Question Number	Scheme	Marks
10(a)	$1+\cos\theta = 1+\frac{\sqrt{3}}{2} \Rightarrow \cos\theta = \frac{\sqrt{3}}{2}$ $\Rightarrow 1+\frac{\sqrt{3}}{2} = k\times\frac{2}{\sqrt{3}} \Rightarrow k = ...$	M1
	$k = \frac{\sqrt{3}}{2}+\frac{3}{4}$ oe	A1
		(2)
(b)	At P $\theta = \frac{\pi}{6}$	B1
	$\int (1+\cos\theta)^2 \,\mathrm{d}\theta = \int \left(1+2\cos\theta+\cos^2\theta\right)\mathrm{d}\theta$ $= \int \left(1+2\cos\theta+\frac{1}{2}+\frac{1}{2}\cos 2\theta\right)\mathrm{d}\theta$	M1
	$\int (1+\cos\theta)^2 \,\mathrm{d}\theta = \frac{3}{2}\theta+2\sin\theta+\frac{1}{4}\sin 2\theta$ (oe)	A1
	$\frac{1}{2}\left[\frac{3}{2}\theta+2\sin\theta+\frac{1}{4}\sin 2\theta\right]_{"\frac{\pi}{6}"}^{\pi}$ $= \frac{1}{2}\left[\left(\frac{3\pi}{2}+0+0\right)-\left(\frac{\pi}{4}+1+\frac{\sqrt{3}}{8}\right)\right] \quad \left(=\frac{5\pi}{8}-\frac{\sqrt{3}}{16}-\frac{1}{2}\right)$	M1
	Triangle: $\frac{1}{2}\times\left(1+\frac{\sqrt{3}}{2}\right)\sin\frac{\pi}{6}\times\left(1+\frac{\sqrt{3}}{2}\right)\cos\frac{\pi}{6} = \frac{1}{2}\left(\frac{1}{2}+\frac{\sqrt{3}}{4}\right)\left(\frac{\sqrt{3}}{2}+\frac{3}{4}\right)$ $\left(=\frac{7\sqrt{3}}{32}+\frac{3}{8}\right)$	M1
	Area of R = $\frac{5\pi}{8}-\frac{\sqrt{3}}{16}-\frac{1}{2}+\frac{7\sqrt{3}}{32}+\frac{3}{8}$	dM1
	$\frac{5\pi}{8}+\frac{5\sqrt{3}}{32}-\frac{1}{8}$	A1
		(7)
		Total 9

Notes:

(a)

M1: Correct method to find the value of k.

A1: Correct value.

(b)

B1: Deduces the correct value of θ at P. May be seen anywhere – in (a) or on Figure 1, or as a limit on their integral.

M1: Attempts $\left(\frac{1}{2}\right)\int r^2\,\mathrm{d}\theta$ achieve (at least) three terms from squaring and applies $\cos^2\theta = \pm\frac{1}{2}\pm\frac{1}{2}\cos 2\theta$. The $\frac{1}{2}$ in the area formula may be omitted for this mark.

Caution: Many have learned a formula $\int \cos^2\theta\,\mathrm{d}\theta = \frac{\theta}{2}+\frac{1}{4}\sin 2\theta$ so the use of the double angle formula may be implied by this.

A1: Correct integration of the r^2

M1: Applies the limits of their $\frac{\pi}{6}$ and π to their attempt at the integral (there must be some evidence of the attempt to subtract). Alternatively, may use limits 0 to π **and** 0 to their $\frac{\pi}{6}$, then subtract. Not dependent, so allow if incorrect double angle identity was used or only two terms from squaring.

M1: Uses a correct strategy to find the exact for the area of the triangle. This may be via $\frac{1}{2}ab$ or $\frac{1}{2}ab\sin C$ as shown in scheme (both are equivalent) or by integration $\frac{1}{2}\int_0^{"\pi/6"} k^2\sec^2\theta\,\mathrm{d}\theta = \frac{k^2}{2}\left[A\tan\theta\right]_0^{"\pi/6"} = \ldots$ Accept $\int_0^{\pi/6}\sec^2\theta\,\mathrm{d}\theta = \frac{\sqrt{3}}{3}$ (oe) without further working shown.

dM1: Fully correct method for the required area. Depends on all previous method marks. The $\frac{1}{2}$ in the area formula must have been included to score this mark.

A1: Cao. Terms may be in a different order and accept if put over a common denominator.

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