

Question		Answer	Marks	AO	Guidance
12		DR			
		$3(1 + \tan^2 \theta) + 2 \tan \theta - 4 [= 0]$	B1	3.1a	correct substitution of $\sec^2 \theta = 1 + \tan^2 \theta$ in equation; may be implied by $3 + 3 \tan^2 \theta + 2 \tan \theta - 4 [= 0]$
		$3 \tan^2 \theta + 2 \tan \theta - 1 = 0$	M1	1.1	3 term quadratic in $\tan \theta$ obtained following attempt at use of Pythagoras; may be implied if equation correct, otherwise substitution must be seen; allow one coefficient error
		$(3 \tan \theta - 1)(\tan \theta + 1) [= 0]$	B1	2.1	value(s) for $\tan \theta$ obtained from their quadratic by valid method; must see correct factorisation or correct use of formula oe
		$\tan \theta = -1, \tan \theta = \frac{1}{3}$	A1	1.1	both correct
		$-45^\circ, 135^\circ, 18.4^\circ \text{ to } 18.435^\circ, -161.6^\circ \text{ to } -161.565^\circ \text{ or } -162^\circ$	A1	1.1	any two values correct; dependent on award of previous A1
			A1	3.2a	all four values correct with no extras in the range; ignore values outside the range if A0A0 allow SC1 for $-\frac{\pi}{4}, \frac{3\pi}{4}, 0.32175 \text{ to } 0.322, -2.8198 \text{ to } -2.82$ NB B0M1B0A1A1A1 is possible
		Alternative method 1			
		$3 + 2 \sin \theta \cos \theta - 4 \cos^2 \theta = 0$			from multiplying through by $\cos^2 \theta$
		$3 + \sin 2\theta - 4(\frac{1}{2}(\cos 2\theta + 1)) [= 0]$	B1		substitution of correct double angle formulae in correct equation
		$\sqrt{5} \sin(2\theta - 63.4) = -1$ or $\sqrt{5} \cos(2\theta + 63.4) = 1$	M1		$R \sin(2\theta \pm \alpha) = k$ or $R \cos(2\theta \pm \alpha) = k$
		$\sin(2\theta - 63.4) = -\frac{1}{\sqrt{5}}$ or $\cos(2\theta + 26.6) = \frac{1}{\sqrt{5}}$	M1 A1		value for $\sin(2\theta - 63.4) = -\frac{1}{\sqrt{5}}$ or $\cos(2\theta + 26.6) = \frac{1}{\sqrt{5}}$ obtained by valid method; A1 if all correct

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		Alternative method 2 $(2 \sin \theta \cos \theta)^2 = (4 \cos^2 \theta - 3)^2$ $4 \sin^2 \theta - 4 \sin^4 \theta = (1 - 4 \sin^2 \theta)^2$ oe or $4 \cos^2 \theta - 4 \cos^4 \theta = (4 \cos^2 \theta - 3)^2$ oe $20 \sin^4 \theta - 12 \sin^2 \theta + 1 = 0$ or $20 \cos^4 \theta - 28 \cos^2 \theta + 9 = 0$ $\sin^2 \theta = 0.5, 0.1$ or $\cos^2 \theta = 0.5, 0.9$ $-45^\circ, 135^\circ, 18.4^\circ \text{ to } 18.435^\circ, -161.6^\circ \text{ to } -161.565^\circ \text{ or } -162^\circ$	B1 M1 B1 A1 A1 A1		from multiplying through by $\cos^2 \theta$ and squaring both sides correct substitution of $\cos^2 \theta = 1 - \sin^2 \theta$ or $\sin^2 \theta = 1 - \cos^2 \theta$ in correct equation 3 term quadratic in $\sin^2 \theta$ or $\cos^2 \theta$ obtained following use of Pythagoras – may be implied if equation correct, otherwise substitution must be seen; allow one coefficient error values for $\sin^2 \theta$ or $\cos^2 \theta$ obtained from their quadratic by valid method; must see correct factorisation or correct use of formula both values of $\sin^2 \theta$ or $\cos^2 \theta$ correct any two values correct; dependent on award of previous A1 all four values correct with no extras in the range; ignore values outside the range if A0A0 allow SC1 for $-\frac{\pi}{4}, \frac{3\pi}{4}, 0.32175 \text{ to } 0.322, -2.8198 \text{ to } -2.82$ NB B0M1B0A1A1A1 is possible
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