Gravitation

- The Phenomenon of attraction between any two objects in the Universe is called gravitation.

- Gravity — attractive force which is exerted by earth on any body.

Universal law of Gravitation.

Everybody in the universe attracts every other body with a force which is directly proportional to the product of their masses & inversely proportional to the square of the distance between them.

$F \propto m_1 m_2$

$F \propto \frac{1}{r^2}$

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

→ Universal gravitational constant.

SI unit of G

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

$G = \frac{N \times m^2}{kg^2}$

$G = 6.67 \times 10^{-11}\ Nm^2 kg^{-2}$

Universal gravitational Constant

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

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

$G = \frac{F \times (1m)^2}{1kg \times 1kg}$

$G = F$

Universal gravitational constant is numerically equal to the gravitational force of attraction between two bodies each of mass 1kg kept at unit distance from each other.

Why gravitational constant (G) is known as Universal gravitational constant?

→ The value of G doesn't depend on mass of two bodies, distance btw two bodies, nature, medium, shape / size.

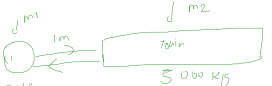
Conditions

(i) When two objects each of 1kg and 1m apart.

$F = G \frac{m_1 m_2}{r^2} = 6.67 \times 10^{-11} \frac{1 \times 1}{1} = 6.67 \times 10^{-11} N$

$= 0.000\ldots\ldots 67 N$

(ii)



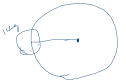
Force of Ball to Train $= G \frac{m_1 m_2}{r^2} = \frac{6 \times 5000}{(1)^2}$

$F = 10006 N$

Force of Train to Ball $= \frac{G m_2 m}{r^2} = \frac{G \cdot 5000 \times 2}{(1)^2}$

$= 10006 N$

(iii)



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

Radius of earth $= 6400 km$

$= 6400 \times 1000 m$

$= 6.4 \times 10^6 m$

$F_{BE} = \frac{6.67 \times 10^{-11} \times 1 \times 6 \times 10^{24}}{(6.4 \times 10^6)^2} = 9.8 N$

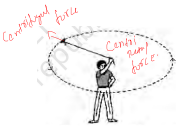
$F_{EA} = 9.8 N$

Newton's 2nd law of motion

$F = ma$

$a_{EA} = \frac{F}{m} = \frac{9.8}{1} = 9.8 ms^{-2}$

$a_{BE} = \frac{F}{m} = \frac{9.8}{6 \times 10^{24} kg} = 1.63 \times 10^{-24} ms^{-2}$



Before the thread is released, the stone moves in a circular path with a certain speed and changes direction at every point. The change in direction involves change in velocity or acceleration. The force that causes this acceleration and keeps the body moving along the circular path is acting towards the centre. This force is called the centripetal (meaning 'centre-seeking') force. In the absence of this

The motion of the moon around the earth is due to the centripetal force. The centripetal force is provided by the force of attraction of the earth. If there were no such force, the moon would pursue a uniform straight line motion.