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

Mark Schemes
Q1.

Question Number	Answer		Mark
(a)	The gravitational field strength [accept "g"] decreases **Or** the (gravitational) force on the satellite/object/mass decreases It is a centripetal force (and not a centrifugal force) The satellite is accelerating and so is not in balance	(1) (1) (1)	3
(b)(i)	See $\frac{mv^2}{r} = \frac{GmM_E}{r^2}$ **Or** $m\omega^2 r = \frac{GMm}{r^2}$ $\therefore v^2 = \frac{GM_E}{r}$ **Or** $v = \sqrt{\frac{GM_E}{r}}$ GM_E is constant (and so v decreases as r increases) **Or** $v^2 \propto \frac{1}{r}$ **Or** $v \propto \frac{1}{\sqrt{r}}$	(1) (1) (1)	3
(b)(ii)	State $T = \frac{2\pi}{\omega}$ and $\omega = \frac{v}{r}$ **Or** $T = \frac{s}{v}$ and $s = 2\pi r$ Hence $T = \frac{2\pi r}{v}$ (so smaller v leads to a larger value of T) [Accept $T = \frac{2\pi GM_E}{v^3}$ for final mark]	(1) (1)	2
(c)	Use of $T = \sqrt{\frac{4\pi^2 r^3}{GM}}$ T = 5530 s [92 minutes] Example of calculation $T = \sqrt{\frac{4\pi^2 r^3}{GM}} = \sqrt{\frac{4\pi^2 (6360000\,\text{m} + 400000\,\text{m})^3}{6.67\times10^{-11}\,\text{N m}^2\,\text{kg}^{-2} \times 5.98\times10^{24}\,\text{kg}}} = 5530\,\text{s}$	(1) (1)	2
(d)	**Max 2** As radius decreases: There is a transfer of gravitational potential energy to kinetic energy [Accept kinetic energy increases and gravitational potential energy decreases] Sum of kinetic and gravitational potential energy decreases **Or** satellite does work against frictional forces **Or** transfer of kinetic energy of satellite to thermal energy **Or** heating occurs	(1) (1)	2

Q2.

Question Number	Answer	Mark
*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Gravitational fields are regions in which a mass experiences a force due to its mass (1) Electric fields are regions in which a charge experiences a force due to its charge (1) Both types of field have an infinite range (1) In each type of field the force varies as an inverse square (1) The force between masses is always attractive whereas the force between charges can be attractive or repulsive **Or** electric fields can cancel or reinforce but gravitational fields always reinforce one another (1) The force between (unit) charges at a given separation is much stronger than the force between (unit) masses at the same separation (1)	6
	Total for question	**6**