Question Number	Scheme	Marks
8(a)	$\cos 2\theta = \cos^2\theta - \sin^2\theta$	
(i)	$\cos 2\theta = 1-\sin^2\theta - \sin^2\theta = 1-2\sin^2\theta$ *	M1A1
(ii)	$\sin 2\theta = \sin\theta\cos\theta + \cos\theta\sin\theta = 2\sin\theta\cos\theta$ *	B1 (3)
(b)	$\cos 4\theta + 2\cos 2\theta = 1-2\sin^2 2\theta + 2\left(1-2\sin^2\theta\right)$	M1
	$=1-2\left(2\sin\theta\cos\theta\right)^2 + 2 - 4\sin^2\theta$	M1
	$=1-8\sin^2\theta\left(1-\sin^2\theta\right)+2-4\sin^2\theta$	M1
	$=8\sin^4\theta - 12\sin^2\theta + 3$ *	A1cso (4)
ALT	**Working in reverse:** $8\sin^4\theta - 12\sin^2\theta + 3$	
	$=8\left(\frac{1}{2}(1-\cos 2\theta)\right)^2 - 12\left(\frac{1}{2}(1-\cos 2\theta)\right)+3$	M1
	$=2\left(1-2\cos 2\theta + \cos^2 2\theta\right) - 6 + 6\cos 2\theta + 3$	M1
	$=2-4\cos 2\theta + 2\left(\frac{1}{2}(1+\cos 4\theta)\right) - 6 + \cos 2\theta + 3$	M1
	$=\cos 4\theta + 2\cos 2\theta$	A1cso
(c)	$4\sin^4 x° - 6\sin^2 x° - \cos 2x° = \frac{1}{2}\left(\cos 4x° + 2\cos 2x° - 3\right) - \cos 2x° + 1.2 = 0$	M1
	$\frac{1}{2}\cos 4x° = 0.3 \qquad \cos 4x° = 0.6$	A1
	$4x° = 53.13...°,\ 306.86...°$	M1
	$x = 13.28°..., 76.71°... \qquad x = 13.3°,\ 76.7°,$	A1 (4)
ALT	**Without using (b):** $4\sin^4 x - 6\sin^2 x - \cos 2x + 1.2 = 0 \quad 4\sin^4 x - 4\sin^2 x + 0.2 = 0$	
	$\sin^2 x = \frac{1}{2} \pm \frac{1}{\sqrt{5}} \quad \left(=0.9472...\ 0.0527\right)$	M1A1
	$\sin x = \sqrt{0.9472...}\ \ x = 76.7°$ or $\sin x = \sqrt{0.0527}\ \ x = 13.3°$	M1A1

Question Number	Scheme	Marks
(d)(i)	$\int\left(2\sin^4\theta-3\sin^2\theta\right)\mathrm{d}\theta=\frac{1}{4}\int\ \left(\cos4\theta+2\cos2\theta-3\right)\mathrm{d}\theta$ $=\frac{1}{4}\left(\frac{1}{4}\sin4\theta+\sin2\theta-3\theta\right)\ \ (+c)$	M1A1
(ii)	$\frac{1}{4}\left[\frac{1}{4}\sin4\theta+\sin2\theta-3\theta\right]_0^{\frac{\pi}{3}}$ $=\frac{1}{4}\left(\frac{1}{4}\sin\frac{4\pi}{3}+\sin\frac{2\pi}{3}-\pi\ (-0)\right)$ $=\frac{1}{4}\left(-\frac{1}{4}\times\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2}-\pi\right),=\frac{3}{32}\sqrt{3}-\frac{1}{4}\pi$	M1 A1,A1 (5) [16]
(a) (i)M1 **A1cso** **(ii)B1** **(b)** **M1** **M1** **M1** **A1cso** **ALT:** **M1** **M1** **M1** **A1cso**	Replace A and B with θ in $\cos\left(A+B\right)=...$ and use $\cos^2\theta=1-\sin^2\theta$ Obtain the **given** result with no errors seen Replace A and B with θ in $\sin\left(A+B\right)=...$ and obtain the **given** result. $\sin\theta\cos\theta+\cos\theta\sin\theta$ must be seen. There are many ways to do this part of the question. The following is for candidates who start from $\cos4\theta+2\cos2\theta$ Some work separately on $\cos4\theta$ and $\left(2\right)\cos2\theta$ initially. Use (a) (i) or $\cos4\theta=\cos^2 2\theta-\sin^2 2\theta$ at least once anywhere in the work Use (a) (ii) and (a) (i) or $\cos2\theta=\cos^2\theta-\sin^2\theta$ again to obtain an expression with no multiples of θ present. This mark **must only be awarded** when expressions for $\cos4\theta$ and $2\cos2\theta$ are combined. Candidates who never combine their separate expressions can gain M1M0M1A0 max. Use $\cos^2\theta=1-\sin^2\theta$ and the identity from (a)(i)to eliminate $\cos^2\theta$ and reach an expression or expressions for $\cos4\theta$ and $2\cos2\theta$ with powers of $\sin\theta$ only (May include a number but no terms with $\cos\theta$) Expressions for $\cos4\theta$ and $2\cos2\theta$ need not be combined. Obtain the **given** result with no errors seen. Working in reverse: Use $\sin^2\theta=\frac{1}{2}\left(1-\cos2\theta\right)$ to replace the powers of $\sin\theta$ Expand $\left(\frac{1}{2}\left(1-\cos2\theta\right)\right)^2$ Use $\cos^2 x=\frac{1}{2}\left(1+\cos2x\right)$ to reach an expression in $\cos4\theta$ and $\cos2\theta$ with no other trig functions. There may be a number and the signs may be wrong Completely correct final expression obtained from correct working.	

Question Number	Scheme	Marks
(c)		
M1	Use the result given in (b) to change the given equation to an equation in $\cos 4x$. No need to collect terms here. (M mark so need not be correct.)	
A1	Correct value for $\cos 4x$ obtained	
M1	For obtaining any correct value for $4x$. Need not be one of the 2 values shown. At least 3 sf must be shown.	
A1	For *both* values shown and no others within the range. Ignore extras outside the range.. **Must** be 3 sf.	
ALT	Without using (b)	
M1	Obtain a 3TQ in $\sin^2 x$ and solve to $\sin^2 x = ...$	
A1	Correct values for $\sin^2 x$ (exact or decimal)	
M1	Use their values of $\sin^2 x$ to solve for x	
A1	For *both* values shown and no others within the range. Ignore extras outside the range. **Must** be 3 sf.	
(d)		
(i)M1	Attempt to use the result given in (b) to change the given integrand into one which can be integrated and attempt the integration. (M mark so integrand need not be correct.) $\cos 4\theta \to \pm\frac{1}{4}\sin 4\theta$, $\cos 2\theta \to \pm\frac{1}{2}\sin 2\theta$	
A1	Fully correct after integration, constant not needed.	
(ii)M1	Substitute the given limits in their changed function, provided the result from (b) has been used in (i). (Candidates who use the equation from (c) cannot have this mark.)	
A1	Replace the trig functions with the *exact* values (not a follow through mark)	
A1cao	Correct final answer in the given form obtained.	