GRAVITATION
FORMULAE

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Gravitational force between any two masses

$$F = \frac{GMm}{R^2}$$

According to Kepler Second Law $\frac{dA}{dt} = \frac{L}{2m}$

According to **Kepler Third Law**

$T^2 \alpha a^3$

$$T^2 = \frac{4\pi^2}{GM} R^3$$

$$\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{r_A}{r_B}\right)^3$$

Acceleration due to gravity

In terms of mass and radius of planet

$$g = \frac{GM}{R^2} = \left[\frac{4\pi}{3}\right]^{2/3} G M^{1/3} \rho^{2/3}$$

In terms of density and radius of planet

$$g = \frac{4}{3}\pi G \rho R$$

Null point distance form smaller mass

$$x = \frac{r}{\sqrt{\frac{m_2}{m_1}} + 1}$$

Acceleration due to gravity in terms of angular velocity of the planet

$$g' = g - \omega^2 R \cos^2\theta$$

ω – angular velocity of the planet

R – radius of the planet

θ – angle of latitude

Variation of acceleration due to gravity with altitude (height h):

$$g_h = \frac{g}{\left[1 + \frac{h}{R}\right]^2}$$

If height is very small then $g_h = g\left[1 - \frac{2h}{R}\right]$

Variation of acceleration due to gravity with depth d:

$$g_d = g\left[1 - \frac{d}{R}\right]$$

Potential energy between the system of two masses

$$U = \frac{-Gm_1m_2}{r}$$

Escape velocity

$$v_e = \sqrt{\frac{2GM}{R}}$$

$$v_e = \sqrt{2gR}$$

Escape velocity at a height h from the surface of the planet

$$\boxed{Ve = \sqrt{\frac{2GM}{R+h}} = \sqrt{2g_h(R+h)}}$$

Orbital velocity

$$v_o = \sqrt{\frac{GM}{R+h}}$$

In terms of g

$$\boxed{\therefore\ v_o = \sqrt{gR}}$$

THANK YOU