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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 4 5 7 8 9 0 5 4 4 8 *

ADDITIONAL MATHEMATICS **4037/13**

Paper 1 **October/November 2024**

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.
- 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 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (LO) 344641

Mathematical Formulae

1. ALGEBRA

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 $u_n = ar^{n-1}$

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

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

2. TRIGONOMETRY

Identities

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

Formulae for ΔABC

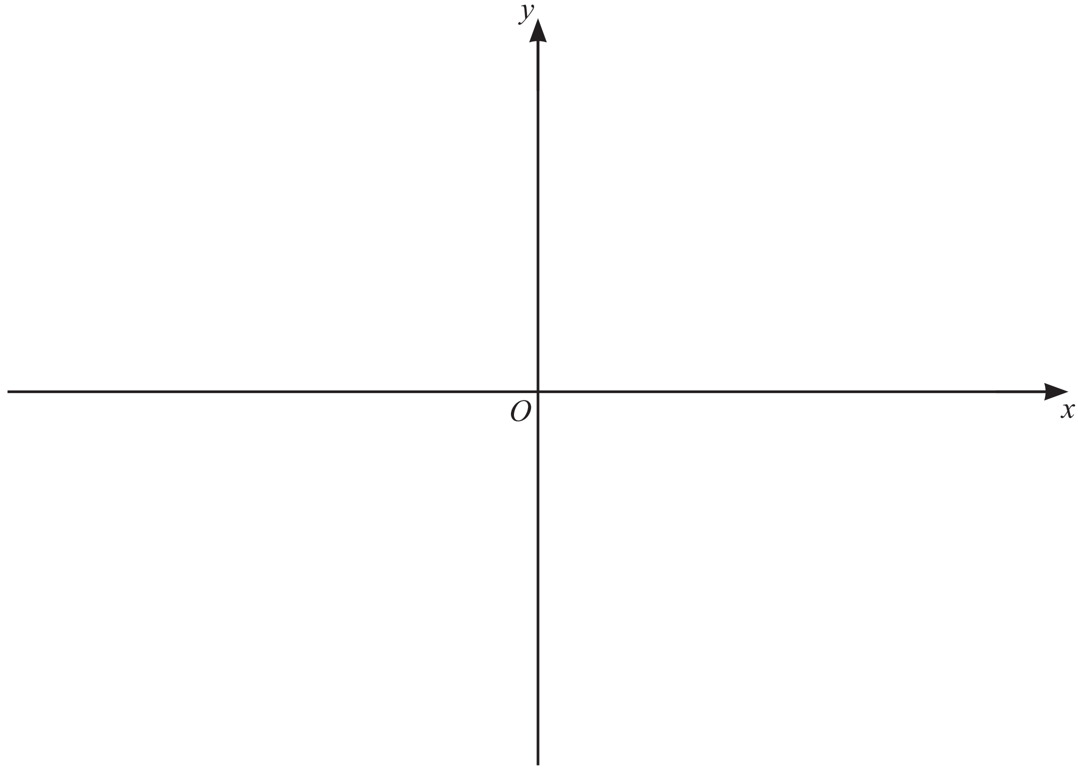
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2}bc\sin A$$

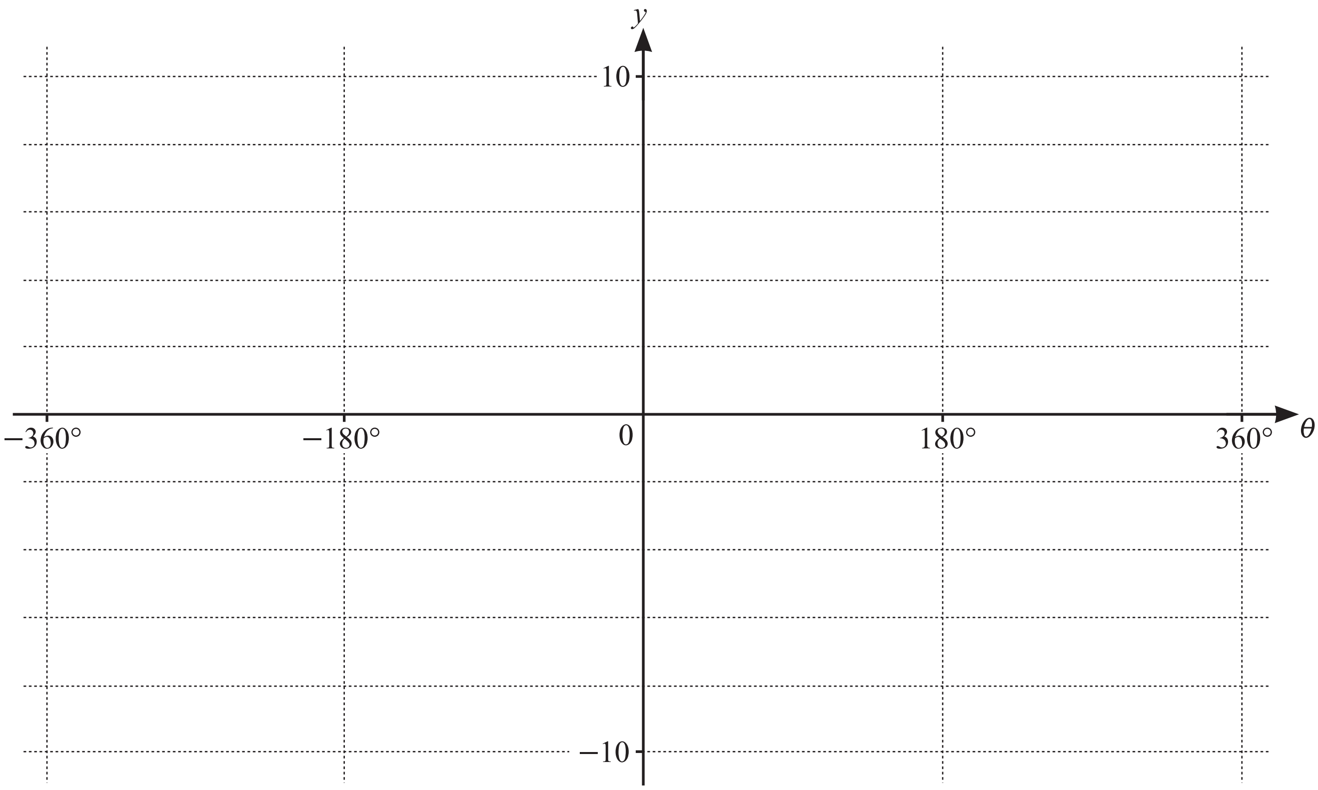
1 **(a)** Find the coordinates of the stationary point on the curve $y = (x+3)(x-4)$. [3]

(b) On the axes, sketch the graph of $y = |(x+3)(x-4)|$, stating the intercepts with the axes. [2]



(c) Given that $k > 0$, write down the values of k for which the equation $|(x+3)(x-4)| = k$ has exactly 2 distinct real roots. [1]

2 On the axes, sketch the graph of $y = 4 + 5\sin\frac{\theta}{2}$, for $-360° \leqslant \theta \leqslant 360°$. State the intercept with the y-axis. [4]



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3 Find the values of k for which the equation $4x^2 - k = 4kx - 2$ has no real roots. [4]

4 **(a)** Write $3+4\log_2 a-\log_2 b$ as a single base 2 logarithm. [3]

(b) Solve the equation $\lg x = 4\log_x 10$. [4]

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5 The polynomial p is such that $p(x) = ax^3 + bx^2 - 19x + c$, where a, b and c are integers. It is given that $x+2$ is a factor of $p(x)$. When $p(x)$ is divided by $x+1$ the remainder is 20.

(a) Show that $7a - 3b = 39$. [3]

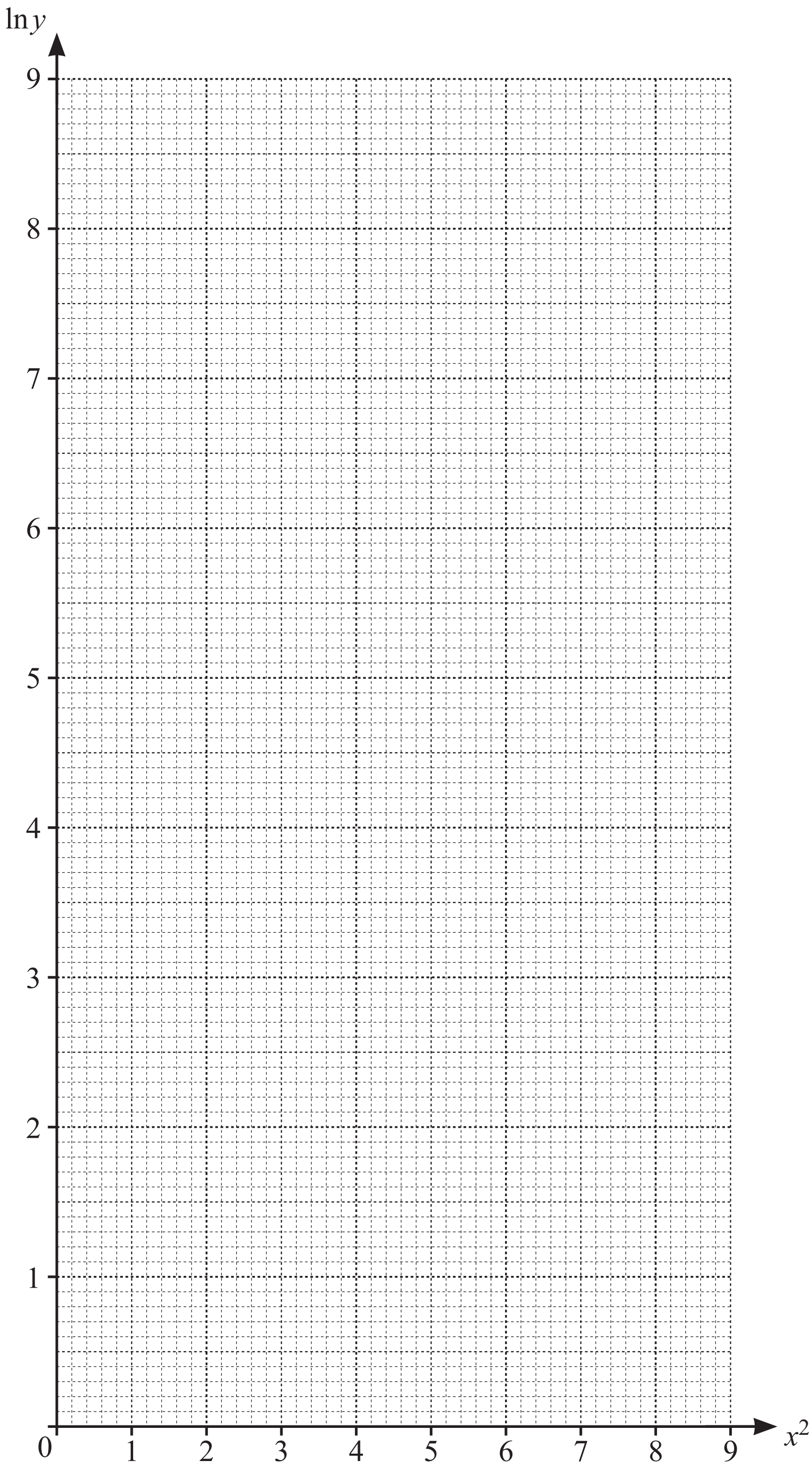
It is also given that when $p'(x)$ is divided by $x-1$ the remainder is 1.

(b) Find the values of a, b and c. [3]

6 The table shows the variables x and y which are related by the equation $y = Ab^{x^2}$, where A and b are constants.

x	1	1.5	2	2.5	3
y	14	33.3	112	532.8	3584

(a) Use the data to draw a straight line graph of $\ln y$ against x^2. [2]



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(b) Use your graph to estimate the values of A and b. Give your answers correct to 1 significant figure. [5]

(c) Use your graph to estimate the value of x when $y = 200$. Give your answer correct to 2 significant figures. [2]

7 **(a)** Given that $y = x^3 \ln x$, find $\frac{dy}{dx}$. [2]

(b) Hence find $\int_1^2 3x^2 \ln x \, dx$, giving your answer in the form $\ln a + b$, where a is an integer and b is a rational number. [4]

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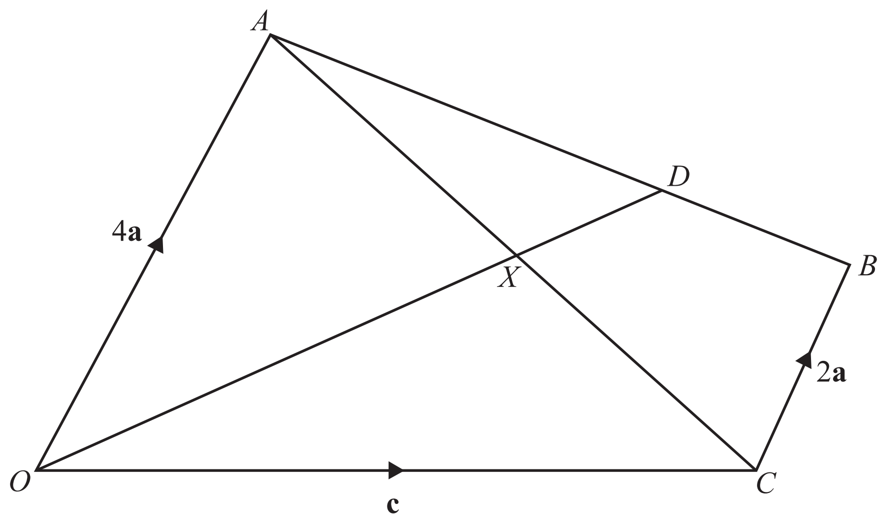
8 The straight line $y = 2x + 1$ intersects the curve $y + xy + 3x^2 = 15$ at the points A and B. The point C with coordinates $\left(\frac{21}{10}, k\right)$ lies on the perpendicular bisector of AB.

(a) Find the exact value of k. [8]

(b) The point D lies on the perpendicular bisector of AB such that its perpendicular distance from AB is twice that of the point C from AB. Find the possible coordinates of D. [4]

9



The diagram shows the trapezium $OABC$, where $\overrightarrow{OA} = 4\mathbf{a}$, $\overrightarrow{OC} = \mathbf{c}$, and $\overrightarrow{CB} = 2\mathbf{a}$. The point D lies on AB such that $AD : DB = 2 : 1$. The point X is the point of intersection of the lines OD and AC. It is given that $\overrightarrow{AX} = \lambda\overrightarrow{AC}$ and $\overrightarrow{OX} = \mu\overrightarrow{OD}$.

Find in terms of **a** and **c**

(a) $\overrightarrow{AB}$ [1]

(b) $\overrightarrow{OD}$. [2]

(c) Find $\overrightarrow{OX}$ in terms of **a**, **c** and μ. [1]

(d) Find $\overrightarrow{AX}$ in terms of **a**, **c** and λ. [2]

(e) Hence find the values of λ and μ. [4]

10 **(a)** Solve the equation $7\tan^2\theta + 5\tan\theta - 2 = 0$, for $-180° \leqslant \theta \leqslant 180°$. [4]

(b) Solve the equation $3\sin(3\phi - 1.5) - 2 = 0$, for $0 < \phi < 3$, where ϕ is in radians. [5]

11 **(a)** The first 3 terms of an arithmetic progression are $\log_x 3$, $\log_x 81$, $\log_x 2187$. Find the sum to n terms, giving your answer in the form $k\log_x 3$, where k is in terms of n. [3]

(b) The first 3 terms of a geometric progression are 1, $3\tan^2\theta$, $9\tan^4\theta$, for $0 < \theta < \frac{\pi}{2}$.

Find the values of θ for which this geometric progression has a sum to infinity. [4]

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