FOR EDEXCEL

GCE Examinations

Advanced Subsidiary

# Core Mathematics C3

Paper G

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.

Mathematical formulae and statistical tables are available.

This paper has seven questions.

*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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**1.** A curve has the equation $y = (3x - 5)^3$.

*(a)* Find an equation for the tangent to the curve at the point $P$ (2, 1). **(4)**

The tangent to the curve at the point $Q$ is parallel to the tangent at $P$.

*(b)* Find the coordinates of $Q$. **(3)**

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**2.** *(a)* Use the identities for $\cos(A + B)$ and $\cos(A - B)$ to prove that

$$2\cos A \cos B \equiv \cos(A + B) + \cos(A - B).$$ **(2)**

*(b)* Hence, or otherwise, find in terms of $\pi$ the solutions of the equation

$$2\cos\left(x + \frac{\pi}{2}\right) = \sec\left(x + \frac{\pi}{6}\right),$$

for $x$ in the interval $0 \leq x \leq \pi$. **(7)**

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**3.** Differentiate each of the following with respect to $x$ and simplify your answers.

*(a)* $\ln(\cos x)$ **(3)**

*(b)* $x^2 \sin 3x$ **(3)**

*(c)* $\dfrac{6}{\sqrt{2x - 7}}$ **(4)**

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**4.** *(a)* Express $2\sin x° - 3\cos x°$ in the form $R\sin(x - \alpha)°$ where $R > 0$ and $0 < \alpha < 90$. **(4)**

*(b)* Show that the equation

$$\operatorname{cosec} x° + 3\cot x° = 2$$

can be written in the form

$$2\sin x° - 3\cos x° = 1.$$ **(1)**

*(c)* Solve the equation

$$\operatorname{cosec} x° + 3\cot x° = 2,$$

for $x$ in the interval $0 \leq x \leq 360$, giving your answers to 1 decimal place. **(5)**

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**5.** *(a)* Show that $(2x + 3)$ is a factor of $(2x^3 - x^2 + 4x + 15)$. **(2)**

*(b)* Hence, simplify

$$\frac{2x^2 + x - 3}{2x^3 - x^2 + 4x + 15}.$$ **(4)**

*(c)* Find the coordinates of the stationary points of the curve with equation

$$y = \frac{2x^2 + x - 3}{2x^3 - x^2 + 4x + 15}.$$ **(6)**

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**6.** The population in thousands, $P$, of a town at time $t$ years after 1st January 1980 is modelled by the formula

$$P = 30 + 50e^{0.002t}.$$

Use this model to estimate

*(a)* the population of the town on 1st January 2010, **(2)**

*(b)* the year in which the population first exceeds 84 000. **(4)**

The population in thousands, $Q$, of another town is modelled by the formula

$$Q = 26 + 50e^{0.003t}.$$

*(c)* Show that the value of $t$ when $P = Q$ is a solution of the equation

$$t = 1000 \ln (1 + 0.08e^{-0.002t}).$$ **(3)**

*(d)* Use the iteration formula

$$t_{n+1} = 1000 \ln (1 + 0.08e^{-0.002t_n})$$

with $t_0 = 50$ to find $t_1$, $t_2$ and $t_3$ and hence, the year in which the populations of these two towns will be equal according to these models. **(4)**

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***Turn over***

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**7.**

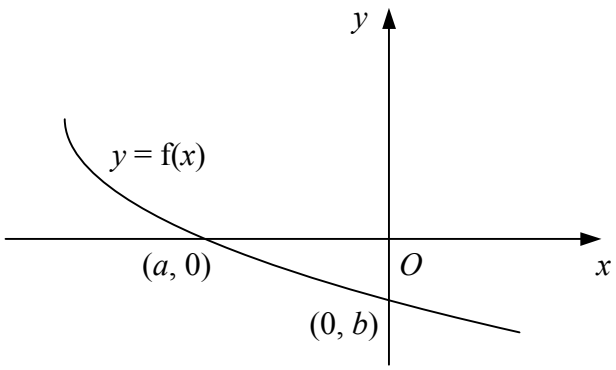



**Figure 1**

Figure 1 shows the graph of $y = \mathrm{f}(x)$ which meets the coordinate axes at the points $(a, 0)$ and $(0, b)$, where $a$ and $b$ are constants.

*(a)* Showing, in terms of $a$ and $b$, the coordinates of any points of intersection with the axes, sketch on separate diagrams the graphs of

*(i)* $y = \mathrm{f}^{-1}(x)$,

*(ii)* $y = 2\mathrm{f}(3x)$. **(6)**

Given that

$$\mathrm{f}(x) = 2 - \sqrt{x+9}\,, \quad x \in \mathbb{R}, \quad x \geq -9,$$

*(b)* find the values of $a$ and $b$, **(3)**

*(c)* find an expression for $\mathrm{f}^{-1}(x)$ and state its domain. **(5)**

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**END**

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