



Cambridge O Level

CANDIDATE NAME

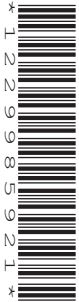


CENTRE NUMBER

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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.





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

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

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 $\triangle ABC$

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

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

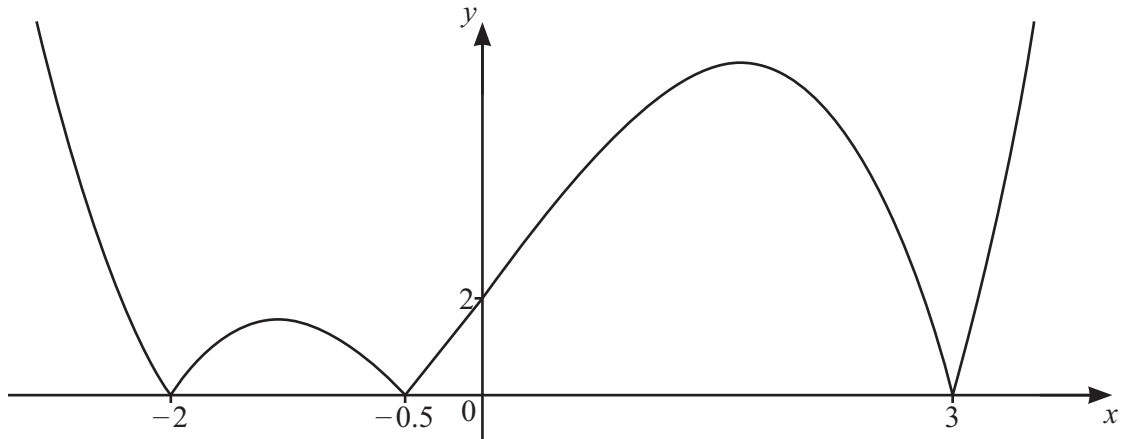
$$\Delta = \frac{1}{2} ab \sin C$$





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 $x^{\frac{1}{3}} + 1 = \frac{6}{x^{\frac{1}{3}}}$.

[4]

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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]



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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]

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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]

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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]



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

(a) Find $\frac{dy}{dx}$ 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]

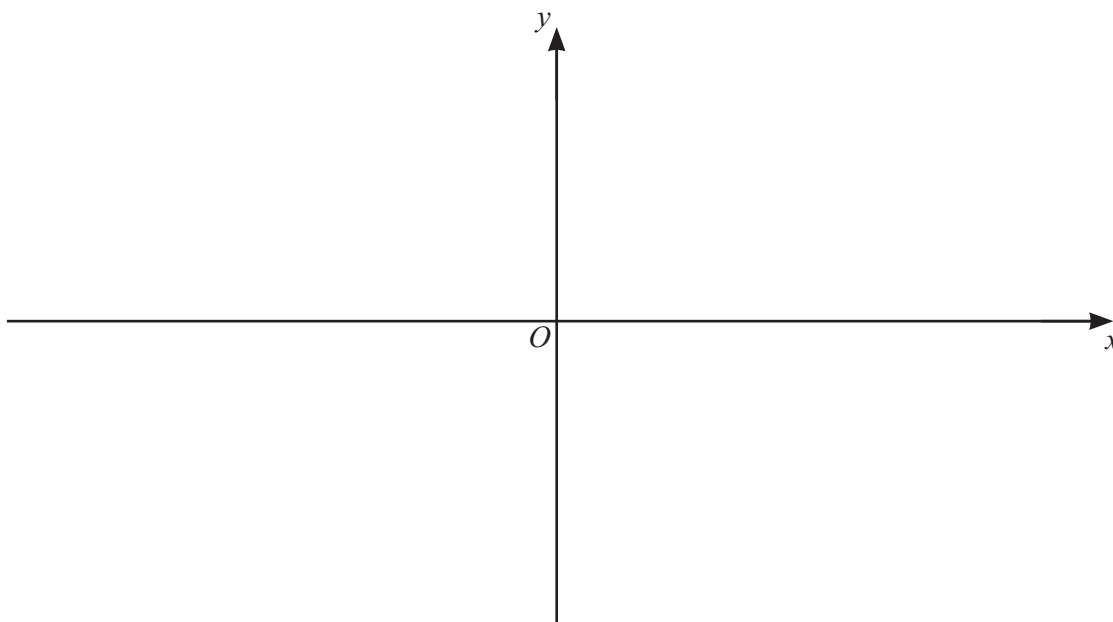
(d) It is given that the equation $f(x) = f^{-1}(x)$ has two roots.

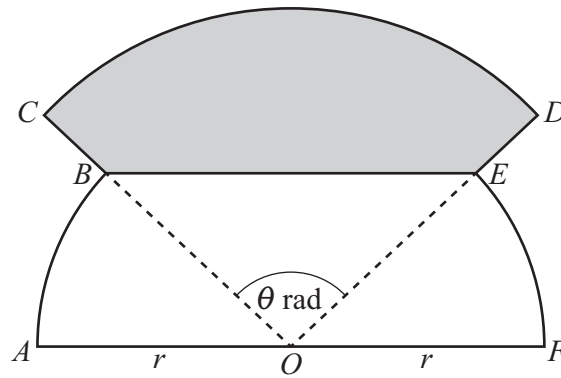
For your value of a , sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$ on the axes.

Label each graph.

State the intercepts of each graph with the axes.

State the equations of any asymptotes. [4]





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 .

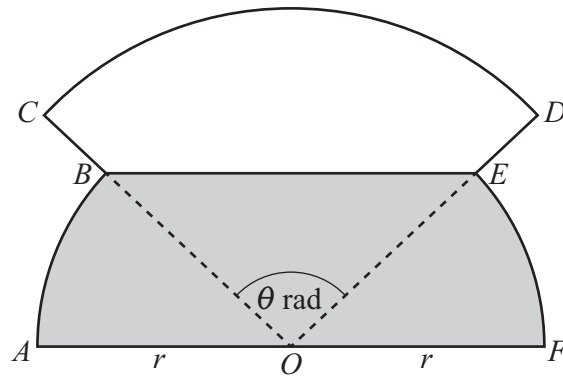
The line BE is parallel to the line AOF .

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

[3]



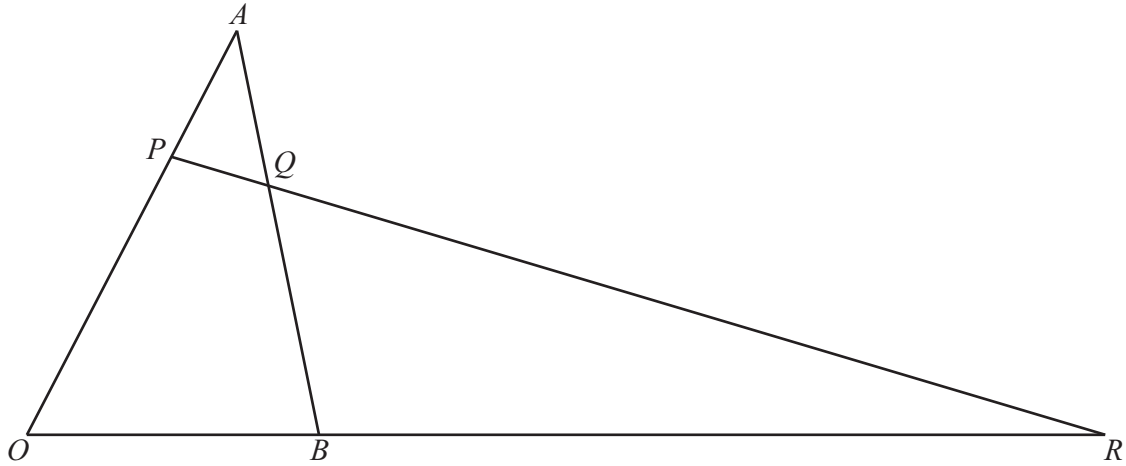
(b)



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]

11



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.



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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]

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