

Class 11 Physics Chapter 7: Gravitation

Very Short Answers

17. Molecules in air in the atmosphere are attracted by gravitational force of the earth. Explain why all of them do not fall into the earth just like an apple falling from a tree.

Answer: Molecules in air are attracted by gravitational force but they do not fall into the earth because they are in random thermal motion with sufficient kinetic energy, whereas an apple has predominantly downward motion due to its much larger mass and lower thermal velocity compared to its gravitational acceleration.

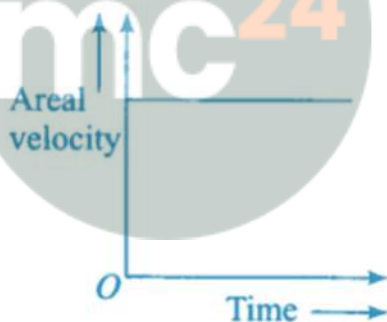
18. Give one example each of central force and non-central force.

Answer:

- **Central force:** Electrostatic force acting on a point charge (force passes through the center)
- **Non-central force:** Nuclear force between atoms (force doesn't necessarily pass through the center of mass)

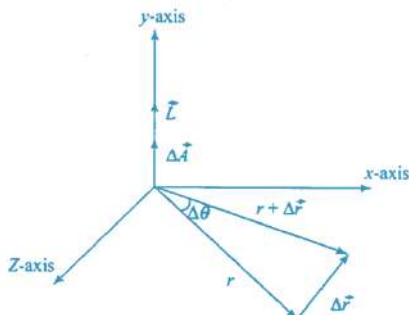
8. Draw areal velocity versus time graph for mars.

Answer: According to Kepler's second law, the areal velocity of Mars around the Sun remains constant throughout its orbit. Therefore, the graph of areal velocity versus time is a horizontal straight line.



20. What is the direction of areal velocity of the earth around the sun?

Answer:

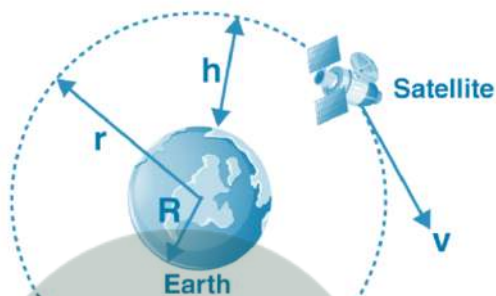


The direction of areal velocity of the Earth around the Sun is perpendicular to the orbital plane, given by the cross product $\mathbf{r} \times \mathbf{v}$, following the right-hand rule (pointing towards the north celestial pole).

21. How is the gravitational force between two point masses affected when they are dipped in water keeping the separation between them the same?

Answer: The gravitational force remains completely unchanged. Unlike electrostatic forces, gravitational forces are independent of the medium. Therefore, when two point masses are dipped in water, the gravitational force between them remains exactly the same.

22. Is it possible for a body to have inertia but no weight?



Answer: Yes, it is possible. Inertia depends only on mass, while weight depends on gravitational field strength. A satellite in orbit around Earth has inertia (resistance to acceleration) but experiences weightlessness due to free fall. Similarly, an object in deep space has inertia but no weight.

23. We can shield a charge from electric fields by putting it inside a hollow conductor. Can we shield a body from the gravitational influence of nearby matter by putting it inside a hollow sphere or by some other means?

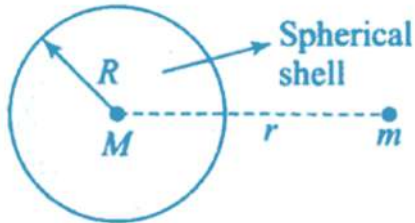
Answer: No, it is impossible to shield a body from gravitational influence. Unlike electric charges which can be positive or negative, mass is always positive, and there's no "negative mass" to create gravitational shielding. Gravitation cannot be screened by any known material or method.

24. An astronaut inside a small spaceship orbiting around the earth cannot detect gravity. If the space station orbiting around the earth has a large size, can he hope to detect gravity?

Answer: Yes, in a large space station, an astronaut can detect tidal effects. Different parts of the station experience slightly different gravitational fields due to varying distances from Earth's center, creating detectable gravitational gradients and relative accelerations.

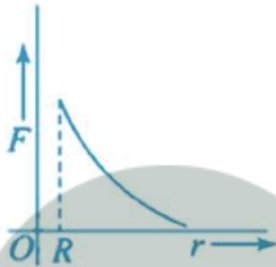
25. The gravitational force between a hollow spherical shell and a point mass is F . Show the nature of F vs r graph where r is the distance of the point from the centre of the hollow spherical shell of uniform density.

Answer: For a hollow spherical shell of radius R and mass M :

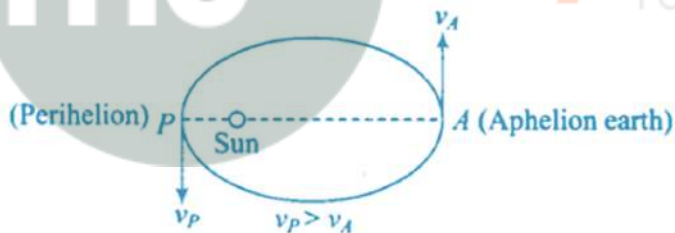


- When $r < R$ (inside): $F = 0$
- When $r \geq R$ (outside): $F = GMm/r^2$

The graph shows zero force inside the shell and inverse-square law outside.



26. Out of aphelion and perihelion, where is the speed of the earth more and why?



Answer: Earth's speed is greater at perihelion (closest to Sun). According to Kepler's second law (conservation of angular momentum):

$$r_p \times v_p = r_A \times v_A$$

Since $r_A > r_p$, therefore $v_p > v_A$

At perihelion, gravitational potential energy is minimum, so kinetic energy is maximum.

27. What is the angle between the equatorial plane and the orbital plane of:

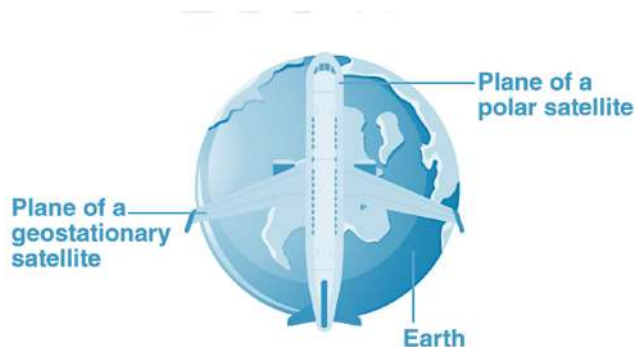
a) polar satellite?

b) geostationary satellite?

Answer:

a) **Polar satellite:** 90° (orbits pass over both poles)

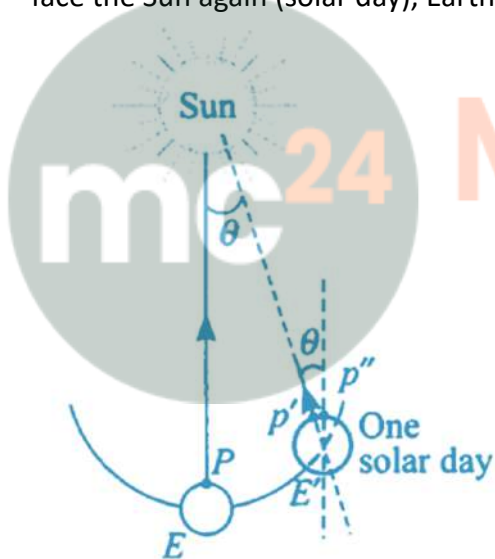
b) **Geostationary satellite:** 0° (orbits in the equatorial plane)



Short Answer

28. Mean solar day is the time interval between two successive noon when sun passes through zenith point. Sidereal day is the time interval between two successive transits of a distant star through the zenith point. By drawing appropriate diagram showing earth's spin and orbital motion, show that mean solar day is four minutes longer than the sidereal day.

Answer: Earth completes one rotation relative to distant stars (sidereal day) in 23h 56m 4s. However, during this time, Earth has moved approximately 1° in its orbit around the Sun. To face the Sun again (solar day), Earth must rotate an additional 1° .



Calculation: Additional rotation time = $(24 \text{ hours}/360^\circ) \times 1^\circ = 4 \text{ minutes}$

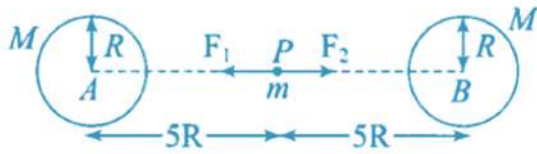
Therefore: Solar day = Sidereal day + 4 minutes = 24 hours

29. Two identical heavy spheres are separated by a distance 10 times their radius. Will an object placed at the mid point of the line joining their centres be in stable equilibrium or unstable equilibrium? Give reason for your answer.

Answer: The equilibrium is **unstable**.

At the midpoint, gravitational forces from both spheres cancel out: $F_1 = F_2 = GMm/(5R)^2$

However, if the object is displaced slightly toward either sphere, the net force increases in that direction, accelerating the object further away from equilibrium. This is the characteristic of unstable equilibrium.



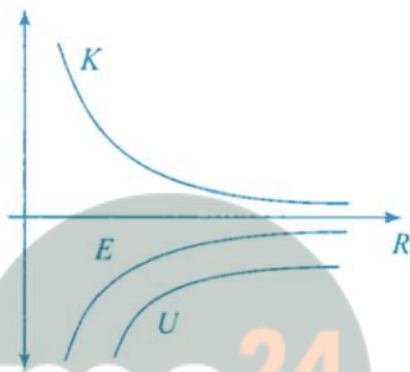
8.30. Show the nature of the following graph for a satellite orbiting the earth.

a) KE vs orbital radius R

b) PE vs orbital radius R

c) TE vs orbital radius R

Answer:

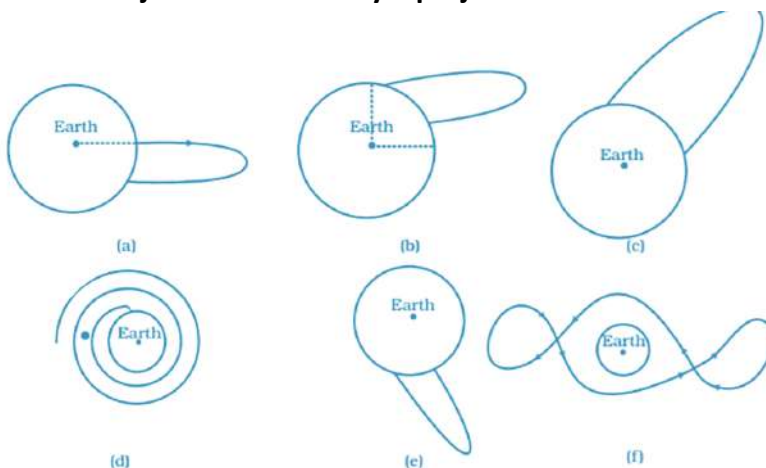


a) $K = \frac{1}{2}mv^2 = \frac{1}{2}m(GM/R)$

b) PE of satellite is $U = -GMm/R = -2K$

c) Total energy of the satellite = $-GMm/2R$

31. Shown are several curves. Explain with reason, which ones amongst them can be possible trajectories traced by a projectile



Answer:

The given options, option (c) show the focus of trajectory.