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ADDITIONAL MATHEMATICS

0606/13

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.



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

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

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

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

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

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

2. TRIGONOMETRY

Identities

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

Formulae for $\triangle ABC$

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



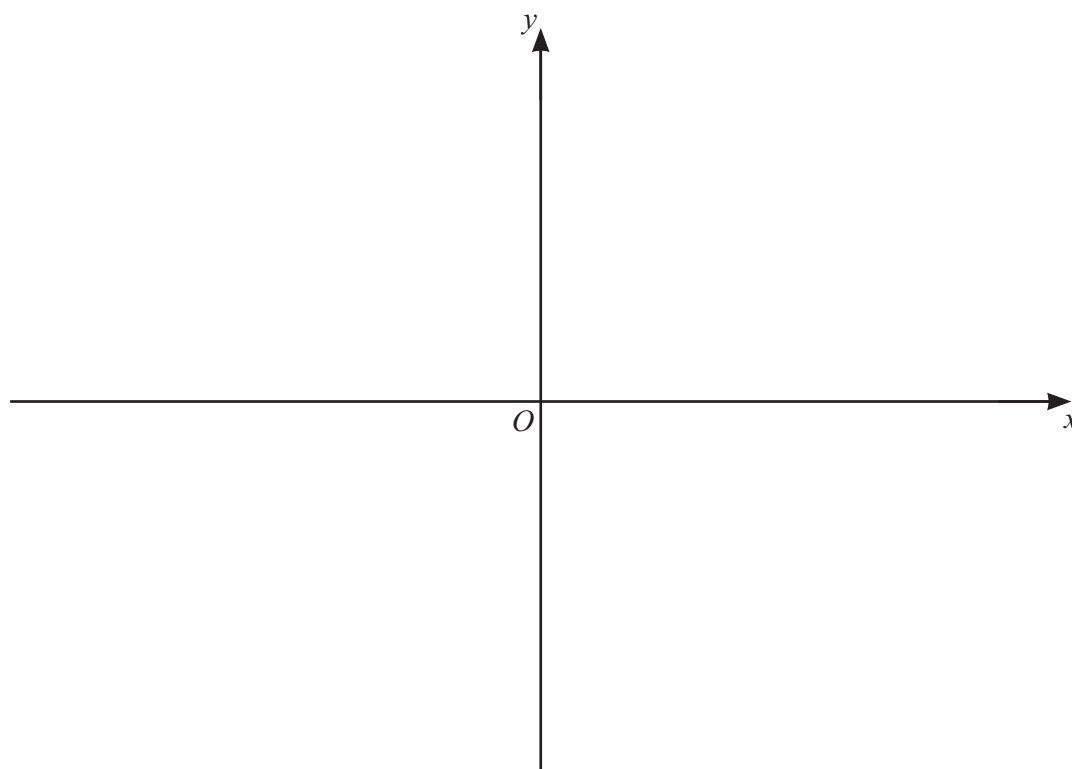


- 1 (a) Find the coordinates of the stationary point on the curve $y = (x+3)(x-4)$.

[3]

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

[2]



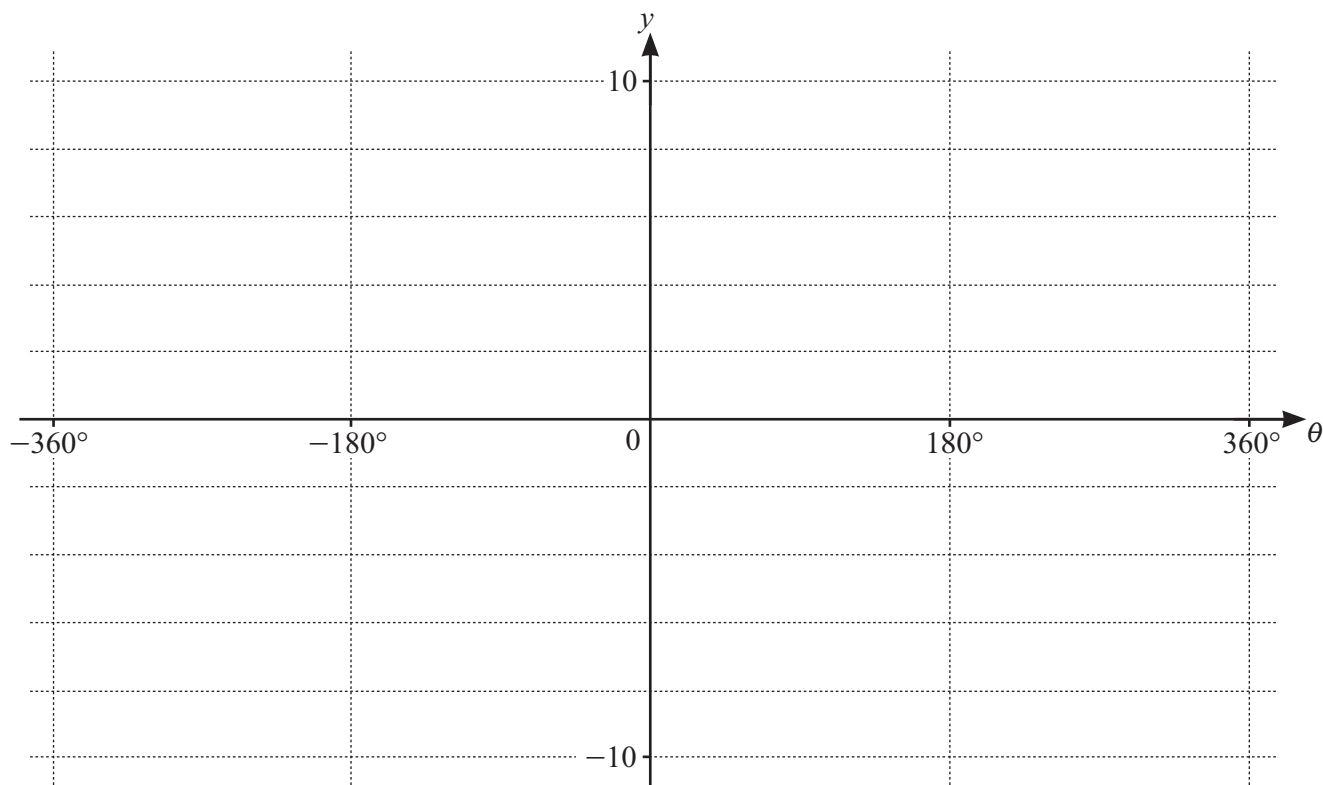
- (c) Given that $k > 0$, write down the values of k for which the equation $|(x+3)(x-4)| = k$ has exactly 2 distinct real roots.

[1]





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





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]





- 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]



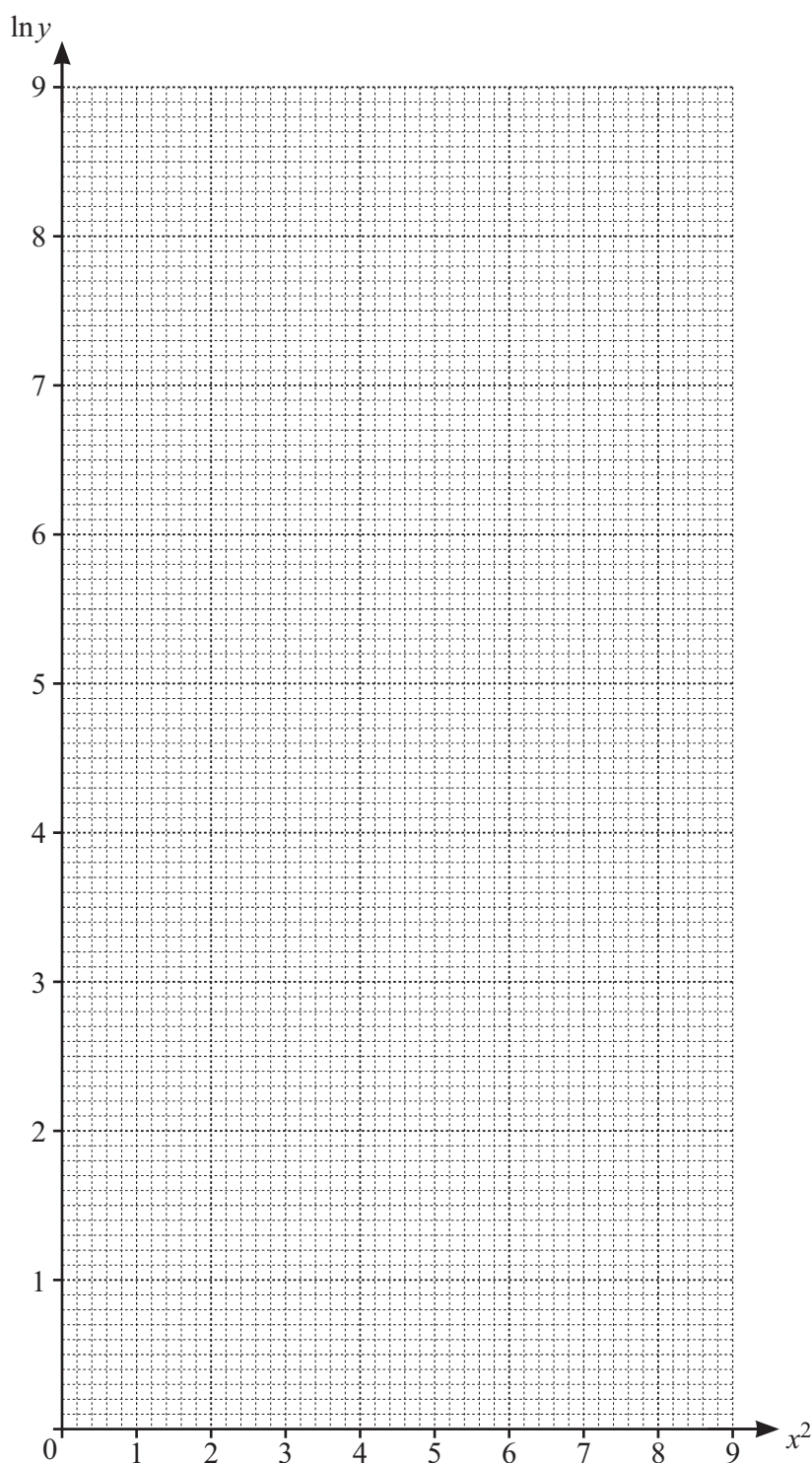


- 6 The table shows the variables x and y which are related by the equation $y = Ab^{x^2}$, where A and b are constants.

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]





- (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]





- 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 .

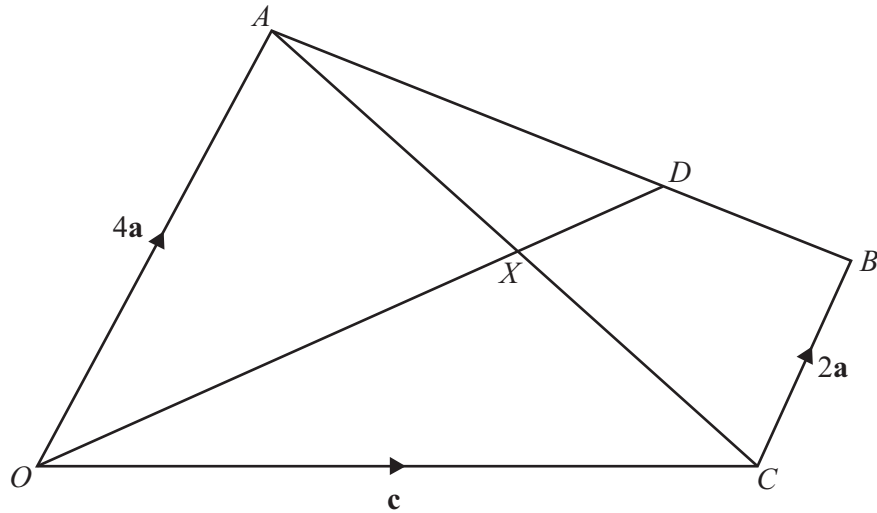
(a) Find the exact value of k .

[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]





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 $\mathbf{a}$ and $\mathbf{c}$

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

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

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

(d) Find $\overrightarrow{AX}$ in terms of $\mathbf{a}$, $\mathbf{c}$ 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 $-180^\circ \leq \theta \leq 180^\circ$.

[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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