

Question			Answer	Marks	AO	Guidance	
9	(a)		$R^2 = 25$ $R = 5$	M1	1.1	Attempt correct process to find R	
			$R\cos\alpha = 3, R\sin\alpha = 4$ hence $\tan\alpha = \frac{4}{3}$	M1	1.1a	Attempt correct process to find $\tan\alpha$ (or equiv with $\sin\alpha$ or $\cos\alpha$)	Condone $\cos\alpha = 3, \sin\alpha = 4$ seen in method, leading to $\tan\alpha = \frac{4}{3}$ M0 for $\tan\alpha = \frac{3}{4}$
			$5\cos(2x - 53.1)$	A1	1.1	Obtain $5\cos(2x - 53.1)$ Could be implied by $R = 5$ and $\alpha = 53.1$ (awrt 53.1)	Condone not being written out in required form, and ISW any error when attempting to do so A0 for $\alpha = 0.927$ radians
				[3]			
9	(b)		DR $5\cos(2x - 53.1) + 6$ $\quad\quad\quad = 4(5\cos(2x - 53.1) - 1)$ $15\cos(2x - 53.1) = 10$	M1	3.1a	Clear fraction, attempt to rearrange and gather like terms	
				A1FT	2.1	Obtain correct harmonic equation, with like terms gathered FT their $R\cos(2x - \alpha)$	Could still be in terms of $\cos 2x$ and $\sin 2x$ eg $9\cos 2x + 12\sin 2x - 10 (= 0)$
			$\cos(2x - 53.1) = \frac{2}{3}$ $2x - 53.1 = 48.2$ $2x = 101.3$ $x = 50.7$	M1*	1.1	Correct process to find at least one value for x Must be solving equation of the form $\cos(2x \pm \alpha) = k$	Allow substitution soi eg $n =$ their $5\cos(2x - 53.1)$ to obtain $3n = 10$
				A1	1.1	Obtain at least one correct value	Likely to be using 48.2

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			$2x - 53.1 = -48.2, 48.2, 311.8, 408.2$ $2x = 4.94, 101.3, 364.9, 461.3$ $x = 2.47, 50.7, 182.5, 230.7$	M1dep* A1 A1 [7]	1.1 1.1 1.1	Correct process to find (at least) one further value for x Obtain one further correct value Obtain all 4 correct values, and no others in given range	Allow answers in range [50.6, 50.7] – see later A1 detail for range for other solutions Correct process to find x from a second value for their $\cos^{-1}(\frac{2}{3})$ Or their first solution + 180° oe Answers in range [2.46, 2.48], [182, 183], [230, 231] Answers in range [2.46, 2.48], [182, 183], [230, 231]

			Alt method if not harmonic form $3\cos 2x + 4\sin 2x + 6$ $\qquad\qquad\qquad = 12\cos 2x + 16\sin 2x - 4$ $9\cos 2x + 12\sin 2x - 10 (= 0)$ $225\sin^2 2x - 240\sin 2x + 19 (= 0)$ $225\cos^2 2x - 180\cos 2x - 44 (= 0)$ $19\tan^2 x - 24\tan x + 1 (= 0)$ $900\cos^4 x - 1260\cos^2 x + 361 (= 0)$ $900\sin^4 x - 540\sin^2 x + 1 (= 0)$	M1 A1FT	3.1a 2.1	Clear fraction, attempt to rearrange and gather like terms Obtain correct equation in a single trig ratio, with like terms gathered	Could have terms in $\cos 2x$ and $\sin 2x$ or even $\tan x$, $\cos x$, $\sin x$, $\cos x \sin x$ (if double angle formulae used) Could be in terms of $\sin x$ or $\cos x$, if double angle formulae used but equation never seen in terms of just $\cos 2x$ or $\sin 2x$
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Question			Answer	Marks	AO	Guidance	
			$x = 2.47, 50.7, 182.5, 230.7$	M1*	1.1	Correct process to find at least one value for x	Solving a 3 term quadratic (or possibly quartic) in a single trig ratio (condone BC) and also attempt x
				A1	1.1	Obtain at least one correct value	Allow answers in range [50.6, 50.7] – see later A1 detail for range for other solutions
				M1dep*	1.1	Correct process to find one further value for x Must be finding a secondary value from their principal value	M0 if just finding principal value from other quadratic root
				A1	1.1	Obtain one further correct value	Answers in range [2.46, 2.48], [182, 183], [230, 231]
				A1	1.1	Obtain all 4 correct values, and no others in given range	Answers in range [2.46, 2.48], [182, 183], [230, 231]