

Q	Marking instructions	AO	Marks	Typical solution
12(a)	Substitutes $t = 0$ into both models and obtains the distance. Condone missing units.	3.4	B1	$t = 0$ $8 - 4 \sin 0 - (1 - \cos 0) = 8$ metres
	Subtotal		1	

Q	Marking instructions	AO	Marks	Typical solution
12(b)	Models the distance between the ceiling and the floor as $c - f$ Condone a sign error when expressions for c and f are substituted.	3.3	M1	$d = c - f$ $= 8 - 4 \sin t - (1 - \cos t)$ $= 7 + \cos t - 4 \sin t$ $R = \sqrt{17}$ $R \cos \alpha = 1$ $R \sin \alpha = 4$ $\tan \alpha = 4, \alpha = 1.33$ $d = 7 + \sqrt{17} \cos(t + 1.33)$
	Uses a compound angle formula to obtain $R \cos \alpha = \pm 1$ or ± 4 or $R \sin \alpha = \pm 4$ or ± 1 or $\tan \alpha = \pm 4$ or $\pm \frac{1}{4}$ PI by $R = \sqrt{17} \approx 4.1$ or AWRT $\alpha = 1.33^\circ$ or AWRT $\alpha = 76^\circ$	3.1a	M1	
	Obtains $R = \sqrt{17} \approx 4.1$ Condone correct answer from $\sqrt{(\pm 1)^2 + (\pm 4)^2}$ Note: M0 M1 A1 is possible	1.1b	A1	
	Obtains AWRT $\alpha = 1.33^\circ$ or AWRT $\alpha = 76^\circ$ No incorrect working seen in finding α Accept other valid values of α $\alpha = 1.33^\circ + 2n\pi$ OE in degrees	1.1b	A1	
	Completes argument to obtain $d = 7 + \sqrt{17} \cos(t + 1.33)$ Accept AWRT 4.1 in place of $\sqrt{17}$ and $\alpha = 1.33^\circ + 2n\pi$ Do not award this mark if $\sin \alpha = \pm 4$ or ± 1 or $\cos \alpha = \pm 1$ or ± 4 is used leading to a value of $\tan \alpha$	2.1	R1	
	Subtotal		5	

Q	Marking instructions	AO	Marks	Typical solution
12(c)	Subtracts their R from 7 provided their $R < 7$	1.1a	M1	$7 - \sqrt{17} = 2.88 \text{ m}$
	Obtains 2.88 metres or 288 cm Correct units must be seen.	3.2a	A1	
	Subtotal		2	

	Question 12 Total		8	
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