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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6219257898

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.
- 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)** Express $9x^2 - 36x + 8$ in the form $p(x+q)^2 + r$, where p, q and r are constants. [2]

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(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]

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

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

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3 **(a)** The graph of $y = \mathrm{f}(x)$ is transformed to the graph of $y = \mathrm{f}(3x) + 2$.

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 $y = \mathrm{g}(x)$. 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]

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

Find the value of t. [5]

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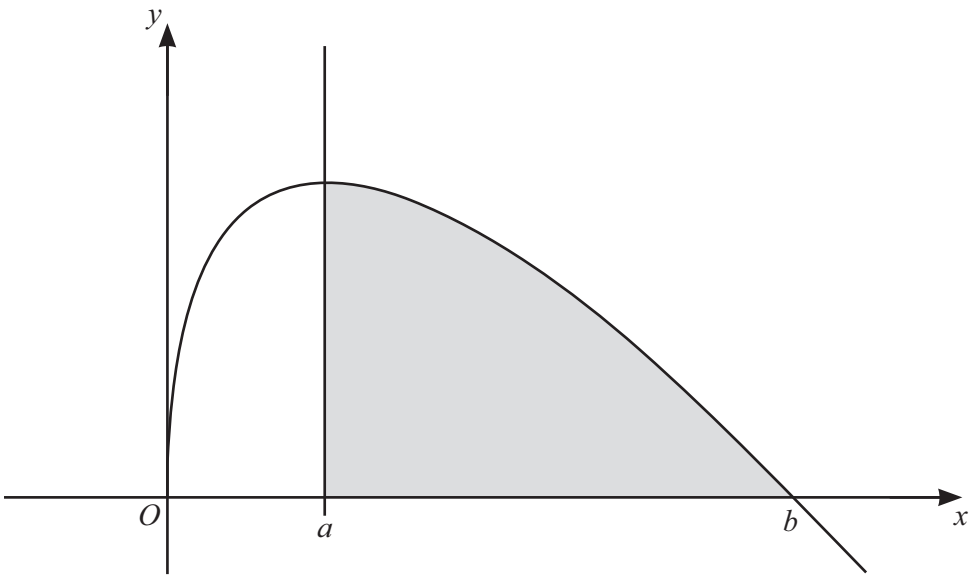
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The equation of a curve is $y = 4x^{\frac{1}{2}} - x$. The curve has a maximum point when $x = a$ and crosses the x-axis at the point with coordinates $(b, 0)$, where $b > 0$. The shaded region is bounded by the curve, the line $x = a$ and the x-axis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

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

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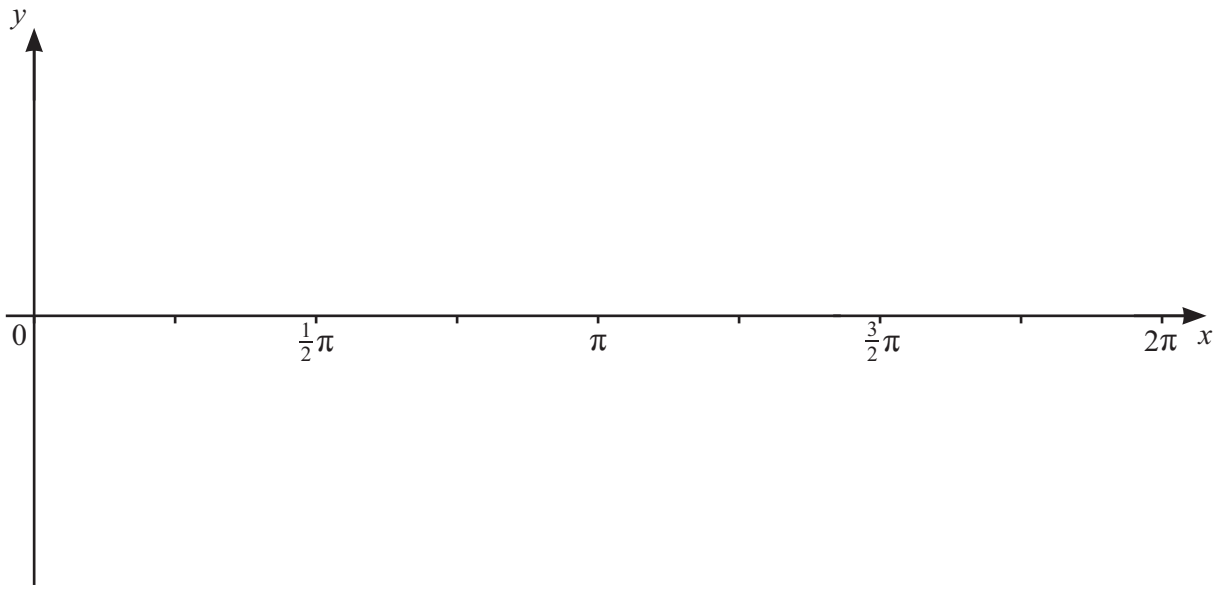
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(b) Find the exact area of the shaded region. [5]

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6 **(a)** Sketch the graph of $y = 3\sin x + 2$ for $0 \leqslant x \leqslant 2\pi$. [2]



(b) Determine the number of solutions in the interval $0 \leqslant x \leqslant 2\pi$ 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 $0 \leqslant x \leqslant 2\pi$. [5]

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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]

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(b) Find the equation of the tangent to the circle at the point Q. [3]

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(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]

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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 $\mathrm{f}(x) = \dfrac{4}{(3x-6)^2} + \dfrac{1}{(3x-6)^3}$ for $x > 2$.

(a) Find an expression for $\mathrm{f}'(x)$ 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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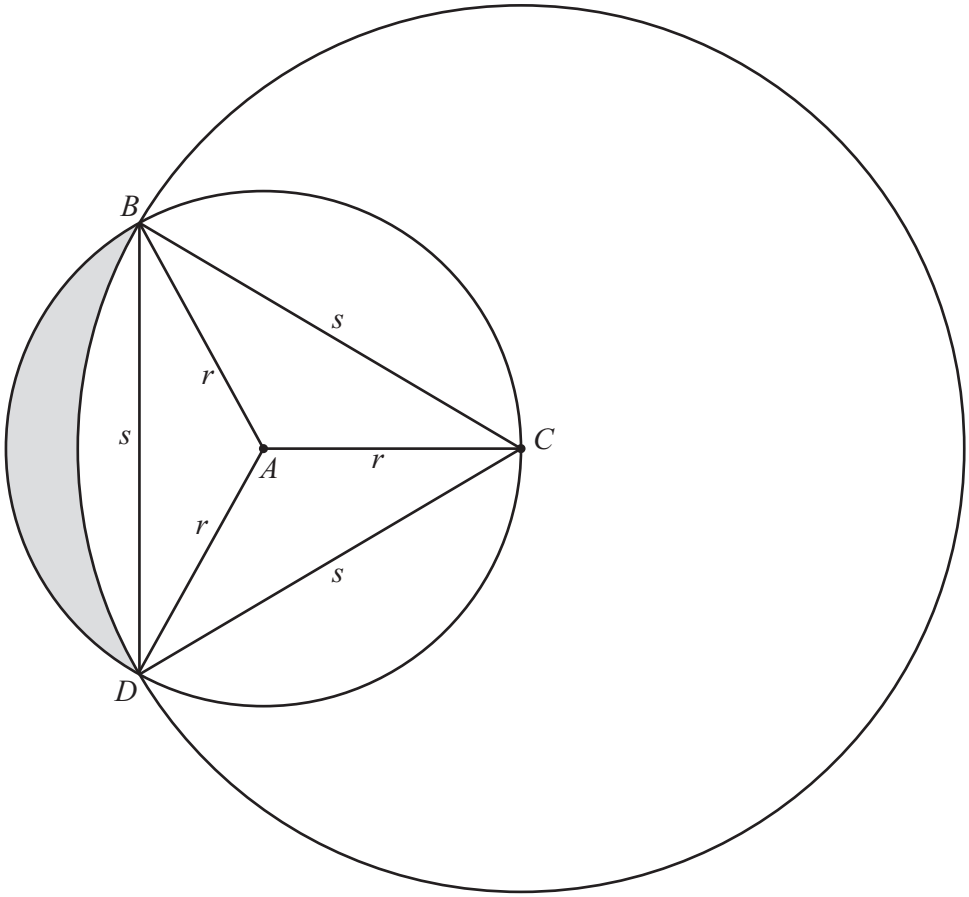
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The diagram shows a circle with centre A and radius r passing through points B, C and D. A larger circle of radius s has centre C and passes through B and D. The length BD is also s.

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

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(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]

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Additional page

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