Question Number	Scheme	Marks
6	$u = 3 + \cos\theta \Rightarrow \dfrac{\mathrm{d}u}{\mathrm{d}\theta} = -\sin\theta$	B1
	$\displaystyle\int \frac{\sin 2\theta}{\sqrt{3+\cos\theta}}\,\mathrm{d}\theta = \int -\frac{2(u-3)}{\sqrt{u}}\,\mathrm{d}u$	M1 A1
	$= -\dfrac{4}{3}u^{\frac{3}{2}} + 12u^{\frac{1}{2}}$	dM1A1
	Uses limits of 3 and 4 within their attempted integration	ddM1
	$= 8\sqrt{3} - \dfrac{40}{3}$	A1
		(7 marks)

Condone the omission of du to be implied

B1: States or uses $\dfrac{\mathrm{d}u}{\mathrm{d}\theta} = -\sin\theta$ o.e. This may be seen within the integrand. Note that B0 will mean that no A marks will be scored.

M1: Simplifies $\dfrac{\sin 2\theta}{\sqrt{3+\cos\theta}}\mathrm{d}\theta$ to a function in terms of u using

- the double angle formula for $\sin 2\theta$ Allow/condone $\sin 2\theta = \kappa \sin\theta\cos\theta$
- the given substitution condoning $\cos\theta = \pm 3 \pm u$
- $\dfrac{\mathrm{d}u}{\mathrm{d}\theta} = \pm\sin\theta$
- $\sqrt{u}$ in the denominator

Expect to see a form $\displaystyle\int k\frac{(\pm u \pm 3)}{\sqrt{u}}(\mathrm{d}u)$ oe condone missing du provided the integral is of the required form. Condone $\mathrm{d}\theta$ for du as a slip for this mark. Condone $k = \pm 1$

A1: $\displaystyle\int -\frac{2(u-3)}{\sqrt{u}}(\mathrm{d}u)$ from correct work. Ignore limits for this mark but allow $\displaystyle\int_3^4 \frac{2(u-3)}{\sqrt{u}}(\mathrm{d}u)$ if the limits are written on the integral (3 and 4) and are the opposite way round. Condone missing du but do not allow $\mathrm{d}\theta$

Do not withhold this mark once a correct expression is seen from correct work.

dM1: Integrates to a form $\alpha u^{\frac{3}{2}} + \beta u^{\frac{1}{2}}$. It is dependent on the previous method mark.

A1: Correct integration, $-\frac{4}{3}u^{\frac{3}{2}} + 12u^{\frac{1}{2}}$ oe Ignore limits but allow e.g. $\frac{4}{3}u^{\frac{3}{2}} - 12u^{\frac{1}{2}}$ if the limits (3 and 4) are the opposite way round– send to review if unsure. May have a constant of integration. **All previous marks should have been scored condoning only $\mathrm{d}\theta$ instead of d*u* as a slip on their integral expression.**

ddM1: Uses limits of 3 and 4 (or alternative 0 and $\frac{\pi}{2}$ if substituted $u = 3 + \cos\theta$) and subtracts either way round within their attempted integration. The expression is sufficient. We must see some evidence of the use of limits for this mark. May be partially evaluated but cannot just be the final answer. It is dependent on both of the previous method marks.

A1: $8\sqrt{3} - \frac{40}{3}$ **provided all previous marks scored**. Do not accept $\frac{24\sqrt{3} - 40}{3}$ as this is not in the required form.

Question Number	Scheme	Marks
7. (a)	Attempts $\overrightarrow{BA}\square\overrightarrow{BC}$ $\begin{pmatrix}-6\\2\\-3\end{pmatrix}\bullet\begin{pmatrix}-4\\3\\-5\end{pmatrix}=24+6+15=45$	M1
	Attempts to apply $\mathbf{a}\bullet\mathbf{b}=\lvert\mathbf{a}\rvert\lvert\mathbf{b}\rvert\cos\theta\Rightarrow 45=7\times\sqrt{50}\cos\theta$	dM1
	$\cos\theta=\frac{9\sqrt{2}}{14}$ oe	A1
		(3)
(b)	Attempts $\sin\theta=\sqrt{1-\left(\frac{9\sqrt{2}}{14}\right)^2}$	M1
	Attempts to apply $\lvert\mathbf{a}\rvert\lvert\mathbf{b}\rvert\sin\theta=7\times\sqrt{50}\times\frac{\sqrt{34}}{14}$	M1
	Area $ABCD = 5\sqrt{17}$	A1
		(3)
		(6 marks)

(a)

M1: Attempts $\overrightarrow{BA}\bullet\overrightarrow{BC}$. Look for $\pm\begin{pmatrix}6\\-2\\3\end{pmatrix}\bullet\pm\begin{pmatrix}4\\-3\\5\end{pmatrix}=\pm24\pm6\pm15$ The expression is sufficient but may be implied by ±45. Condone slips but at least two products should be correct.

dM1: Uses $\mathbf{a}\bullet\mathbf{b}=\lvert\mathbf{a}\rvert\lvert\mathbf{b}\rvert\cos\theta$ with either of $\lvert\mathbf{a}\rvert$ or $\lvert\mathbf{b}\rvert$ found using a correct method. Either length may be implied by "$\sqrt{49}$" oe or "$\sqrt{50}$" oe. It is dependent on the previous method mark.

A1: $\cos\theta=\frac{9\sqrt{2}}{14}$ o.e such as $\cos\theta=\frac{9}{7\sqrt{2}}$ **Must be exact**

Note that $\cos\theta=-\frac{9\sqrt{2}}{14}$ or $\cos\theta=\frac{9\sqrt{2}}{14}$ from $\mathbf{a}\bullet\mathbf{b}=-45$ is M1dM1A0

Alt (a) using the cosine rule

M1: Attempts to find $\lvert\overrightarrow{AC}\rvert$, $\lvert\overrightarrow{AB}\rvert$ and $\lvert\overrightarrow{BC}\rvert$ (or $\lvert\overrightarrow{AC}\rvert^2$, $\lvert\overrightarrow{AB}\rvert^2$ and $\lvert\overrightarrow{BC}\rvert^2$) using a correct method with at least two lengths correct. May be seen within the cosine rule formula.

dM1: Uses the cosine rule to form a correct equation using their lengths in the correct positions. It is dependent on the previous method mark.