

Q3.

Question	Scheme	Marks	AOs
(a)	$y = \operatorname{cosec}^3 \theta \Rightarrow \frac{dy}{d\theta} = -3\operatorname{cosec}^2 \theta \operatorname{cosec} \theta \cot \theta$	B1	1.1b
	$\frac{dy}{dx} = \frac{dy}{d\theta} \div \frac{dx}{d\theta}$	M1	1.1b
	$\frac{dy}{dx} = \frac{-3\operatorname{cosec}^3 \theta \cot \theta}{2 \cos 2\theta}$	A1	1.1b
	(3)		
(b)	$y = 8 \Rightarrow \operatorname{cosec}^3 \theta = 8 \Rightarrow \sin^3 \theta = \frac{1}{8} \Rightarrow \sin \theta = \frac{1}{2}$	M1	3.1a
	$\theta = \frac{\pi}{6} \Rightarrow \frac{dy}{dx} = \frac{-3\operatorname{cosec}^3\left(\frac{\pi}{6}\right) \cot\left(\frac{\pi}{6}\right)}{2 \cos\left(\frac{2\pi}{6}\right)} = \dots$ or $\sin \theta = \frac{1}{2} \Rightarrow \frac{dy}{dx} = \frac{-3 \times \frac{\cos \theta}{\sin^3 \theta}}{2(1-2\sin^2 \theta)} = \frac{-3 \times 8 \times \frac{\sqrt{3}/2}{1/2}}{2\left(1-2 \times \frac{1}{4}\right)}$	M1	2.1
	$= -24\sqrt{3}$	A1	2.2a
	(3)		
(6 marks)			

Notes
(a)
B1: Correct expression for $\frac{dy}{d\theta}$ seen or implied in any form e.g. $\frac{-3 \cos \theta}{\sin^4 \theta}$
M1: Obtains $\frac{dx}{d\theta} = k \cos 2\theta$ or $\alpha \cos^2 \theta + \beta \sin^2 \theta$ (from product rule on $\sin\theta\cos\theta$) and attempts $\frac{dy}{dx} = \frac{dy}{d\theta} \div \frac{dx}{d\theta}$
A1: Correct expression in any form. May see e.g. $\frac{-3 \cos \theta}{2 \sin^4 \theta \cos 2\theta}, -\frac{3}{4 \sin^4 \theta \cos \theta - 2 \sin^3 \theta \tan \theta}$
(b)
M1: Recognises the need to find the value of $\sin \theta$ or θ when $y = 8$ and uses the y parameter to establish its value. This should be correct work leading to $\sin \theta = \frac{1}{2}$ or e.g. $\theta = \frac{\pi}{6}$ or 30° .
M1: Uses their value of $\sin \theta$ or θ in their $\frac{dy}{dx}$ from part (a) (working in exact form) in an attempt to obtain an exact value for $\frac{dy}{dx}$. May be implied by a correct exact answer.
If no working is shown but an exact answer is given you may need to check that this follows their $\frac{dy}{dx}$.
A1: Deduces the correct gradient