Question Number	Scheme	Marks
8(a)	$a = 2a\sin 2\theta \Rightarrow \sin 2\theta = \frac{1}{2} \Rightarrow 2\theta = ...$	M1
	$\sin 2\theta = \frac{1}{2} \Rightarrow 2\theta = \frac{\pi}{6}, \frac{5\pi}{6}$	A1
	$\left(a, \frac{\pi}{12}\right), \left(a, \frac{5\pi}{12}\right)$	A1
		(3)

(a) Notes

M1: Sets $a = 2a\sin 2\theta$ and attempts to solve for 2θ

A1: Obtains $2\theta = \frac{\pi}{6}$ or $\frac{5\pi}{6}$ which may be implied.

A1: Both points correct. Can be written as e.g. $r = a$, $\theta = \frac{\pi}{12}, \frac{5\pi}{12}$

Apply isw once the correct r and θ are seen for both points and condone coordinates written the wrong way round.

(b)	$\frac{1}{2}\times a^2\times\frac{\pi}{3}$ oe	B1
	$\left(\frac{1}{2}\right)\int r^2\,(\mathrm{d}\theta)=\left(\frac{1}{2}\right)\int(2a\sin 2\theta)^2\,(\mathrm{d}\theta)$	M1
	$\cos 4\theta=1-2\sin^2 2\theta\Rightarrow\sin^2 2\theta=\frac{1}{2}(1-\cos 4\theta)$	M1
	$\int(1-\cos 4\theta)(\mathrm{d}\theta)=\theta-\frac{1}{4}\sin 4\theta$ **or** $2\int(1-\cos 4\theta)(\mathrm{d}\theta)=2\theta-\frac{1}{2}\sin 4\theta$	A1
	$I=a^2\left[\theta-\frac{1}{4}\sin 4\theta\right]_0^{\frac{\pi}{12}}=a^2\left\{\left(\frac{\pi}{12}-\frac{1}{4}\sin 4.\frac{\pi}{12}\right)-(0)\right\}$	**dd**M1
	$R=2I+\frac{a^2\pi}{6}=2a^2\left(\frac{\pi}{12}-\frac{\sqrt{3}}{8}\right)+\frac{a^2\pi}{6}$	**d**M1
	$R=\frac{1}{12}a^2\left(4\pi-3\sqrt{3}\right)$	A1
		(7)
		Total 10

(b) Notes

B1: Any correct expression for the sector area in any form.

May be seen from an **evaluated** integral e.g. $\frac{1}{2}\int_{\frac{\pi}{12}}^{\frac{5\pi}{12}}a^2\mathrm{d}\theta=\frac{1}{2}\left[a^2\theta\right]_{\frac{\pi}{12}}^{\frac{5\pi}{12}}=\underline{\frac{1}{2}a^2\left(\frac{5\pi}{12}-\frac{\pi}{12}\right)}$

M1: Attempts to use $\int r^2\mathrm{d}\theta$ with $r=2a\sin 2\theta$. Condone the omission of "dθ"

Limits not needed (ignore any shown) and the $\frac{1}{2}$ may be missing.

M1: Uses $\sin^2 2\theta=\frac{\pm1\pm\cos 4\theta}{2}$ in an attempt to reach an integrable form.

Allow equivalent work e.g. uses $\sin^2 2\theta=1-\cos^2 2\theta$ and then $\cos^2 2\theta=\frac{\pm1\pm\cos 4\theta}{2}$.

A1: Fully correct integration. Condone the omission of "dθ" earlier and condone the omission of the a^2. Limits not needed (ignore any shown) and the $\frac{1}{2}$ may be missing.

ddM1: An attempt to find one or both of the regions either side of the sector.

ie uses limits 0 and their $\frac{\pi}{12}$ and/or their $\frac{5\pi}{12}$ and $\frac{\pi}{2}$ both limits to be substituted and subtracted (if non-zero after substitution).

Limits to be used the correct way round. If two integrals seen award mark if either correct.

Depends on both previous method marks.

dM1: Fully correct strategy for the complete area (their sector + 2*I* or their sector + *I* if the $\frac{1}{2}$ was missing throughout.) All areas must be positive.

Depends on <u>all</u> the previous method marks.

A1: Correct expression in the required form.