

HOTS AND CASE STUDY BASED QUESTIONS

CLASS-XI

SUB - PHYSICS

CHAPTER- GRAVITATION

1. What will be the feeling of an astronaut inside a satellite about his weight when the satellite is in the process of being launched by a rocket?
2. A piece of matter of mass wqm is thrown up vertically from the Earth surface and it rises up to a height R (Radius of the earth= R). What is the initial velocity of the piece of matter? Show that the increase in potential energy of the piece of matter is $1/2 mgR$.
3. Calculate the distance from the earth surface at which acceleration due to gravity is same below and above the surface of the earth.
4. Suppose the gravitational force varies inversely as the n th power of distance. Then, find the expression for the time period of a planet in a circular orbit of radius R around Sun.
5. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would Earth have to be compressed to be a black hole? (Mass of earth = 5.98×10^{24} kg)
6. The ratio of acceleration due to gravity $g_1 : g_2$ are the surfaces of two planets is $5 : 2$ and the ratio of their respective average densities $\rho_1 : \rho_2$ is $2 : 1$. What is the ratio of their respective escape velocities $v_1 : v_2$ be two from the surface of the planets?
7. Considering the earth as a uniform sphere of radius R , show that if the acceleration due to gravity at a height h from the surface of the Earth is equal to the acceleration due to gravity at the same depth, then

$$h = 1/2 (\sqrt{5} - 1) R.$$

8. Raima was doing the homework sitting in the balcony of their home, suddenly she saw a white lean patch in the sky and she knew what it was. She knows that this patch is mark of rocket motion. She was curious to know how rocket can go out in space and does not return but aeroplane does. She knows that earth pulls everything towards itself due to gravitation that is why whatever she throws up return back to the earth. Now she went to her

father and asked what is the reason behind which makes the rocket go beyond earth's gravitation. Her father explained the principle of launching rocket that if the projection speed is increases above some certain value then it crosses the gravitational field of earth.

A. What do you mean by escape velocity?

B. If a spaceship is launched into a circular orbit close to the earth's surface. What additional velocity has to be imparted to the space ship in the orbit to overcome the gravitational pull.(Radius of earth is 6400 km)

C. Calculate the escape velocity on the surface of a planet of mass 9×10^{24} kg and radius 6.6×10^3 km.

9. A body is released at a distance r from the centre of the earth. Prove that the velocity v of the body when it strikes the surface of the earth is given by,

$$v = R \left[2g \left(\frac{1}{R} - \frac{1}{r} \right) \right]^{1/2}, \text{ where } R \text{ is the radius of the earth and } r > R.$$

10. Calculate the gravitational field and potential at the centroid of an equilateral triangle when three equal masses placed at each of its corners.