Question	Scheme	Marks	AOs
1	**Examples:** $4\sin\frac{\theta}{2}\approx 4\left(\frac{\theta}{2}\right),\ 3\cos^2\theta\approx 3\left(1-\frac{\theta^2}{2}\right)^2$ $3\cos^2\theta = 3\left(1-\sin^2\theta\right)\approx 3\left(1-\theta^2\right)$ $3\cos^2\theta = 3\frac{(\cos 2\theta+1)}{2}\approx\frac{3}{2}\left(1-\frac{4\theta^2}{2}+1\right)$	M1	1.1a
	Examples: $4\sin\frac{\theta}{2}+3\cos^2\theta\approx 4\left(\frac{\theta}{2}\right)+3\left(1-\frac{\theta^2}{2}\right)^2$ $4\sin\frac{\theta}{2}+3\cos^2\theta = 4\left(\frac{\theta}{2}\right)+3\left(1-\sin^2\theta\right)\approx 2\theta+3\left(1-\theta^2\right)$ $4\sin\frac{\theta}{2}+3\cos^2\theta = 4\sin\frac{\theta}{2}+3\frac{(\cos 2\theta+1)}{2}\approx 4\left(\frac{\theta}{2}\right)+\frac{3}{2}\left(1-\frac{4\theta^2}{2}+1\right)$	dM1	1.1b
	$=2\theta+3\left(1-\theta^2+...\right)=3+2\theta-3\theta^2$	A1	2.1
		(3)	
		(3 marks)	

Notes

M1: Attempts to use at least one correct approximation **within the given expression**.

Either $\sin\frac{\theta}{2}\approx\frac{\theta}{2}$ or $\cos\theta\approx 1-\frac{\theta^2}{2}$ or e.g. $\sin\theta\approx\theta$ if they write $\cos^2\theta$ as $1-\sin^2\theta$ or e.g. $\cos 2\theta\approx 1-\frac{(2\theta)^2}{2}$ (condone missing brackets) if they write $\cos^2\theta$ as $\frac{1+\cos 2\theta}{2}$.

Allow sign slips only with any identities used but the appropriate approximations must be applied.

dM1: Attempts to use correct approximations **with the given expression** to obtain an expression in terms of θ only. **Depends on the first method mark.**

A1: Correct terms following correct work. Allow the terms in any order and ignore any extra terms if given correct or incorrect.

Question	Scheme	Marks	AOs
2a	$2\alpha + \frac{1}{2}\left(1 - \frac{\alpha^2}{2}\right)$	M1	1.2
	$2\alpha + \frac{1}{2}\left(1 - \frac{\alpha^2}{2}\right) = 0 \Rightarrow 2\alpha + \frac{1}{2} - \frac{\alpha^2}{4} = 0 \Rightarrow \alpha = ...$	dM1	1.1b
	$\alpha = -0.243$ (3dp) only	A1	2.3
		(3)	
b	$f'(0) = \frac{1}{2}\cos 0 \Rightarrow ... \Rightarrow y = ...x + 3$	M1	1.1b
	$y = \frac{1}{2}x + 3$	A1	1.1b
		(2)	
		(5 marks)	

Notes

(a) **Note on EPEN this is M1A1A1 but we are marking this as M1dM1A1**

Accept to be in terms of α or another variable e.g. x

Note: -0.243 **with no working is 0 marks**

M1: Fully substitutes $\cos x = 1 - \frac{x^2}{2}$ into the derivative.

dM1: Attempts to multiply out to achieve a 3TQ (= 0) **and** attempts to find a value for α. Condone slips. Allow solving the quadratic via any method (usual rules apply).

If they use a calculator then you may need to check this.

A1: $(\alpha =) -0.243$ only cao Can only be scored provided a correct 3TQ is seen. If both roots found then the other one must be rejected (or a choice made of -0.243 e.g. underlining it or a tick)

Condone $x = -0.243$

(b)

M1: Attempts to find the gradient of the curve when $x = 0$ and achieves an equation of the form $y = "f'(0)"x + 3$.

$x = 0$ must be fully substituted in and a value must be found for the gradient. Do not allow this mark if they attempt to use a changed gradient e.g. the gradient of the normal.

Also allow attempts using the small angle approximation:

$$f'(x) \approx 2x + \frac{1}{2}\left(1 - \frac{x^2}{2}\right) \text{ when } x = 0,\ f'(0) = "\frac{1}{2}" \Rightarrow y = "f'(0)"x + 3$$

A1: $y = \frac{1}{2}x + 3$ or equivalent in the form $y = mx + c$ isw Stating just the values $m = 0.5,\ c = 3$ without the correct equation is A0