Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

(a) The weight *w* of an object on the Earth can be represented either as $w = mg$ or $w = \frac{GMm}{r^2}$.

(i) Explain the meaning of *g* and *G* in these equations.

_____

_____

_____

_____

_____

_____

(3)

(ii) Use the equations above to show that $M = \frac{gr^2}{G}$.

_____

_____

_____

(1)

(iii) Calculate the mass of the Earth to a precision consistent with the data below.

mean radius of the Earth, = 6.4×10^6 m

$G = 6.7 \times 10^{-11}$ N m^2 kg^{-2}

$g = 9.8$ N kg^{-1}

_____

_____

_____

_____

_____

mass of the Earth _____ kg

(3)

(b) The figure below shows a satellite in a geostationary orbit around the Earth.

(i) State the time period for a geostationary satellite.

(1)

(ii) The height of a geostationary satellite in orbit is approximately 36 000 km above the surface of the Earth.
Calculate the radius of a geostationary orbit.

radius _____ m

(1)

(iii) Calculate the speed, in km s^{-1}, of a satellite in a geostationary orbit.

speed _____ km s^{-1}

(3)

(iv) State a common use for a geostationary satellite.

_____

(1)

(v) Explain why a geostationary orbit is necessary for this use.

_____

_____

_____

(1)

(Total 14 marks)

Q2.

(a) State, in words, Newton's law of gravitation.

_____

_____

_____

_____

_____

(3)

(b) By considering the centripetal force which acts on a planet in a circular orbit, show that $T^2 \propto R^3$, where T is the time taken for one orbit around the Sun and R is the radius of the orbit.

_____

_____

_____

_____

_____

(3)

(c) The Earth's orbit is of mean radius 1.50×10^{11} m and the Earth's year is 365 days long.

(i) The mean radius of the orbit of Mercury is 5.79×10^{10} m. Calculate the length of Mercury's year.

_____

_____

_____

_____

_____

_____

(ii) Neptune orbits the Sun once every 165 Earth years.

Calculate the ratio $\frac{\text{distance from Sun to Neptune}}{\text{distance from Sun to Earth}}$.

(4)

(Total 10 marks)