

CHAPTER EIGHT

GRAVITATION

Orbital Velocity:

“The minimum velocity required by an object to revolve in an orbit is called Orbital velocity”.

Let us consider a body of mass ‘m’ is revolving in an orbit of ‘h’ from the surface. It should have some minimum velocity to remain in an orbit because the gravitational pull must be balanced by centrifugal force.

$$\therefore \cancel{m}g = \frac{\cancel{m}v_0^2}{r}$$

$$g = \frac{v_0^2}{r}$$

$$\therefore V_0 = \sqrt{gr} \quad (\text{or}) \quad V_0 = \sqrt{g(R+h)}$$

If it is nearer to the earth’s surface $h < R$.

$$\therefore V_0 = \sqrt{gR}$$

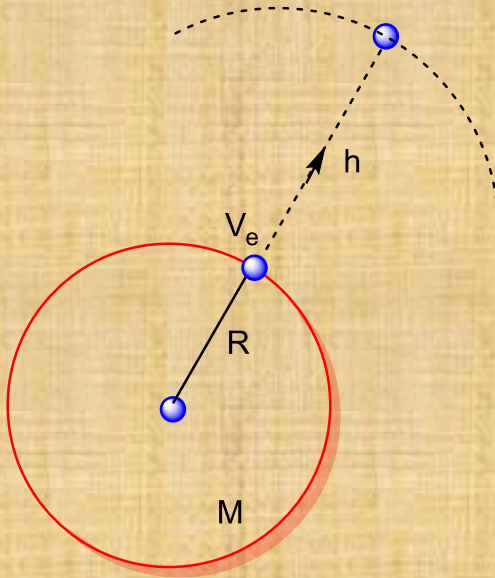
For earth’s orbit its value is 7.9 Km/sec

Escape Velocity:

The minimum velocity that should be imparted to a body on the surface so as to escape from gravitational influence is called Escape velocity.

The expression for escape velocity can be obtained using law of conservation of energy principle.

Let us consider a body of mass m in through with a velocity V_e , from the surface so that it escapes from gravitational influence.



This is possible when KE on the ground = Gravitational PE

$$\Rightarrow \frac{1}{2} m V_e^2 = \frac{GMm}{(R+h)}$$

$$V_e^2 = 2 \frac{GM}{(R+h)}$$

Which can be written as,

$$V_e^2 = 2 \frac{GM}{(R+h)^2} \times (R+h)$$

$$\therefore V_e = \sqrt{2g(R+h)}$$

If 'h' is small, then

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

$$V_e = \sqrt{2}V_0$$

Its value is 11.2 Km/s on earth surface.