Oxford Cambridge and RSA

# AS Level Mathematics B (MEI)

**H630/01** Pure Mathematics and Mechanics

## Question Set 3

**1.** **In this question you must show detailed reasoning.**

Show that the equation $x = 7 + 2x^2$ has no real roots. **[3]**

**2.** **In this question you must show detailed reasoning.**

Fig. 2 shows the graphs of $y = 4\sin x°$ and $y = 3\cos x°$ for $0 \leqslant x \leqslant 360$.

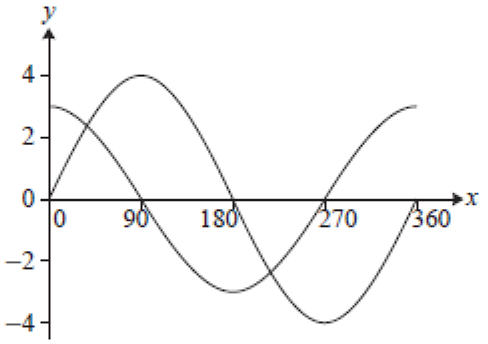


**Fig. 2**

Find the $x$-coordinates of the two points of intersection, giving your answers correct to 1 decimal place. **[3]**

**3** Given that $k$ is an integer, express $\dfrac{3\sqrt{2}-k}{\sqrt{8}+1}$ in the form $a + b\sqrt{2}$ where $a$ and $b$ are rational expressions in terms of $k$. **[4]**

**4** A triangle ABC has sides AB = 5 cm, AC = 9 cm and BC = 10 cm.

**(a)** Find the cosine of angle BAC, giving your answer as a fraction in its lowest terms. **[2]**

**(b)** Find the exact area of the triangle. **[3]**

**5** **In this question you must show detailed reasoning.**

**(a)** Nigel is asked to determine whether $(x+7)$ is a factor of $x^3 - 37x + 84$. He substitutes $x = 7$ and calculates $7^3 - 37 \times 7 + 84$. This comes to 168, so Nigel concludes that $(x+7)$ is not a factor.

Nigel's conclusion is wrong.

- Explain why Nigel's argument is not valid.
- Show that $(x+7)$ is a factor of $x^3 - 37x + 84$. **[2]**

**(b)** Sketch the graph of $y = x^3 - 37x + 84$, indicating the coordinates of the points at which the curve crosses the coordinate axes. **[5]**

**(c)** The graph in part (b) is translated by $\begin{pmatrix}1\\0\end{pmatrix}$. Find the equation of the translated graph, giving your answer in the form $y = x^3 + ax^2 + bx + c$ where $a$, $b$ and $c$ are integers. **[4]**

**6** **In this question you must show detailed reasoning.**

Show that the only stationary point on the graph of $y = x^2 - 4\sqrt{x}$ is a minimum point at $(1, -3)$. **[7]**

**7** **In this question you must show detailed reasoning.**

**(a)** Sketch the gradient function for the curve $y = 24x - 3x^2 - x^3$. **[5]**

**(b)** Determine the set of values of $x$ for which $24x - 3x^2 - x^3$ is decreasing. **[2]**

**8** David puts a block of ice into a cool-box. He wishes to model the mass $m$ kg of the remaining block of ice at time $t$ hours later. He finds that when $t = 5$, $m = 2.1$, and when $t = 50$, $m = 0.21$.

**(a)** David at first guesses that the mass may be inversely proportional to time. Show that this model fits his measurements. **[3]**

**(b)** Explain why this model

**(i)** is not suitable for small values of $t$, **[1]**

**(ii)** cannot be used to find the time for the block to melt completely. **[1]**

David instead proposes a linear model $m = at + b$, where $a$ and $b$ are constants.

**(c)** Find the values of the constants for which the model fits the mass of the block when $t = 5$ and $t = 50$. **[3]**

**(d)** Interpret these values of $a$ and $b$. **[2]**

**(e)** Find the time according to this model for the block of ice to melt completely. **[1]**

## Total Marks for Question Set 3: 51 marks