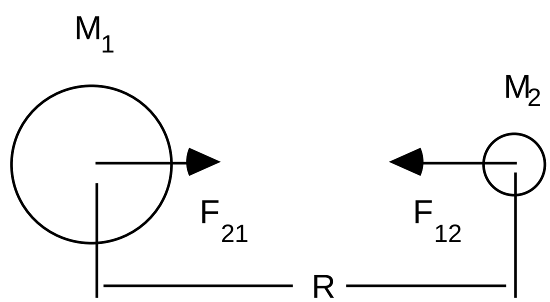
Gravity : Notes-5

Newton's law of gravity states that any two objects will have a force of attraction between them. This force is given by the equation:

$$F = \frac{GM_1M_2}{R^2}$$

G is a constant equal to 6.67×10^{-11}. M_1 and M_2 are the masses (in kilograms) of the two objects. R is the distance (in meters) between the centers of the two objects.



The two bodies, M_1 and M_2, are attracted towards each other, by the force of gravity. The force F_{21} is the force of M_2 on M_1. The force F_{12} is the force of M_1 on M_2. F_{21} equals F_{12}. They are equal and opposite by Newton's third law.

This force is small. But the bodies will accelerate towards each other if there is no friction. In the case of the Earth-Moon system, the moon is accelerating towards the Earth. (it is falling). But the moon has a tangential component to its velocity. So it keeps moving in a circle (actually an ellipse) around the Earth.

For satellites moving in a circular orbit about a large body, the force of gravity on the satellite equals the centripetal force on the satellite.

$$F_g = F_c$$

$$\frac{GMm}{R^2} = \frac{4m\Pi^2 R}{T^2}$$

This leads to **Kepler's Law**. For a satellite we have:

$$\frac{R^3}{T^2} = \text{constant}$$

The value of the constant depends on the mass of the planet (or body) that the satellite is orbiting.

Also, we have:

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

We can find the speed of a satellite that moves in a circular orbit about a planet. M is the mass of the planet and R is the distance the satellite is from the planet's center.

$$V = \sqrt{\frac{GM}{R}}$$