# Core Mathematics C3 Advanced Level 

For Edexcel

Paper H Time: 1 hour 30 minutes

Instructions and Information
Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration.
Full marks may be obtained for answers to ALL questions.
The booklet 'Mathematical Formulae and Statistical Tables', available from Edexcel, may be used.

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

## Advice to Candidates

You must show sufficient working to make your methods clear to an examiner.
Answers without working may gain no credit.

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Herts. AL8 6LP
Tel. 01707333232

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1. Prove by contradiction that there are no pairs of positive integers $x$ and $y$ such that

$$
\begin{equation*}
x^{2}-y^{2}=18 \tag{6}
\end{equation*}
$$

2. Simplify $\frac{2 x^{2}+5 x-3}{4 x^{2}-1} \times \frac{2 x^{2}+x}{x^{2}+8 x+15}$.
3. The function f is defined by

$$
\mathrm{f}: x \mapsto 2 x-1, \quad x \in \mathbb{R}
$$

(a) Find $\mathrm{f}^{-1}(x)$ and state the domain of $\mathrm{f}^{-1}$.

The function g is defined by

$$
\mathrm{g}: x \mapsto 3 x^{2}+1, \quad x \in \mathbb{R}
$$

(b) Find $\mathrm{gf}^{-1}(x)$.
(c) Find the values of $x$ which satisfy $\mathrm{gf}^{-1}(x)=\frac{7}{4}$.
$\qquad$
4. Given that $x=\cos ^{-1}\left(\frac{-5}{13}\right)$, find the exact value of
(a) $\tan x$,
(b) $\operatorname{cosec} 2 x$.
5. (a) Given $0<a<b$, sketch the graphs of $y=x-a$ and $y=|x-b|$ on the same axes.
(b) Find the area of the triangle enclosed by the two graphs and the $y$-axis.
$\qquad$
6. Giving your answers to 2 decimal places, solve the simultaneous equations

$$
\begin{gather*}
\mathrm{e}^{y}=3-x \\
2 y=\ln (x+2)^{2}-4 \tag{8}
\end{gather*}
$$

7. (a) Differentiate the following with respect to $x$, simplifying your answers.
(i) $x \ln (3 x+4)$
(ii) $\left(3 x^{2}+7\right)^{5}$
(b) Using the derivatives for $\sin x$ and $\cos x$, prove that $\frac{\mathrm{d}}{\mathrm{d} x}(\cot x)=-\operatorname{cosec}^{2} x$.
8. The curve with equation $y=\mathrm{e}^{-\frac{1}{2} x}$ crosses the $y$ axis at the point $P(0, p)$.
(a) Sketch the graph of $y=\mathrm{e}^{-\frac{1}{2} x}$, showing the exact value of $p$.

The normal to the curve at the point $Q$, with $x$-coordinate $q$, passes through the origin.
(b) Show that $x=q$ is a solution of the equation $2 x \mathrm{e}^{x}-1=0$.
(c) Show that the equation in (b) can be rearranged in the form $x=\frac{1}{2 \mathrm{e}^{x}}$.
(d) Use the iteration formula

$$
x_{n+1}=\frac{1}{2 \mathrm{e}^{x_{n}}}, \text { with } x_{0}=0.4
$$

to find $x_{1}, x_{2}, x_{3}$ and $x_{4}$. Hence write down, to 3 decimal places, an approximation for $q$.
9. (a) (i) Express

$$
40 \cos \theta-9 \sin \theta \quad \text { in the form }
$$

$$
\begin{equation*}
R \cos (\theta+\alpha) \quad \text { where } \quad R>0 \quad \text { and } \quad 0<\alpha<90^{\circ} . \tag{4}
\end{equation*}
$$

(ii) Hence solve the equation

$$
\begin{equation*}
40 \cos \theta-9 \sin \theta=4 \tag{3}
\end{equation*}
$$

for $0<\theta<90^{\circ}$, giving your answer to 1 decimal place.
(b) Solve the equation

$$
\begin{equation*}
6 \sin \theta=2 \operatorname{cosec} \theta+1 \tag{5}
\end{equation*}
$$

for $0<\theta<180$, giving your answers to 1 decimal place.

