Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	• A (resultant) force F is required to maintain circular motion (1) • This force is friction (between car/slider and track) (1) • As v increased F required increased until it exceeds friction and car slides off track (1)	alt: A (resultant) force acts to the centre of the circle.	3

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
i	• Use of $\omega = 2\pi/T$ (1) • For at least 2 full cycles (1) • $\omega = 6.5 \times 10^{-6}$ (radian s^{-1}) (1)	For MP3, accept correctly rounded answers in range 6.5×10^{-6} radian s^{-1} to 6.6×10^{-6} radian s^{-1} Example of calculation $\omega = 5 \times 2\pi / (56 \times 24 \times 60 \times 60)$ s $= 6.49 \times 10^{-6}$ radian s^{-1}	3
ii	• Equates $F = Gm_1m_2/r^2$ and $F = m\omega^2r$ Or $F = Gm_1m_2/r^2$ and $F = mv^2/r$ with $v = 2\pi r/T$ (1)(1) • Correct rearrangement and substitution (e.g. in $r^3 = Gm_1/\omega^2$) (1) • $r = 7.2 \times 10^9$ m (ecf from (b)(i))	Example of calculation $r^3 = 6.67 \times 10^{-11}$ N m^2 $kg^{-2} \times 0.12 \times 1.99 \times 10^{30}$ kg / $(6.5 \times 10^{-6}$ radian $s^{-1})^2$ $r = 7.2 \times 10^9$ m ($r = 7.6 \times 10^9$ m for 'show that' value)	3

Q3.

Question Number	Answer		Mark
(a)(i)	$R = 9.32$ kN Example of answer $R = 950\ \text{kg} \times 9.81\ \text{m s}^{-2}$ $R = 9320$ N	(1)	1
(a)(ii)	Use of $F = mv^2/r$ $R = mg - mv^2/r$ $R = 2480$ N ecf their value of R Example of calculation $R = 9320\ \text{N} - (950\ \text{kg} \times 12.0^2\ \text{m}^2\ \text{s}^{-2} / 20.0\ \text{m})$ $R = 2480$ N	(1) (1) (1)	3
(b)	An answer that either states implicitly or implies that 'The required centripetal force > mg and so cannot be provided'.	(1)	1
	Total for question		5

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
	• inner lane covers a smaller distance	(1)		
	• inner lane has a smaller radius of curvature	(1)		
	• (maximum horizontal force is the same for both cars) therefore maximum speed is greater for the car on the outside lane (so outcome unclear)	(1)		3