

# Chapter 7

## Gravitation

### NCERT Exemplar Questions

#### Multi Choice Questions type I

1. The earth is an approximate sphere. If the interior contained matter which is not of the same density everywhere, then on the surface of the earth, the acceleration due to gravity

  - (a) will be directed towards the centre but not the same everywhere.
  - (b) will have the same value everywhere but not directed towards the centre.
  - (c) will be same everywhere in magnitude directed towards the centre.
  - (d) cannot be zero at any point.
2. As observed from earth, the sun appears to move in an approximate circular orbit. For the motion of another planet like mercury as observed from earth, this would

  - (a) be similarly true.
  - (b) not be true because the force between earth and mercury is not inverse square law.
  - (c) not be true because the major gravitational force on mercury is due to sun.
  - (d) not be true because mercury is influenced by forces other than gravitational forces.

3. Different points in earth are at slightly different distances from the sun and hence experience different forces due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the c.m. (centre of mass) causing translation and a net torque at the c.m. causing rotation around an axis through the c.m. For the earth-sun system (approximating the earth as a uniform density sphere)
- (a) the torque is zero.
  - (b) the torque causes the earth to spin.
  - (c) the rigid body result is not applicable since the earth is not even approximately a rigid body.
  - (d) the torque causes the earth to move around the sun.
4. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,
- (a) the solar cells and batteries in satellites run out.
  - (b) the laws of gravitation predict a trajectory spiralling inwards. (c) of viscous forces causing the speed of satellite and hence height to gradually decrease.
  - (d) of collisions with other satellites.
5. Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon

- (a) will be elliptical.
- (b) will not be strictly elliptical because the total gravitational force on it is not central.
- (c) is not elliptical but will necessarily be a closed curve.
- (d) deviates considerably from being elliptical due to influence of planets other than earth.
6. In our solar system, the inter-planetary region has chunks of matter (much smaller in size compared to planets) called asteroids. They
- (a) will not move around the sun since they have very small masses compared to sun.
- (b) will move in an irregular way because of their small masses and will drift away into outer space.
- (c) will move around the sun in closed orbits but not obey Kepler's laws.
- (d) will move in orbits like planets and obey Kepler's laws
7. Choose the wrong option.
- (a) Inertial mass is a measure of difficulty of accelerating a body by an external force whereas the gravitational mass is relevant in determining the gravitational force on it by an external mass.
- (b) That the gravitational mass and inertial mass are equal is an experimental result.
- (c) That the acceleration due to gravity on earth is the same for all bodies is due

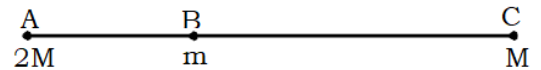
to the equality of gravitational mass and inertial mass.

(d) Gravitational mass of a particle like proton can depend on the presence of neighboring heavy objects but the inertial mass cannot.

8. Particles of masses  $2M$ ,  $m$  and  $M$  are respectively at points A, B and C with  $AB = \frac{1}{2}(BC)$ .  $m$  is much-much smaller than  $M$  and at time  $t = 0$ , they are all at rest (Figure).

At subsequent times before any collision takes place:

- (a)  $m$  will remain at rest.  
 (b)  $m$  will move towards  $M$ .  
 (c)  $m$  will move towards  $2M$ .  
 (d)  $m$  will have oscillatory motion.



### Multiple Choice Questions Type II (More than one options is correct)

9. Which of the following options are correct?
- (a) Acceleration due to gravity decreases with increasing altitude.  
 (b) Acceleration due to gravity increases with increasing depth  
 (assume the earth to be a sphere of uniform density).  
 (c) Acceleration due to gravity increases with increasing latitude.  
 (d) Acceleration due to gravity is independent of the mass of the earth.

10. If the law of gravitation, instead of being inverse-square law, becomes an inverse-cube law-

- (a) planets will not have elliptic orbits.
- (b) circular orbits of planets is not possible.
- (c) projectile motion of a stone thrown by hand on the surface of the earth will be approximately parabolic.
- (d) there will be no gravitational force inside a spherical shell of uniform density.

11. If the mass of sun were ten times smaller and gravitational constant  $G$  were ten times larger in magnitudes-

- (a) walking on ground would become more difficult.
- (b) the acceleration due to gravity on earth will not change. (c) raindrops will fall much faster.
- (d) airplanes will have to travel much faster.

12. If the sun and the planets carried huge amounts of opposite charges,

- (a) all three of Kepler's laws would still be valid.
- (b) only the third law will be valid.
- (c) the second law will not change.
- (d) the first law will still be valid.

13 There have been suggestions that the value of the gravitational constant  $G$  becomes smaller when considered over very large time period (in billions of years) in the future. If that happens, for our earth,

- (a) nothing will change.
- (b) we will become hotter after billions of years.
- (c) we will be going around but not strictly in closed orbits.
- (d) after sufficiently long time we will leave the solar system.

14. Supposing Newton's law of gravitation for gravitation forces  $F_1$  and  $F_2$  between two masses  $m_1$  and  $m_2$  at positions  $r_1$  and  $r_2$  and

$$F_1 - F_2 = -\frac{r_{12}}{r_{12}^3} G M_0^2 \left( \frac{m_1 m_2}{M_0^2} \right)^n$$

where  $M_0$  is constant of dimension of mass  $r_{12} = r_1 - r_2$

- (a) the acceleration due to gravity on earth will be different for different objects.
- (b) none of the three laws of Kepler will be valid.
- (c) only the third law will become invalid.
- (d) for  $n$  negative, an object lighter than water will sink in water.

15. Which of the following are true?

- (a) A polar satellite goes around the earth's pole in north-south direction.
- (b) A geostationary satellite goes around the earth in east-west direction.
- (c) A geostationary satellite goes around the earth in west-east direction.

(d) A polar satellite goes around the earth in east-west direction.

16. The centre of mass of an extended body on the surface of the earth and its centre of gravity

(a) are always at the same point for any size of the body. (b) are always at the same point only for spherical bodies. (c) can never be at the same point.

(d) is close to each other for objects, say of sizes less than 100 m.

(e) both can change if the object is taken deep inside the earth.

Answer Keys:

1 d

2 c

3 a

4 c

5 b

6 d

7 d

8 c

9 a, c

10 a, c

11 a, c, d

12 c, d

13 c, d

14 a, c, d

15 a, c

16 d

