Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
i	• use of $s = \frac{(u+v)}{2} \times t$ (1) • $v = 3.1$ (m s^{-1}) (1)	Example of calculation: 1.1 $m = \frac{(0+v)}{2} \times 0.77$ s $v = 3.1$ m s^{-1}	2
ii	• use of $F = mv^2/r$ (1) • $F = 11$ N (allow ecf from (i)) (1)	Example of calculation: $F = \frac{0.050 \text{ kg} \times 3.1^2 \text{ (m s}^{-1})^2}{0.042 \text{ m}}$ $F = 11.4$ N "show that value" gives $F = 10.7$ N	2

Q2.

Question Marks	Acceptable Answers	Additional guidance	Mark
	• Magnet accelerates ball (1) Or magnet increases ball's KE • Momentum is conserved in the collision(s) (1) • (Since collisions are elastic) KE conserved so third ball moves off with the same velocity/KE as incoming ball hit magnet with (1)	Marks can be gained by discussing either set of balls	3

Q3.

Question Number	Answer		Mark
(a)(i)	See $F = GMm/r^2$	(1)	
	Equated to mg to give required expression **Or** use of g = F/m	(1)	2
(a)(ii)	Use of $g = \omega^2 r$ OR $g = v^2/r$	(1)	
	Use of $\omega = 2\pi/T$ OR $v = 2\pi r/T$	(1)	
	Correct algebra leading to expression given	(1)	3
	Example of calculation: $\omega^2 r = \frac{GM}{r^2}$ $\left(\frac{2\pi}{T}\right)^2 = \frac{GM}{r^3}$ $r^3 = \frac{GMT^2}{4\pi^2}$		
(a)(iii)	See T = 24 hours	(1)	
	T converted into s	(1)	
	$r = 4.2 \times 10^7$ m	(1)	3
	Example of calculation: $T = 24 \times 60 \times 60$ s = 86 400 s $r^3 = \frac{GMT^2}{4\pi^2} = \frac{6.67\times10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 6.0\times10^{24}\ \text{kg} \times (86400\ \text{s})^2}{4\pi^2} = 7.57\times10^{22}\ \text{m}^3$ $r = \sqrt[3]{7.57\times10^{22}\ \text{m}^3} = 4.23\times10^7\ \text{m}$		
(b)	The satellite must rotate with the Earth **Or** the satellite must be in a geosynchronous orbit **Or** any non-equatorial orbit would cause the satellite to move N-S		1
	Total for question		9

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
	• Use of $F = \frac{mv^2}{r}$	(1)	Example of derivation: $mg = \frac{mv^2}{r}$ $v = \sqrt{gr}$	(2)
	• States that $F = mg$ only as reaction force is zero	(1)		