

## Short Answer Type Questions – II

**Q.1. What would happen if gravity suddenly disappear?**

**Ans.** If gravity suddenly disappears,

- (i) All bodies will lose their weights.
- (ii) We shall be thrown away from the surface of earth due to centrifugal force.
- (iii) The motion of planets around the sun will cease because centripetal force shall not be provided.
- (iv) Motion of the satellite around earth will also be not possible as no centripetal force will be provided.

**Q.2. We cannot move even a finger without disturbing all the stars. Explain.**

**Ans.** According to Newton's law of gravitation, everybody in this universe attracts every other body with a force which is inversely proportional to the square of the distance between them. When we move our finger, the distance of the objects with respect to finger changes, disturbing the entire universe including stars.

**Q.3. What is binding energy of satellite?**

**Ans.** The minimum energy required to free a satellite from the gravitational attraction is called binding energy. Binding energy is the negative value of total energy of satellite. Let a satellite of mass  $m$  be revolving around earth of mass  $M$  and radius  $R$ .

∴ Total energy of satellite

$$\begin{aligned} &= \text{P.E} + \text{K.E.} \\ &= -\frac{GMm}{R} + \frac{1}{2}mv^2 \\ &= \frac{GMm}{R} + \frac{mGM}{2R} \\ &= -\frac{GMm}{2R} \end{aligned}$$

∴ Binding energy of satellite

$$\begin{aligned} &= -[\text{total energy of satellite}] \\ &= \frac{GMm}{2R} \end{aligned}$$

**Q.4. What are the conditions under which a rocket fired from the earth, launches an artificial satellite of earth?**

**Ans.** Following are the basic conditions:

- (i) The rocket must take the satellite to a suitable height above surface of earth.
- (ii) From the desired height, the satellite must be projected with a suitable velocity, called the orbital velocity.

(iii) In the orbital path of satellite, the air resistance should be negligible so that its velocity does not decrease and it does not burn due to the heat produced.

**Q.5. Why does moon has no atmosphere?**

**Ans.** Moon has no atmosphere because the value of acceleration due to gravity 'g' on surface of moon is small. Therefore, the value of escape velocity on the surface of the moon is small (only  $2.5 \text{ km s}^{-1}$ ). The molecules of the atmospheric gases on the surface of the moon have thermal velocities greater than the escape velocity. That is why all the molecules of gases have escaped and there is no atmosphere on moon.

**Q.6. Derive an expression for the gravitational potential energy above the surface of earth.**

**Ans.** Let the body of mass  $m$  be taken at height  $h$  above the surface of earth. At any instant of time  $t$  it reaches at a distance  $x$  from the centre of earth. The work done in raising through  $dx$  is.

$$dW = \frac{GMm}{x^2} \cdot dx$$

$$= \Delta(\text{P. E.})$$

Hence the work done in taking the body from surface of the earth ( $x = R$ ) to a height  $h$  ( $x = R + h$ ) is

$$\text{P.E.} = W$$

$$= \int_R^{R+h} \frac{1}{x^2} dx$$

$$= GMm \int_R^{R+h} \frac{1}{x^2} dx$$

$$= -GMm \left[ \frac{1}{x} \right]_R^{R+h}$$

$$= -GMm \left[ \frac{1}{R+h} - \frac{1}{R} \right]$$

$$= -\frac{GMm}{R} \left[ \frac{1}{1+\frac{h}{R}} - 1 \right]$$

$$= -\frac{GMm}{R} \left[ \left(1 + \frac{h}{R}\right)^{-1} - 1 \right]$$

Since,

$$R \gg h$$

$\therefore$

$$\text{P.E.} = -\frac{GMm}{R} \left[ 1 - \frac{h}{R} - 1 \right]$$

$$= \frac{GMmh}{R^2}$$

$$= \left( \frac{GM}{R^2} \right) mh \quad \left[ \text{as } g = \frac{GM}{R^2} \right]$$

$$= mgh$$

P.E. above the surface of earth

$$= mgh$$