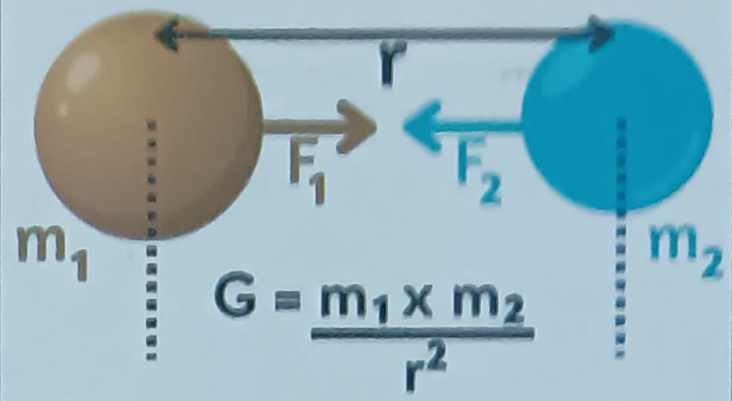
Gravitation

Newton's Gravitational Law

G = universal gravitational constant
($G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$)

m_1 and m_2 are masses of two bodies
r = distance between two bodies



$$G = \frac{m_1 \times m_2}{r^2}$$

Acceleration due to Gravity(g)

M = mass of earth = $6.4 \times 10^{24} kg$
R = radius of earth = 6.38×10^{6}

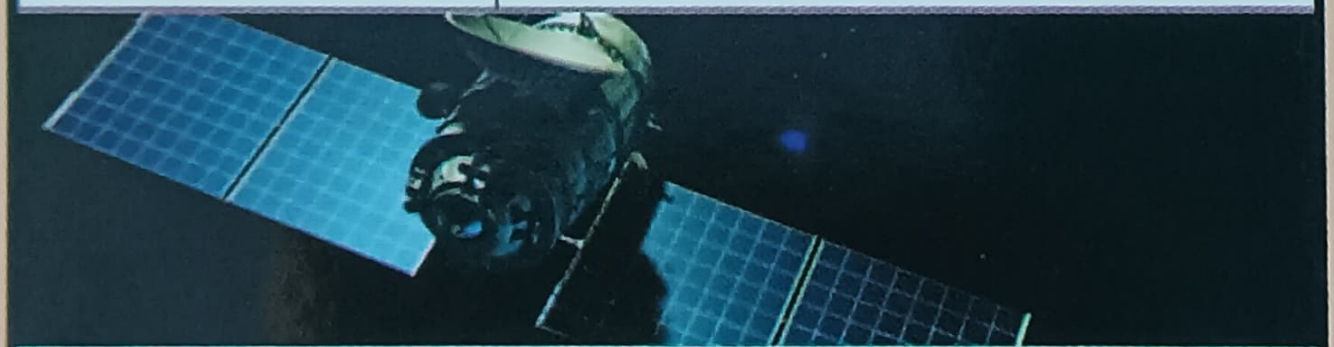
$$g = \frac{GM}{R^2}$$

Factors affecting g

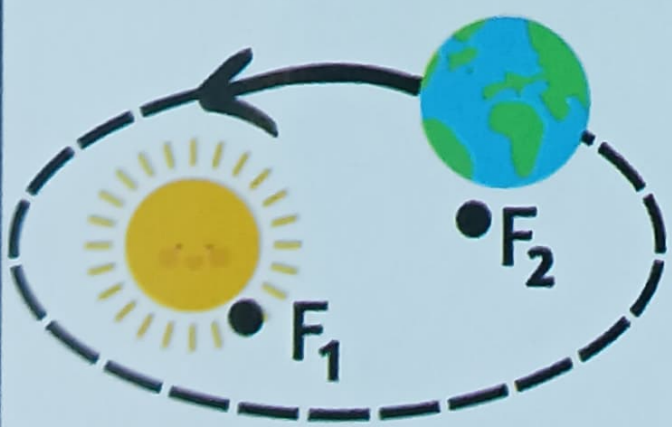
Effect of altitude h = height from earth's surface	$g' = \frac{g}{\left(1+\frac{h}{R}\right)^2}$
Effect of depth d = depth from earth's surface	$g' = \left(1-\frac{d}{R}\right)$
Intensity of Gravitational Field	$I = \frac{F}{m} = \frac{GM}{r^2}$
Gravitaional Potentoial Energy	$U = -\frac{Gm_1m_2}{r}$
Gravitational Potential at a distance h from Earth's surface	$\Delta U = \frac{mgh}{1+\frac{h}{R}}$

Satellite

Escape Speed	$v_e = \sqrt{2gR} = 11.2 km/s$
Orbital Velocity	$v_o = \sqrt{\frac{GM}{R}} = R\sqrt{\frac{g}{R+h}}$
Time Period of Satellite	$T = \frac{2\pi r}{\sqrt{\frac{GM}{r}}} = \frac{2\pi(R+h)}{v_0}$
Energy of Satellite in Orbit	Total energy, $E = KE + PE$ $E = -\frac{GMm}{2(R+h)} = -\frac{GMm}{2r}$ $KE = -TE\ ;\ PE = 2TE$

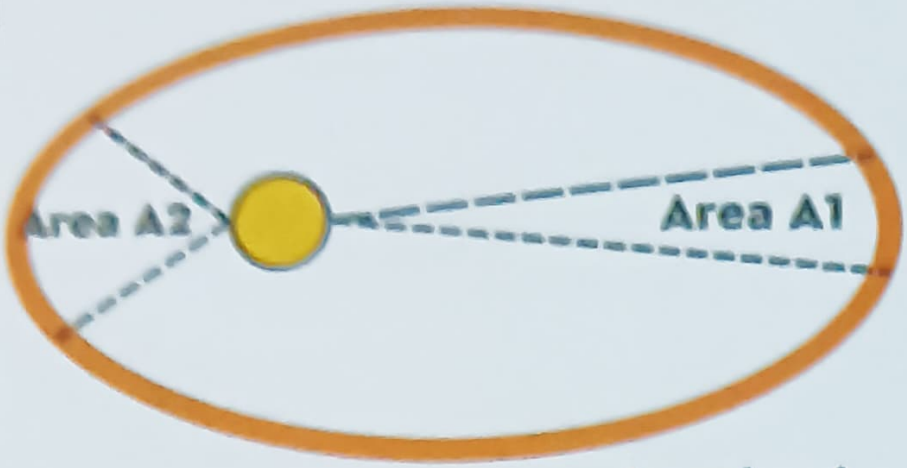


Kepler's Law of Planetary Motion



Law of Orbit

Every planet revolves around the sun in an elliptical orbit and sun is at its one focus.



A1 = A2

Law of Area

Areal velocity of a planet

$$\frac{dA}{dt} = \frac{L}{2m} = \text{constant}$$

The radius vector drawn from the sun to a planet sweeps equal areas in equal intervals of time, i.e. the arial velocity of the planet around the sun is constant.

Law of Period

The square of time period ofrevolution of a planet aroud the sun is directly proportional to the cube of the semi major axisof its elliptical orbit.

$$T^2 \propto a^3 \text{ or } \left(\frac{T_1}{T_2}\right)^2 = \left(\frac{a_1}{a_2}\right)^3$$

NEET 2023 PYQ'S (Chapter 6-8)

- The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be : **16U**

- The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is : **$\sqrt{3} : \sqrt{5}$**

- The angular acceleration of a body, moving along the circum. of a circle, is : **Along the axis of rotation.**

- Two bodies of mass m and 9m are placed at a distance R. The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be (G=gravitational constant) : **-16Gm/R**

- A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $3\pi/Gd$ represents : **T^2**