Cambridge Assessment International Education

# Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*0123456789*

**ADDITIONAL MATHEMATICS** **4037/01**

Paper 1 Non-calculator **For examination from 2025**

SPECIMEN PAPER **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 $l$. $A = \pi rl$

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

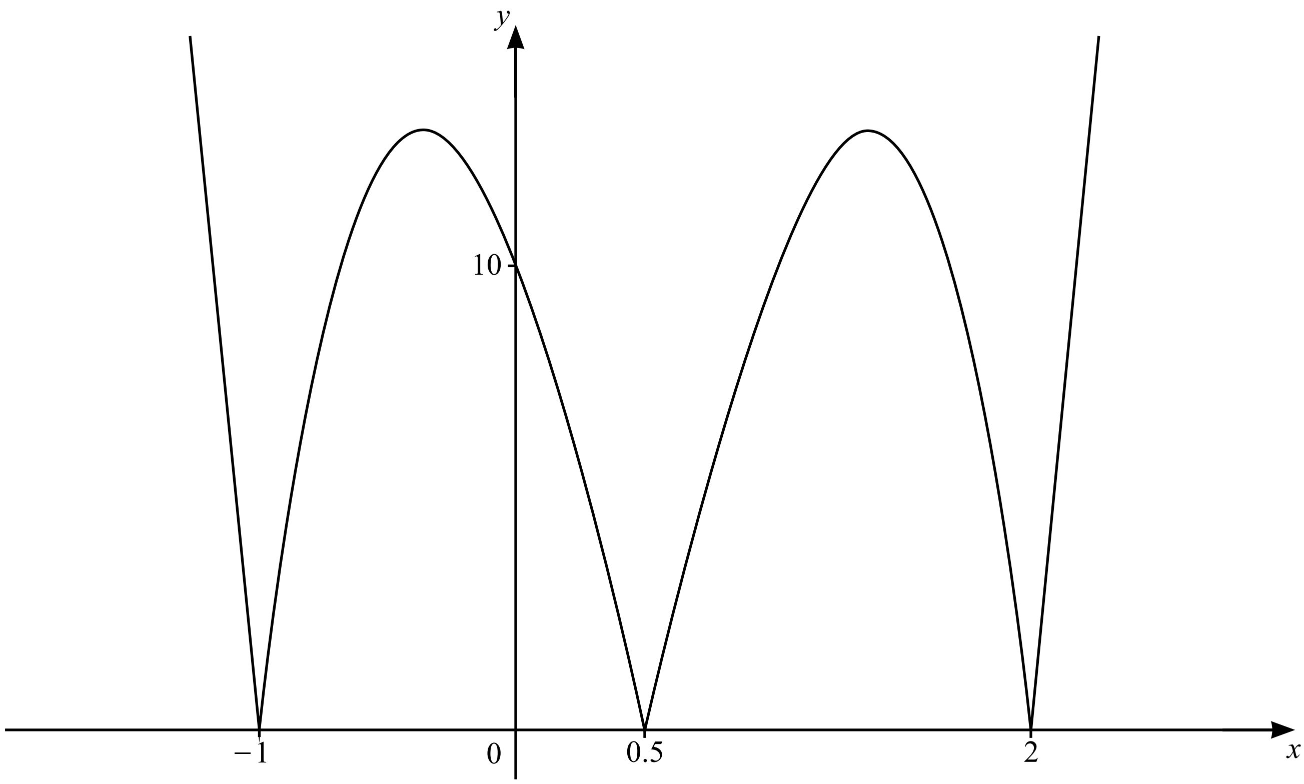
$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulas for $\Delta ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$\Delta = \frac{1}{2}ab\sin C$$

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

**1**




The diagram shows the graph of $y = |f(x)|$, where $f(x)$ is a cubic function.

Find the possible expressions for $f(x)$ in factorised form. [3]

**2** The polynomial $p(x) = 6x^3 + ax^2 + bx + 2$, where $a$ and $b$ are integers, has a factor of $x - 2$.

**(a)** Given that $p(1) = -2p(0)$, find the values of $a$ and $b$. [4]

**(b)** Using your values of $a$ and $b$,

**(i)** find the remainder when $p(x)$ is divided by $2x - 1$ [2]

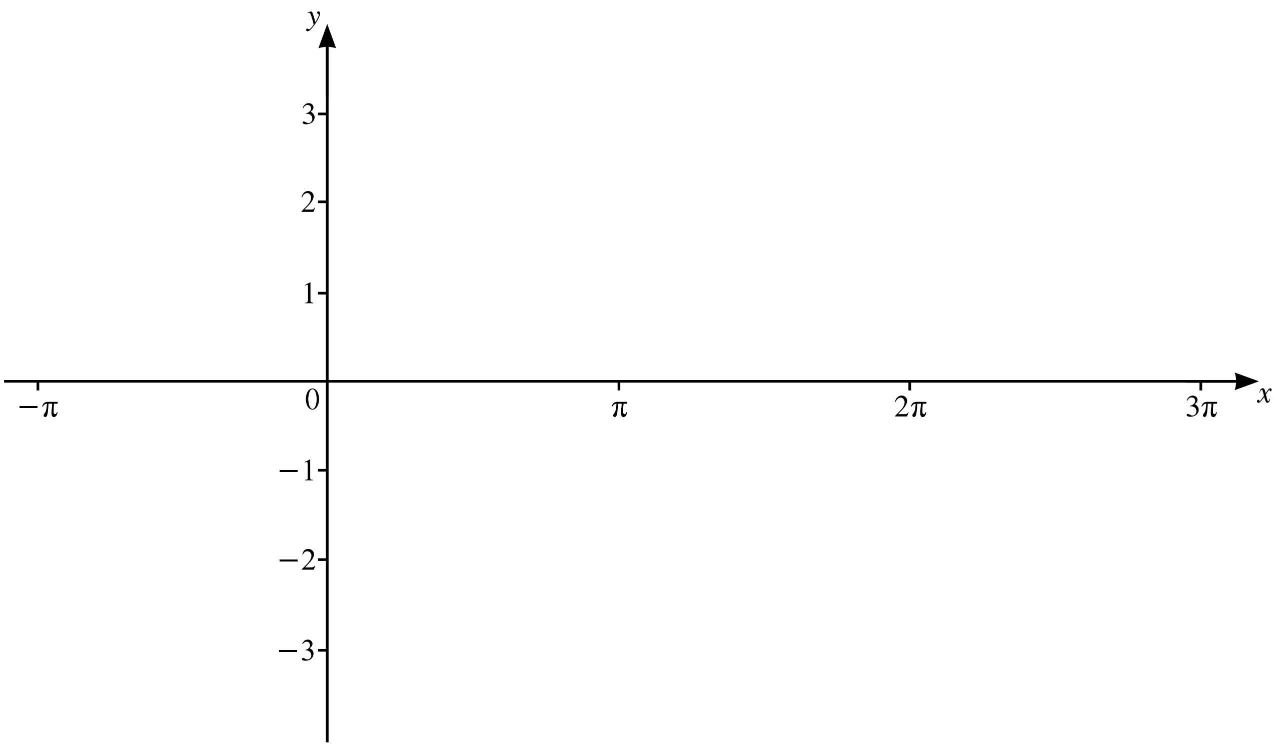
**(ii)** factorise $p(x)$. [2]

**3** In this question, all angles are in radians.

**(a)** Write down the amplitude of $2\cos\frac{x}{3} - 1$. [1]

**(b)** Write down the period of $2\cos\frac{x}{3} - 1$. [1]

**(c)** On the axes below, sketch the graph of $y = 2\cos\frac{x}{3} - 1$ for $-\pi \leqslant x \leqslant 3\pi$. [3]



**4** The parallelogram $OABC$ is such that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$. The point $D$ lies on $OC$ such that $OD:DC = 1:2$. The point $E$ lies on $AC$ such that $AE:EC = 2:1$.

Show that $\overrightarrow{OB} = k\overrightarrow{DE}$, where $k$ is an integer to be found. [5]

**5** **(a)** Given that $\log_a p + \log_a 5 - \log_a 4 = \log_a 20$, find the value of $p$. [2]

**(b)** Solve the equation $3^{2x+1} + 8(3^x) - 3 = 0$. [3]

**(c)** Solve the equation $4\log_y 2 + \log_2 y = 4$. [3]

**6** **(a)** $f(x) = 3e^{2x} + 1$ for $x \in \mathbb{R}$

$g(x) = x + 1$ for $x \in \mathbb{R}$

**(i)** Write down the range of f and the range of g. [2]

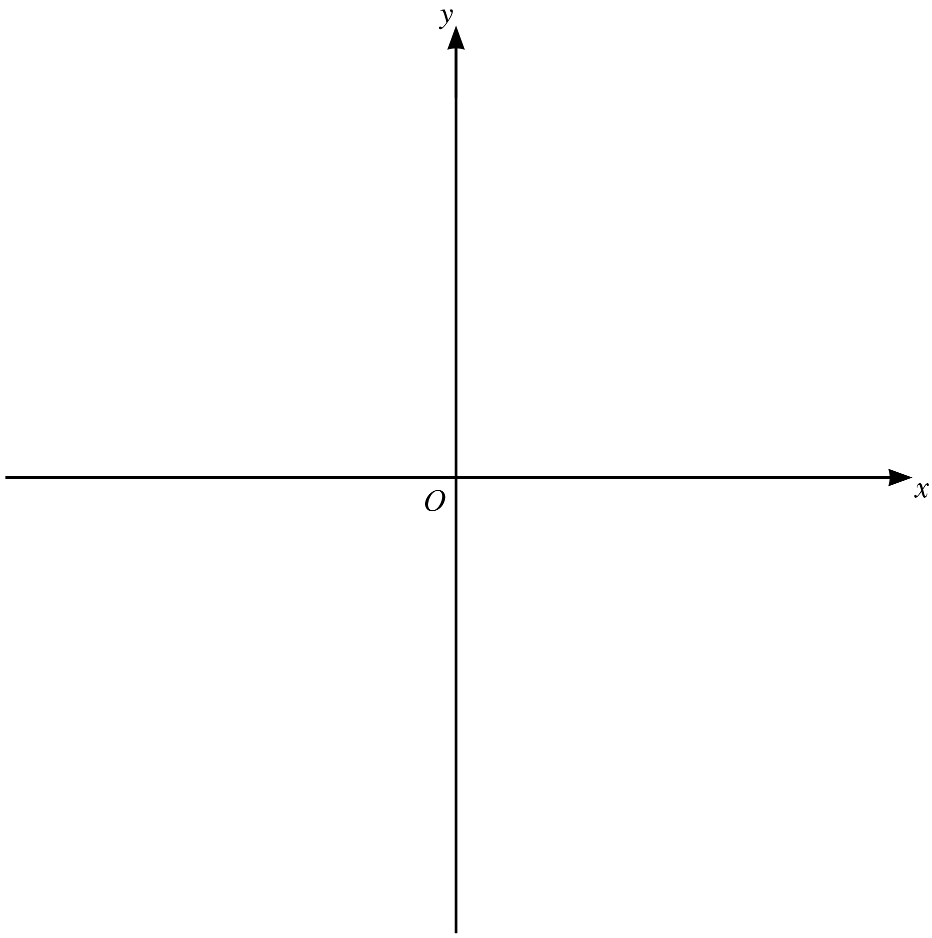
**(ii)** Find $g^2(0)$ . [1]

**(iii)** Hence find $fg^2(0)$ . [2]

**(iv)** On the axes below, sketch the graphs of $y = \mathrm{f}(x)$ and $y = \mathrm{f}^{-1}(x)$.

State the intercepts with the coordinate axes and the equations of any asymptotes. [4]




**(b)** It is given that $\mathrm{h}(x) = a + \dfrac{b}{x^2}$, where $a$ and $b$ are constants.

**(i)** Explain why $-2 \leqslant x \leqslant 2$ is not a suitable domain for $\mathrm{h}(x)$. [1]

**(ii)** Given that $\mathrm{h}(1) = 4$ and $\mathrm{h}'(1) = 16$, find the values of $a$ and $b$. [2]

**7** **(a)** In an arithmetic progression, the 5th term is equal to $\frac{1}{3}$ of the 16th term. The sum of the 5th term and the 16th term is equal to 33.

Find the sum of the first 10 terms of this progression. [6]

**(b)** In a geometric progression, the sum of the first two terms is equal to 16. The sum to infinity is equal to 25.

Find the possible values of the first term. [6]

**8** **(a)** Given that $\int_1^a \left(\frac{2}{2x+3} + \frac{3}{3x-1} - \frac{1}{x}\right) dx = \ln 2.4$, where $a > 1$, find the value of $a$. [7]

**(b)** **(i)** Find $\frac{\mathrm{d}}{\mathrm{d}x}(6\sin^3 kx)$, where $k$ is a constant. [2]

**(ii)** Hence find $\int(\sin^2 2x\cos 2x)\,\mathrm{d}x$ . [2]

**9** In this question, the units are metres and seconds.

A particle $P$ is travelling in a straight line. Its acceleration, $a$, away from a fixed point $O$, at time $t$, is given by $a = (3t+2)^{-\frac{1}{3}}$, where $t \geqslant 0$.

When $t = 2$, $P$ is travelling with a velocity of 8 and has a displacement of $-4.8$ from $O$.

**(a)** Find an expression for the velocity of $P$ at time $t$. [3]

**(b)** Explain why $P$ is never at rest. [1]

**(c)** Find the displacement of $P$ from $O$ when $t = \frac{25}{3}$. [4]

**Question 10 is printed on the next page.**

**10** A circle has a centre $(2, -4)$ and radius 3.
The line $y = 2x - 3$ intersects the circle at points $A$ and $B$.
The perpendicular bisector of line $AB$ intersects the circle at points $X$ and $Y$.

Find the area of kite $AXBY$. [8]