Chapter- 8

Gravitation

01. Why do planets move slower along their orbits when they are farthest from the sun (at apogee) and faster when nearest (at perigee) from the sun?

02. According to Kepler's second law, the radius vector to a planet from the sun sweeps out equal areas in equal intervals of time. This law is a consequence of which conservation law?

03. If the earth is at one half its present distances from the sun, how many days will be there in a year?

04. If the density of the planet is doubled without any change in its radius, how does 'g' change on the planet?

05. On earth, value of G = 6.67 x 10^{-11} Nm^2 kg^{-2}. What is its value on the moon, where g is nearly one-sixth than that of the earth?

06. Draw the graph showing the variation of acceleration due to gravity 'g' with distance from the centre of the earth.

07. Why does a body weigh more at poles than at equator?

08. why does earth impart the same acceleration to all the bodies?

09. Define Gravitational field intensity. Is it scalar or vector?

10. Prove that gravitational force obeys Newton's 3rd law of motion.

11. Show that Kepler's second law follows from the law of conservation of angular momentum.

12. At what depth below the surface of the earth does the acceleration due to gravity become 1% of its value at the surface of the earth? Earth considered as the sphere of radius $6.4\times10^{6} m$.

13. What is meant by the acceleration due to gravity? Derive an expression for it in terms of the mass of the earth and the gravitational constant.

14. Show that the value of acceleration due to gravity decreases with the altitude.

15. Define acceleration due to gravity. Show that gravity decreases with depth.

16. If the change in the value of g at the height h above the surface of the earth is the same as at a depth d below it, both d and h being much smaller than the radius of the earth, find the relation between d and h.

17. A satellite is orbiting the earth with speed v_0. To make the satellite escape, what should be the minimum percentage increase in velocity?

18. Derive the expression for orbital velocity. Find its value for the satellite which is orbiting close to the earth surface.

19. Derive the expression for the time of revolution for satellite. Find out the time of revolution of the satellite which is revolving close to the surface of the earth.

20. Derive the expression for the total energy of satellite while revolving around the planet. What is the importance of -ve potential energy? Draw the graph showing the variation of the kinetic, potential and total energy of a satellite with distance from the centre of the planet.

21.Derive the expressions for

(i) escape speed (ii) find out the escape speed (a) earth (b) on the moon

(iii) why the earth has an atmosphere whereas the moon has no atmosphere?

22. What do you mean by a satellite? What is a geostationary satellite? What are the three conditions which must be met by a satellite to be a geostationary satellite?

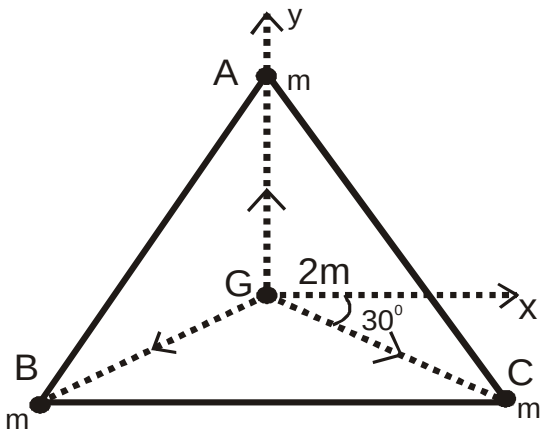
23. (a) Suppose the gravitational force varies inversely as the n^{th} power of distance. Then, find the expression for the time of a planet in a circular orbit of radius 'r' around the sun.

(b)Find the potential energy of the system of four particles each of mass's' placed at vertices of a square of side 'l'. Also, find the potential at the centre of the square.

24. (i) Three equal masses of m kg each are fixed at the vertices of an equilateral triangle ABC.

(a) What is the force acting on a mass 2 m placed at the centroid G of the triangle?

(b) What is the force if the mass at the vertex A is doubled?



25. Define gravitational potential energy. Derive an expression for it. Hence find the relation between gravitational potential and potential energy.
26. A geostationary satellite is orbiting the earth at a height 6R above the surface of the earth, where R is the radius of the earth. Find the period of another satellite at a height of 2.5 R from the surface of the earth in hours.
27. . Find the potential energy of a system of four particles placed at the vertices of a square of side L. Find the potential at the Centre of the square.
28. If the earth has a mass 9 times and radius twice that of a planet mars, calculate the minimum velocity required by a rocket to pull out of gravitational force of Mars. Take the escape velocity on the surface of the earth to be $11.2 kms^{-1}$.
29. Find the work done to bring 4 particles each of mass 100 gram from large distances to the vertices of a square of side 20 cm.
30. A satellite orbits the earth at a height of 400 km from its surface. Compute its (i) kinetic energy, (ii) potential energy, and (iii) total energy. Mass of the satellite = 500 kg. Mass of the earth = $6.0 \times 10^{24} kg$, a radius of the earth = $6.4 \times 10^{6} m$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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