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# Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

**ADDITIONAL MATHEMATICS**                                            **0606/12**

Paper 1                                                   **February/March 2023**

                                                                        **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.

**2**

*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 $\Delta ABC$*

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

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

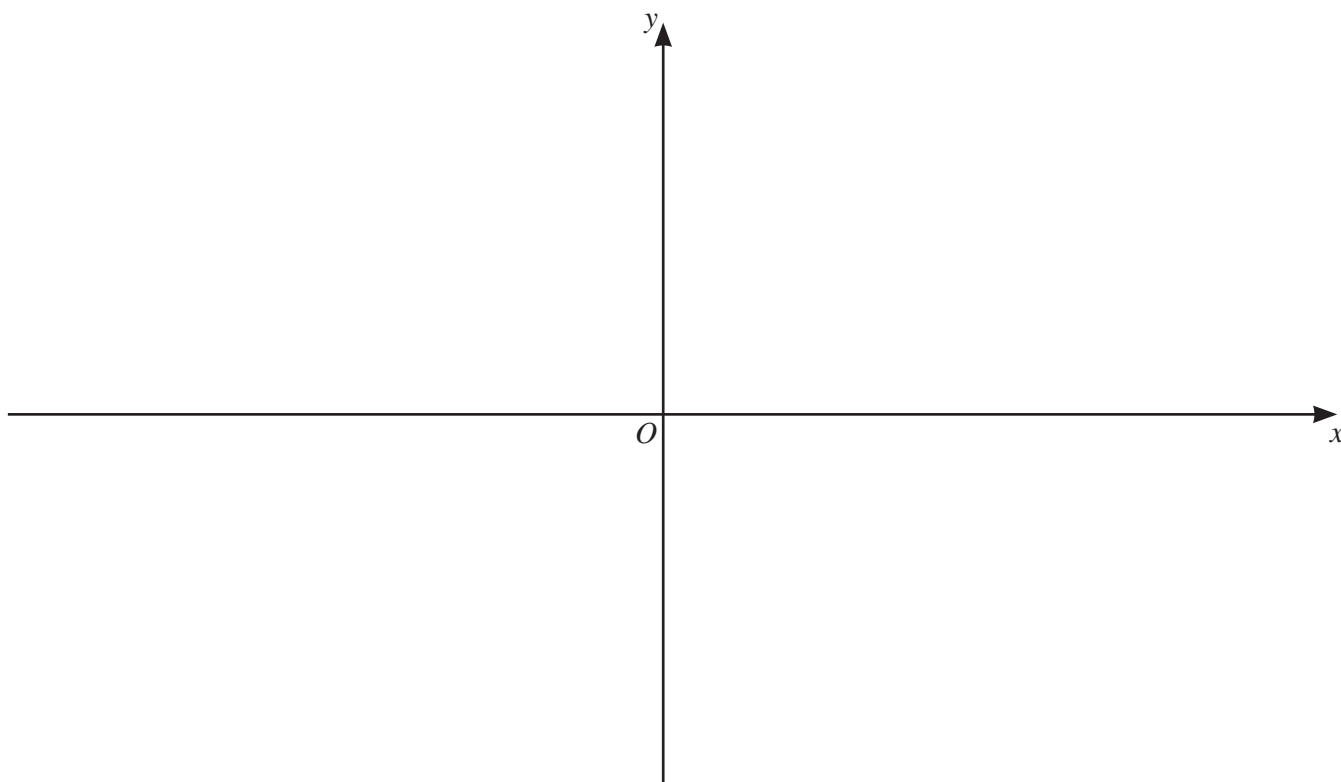$$\Delta = \frac{1}{2}bc \sin A$$

**3**

1   Find the exact values of $k$ such that the straight line $y = 1 - k - x$ is a tangent to the curve $y = kx^2 + x + 2k$. [4]

**4**

**2**  A curve has equation   $y = (5-x)(x+2)^2$.

**(a)**  Find the *x*-coordinates of the stationary points on the curve.  [4]

**(b)**  On the axes below, sketch the graph of   $y = (5-x)(x+2)^2$,   stating the coordinates of the points where the curve meets the axes.  [3]

**(c)** Find the values of $k$ for which the equation $k = (5-x)(x+2)^2$ has one distinct root only. [3]

**6**

**3** Find the coefficient of $x^8$ in the expansion of $\left(1-x^2\right)\left(2x-\dfrac{1}{x}\right)^{10}$. [5]

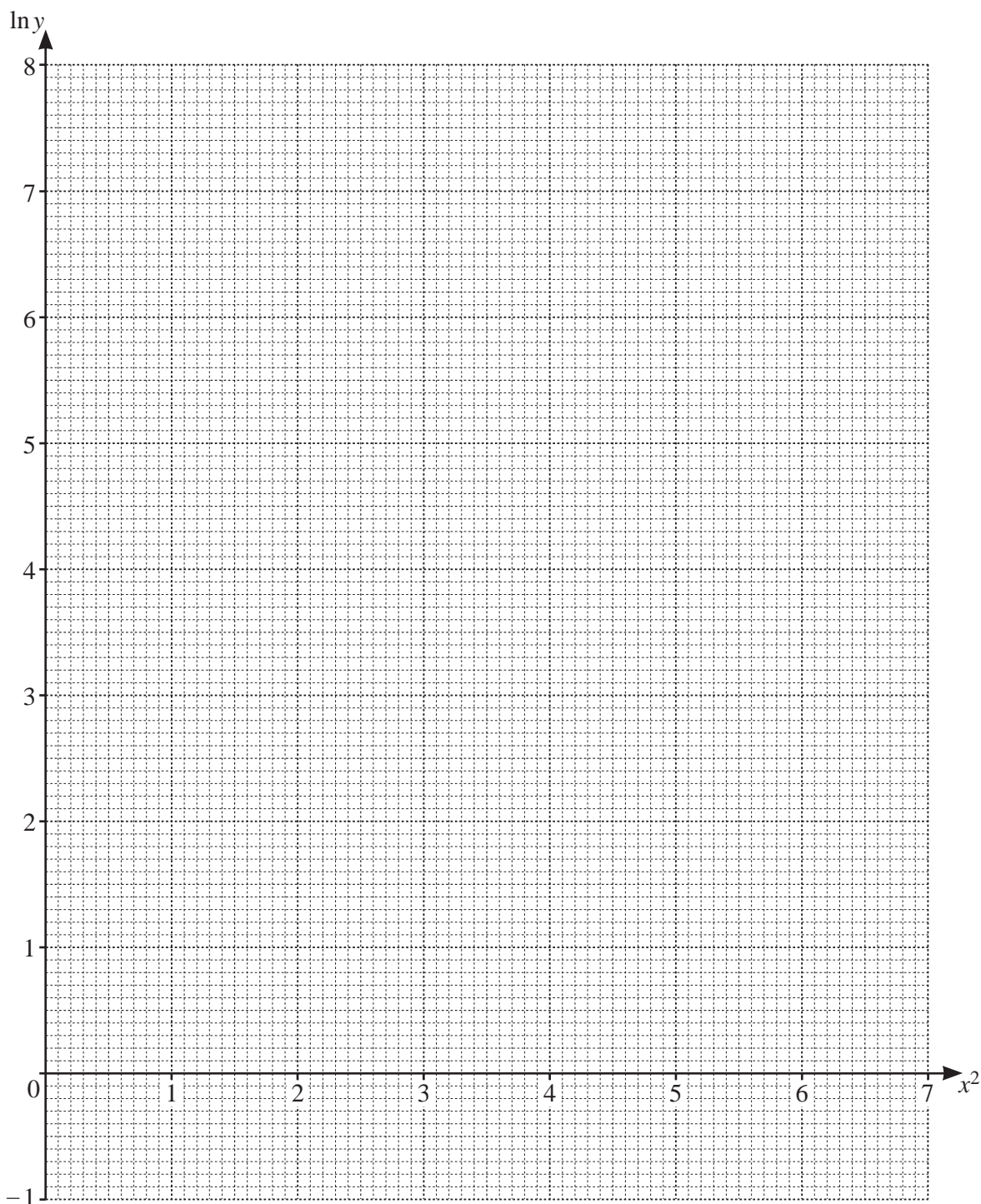**4** **(a)** Write $3\lg x - 2\lg y^2 - 3$ as a single logarithm to base 10. [3]

**(b)** Solve the equation $\log_3 x + \log_x 3 = \dfrac{5}{2}$. [5]

**5** The table shows values of the variables $x$ and $y$, which are related by an equation of the form $y = Ab^{x^2}$, where $A$ and $b$ are constants.

| $x$ | 1 | 1.5 | 2 | 2.5 |
|---|---|---|---|---|
| $y$ | 2.0 | 11.3 | 128 | 2896 |

**(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)** Estimate the value of *y* when *x* = 1.75.

[2]

**(d)** Estimate the positive value of *x* when *y* = 20.

[2]

**6** Given that $f''(x) = (5x+2)^{-\frac{2}{5}}$, $f'(6) = \dfrac{17}{3}$ and $f(6) = \dfrac{26}{3}$, find an expression for $f(x)$. [8]
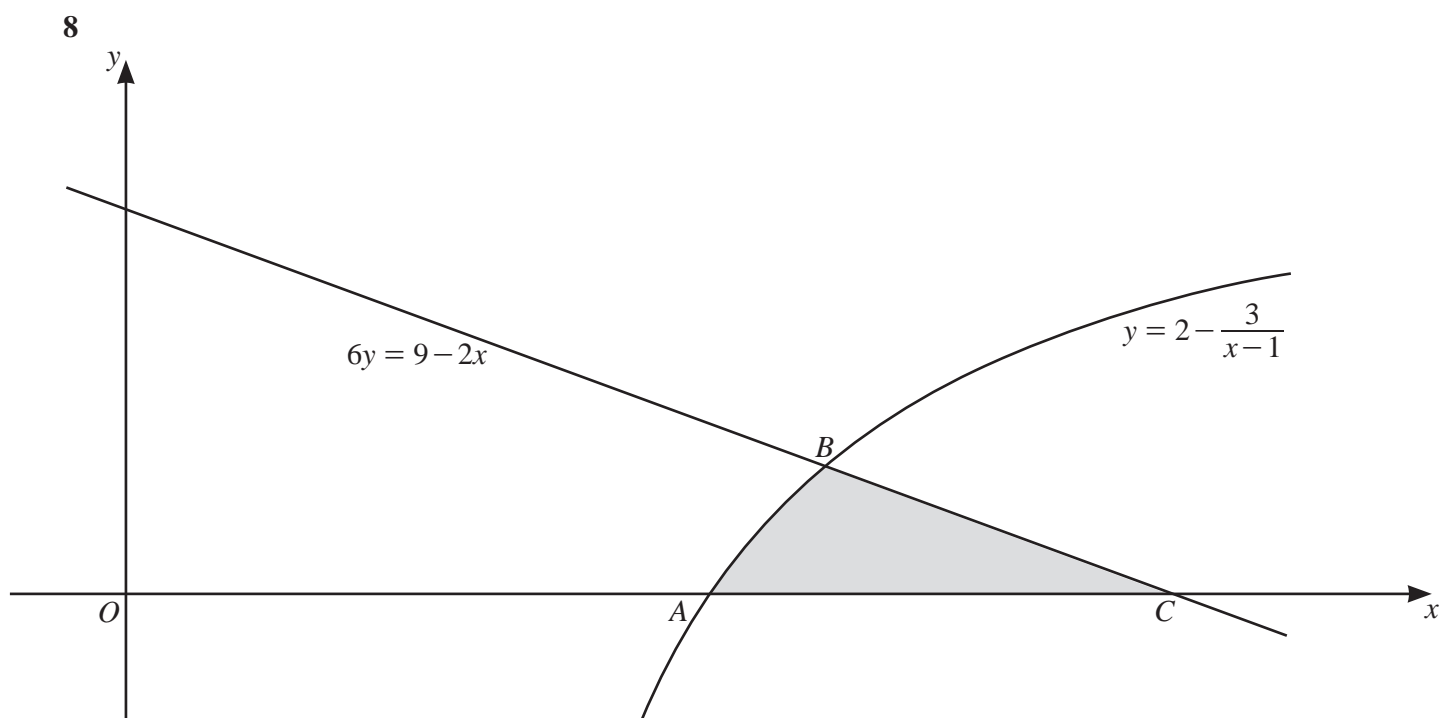
**11**

**7** **(a)** A 5-character password is to be formed from the following 13 characters.

| | | | | | |
|---|---|---|---|---|---|
| Letters | A | B | C | D | E |
| Numbers | 9 | 8 | 7 | 6 | 5 |
| Symbols | * | # | ! | | |

No character may be used more than once in any password.

**(i)** Find the number of possible passwords that can be formed. [1]

**(ii)** Find the number of possible passwords that contain at least one symbol. [2]

**(b)** Given that $16 \times {}^nC_{12} = (n-10) \times {}^{n+1}C_{11}$, find the value of $n$. [3]

**8**



The diagram shows part of the curve $y = 2 - \dfrac{3}{x-1}$ and the straight line $6y = 9 - 2x$. The curve intersects the $x$-axis at point $A$ and the line at point $B$. The line intersects the $x$-axis at point $C$. Find the area of the shaded region $ABC$, giving your answer in the form $p + \ln q$, where $p$ and $q$ are rational numbers. [11]

Additional working space for Question 8.

 **[Turn over**

**9** In this question, all lengths are in metres.

**(a)** A particle $P$ has position vector $\begin{pmatrix} 2+12t \\ 5-5t \end{pmatrix}$ at a time $t$ seconds, $t \geqslant 0$.

**(i)** Write down the initial position vector of $P$. [1]

**(ii)** Find the speed of $P$. [2]

**(iii)** Determine whether $P$ passes through the point with position vector $\begin{pmatrix} 158 \\ -48 \end{pmatrix}$. [2]

**(b)**
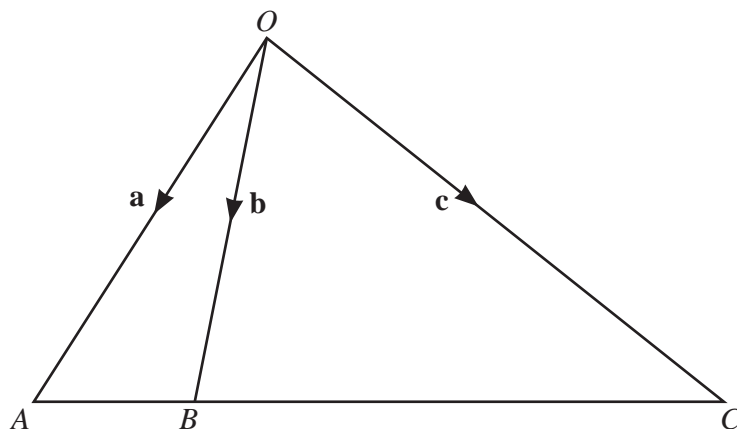


The diagram shows the triangle $OAC$. The point $B$ lies on $AC$ such that $AB\colon AC = 1\colon 4$. Given that $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$, find $\mathbf{c}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [3]

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

**10** **(a)** It is given that $2 + \cos\theta = x$ for $1 < x < 3$ and $2\operatorname{cosec}\theta = y$ for $y > 2$. Find $y$ in terms of $x$.

[4]

**(b)** Solve the equation $3\cos\dfrac{\phi}{2} = \sqrt{3}\sin\dfrac{\phi}{2}$ for $-4\pi < \phi < 4\pi$.

[5]