Quiz 4

Name: _____ Student Number: _____

1. (6 marks) Derive Kepler's law relating the orbital period to the radius of a circular orbit from Newton's Laws. Be sure to define all variables.

See Notes

2. (4 marks) Consider the Gravitational force between the Earth and a mass m.

$F = G M_{Earth} m / r^2$

a) Find an expression for the acceleration due to the gravity at the Earth's surface.

$R_{Earth} = 6400$ km

$M_{Earth} = 6 \times 10^{24}$ kg

$G = 6.67 \times 10^{-11}$ Nt m^2/kg^2

$$\frac{G M_E m}{r_E^2} = mg$$

$$g = \frac{G M_E}{r_E^2}$$

$$= \frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{(6.4 \times 10^6)^2}$$

$$= 9.8 \text{ m/sec}^2$$

b) What is the effect on g if the radius of the Earth doubles while the Earth's density remains constant?

$$g \propto \frac{M_E}{r_E^2}$$

$$\propto \frac{r_E^3}{r_E} \quad \text{since } M_E = \rho \frac{4}{3} \pi r_E^3 \quad (\rho = \text{density})$$

$$\propto r_E$$

$\therefore$ if r_E doubles, so does g.

Total = 10 marks