Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Desciptor
1a	Uses $v = r\omega$ to explain Maisie will be travelling at a greater speed than Dora.	**B1**	1.2	TBC
	Uses $F = mr\omega^2$ to explain Maisie will experience a greater (radial) force than Dora.	**B1**	1.2	
	Assume Maisie has a greater mass than Dora.	**B1**	2.4	
	Any other valid assumption in the model, e.g. No air resistance	**B1**	3.5a	
		(4)		
1b	Formulates two forces using m, $4m$, r and r+1, Maisie's Force = $4m\,(r + 1)\,\omega^2$ and Dora's Force = $mr\omega^2$	**M1**	3.1b	TBC
	Equates using correct given relationship: $6\,mr\omega^2 = 4m\,(r + 1)\,\omega^2$	**M1**	1.1a	
	Solves to find $r = 2$ m	**A1**	1.1b	
	Interprets solution to state Maisie's horse is 3 m from the centre.	**A1**	3.2a	
		(4)		
	(8 marks)			

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
2a	States Max Friction = μmg, where m is the mass of a vehicle.	M1	1.2	TBC
	Using $F = ma$, states radial force in terms of v: $F = m\frac{v^2}{r}$	M1	1.2	
	Equates to find maximum safe speed: $\mu mg = \frac{mv_{max}^2}{r}$	M1	1.1a	
	Substitutes $\mu = \frac{3}{4}$ and shows correct working: $\frac{3}{4}mg = \frac{mv_{max}^2}{r} \implies v_{max} = \frac{\sqrt{3}}{2}(gr)^{\frac{1}{2}}$	A1*	2.1	
		(4)		
2b	Finds value of v_{max}: $v_{max} = \frac{72}{0.9} = \frac{720}{9}$ km/h oe	M1	3.1b	TBC
	Changes units using 1000/3600 and obtains $\frac{200}{9}$ ms^{-1}	A1*	1.1b	
		(2)		
2c	Uses *their* v_{max} and equates: $\frac{200}{9} = \frac{\sqrt{3}}{2}(gr)^{\frac{1}{2}}$	M1	1.1a	TBC
	Solves correctly for r: $r = \frac{160{,}000}{243g}$ m oe	A1	1.1b	
	Uses r value and converts km/h to m/s with correct sdt form: Time = $\frac{160{,}000\pi}{486g} \div \frac{72 \times 1000}{3600}$	M1	1.1b	
	Finds time = 5.28 s	A1	1.1b	
		(4)		
				(10 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
3a	Resolves vertically using tension in string, T: $T\cos\theta = mg$	**M1**	3.3	TBC
	Resolves horizontally using radius, r: $z\sin\theta = \frac{mv^2}{r}$	**M1**	3.3	
	Eliminates T by dividing: $\tan\theta = \frac{\left(\frac{mv^2}{r}\right)}{mg} = \frac{v^2}{gr}$	**M1**	1.1b	
	From the diagram: $\tan\theta = \frac{r}{L\cos\theta}$	**M1**	1.1b	
	Substitutes and makes v the subject: $\frac{r}{L\cos\theta} = \frac{v^2}{gr} \implies v = \sqrt{\frac{gr^2}{L\cos\theta}}$	**A1**	1.1b	
	Uses $\omega = \frac{v}{r}$ and period $= \frac{2\pi}{\omega}$ to show period $= 2\pi\sqrt{\frac{L\cos\theta}{g}}$	**A1***	2.1	
		(6)		
3b	Equates with given value: $2 = 2\pi\sqrt{\frac{L\cos\theta}{g}}$	**M1**	3.4	TBC
	Rearranges appropriately: $L\cos\theta = \frac{g}{\pi^2}$	**M1**	1.1b	
	States/uses range for $\cos\theta$ to have a solution: $\lvert\cos\theta\rvert \leqslant 1$	**A1**	1.2	
	Deduces strict inequality as $r > 0$, so $\lvert\cos\theta\rvert < 1 \implies L > \frac{g}{\pi^2}$	**A1***	2.2a	
		(4)		
3c	Mentions air resistance to motion has been ignored only.	**B1**	3.5a	TBC
	Explains how air resistance would constantly reduce speed so that circular motion would not be achieved and thus a 2-second period, as stated, would never happen.	**B1**	3.5b	
		(2)		
				(12 marks)

Notes