

Question			Answer	Marks	AO	Guidance
12	(a)		DR $\frac{dy}{d\theta} = -2 \sin \theta - 2 \sin 2\theta$ $\sin \theta + 2 \sin \theta \cos \theta = 0$ $\sin \theta(1 + 2 \cos \theta) = 0$ $\sin \theta = 0$ or $\cos \theta = -\frac{1}{2}$, $\theta = 0, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}$ (2, 3) (2, -1) $\left(2 - \frac{\sqrt{3}}{2}, -1.5\right)$ $\left(2 + \frac{\sqrt{3}}{2}, -1.5\right)$	M1 M1 *M1 DM1 A1 A1 A1 A1	3.1a 3.1a 1.1 1.1 3.2a 3.2a	For differentiation of y wrt. θ, may be as part of $\frac{dy}{dx}$ For $\frac{dy}{d\theta} = 0$ or $\frac{dy}{dx} = 0$ and use of sine or cosine double angle formula. If $\frac{dx}{d\theta}$ is used incorrectly then give M0 All on one side and factorised. If they have divided through by $\sin \theta$ then 1 = -2 cos θ or 1 + 2 cos θ = 0 will earn this mark Dependent on the previous method mark At least one trig value Condone if divides through by sin. www A marks dependent on M4 At least 2 correct values All four values correct with no extras www At least 2 correct coordinates oe, must be exact form www All four coordinates correct with no extras oe, must be exact form
				[8]		

Question			Answer	Marks	AO	Guidance
12	(b)		$x = 2$	B1	2.2a	
				[1]		

Q12a. This is a DR question and runs over to page 11 so please check and mark as BP or SEEN if empty and mark if there is something there. The first M1 is for differentiating y wrt θ . It might be seen on it's own as $dy/d\theta$ or as the numerator of dy/dx . We are ignoring $dx/d\theta$ unless they try to use it incorrectly in their subsequent work. The second M1 is for putting their expression equal to 0 AND using either $\sin 2\theta = 2 \sin \theta \cos \theta$ or $\cos 2\theta =$ one of the correct forms. But if $dx/d\theta$ is used incorrectly here then give M0. The third M1 is for getting terms on one side and factorised. However, some divide through by $\sin$ at this point – they can still get the M1 and also the fourth M1. The 3rd and 4th M1s can be implied (BOD) by seeing 2 correct solutions $\sin \theta = 0$ and $\cos \theta = -\frac{1}{2}$. The 4th M1 is dependent on the previous M1. (We have seen some candidates obtain $\sin \theta = 0$ (and possibly $\cos \theta = -\frac{1}{2}$) from completely wrong working but this does not score).

The A marks are dependent on getting M4 and are for finding exact values of θ and the coordinates. Note that the A marks are all www marks (without wrong working), so dividing through by $\sin \theta$ will cost all the A marks. Allow equivalent correct forms (e.g. $\frac{4-\sqrt{3}}{2}$ for $2 - \frac{\sqrt{3}}{2}$, $\frac{4+\sqrt{3}}{2}$ for $2 + \frac{\sqrt{3}}{2}$) for the x-values.

CHECK PAGE 11 for working

Q12b. $x=2$ is the only acceptable answer for B1.