

Part I

1. The reason the Moon does not fall down and collide with the Earth is because
 - (a) It is being pulled by the Sun and planets as well as by Earth.
 - (b) The net force on it is zero.
 - (c) It is beyond the main pull of Earth's gravity.
 - (d) None of the above.

2. Two identical satellites orbit the earth in circular orbits. If the radius of satellite A is less than the radius of satellite B then
 - (a) the kinetic energy of A is less than that of B;
 - (b) the potential energy of A is less than that of B;
 - (c) the acceleration of A is less than that of B;
 - (d) all of the above.

3. The path of comets around the sun is elliptical and so the distance from the comet to the sun varies. The point of closest approach is called the perigee and the point of furthest reach is called the apogee. Suppose that for a particular comet the apogee is twice as far from the sun as the perigee. Comparing the strength of the force between the sun and the comet at the apogee and the perigee the force is
 - (a) four times as strong at the perigee.
 - (b) twice as strong at the perigee.
 - (c) the same at the apogee and the perigee since acceleration constant along a closed orbit.
 - (d) half as strong at the perigee.

4. The escape velocity of a spaceship from a planet depends on
 - (a) The mass of the planet and the mass of the spaceship.
 - (b) The mass and the diameter of the planet.
 - (c) The mass of the planet only.
 - (d) The diameter of the planet only.

5. Which of the following statements is true of a satellite orbiting the earth on a circular path?
- (a) It moves with constant speed and acceleration of zero magnitude.
 - (b) It moves with constant velocity and acceleration of constant magnitude.
 - (c) It moves with variable velocity and acceleration of zero magnitude.
 - (d) It moves with constant speed and acceleration of constant magnitude.

Part II

1. Suppose a satellite with mass m orbits the Earth with period T and radius R .
- (a) If another satellite with a larger mass orbits the Earth with the same period, would the radius of the orbit be larger, smaller or the same? Explain your answer.

 - (b) If another satellite with the same mass orbits the earth with a longer period would the radius of the orbit be larger, smaller or the same? Explain your answer.

 - (c) If a small amount of air resistance were to act on the satellite describe what would happen to the period and the radius of the orbit over time. Explain your answer.

2. A 6.8×10^4 kg spaceship orbits a distant planet circling with a period of 26 hours and an orbital radius of 16×10^6 m.

(a) Find

(i) the velocity of the spaceship.

(ii) the centripetal acceleration of the spaceship.

(iii) the mass of the planet.

(iv) the total energy of the spaceship.

(b) (i) What forces if any act on the astronauts inside the spaceship?

(ii) Explain why the astronauts feel weightless.

(c) The spaceship decreases its orbital radius to get a closer view of the planet.

(i) In this lower orbit will its speed be greater or smaller? Explain.

(ii) Will its total energy be decreased or increased? Explain.

(iii) In order for it to drop into a lower orbit will the captain need to apply forward or reverse thrusters? Explain.