Question Number	Scheme	Notes	Marks
5	$r^2 = 100\cos^2\theta + 20\cos\theta\tan\theta + \tan^2\theta$	Any correct expression for r^2	**B1**
	$\left\{\frac{1}{2}\right\}\int_0^{\frac{\pi}{3}} r^2\,\mathrm{d}\theta = \left\{\frac{1}{2}\right\}\int_0^{\frac{\pi}{3}} \left(100\cos^2\theta + 20\sin\theta + \tan^2\theta\right)\left\{\mathrm{d}\theta\right\}$	Attempts formula for the area with their r^2 which may not be expanded Condone missing $\frac{1}{2}$ and limits not required	**M1**
	$= \frac{1}{2}\int_0^{\frac{\pi}{3}} \left(50\left(1+\cos 2\theta\right) + 20\sin\theta + \sec^2\theta - 1\right)\left\{\mathrm{d}\theta\right\}$ **M1**: Uses $\cos^2\theta = \pm\frac{1}{2} \pm \frac{1}{2}\cos 2\theta$ **or** $\tan^2\theta = \pm\sec^2\theta \pm 1$ in their r^2 **M1**: Uses both $\cos^2\theta = \pm\frac{1}{2} \pm \frac{1}{2}\cos 2\theta$ **and** $\tan^2\theta = \pm\sec^2\theta \pm 1$ in their r^2 Both M marks can be scored without the integral and the $\frac{1}{2}$. Condone mixed variables. **A1**: Correct integral following $\cos^2\theta = \frac{1}{2} + \frac{1}{2}\cos 2\theta$ and $\tan^2\theta = \sec^2\theta - 1$. The $\cos\theta\tan\theta$ must be written as $\sin\theta$ (implied if appropriately integrated later). The $\frac{1}{2}$ is required (it may be seen later) but limits/ $\mathrm{d}\theta$ are not needed. Allow mixed variables if subsequent work recovers this.		**M1** **M1** **A1**
	$= \frac{1}{2}\left[49\theta + 25\sin 2\theta - 20\cos\theta + \tan\theta\right]_0^{\frac{\pi}{3}}$ or $\left[\frac{49}{2}\theta + \frac{25}{2}\sin 2\theta - 10\cos\theta + \frac{1}{2}\tan\theta\right]_0^{\frac{\pi}{3}}$ **M1**: Achieves **three** of the following four integrated forms: $k \to k\theta$ (at least once), $\cos 2\theta \to \ldots\sin 2\theta$, $\sin\theta \to \ldots\cos\theta$, $\sec^2\theta \to \ldots\tan\theta$. Ignore other terms if 3 of the above are satisfied. No $\frac{1}{2}$ or limits required. Condone mixed variables. **A1**: Correct integration including the $\frac{1}{2}$ (may be seen later). Limits not required. May be unsimplified e.g., 49θ seen as $50\theta - \theta$. Allow mixed variables if subsequent work recovers this.		**M1** **A1**
	$= \frac{1}{2}\left(\frac{49\pi}{3} + 25\sin\frac{2\pi}{3} - 20\cos\frac{\pi}{3} + \tan\frac{\pi}{3} - \left(0 + 0 - 20 + 0\right)\right)$ $\left\{= \frac{1}{2}\left(\frac{49\pi}{3} + \frac{25\sqrt{3}}{2} - 10 + \sqrt{3} + 20\right) \text{ or } \frac{49\pi}{6} + \frac{25\sqrt{3}}{4} - 5 + \frac{\sqrt{3}}{2} + 10\right\}$ Applies the correct limits to an expression of the form $p\theta + q\sin 2\theta + r\cos\theta + s\tan\theta$ $\left(p, q, r, s \neq 0\right)$ Allow slips but there must be a clear attempt to substitute, and they must only subtract the value of their r, e.g. if $r = -20$ work must have or imply ...– (–20) or +20. Allow mixed variables if the substitution recovers this.		**M1**
	$= \frac{1}{12}\left(98\pi + 81\sqrt{3} + 60\right)$	Correct answer or values for a, b & c	**A1**
	Note that there are other viable routes through the integration e.g., use of integration by parts		**(9)**
			Total 9