CHAPTER-8

GRAVITATION

I. One mark questions (PART – A):

1. State Kepler's law of orbits.(K)
2. State Kepler's law of areas. (K)
3. State Kepler's law of periods. (K)
4. Which physical quantity is conserved in the case of law of areas? (U)
5. State universal law of gravitation. (K)
6. Express universal law of gravitation in mathematical form. (S)
7. Express universal law of gravitation in vector form. (S)
8. Write the relation between g and G. (K)
9. Write the expression for acceleration due to gravity at a point above the surface of the earth. (K)
10. Write the expression for acceleration due to gravity at a point below the surface of the earth. (K)
11. Write the expression for gravitational potential energy of a particle at a point which is at a distance of r from the center of the earth. (K)
12. Write the expression for gravitational potential energy between two masses separated by a distance. (K)
13. What is escape speed? (K)
14. What is a satellite? (K)
15. What is the value of period of moon? (K)
16. What are geostationary satellites? (K)
17. What are polar satellites? (K)
18. Give the period of geostationary satellites? (K)
21. Name the group of the geostationary satellites sent up by India? (K)
22. Give an important use of geostationary satellites. (U)
23. Write the dimensional formula for gravitational constant.(S)
24. Define orbital speed of a satellite around the earth. (K)
25. Name the force that provides the necessary centripetal force for the earth around the sun in an approximately circular orbit. (U)
26. How does the escape velocity of a body varies with the mass of the earth? (A)
27. How does speed of the earth changes when it is nearer to the sun? (A)
28. What are central forces? (U)
29. Give the value of escape speed for moon. (K)
30. Give the relation between escape speed and orbital speed for satellites close to earth. (S)
31. Write the dimensional formula of "G'. (S)

II. Two mark questions (PART – B):

1. State and explain Kepler's law of orbits. (U)
2. State and explain Kepler's law of areas. (U)
3. State and explain Kepler's law of periods. (U)
4. State universal law of gravitation. Express it in mathematical form. (U)
5. Moon has no atmosphere. Why? (A)
6. An object weighs more on the surface than at the centre of the earth. Why? (A)
7. A body weighs more at pole than at equator of the earth. Explain why? (A)

8. Define gravitational potential energy of a body. Give an expression for it. (U)
9. State and explain Newton's law of gravitation. (U)
10. Give two uses of polar satellites. (K)

Three mark questions (PART – C):

1. Derive the relation between gravitational constant and acceleration due to gravity. (S)
2. Write the expression for escape speed on the earth. Give its value in the case of earth. (K)
3. Explain the state of weightlessness of a body. (U)
4. The radius and mass of a planet are two times that of the earth's values. Calculate the acceleration due to gravity on the surface of the planet. (S)
5. Distinguish between 'Geostationary' and 'polar' satellites. (U)
6. Give any three applications of artificial satellites. (K)

Five mark questions (PART – D):

1. State Kepler's laws of planetary motion and explain law of areas. (U)
2. Derive the expression for acceleration due to gravity at a point above the surface of the earth. (S)
3. Derive the expression for acceleration due to gravity at a point below the surface of the earth. (S)
4. Derive the expression for gravitational potential energy of a particle at a point due to the earth. (S)
5. Obtain the expression for escape speed. (S)
6. Derive the expression for orbital speed of a satellite/ period of a satellite around the earth. (S)
7. Obtain the expression for energy of an orbiting satellite. (S)

PROBLEMS

1. A rocket is fired from the earth towards the sun. At what distance from the earth's centre is the gravitational force on the rocket zero ? Mass of the sun = 21 x 0^{30} kg, mass of the earth = 6 x 10^{24} kg. Neglect the effect of other planets etc. (orbital radius= 1.5 x 10^{11} m). (A)
2. How will you 'weigh the sun', that is estimate its mass? The mean orbital radius of the earth around the sun is 1.5 x10^{8} km. (A)
3. A Saturn year is 29.5 times the earth year. How far is the Saturn from the sun if the earth is 1.50 x10^{8} km away from the sun? (A)
4. A body weighs 63 N on the surface of the earth. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth? (A)
5. Assuming the earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the earth if it weighed 250 N on the surface? (A)
6. A rocket is fired vertically with a speed of 5 km s^{-1} from the earth's surface. How far from the earth does the rocket go before returning to the earth ? Mass of the earth= 6.0x10^{24} kg; mean radius of the earth = 6.4x10^{6} m; G = 6.67x10^{-11} N m2 kg^{-2}. (A)