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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 1 2 2 9 9 8 5 9 2 1 *

ADDITIONAL MATHEMATICS **4037/12**

Paper 1 Non-calculator **May/June 2025**

2 hours

You must answer on the question paper.

No additional materials are needed.

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.
- Calculators must **not** be used in this paper.
- You must show all necessary working clearly.

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages.

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List of formulas

Equation of a circle with centre (a, b) and radius r. $(x-a)^2 + (y-b)^2 = r^2$

Curved surface area, A, of cone of radius r, sloping edge l. $A = \pi r l$

Surface area, A, of sphere of radius r. $A = 4\pi r^2$

Volume, V, of pyramid or cone, base area A, height h. $V = \frac{1}{3}Ah$

Volume, V, of sphere of radius r. $V = \frac{4}{3}\pi r^3$

Quadratic equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial theorem

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!\,r!}$

Arithmetic series

$$u_n = a + (n-1)d$$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulas for ΔABC

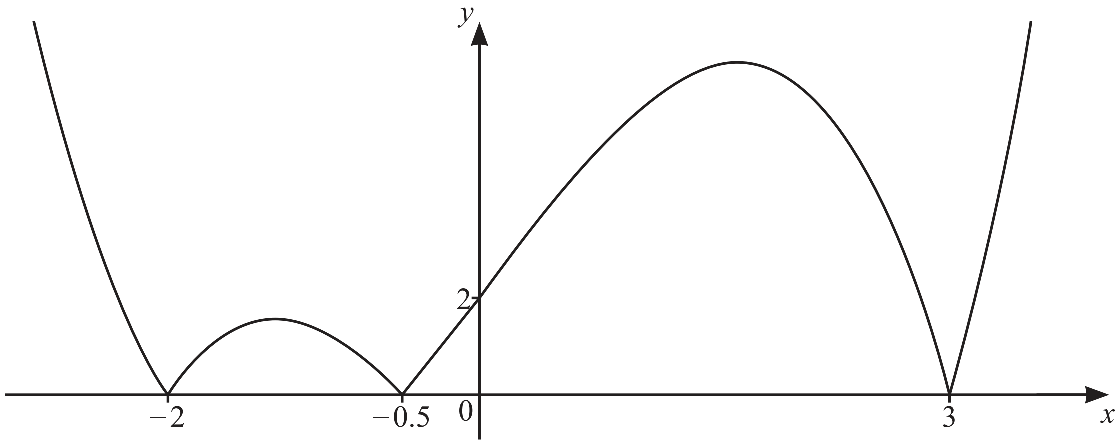
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\Delta = \frac{1}{2}ab\sin C$$

Calculators must **not** be used in this paper.

1



The diagram shows the graph of $y = |f(x)|$, where f is a cubic polynomial.
Find expressions for the two possible functions $f(x)$.
Write each expression in fully factorised form. [3]

2 Solve the equation $x^{\frac{1}{3}} + 1 = \dfrac{6}{x^{\frac{1}{3}}}$. [4]

3 A circle with centre C has the equation $x^2+y^2-10x-4y+24=0$.

(a) Show that the line $y=2x-3$ is a tangent to this circle. [3]

(b) Given that this tangent touches the circle at the point P, find the coordinates of P. [2]

(c) Find the equation of the circle which has its centre at P and passes through the origin. [3]

4 **(a)** Find $\int_0^{\pi} \sin\theta \, d\theta$. [2]

(b) Given that $0 < \alpha < \frac{\pi}{2}$, show that $\frac{\sec\alpha}{\cot\alpha + \tan\alpha}$ can be written as $\sin\alpha$. [3]

5 The polynomial p is such that $p(x) = 3x^3 - 7x^2 + ax + b$, where a and b are integers.

It is given that $p'(-1) = 21$ and that $x - 2$ is a factor of $p(x)$.

(a) Find the values of a and b. [4]

(b) Hence write $p(x)$ as a product of linear factors with integer coefficients. [3]

(c) Using your values of a and b, solve the equation $3e^{6y} - 7e^{4y} + ae^{2y} + b = 0$. [3]

6 When $\ln y$ is plotted against x^3, a straight line passing through the points $(2, 5)$ and $(-8, 25)$ is obtained.

(a) Find y in terms of x. [4]

(b) Find the value of x when $y = e^{25}$. [2]

7 A geometric progression has a 4th term of $\frac{8k^6}{27}$ and a 6th term of $\frac{32k^{10}}{243}$, where k is a constant.

The common ratio of this geometric progression is positive.

(a) Find the common ratio in terms of k and the value of the first term of this geometric progression. [4]

(b) Given that this geometric progression has a sum to infinity of 3, find the possible values of k. [3]

8 It is given that $y = \dfrac{\ln(3x^2 + 16)}{x + 2}$.

(a) Find $\dfrac{dy}{dx}$ when $x = 0$.

Give your answer in the form $\ln p$, where p is a constant. [5]

(b) Given that x increases from 0 to h, where h is small, write down the approximate change in y. [1]

9 It is given that $f(x) = 2\ln(3x-4)$, for $x > a$, and that f^{-1} exists.

(a) Find the least possible value of a. [1]

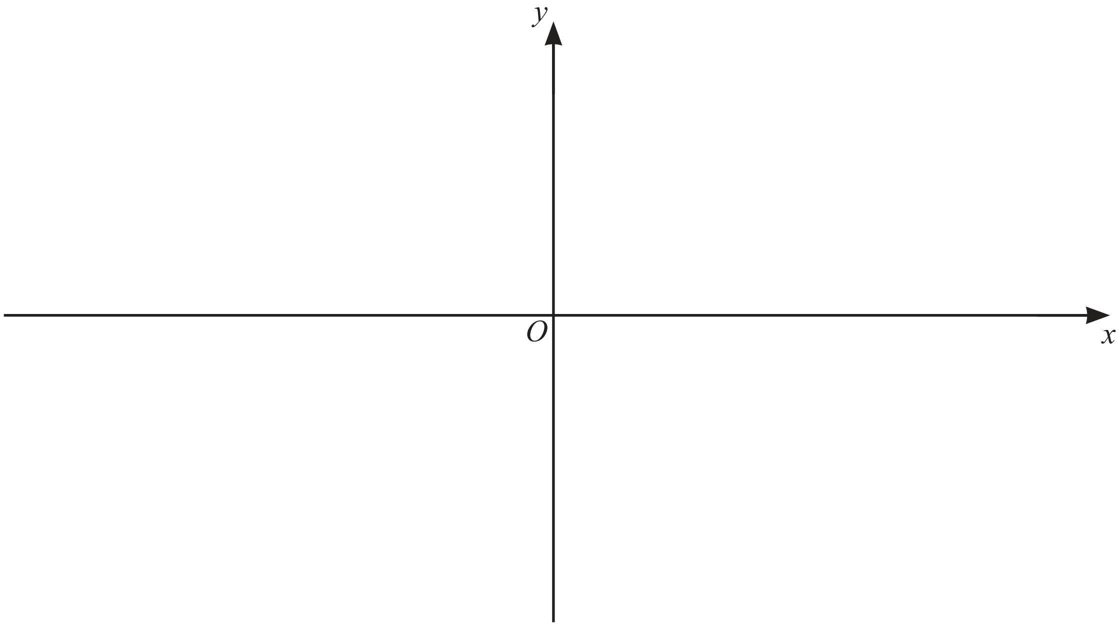
(b) For your value of a, find the range of f. [1]

(c) For your value of a, find an expression for $f^{-1}(x)$. [2]

(d) It is given that the equation $f(x) = f^{-1}(x)$ has two roots.

For your value of a, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$ on the axes.

Label each graph.
State the intercepts of each graph with the axes.
State the equations of any asymptotes. [4]



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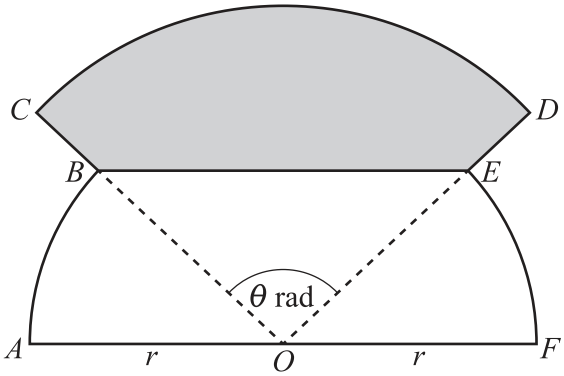


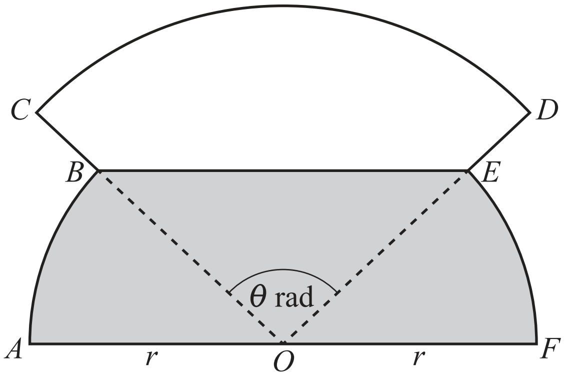
The diagram shows the shape $OABCDEF$.
AOF is a straight line.
OAB and OEF are sectors of a circle with centre O and radius r.
Angle BOA = angle EOF.

OCD is a sector of a circle with centre O and radius $\frac{4r}{3}$.

Angle COD is θ radians.
The point B lies on the line OC and the point E lies on the line OD.
The line BE is parallel to the line AOF.

(a) Find, in terms of r and θ, the area of the shaded region $BCDE$. [3]

(b)



The diagram shows the shape from part **(a)** with region *OABEF* shaded.
Find, in terms of r and θ, the perimeter of the shaded region. [5]

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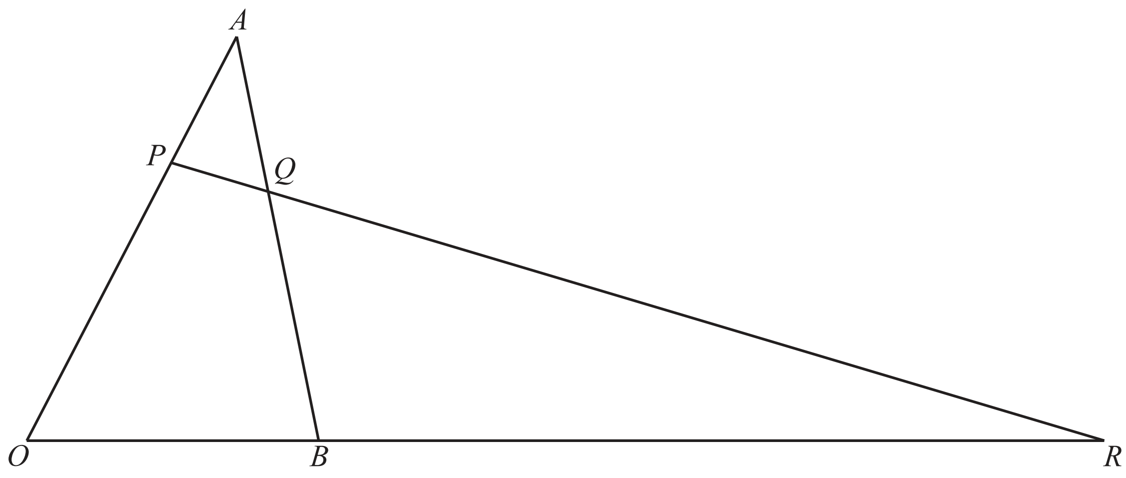

The diagram shows the triangle OAB, where $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

The point P lies on OA such that $\overrightarrow{OP} = \frac{3}{4}\overrightarrow{OA}$.

The point Q lies on AB such that $\overrightarrow{AQ} = \frac{1}{3}\overrightarrow{AB}$.

The straight line through P and Q meets the straight line through O and B at the point R.
It is given that $\overrightarrow{OR} = \lambda\mathbf{b}$ and $\overrightarrow{PR} = \mu\overrightarrow{PQ}$, where λ and μ are constants.

(a) Find $\overrightarrow{OR}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and μ. [6]

(b) Hence find the values of λ and μ. [3]

Question 12 is printed on the next page.

12 A curve is such that its gradient at the point (x, y) is given by $(5x-2)^{\frac{1}{3}}$.

The curve passes through the point $\left(2, \frac{32}{5}\right)$.

Find the coordinates of the stationary point on the curve. [6]