Question Number	Scheme	Notes	Marks
7(a)	$\sin\theta = \frac{1}{2\mathrm{i}}\left(\mathrm{e}^{\mathrm{i}\theta} - \mathrm{e}^{-\mathrm{i}\theta}\right)$ $\Rightarrow \sin^4\theta = \left\{\frac{1}{(2\mathrm{i})^4}\right\}\left(\left(\mathrm{e}^{\mathrm{i}\theta}\right)^4 + 4\left(\mathrm{e}^{\mathrm{i}\theta}\right)^3\left(-\mathrm{e}^{-\mathrm{i}\theta}\right) + 6\left(\mathrm{e}^{\mathrm{i}\theta}\right)^2\left(-\mathrm{e}^{-\mathrm{i}\theta}\right)^2 + 4\mathrm{e}^{\mathrm{i}\theta}\left(-\mathrm{e}^{-\mathrm{i}\theta}\right)^3 + \left(\mathrm{e}^{-\mathrm{i}\theta}\right)^4\right)$ Expands $\left(\mathrm{e}^{\mathrm{i}\theta} - \mathrm{e}^{-\mathrm{i}\theta}\right)^4$ or squares twice. Allow slips but must have at least 4 terms and include an attempt at binomial coefficients which may be uncalculated e.g., $\binom{4}{3}$... Allow via $\left\{\frac{1}{(2\mathrm{i})^4}\right\}\left(z - \frac{1}{z}\right)^4 = \left\{\frac{1}{16}\right\}\left(z^4 - 4z^2 + 6 - 4z^{-2} + z^{-4}\right)$		**M1**
	$= \frac{1}{16}\left(\mathrm{e}^{4\mathrm{i}\theta} - 4\mathrm{e}^{2\mathrm{i}\theta} + 6 - 4\mathrm{e}^{-2\mathrm{i}\theta} + \mathrm{e}^{-4\mathrm{i}\theta}\right)$ or $\frac{1}{16}\left(z^4 - 4z^2 + 6 - 4z^{-2} + z^{-4}\right)$ Correct simplified expansion. The $\frac{1}{16}$ may be applied later		**A1**
	$= \frac{1}{16}\left(\cos 4\theta + \mathrm{i}\sin 4\theta + \cos 4\theta - \mathrm{i}\sin 4\theta - 4\left(\cos 2\theta + \mathrm{i}\sin 2\theta + \cos 2\theta - \mathrm{i}\sin 2\theta\right) + 6\right)$ or $= \frac{1}{16}\left(\mathrm{e}^{4\mathrm{i}\theta} + \mathrm{e}^{-4\mathrm{i}\theta} - 4\left(\mathrm{e}^{2\mathrm{i}\theta} + \mathrm{e}^{-2\mathrm{i}\theta}\right) + 6\right) = \frac{1}{16}\left(2\cos 4\theta - 4\left(2\cos 2\theta\right) + 6\right)$ Completes an attempt to use $\mathrm{e}^{n\theta\mathrm{i}} = \cos n\theta + \mathrm{i}\sin n\theta$ or $\cos n\theta = \frac{1}{2}\left(\mathrm{e}^{\mathrm{i}n\theta} + \mathrm{e}^{-\mathrm{i}n\theta}\right)$ to express the expansion in terms of trig functions. The $\frac{1}{16}$ may be incorrect or missing		**dM1**
	$\frac{1}{16}\left(2\cos 4\theta - 8\cos 2\theta + 6\right) \Rightarrow \frac{1}{8}\left(\cos 4\theta - 4\cos 2\theta + 3\right)$ Correct expression in the required form		**A1**
			(4)
(b)	$\Rightarrow \sin^4\left(\frac{1}{2}\pi - \theta\right) = \frac{1}{8}\left(\cos 4\left(\frac{1}{2}\pi - \theta\right) - 4\cos 2\left(\frac{1}{2}\pi - \theta\right) + 3\right)$ $\cos^4\theta = \frac{1}{8}\left(\cos 4\left(\frac{1}{2}\pi - \theta\right) - 4\cos 2\left(\frac{1}{2}\pi - \theta\right) + 3\right)$ $= \frac{1}{8}\left(\cos\left(2\pi - 4\theta\right) - 4\cos\left(\pi - 2\theta\right) + 3\right)$ $= \frac{1}{8}\left(\cos 4\theta + 4\cos 2\theta + 3\right)$ oe e.g., $\frac{1}{8}\cos 4\theta + \frac{1}{2}\cos 2\theta + \frac{3}{8}$ M1: $\sin^4\theta = A\cos 4\theta + B\cos 2\theta + C \Rightarrow \cos^4\theta = D\cos 4\theta + E\cos 2\theta + F$ Do not allow if something other than $\cos\theta = \sin\left(\frac{\pi}{2} - \theta\right)$ is clearly being used A1: Any correct expression in terms of $\cos 4\theta$ and $\cos 2\theta$ (not fortuitous)		**M1** **A1**
			(2)
(c)	$\int\left(\sin^4\theta + \cos^4\theta\right)\mathrm{d}\theta = \int\left(\frac{1}{8}\left(\cos 4\theta - 4\cos 2\theta + 3\right) + \frac{1}{8}\left(\cos 4\theta + 4\cos 2\theta + 3\right)\right)\mathrm{d}\theta$ $\left\{= \int\left(\frac{1}{4}\cos 4\theta + \frac{3}{4}\right)\mathrm{d}\theta \quad \text{or e.g., } \frac{1}{8}\int\left(2\cos 4\theta + 6\right)\mathrm{d}\theta\right\}$ Uses their expressions from (a) and (b) both of correct form and different and substitutes correctly within an integral. M0 if expression would reduce to just *k*. Must be consistent if only seen with terms collected		**M1**
	$= \frac{1}{16}\sin 4\theta + \frac{3}{4}\theta\left(+c\right)$	Correct 2 term result with or without + *c*	**A1**
			(2)
			Total 8