## Cambridge IGCSE ${ }^{\text {TM }}$

CANDIDATE NAME

CENTRE NUMBER


## ADDITIONAL MATHEMATICS

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 [ ].


## Mathematical Formulae

## 1. ALGEBRA

## Quadratic Equation

For the equation $a x^{2}+b x+c=0$,

$$
x=\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a}
$$

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

$$
\begin{aligned}
& u_{n}=a+(n-1) d \\
& S_{n}=\frac{1}{2} n(a+l)=\frac{1}{2} n\{2 a+(n-1) d\}
\end{aligned}
$$

Geometric series $\quad u_{n}=a r^{n-1}$

$$
\begin{aligned}
& S_{n}=\frac{a\left(1-r^{n}\right)}{1-r} \quad(r \neq 1) \\
& S_{\infty}=\frac{a}{1-r}(|r|<1)
\end{aligned}
$$

## 2. TRIGONOMETRY

Identities

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

Formulae for $\triangle A B C$

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

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

2 A curve has equation $y=(5-x)(x+2)^{2}$.
(a) Find the $x$-coordinates of the stationary points on the curve.
(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.

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

3 Find the coefficient of $x^{8}$ in the expansion of $\left(1-x^{2}\right)\left(2 x-\frac{1}{x}\right)^{10}$.

4 (a) Write $3 \lg x-2 \lg y^{2}-3$ as a single logarithm to base 10 .
(b) Solve the equation $\log _{3} x+\log _{x} 3=\frac{5}{2}$.

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

(b) Use your graph to estimate the values of $A$ and $b$. Give your answers correct to 1 significant figure.
(c) Estimate the value of $y$ when $x=1.75$.
(d) Estimate the positive value of $x$ when $y=20$.

6 Given that $\mathrm{f}^{\prime \prime}(x)=(5 x+2)^{-\frac{2}{5}}, \mathrm{f}^{\prime}(6)=\frac{17}{3}$ and $\mathrm{f}(6)=\frac{26}{3}$, find an expression for $\mathrm{f}(x)$.

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.
(ii) Find the number of possible passwords that contain at least one symbol.
(b) Given that $16 \times{ }^{n} \mathrm{C}_{12}=(n-10) \times{ }^{n+1} \mathrm{C}_{11}$, find the value of $n$.

8


The diagram shows part of the curve $y=2-\frac{3}{x-1}$ and the straight line $6 y=9-2 x$. 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 $A B C$, giving your answer in the form $p+\ln q$, where $p$ and $q$ are rational numbers.

Additional working space for Question 8.

9 In this question, all lengths are in metres.
(a) A particle $P$ has position vector $\binom{2+12 t}{5-5 t}$ at a time $t$ seconds, $t \geqslant 0$.
(i) Write down the initial position vector of $P$.
(ii) Find the speed of $P$.
(iii) Determine whether $P$ passes through the point with position vector $\binom{158}{-48}$.
(b)

 $\overrightarrow{O A}=\mathbf{a}, \overrightarrow{O B}=\mathbf{b}$ and $\overrightarrow{O C}=\mathbf{c}$, find $\mathbf{c}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

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

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