of $y = 1 - 6x - x^2$ by a reflection followed by a translation of $\begin{pmatrix} m \\ n \end{pmatrix}$. Give details of the reflection and determine the values of m and n . [3]

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5 (a) Show that $\tan^4 \theta - 1 \equiv \frac{1 - 2 \cos^2 \theta}{\cos^4 \theta}$.

[3]

(b) Hence solve the equation $\cos^2\theta(\tan^4\theta - 1) = 7$ for $0^\circ < \theta < 180^\circ$.

[4]



6 Functions f and g are defined by

$$f(x) = (x + 3)^2 - 12 \quad \text{for } x \geq 0,$$

$$g(x) = 2x - 5 \quad \text{for } x \in \mathbb{R}.$$

(a) State the range of f . [1]

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(b) Find an expression for $f^{-1}(x)$. [2]

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(c) Solve the equation $gf(x) = 69$. [4]

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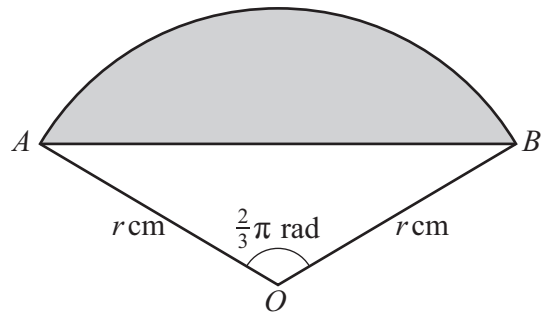
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The diagram shows a sector of a circle with centre O and radius r cm. The shaded region is bounded by the chord AB and the arc AB . The size of angle AOB is $\frac{2}{3}\pi$ radians.

- (a) Show that the area of the shaded region is approximately $0.614r^2 \text{ cm}^2$. [2]

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.

It is given that the radius of the circle is increasing at a rate of 0.4 cm s^{-1} .

- (b) (i) Find the rate of increase of the area of the shaded region at the instant when $r = 20$.
Give your answer correct to 2 significant figures.

[3]

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- (ii) Find the rate of increase of the length of the arc AB . Give your answer correct to 2 significant figures.

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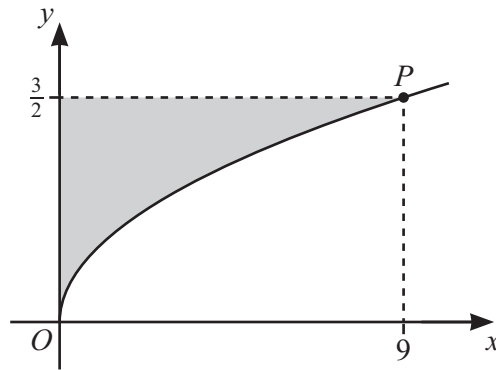
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The diagram shows the curve with equation $y = \frac{1}{2}\sqrt{x}$ and the point P with coordinates $(9, \frac{3}{2})$. The shaded region is bounded by the curve and the lines $x = 0$ and $y = \frac{3}{2}$.

- (a) Find the area of the shaded region.

[3]

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.



(b) The shaded region is rotated through 360° about the **y-axis**.

Find the exact volume of the solid produced.

[4]

[illegible]



- 9 An arithmetic progression has first term 2 and common difference d . The sum of the first n terms is denoted by S_n .

- (a)** It is given that $(S_2 - 1)$, S_4 , S_9 are the first three terms of a second arithmetic progression.

Find the value of d .

[4]

[illegible]



(b) Hence find the difference between the values of the 15th terms of the two arithmetic progressions. [4]

[illegible]



- (a)** Find the coordinates of these two points of intersection.

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.



(b) The circle has centre C and the two points of intersection are denoted by A and B .

Find the area of the triangle ABC .

[3]





- 11 A curve passes through the point $P(4, 3)$ and is such that

$$\frac{dy}{dx} = \frac{8}{x^2} - \frac{10}{(2x-3)^2}.$$

- (a) Find the equation of the normal to the curve at P . Give your answer in the form $y = mx + c$. [3]

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- (b) Find the rate of change of the gradient of the curve when $x = 4$. [3]

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(c) Given that the curve also passes through the point $(-1, q)$, find the value of q .

[5]

[illegible]

[illegible]





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Cambridge International AS & A Level

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MATHEMATICS**9709/12**

Paper 1 Pure Mathematics 1

October/November 2025**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.
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- You should use a calculator where appropriate.
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- 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 (a)** Express $9x^2 - 36x + 8$ in the form $p(x+q)^2 + r$, where p , q and r are constants. [2]

[illegible]

- (b)** Hence find the set of values of the constant k for which the equation $9x^2 - 36x + 8 = k$ has no real roots. [1]

- (c) Find the exact roots of the equation $9x^2 - 36x + 8 = -15$. [2]

[illegible]



2 Find the term independent of x in the expansion of $\left(2x^2 - \frac{3}{x}\right)^6$. [3]

[illegible]



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

Describe fully the two transformations which have been combined to give the resulting graph. [3]

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- (b) A different graph has equation $y = g(x)$. This graph is stretched by scale factor 3 in the y -direction and then reflected in the y -axis.

Write down the equation of the transformed graph in terms of the function g . [2]

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- 4 The equation of a curve is such that $\frac{dy}{dx} = kx^3 + \frac{2}{x^2}$, where k is a constant. The curve passes through the point $S(2, 20)$ and the gradient of the curve at S is $\frac{65}{2}$.

(a) Find the value of k .

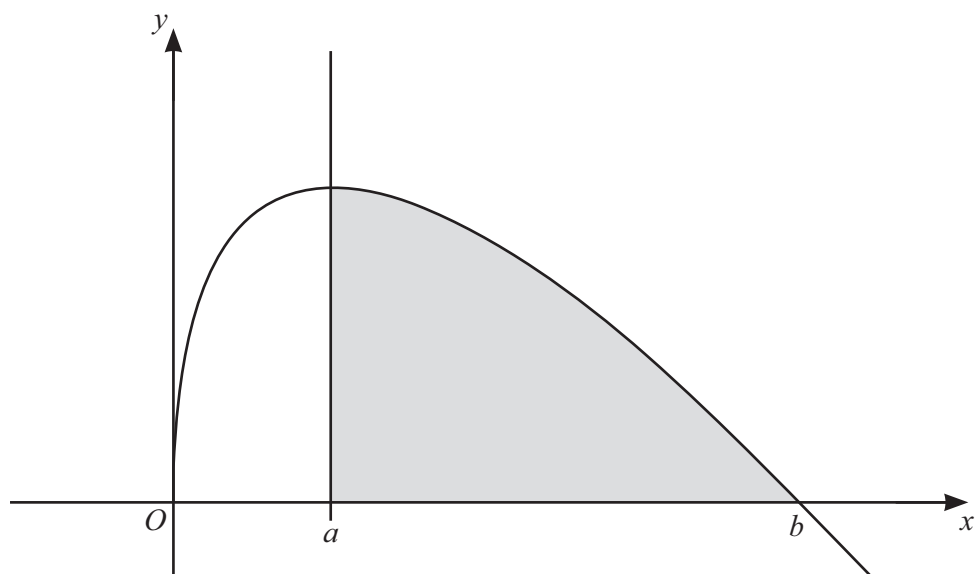
[1]

- (b)** The coordinates of a point T on the curve are $(1, t)$.

Find the value of t .

[5]

[illegible]



The equation of a curve is $y = 4x^{\frac{1}{2}} - x$. The curve has a maximum point when $x = a$ and crosses the x -axis at the point with coordinates $(b, 0)$, where $b > 0$. The shaded region is bounded by the curve, the line $x = a$ and the x -axis (see diagram).

- (a) Find the value of a .

[3]

[illegible]



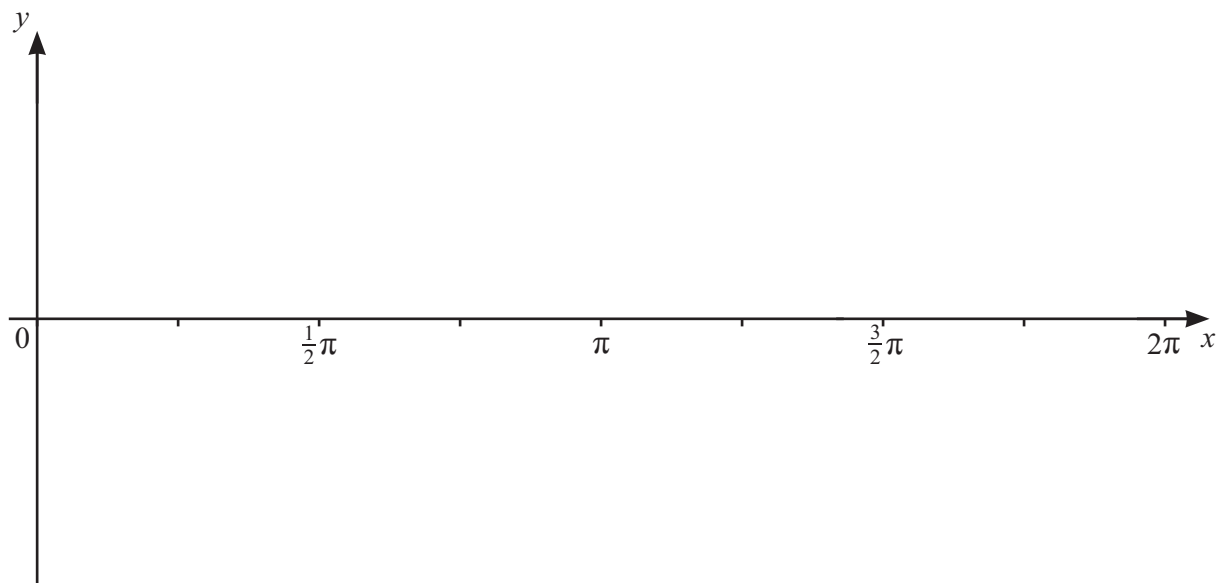
(b) Find the exact area of the shaded region.

[5]

[illegible]

- 6 (a) Sketch the graph of $y = 3 \sin x + 2$ for $0 \leq x \leq 2\pi$.

[2]



- (b) Determine the number of solutions in the interval $0 \leq x \leq 2\pi$ of each of the following equations.

(i) $3 \sin x + 2 = x$ [1]

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(ii) $3 \sin x + 2 = 5 - x$ [1]

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(c) Solve the equation $3 \sin x + 2 = 5 \cos^2 x - 1$ for $0 \leq x \leq 2\pi$.

[5]

[illegible]



- 7 The coordinates of the points P and Q are $(1, 1)$ and $(7, 11)$ respectively. The line segment PQ forms a diameter of a circle.

(a) Find the equation of the circle.

[4]

[illegible]

(b) Find the equation of the tangent to the circle at the point Q .

[3]

[illegible]



(c) The other point on the circle with x -coordinate 7 is R .

Find the coordinates of the point of intersection of the tangent at Q with the tangent at R . [4]

[illegible]

- 8 The first three terms of a geometric progression are a , b and c respectively, where a , b and c are positive constants. The first three terms of an arithmetic progression are a , b and $-3c$ respectively.

(a) Show that $a^2 - 10ac + 9c^2 = 0$. [3]

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It is now given that $a = 9$ and c takes the smaller of its two possible values.

(b) (i) Find the sum to infinity of the geometric progression. [5]

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(ii) Find the sum of the first 20 terms of the arithmetic progression. [3]

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9 The function f is defined by $f(x) = \frac{4}{(3x-6)^2} + \frac{1}{(3x-6)^3}$ for $x > 2$.

(a) Find an expression for $f'(x)$ and hence determine whether f is an increasing function, a decreasing function or neither. [4]

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(b) State whether f^{-1} exists. Give a reason for your answer. [1]

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The function g is defined by $g(x) = 4x - 3$ for $x > a$.

- (c) Find the range of g in terms of the constant a . [1]

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- (d) Find the set of values of a for which the composite function fg exists. [2]

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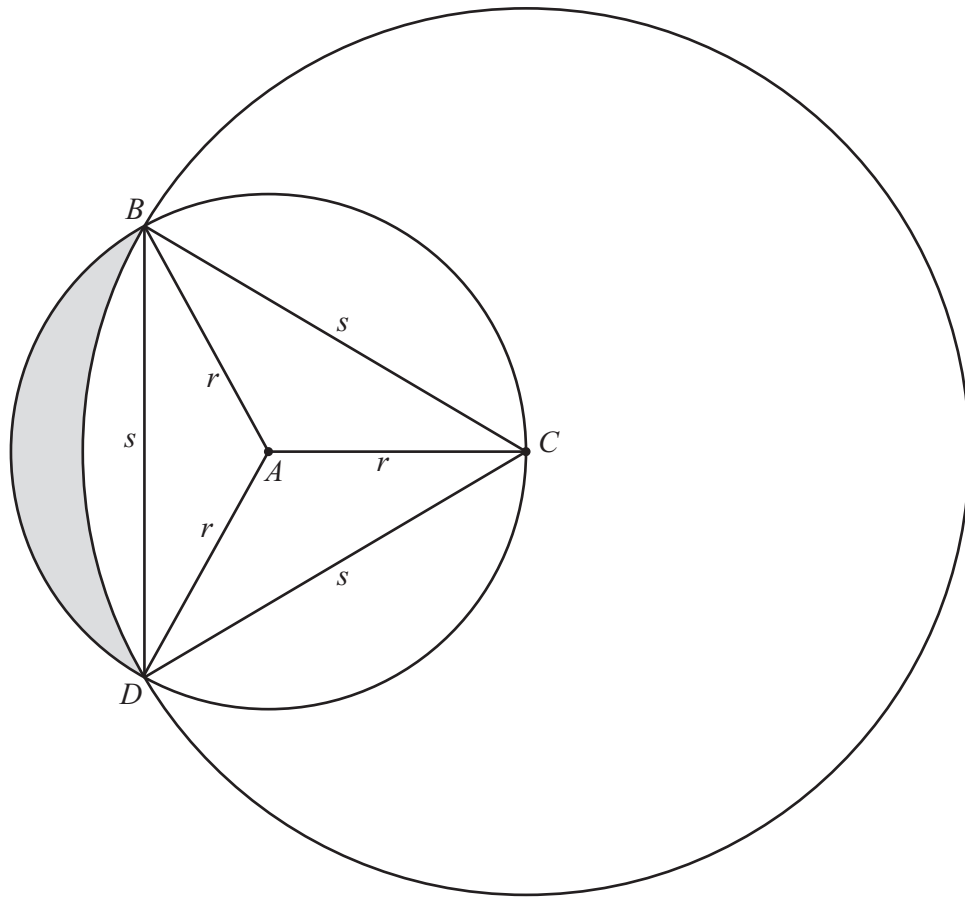
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The diagram shows a circle with centre A and radius r passing through points B , C and D . A larger circle of radius s has centre C and passes through B and D . The length BD is also s .

- (a) Show that $s = \sqrt{3}r$. [2]

[illegible]



- (b)** Find an expression for the area of the shaded region. Give your answer in the form $(a + b\pi)r^2$, where a and b are constants to be found. [7]

[illegible]



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MATHEMATICS**9709/13**

Paper 1 Pure Mathematics 1

October/November 2025**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.
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- 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 **16** pages.

- 1 (a) Expand $\left(2 - \frac{1}{2}x\right)^6$ in ascending powers of x up to and including the term in x^3 . [3]

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- (b) Hence find the coefficient of x^3 in the expansion of $(3 - x + 2x^3)\left(2 - \frac{1}{2}x\right)^6$. [2]

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2 (a) Solve the equation $\tan^{-1}(5x-3) = -\frac{1}{4}\pi$.

[2]

(b) Solve the equation $5 \cos^2 \theta = 4 \sin \theta + 4$ for $\frac{1}{2}\pi \leq \theta \leq 2\pi$.

[4]



- 3 The equation of a curve is $y = f(x)$, where $f(x) = \frac{1}{2}x^{\frac{2}{3}}(x-2)^2$. The following points lie on the curve. Non-exact values of the y -coordinates are given correct to 6 decimal places.

$$A(8, 72), B(8.001, k), C(8.01, 72.300388), D(8.1, 75.038882)$$

- (a) Find the value of k . Give your answer correct to 6 decimal places. [1]

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The table below shows the gradients of the chords AB and AC , given correct to 4 decimal places.

Chord	AB	AC	AD
Gradient of chord	30.0039	30.0388	

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

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- (c) State what the values in the table suggest about the value of $f'(8)$. [1]

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4 The first, second and third terms of a progression are 20, k and $k - 5$ respectively.

(a) Given that the progression is arithmetic, find the 30th term. [2]

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(b) Given instead that the progression is geometric, find the sum to infinity. [4]

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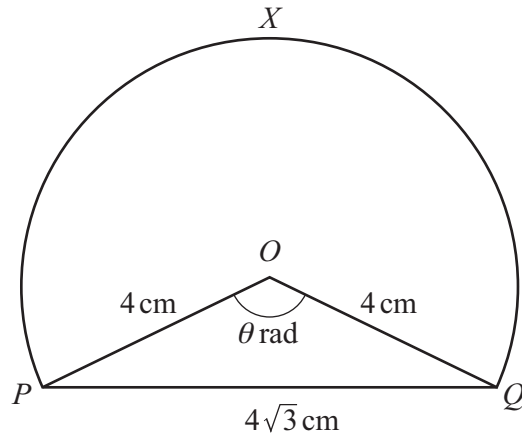
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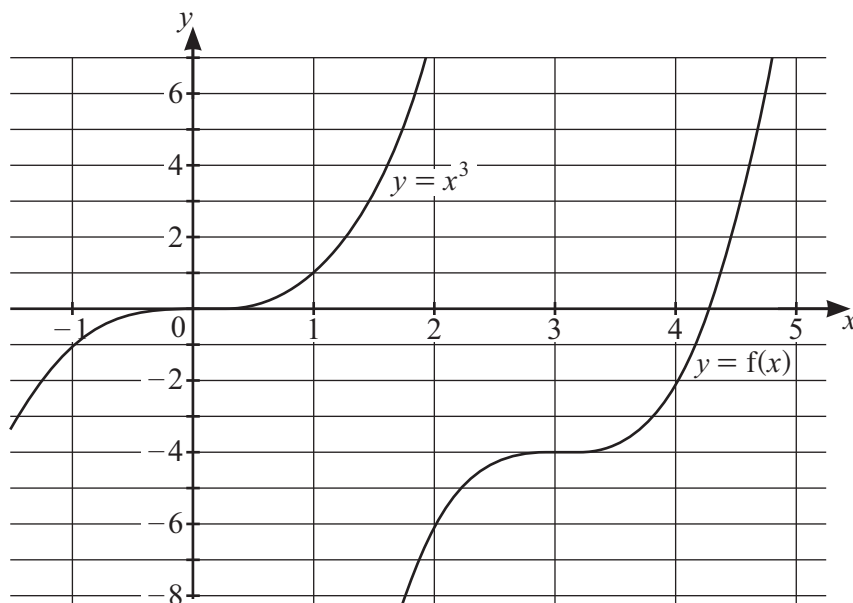
The diagram shows part of a circle with centre O and radius 4 cm. The chord PQ is of length $4\sqrt{3}$ cm and angle $POQ = \theta$ radians. The point X lies on the circle.

- (a) Find the exact value of θ . [2]

[illegible]

- (b)** Find the exact area of the segment PXQ . [3]

[illegible]



The diagram shows the graphs of $y = x^3$ and $y = f(x)$. The graph of $y = x^3$ is transformed to the graph of $y = f(x)$ by a sequence of transformations.

- (a) Describe fully a suitable sequence of transformations. Make clear the order in which the transformations are applied. [5]

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- (b) You are given that $f(x) = a(x+b)^3 + c$.

State the values of the constants a , b and c .

[3]

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- 7 The function g is defined by $g(x) = \frac{2}{ax-3} + \frac{1}{2}$ for $x > \frac{3}{a}$, where a is a positive constant.

Find $g^{-1}(x)$ and hence verify that if $a = 6$ then $g^{-1}(x) \equiv g(x)$. [4]

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.



8 The points $(6, 1)$ and $(-2, 7)$ lie at the opposite ends of a diameter of a circle.

(a) Find the equation of the circle.

[3]

[illegible]

(b) There are two tangents to the circle which have gradient $-\frac{1}{2}$.

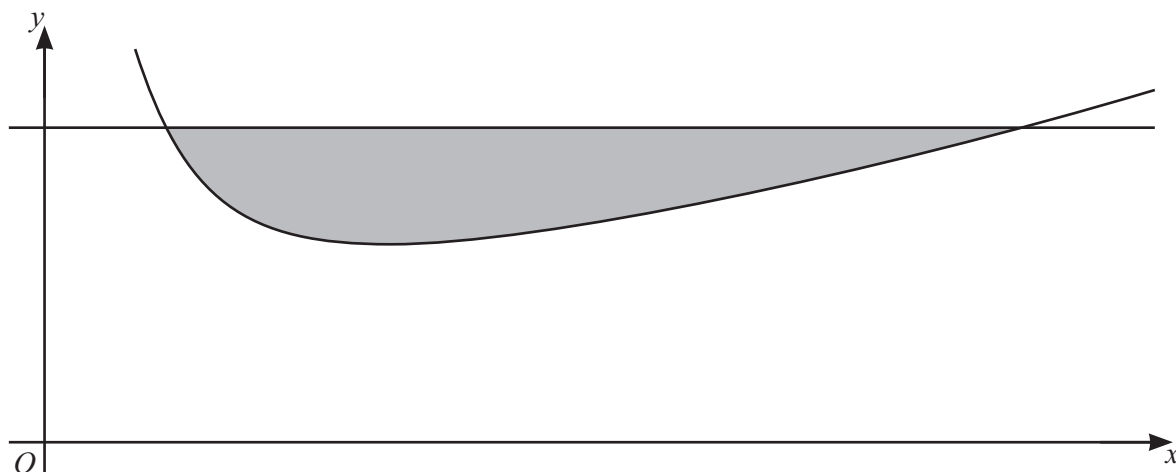
Find the exact values of the x -coordinates of the points at which these tangents touch the circle.

[5]

[illegible]



9



The diagram shows part of the curve with equation $y = \frac{1}{2}x + \frac{4}{x}$ and the line $y = 4.5$.

Find the exact volume of the solid formed when the shaded region is rotated through 360° about the x -axis. [8]

[illegible]



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10 A function f is defined by $f(x) = px^2 + 4x + q$ for $x \in \mathbb{R}$, where p and q are constants.

(a) It is given that $p = 2$ and $q = 10$.

(i) Express $f(x)$ in the form $a(x+b)^2+c$, where a , b and c are constants. [3]

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(ii) State the range of f . [1]

[illegible]



(b) It is given instead that $q = -5$ and the roots of $f(x) = 0$ are $5m$ and $-9m$, where m is a constant.

Find the values of p and m .

[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 entire width of the page. There are no margins, text, or other markings present.



11 The equation of a curve is $y = \frac{8}{3x-8} - \frac{6}{x-1}$.

- (a) Find the coordinates of the point at which the tangent to the curve at the point $(3, 5)$ intersects the line $y = -8x$. [6]

This image shows a full page of a worksheet designed for handwriting practice. It consists of multiple rows 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) (i) Find the x -coordinates of each of the stationary points of the curve.

[3]

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(ii) Find $\frac{d^2y}{dx^2}$ and hence determine the nature of each of the stationary points.

[4]

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Additional page

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MATHEMATICS**9709/15**

Paper 1 Pure Mathematics 1

October/November 2025**1 hour 50 minutes**

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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.

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1 A circle has centre $(2, 6)$ and radius 10.

(a) State the equation of the circle.

[2]

(b) The circle passes through the point $(8, k)$.

Find the two possible values of k .

[3]





2 A geometric progression has first term $3 + 4\sqrt{2}$ and second term $5 - \sqrt{2}$.

- (a) Find the common ratio of the geometric progression. Give your answer in the form $\sqrt{2} + p$, where p is an integer to be found. [3]

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- (b) Find the sum to infinity of the geometric progression. [2]

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- 3 (a) Express $4x^2 + 10x + 6$ in the form $a(x+b)^2 + c$, where a , b and c are rational constants to be determined. [2]

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- (b) The curve with equation $y = 4x^2 + 10x + 6$ and the line $y = k$ have exactly one point of intersection.

Using your answer to part (a) or otherwise, state the value of the constant k . [1]

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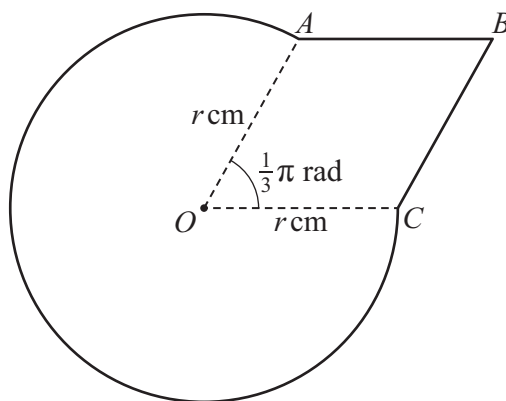
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4



The diagram shows the design for a company's new logo. The sector of the circle, centre O , has radius r cm. The acute angle $AOC = \frac{1}{3}\pi$ radians. The quadrilateral $OABC$ is a rhombus.

- (a) Find an expression for the perimeter of the design. Give your answer in terms of π and r . [2]

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- (b)** It is now given that the perimeter of the design is 200 cm.

Find the area of the design. Give your answer to 3 significant figures. [5]

[illegible]



5 Solve the equation

$$x^3 - 28 + \frac{27}{x^3} = 0.$$

[3]





6 (a) Show that the equation

$$6 \sin \theta + \frac{1}{\tan \theta} = \frac{4}{\sin \theta}$$

can be written in the form

$$6 \cos^2 \theta - \cos \theta - 2 = 0. \quad [3]$$

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.



(b) Hence, solve the equation

$$6 \sin \theta + \frac{1}{\tan \theta} = \frac{4}{\sin \theta}$$

for $0^\circ \leq \theta \leq 360^\circ$.

[4]





(b) Find the exact value of r which corresponds to the maximum value of V .

[3]

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(c) Hence, find the maximum value of V .

[2]

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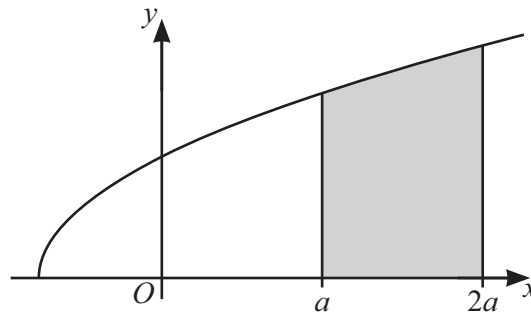
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The diagram shows the curve with equation $y = \sqrt{6x+5}$. The shaded region is bounded by the curve, the x -axis and the lines $x = a$ and $x = 2a$, where a is a positive constant.

The shaded region is rotated through 360° about the x -axis to form a solid. The solid has volume, V , such that $V \geq 46\pi$.

- (a) Show that $9a^2 + 5a - 46 \geq 0$. [4]

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- (b) Find the range of possible values of a . [3]

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- 9 In the expansion of $(p + qx)^4$, the coefficient of x is equal to the coefficient of x^2 . The constants p and q are both positive.

(a) Find the ratio $p : q$. Give your answer in its simplest form. [3]

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(b) It is given that the coefficient of x^3 is 486.
Find the values of p and q . [4]

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10 The function f is defined by

$$f(x) = 3 + \frac{7}{x-2}$$

for $x > 2$.

(a) It is given that $f(a) = 4$.

Find the value of a .

[2]

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(b) Find an expression for $f^{-1}(x)$ and state the domain of f^{-1} .

[4]

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(c) The function g is defined by

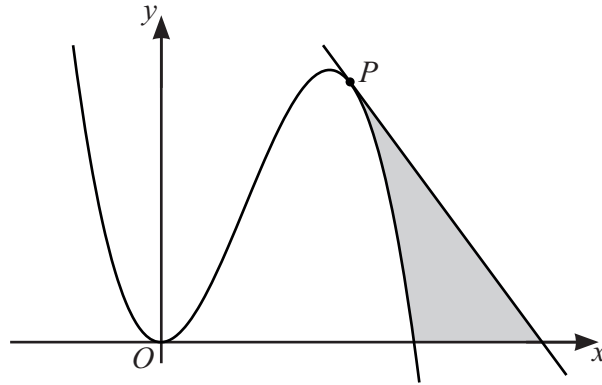
$$g(x) = \frac{1+4x}{2x-3}$$

for $x > \frac{3}{2}$.

Show that $\text{fg}(x) \equiv kx$, where k is a constant to be determined.

[3]

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



The diagram shows the curve with equation $y = 4x^2 - x^3$ and the tangent to the curve at the point P . The point P has x -coordinate 3.

- (a) Find the equation of the tangent to the curve at the point P . Give your answer in the form $y = mx + c$. [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.

- (b) The shaded region is bounded by the curve, the x -axis and the tangent to the curve at P .

Find the exact area of the shaded region.

[6]

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The graph of $y = 4x^2 - x^3$ is transformed by a stretch of scale factor $\frac{1}{3}$ in the x -direction. The point Q is the image of P under this transformation. The transformed shaded region is bounded by the transformed curve, the x -axis and the tangent to the transformed curve at Q .

- (c) (i) Find the equation of the transformed curve in the form $y = mx^2 + nx^3$, where m and n are integers to be found. [1]

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- (c) (ii) State the coordinates of Q and the area of the transformed shaded region. [2]

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Additional page

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

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