Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Use of $v = \frac{2\pi r}{T}$ (1) or $\omega = \frac{2\pi}{T}$ • Use of $a = \frac{v^2}{r}$ (1) or $r\omega^2$ • $a = 8.8\ \text{m s}^{-2}$ (1)	Example of calculation $v = \frac{2\pi 6800000\text{m}}{92\times 60\text{s}} = 7740\ \text{m s}^{-1}$ $a = \frac{7740^2(\text{m s}^{-1})^2}{6800000\ \text{m}} = 8.81\ \text{m s}^{-2}$ or $\omega = \frac{2\pi}{92\times 60\ \text{s}} = 1.14\times 10^{-3}\ \text{rad s}^{-1}$ $a = 6800000\ \text{m} \times (1.14\times 10^{-3}\ \text{rad s}^{-1})^2$ $a = 8.81\ \text{m s}^{-2}$	3
(ii)	• The astronauts have weight or not weightless (1) **Or** Earth's gravitational field = 8.8 N kg^{-1} on ISS (ECF from (b)(i)) • Earth's gravitational field keeps astronauts/ISS in circular motion (1) **Or** Weight provides the centripetal force • Our notion of "weight" is reaction force acting on us from the ground/floor (1) • There are no reaction forces from the ISS on the astronauts so they "feel" weightless (1)		4

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Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: • The centripetal force is provided by friction (1) • There is a max (frictional) force **Or** (frictional) force is the same when coin starts to slide (1) • $F=m\omega^2r$ so as r increased ω decreased (1)	For MP3 accept ω^2 for ω	3

Q3.

Question Number	Answer		Mark
(a)	Use of $v = 2\pi r/t$ **Or** $v = r\omega$ **and** $T = 2\pi/\omega$ $t = 1.5 \times 10^3$ s [24.6 minutes] Example of calculation $t = 2\pi r/v$ $t = (2\pi \times 61\text{ m}) / 0.26\text{ m s}^{-1}$ $t = 1473$ s	(1) (1)	2
(b)	Use of $F = mv^2/r$ $F = 11$ N Example of calculation $F = 9.7 \times 10^3\text{ kg} \times (0.26\text{ m s}^{-1})^2 / 61\text{ m}$ $F = 10.7$ N	(1) (1)	2
(c)(i)	Three arrows all pointing to the centre of the circle (accept free hand and lines of varying length)	(1)	1

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* (c)(ii)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Maximum at C / bottom **and** Minimum at A / top At C contact/reaction force (R) greater than weight (accept $R - W = mv^2/r$ or $R = W + mv^2/r$) At A contact/reaction force is less than the weight. (accept $W - R = mv^2/r$ or $R = W - mv^2/r$) Any statement that centripetal force / acceleration is provided by weight/reaction **Or** centripetal force is the resultant force This is a qwc question so a bald statement of the equations can score the marks but to get full marks there must be clear explanation in words.	**(1)** **(1)** **(1)** **(1)**	**4**

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