PHYSICS

BOOKS - NCERT PHYSICS (HINGLISH)

GRAVITATION

Multiple Choice Question

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1. The earth is an approximate sphere. If the interior contained matter which is not of the same density every where, 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

Answer: D

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2. As observed from the earth, the sun appears to move an approx. circular orbit. For the motion of another planet like mercury as observed from the earth, this would

A. be similarly true

B. not be true because the force between the earth and mercury is not inverse square law

C. not be true because the major gravitational force on mercury is due to the sun

D. not be true mercury is influenced by force other than gravitational forces

Answer: C

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3. Different points in the earth are at slightly different distance from the sun and hence experience different force 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 CM (centre of mass) causing translation and a net torque at the CM causing rotation around an axis through the CM. for the earth-sun system (approximating the earth as a uniform density sphere).

A. the torque is zero

B. the torque cause 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

Answer: A

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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 law of gravitation predict a trajectory spiralling inwards

C. of viscous force causing the speed of satellite and hence hight to gradually decrease

D. of collisions with other satellites

Answer: C

5. Both earth and moon are subjected to the gravitational force of the sun. as observed from the sun, the orbit of the moon

A. will be elloptical

B. will not be strictly elliptical beause the total gravitational force on it is not centre

C. is not elliptical but will necessarily be a closed curve

D. deviates considerably from being elliptical due to influence of

planets other than the earth

Answer: B

6. In our solar system, the inter-planetery region has chunks of matter (much smaller in size compared to planets) called asteriods. They

A. will not move around the sun, since they have very small

masses compared to the 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 obits like planets and obey Kepler's laws

Answer: D

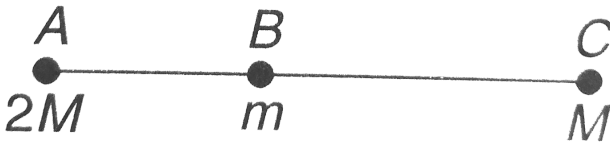▶ **Watch Video Solution**

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 the 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 neighouring heavy objects but the inertial mass cannot

Answer: D

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8. particles of masses 2M m and M are resectively at points A , B and C with $AB = \dfrac{1}{2}(BC)$ m is much - much smaller than M and at time $t = 0$ they are all at rest as given in figure . As subsequent times before any collision takes palce .

A. m will remain at rest

B. m will move towards M

C. m will move towards 2M

D. m will have oscillatory motion

Answer: C

9. Which of the following options are correct ?

A. Acceleration due to gravity decrease with icreasing altitude

B. Acceleration due to gravity increase with increasing depth (assume the earth to be a sphere of uniform density)

C. Acceleration due to gravity increase with increasing latitude

D. Acceleration due to gravity is independent of the mass of the earth

Answer: A::C::D

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

    A. planets will not have elliptic obits

    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

Answer: A::C

11. If the mass of sun were len times smaller and gravitational consitant G were ten times larger in magnitudes

    A. walking on ground would become more difficult

    B. the acceleration due to gravity on the earth will not change

    C. raindrops will fall much faster

    D. airplanes will have to travel much faster

Answer: A::C::D

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

    A. all three of Kepler's law 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

Answer: A::C::D

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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 the 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

Answer: C::D

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 read

where M_0 is a constant of dimension of mass, $r_{12} = r_1 - r_2$ and n is a number. In such a case,

    A. the acceleration due to gravity on the 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

Answer: A::C::D

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

Answer: A::C

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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 size less than 100 m

Answer: D

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Very Short Answer Type Question

1. Moelcules 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.

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

3. Draw areal velocity time graph for Mars.

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

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

the same ?

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

7. 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 hollw sphere or by some other means ?

8. An astronaut inside a small spaceship orbitting around the earth cannot detect gravity. If the space station orbtitting around the

earth has a large size, can he hope to detect gravity ?

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9. The gravitational force between a hollow spherical shell (of radius R and uniform density) and a point mass is F. Show the nature of F versus r graph where r is the distance of the point from the centre of the hollow spherical shell of uniform density

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

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11. What is the angle between the equatorial plane and the orbital plane of (a) Polar satellitee ? (b) Geostationary satellite?

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1. Mean solar day is the time interval between two successive noon when sun passes through zenith point (meridian).

Sidereal day is the time interval between two successive transit of a distant star through the zenith point (meridian).

By drawing appropriate diagram showing the earth's spin and orbital motion, show that mean solar day is 4 min longer than the sidereal day. In other words, distant stars would rise 4 min early every successive day.

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2. 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.
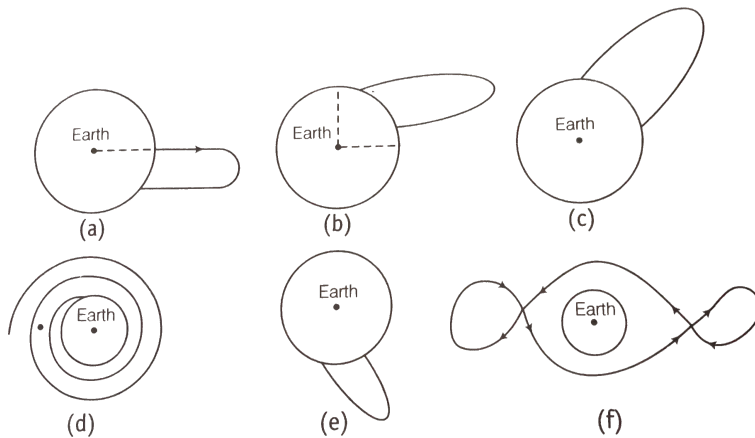
3. Show the nature of the following graph for a satellite orbiting the earth.

(a) KE vs orbitial radius R (b) PE vs orbital radius r (c) TE vs orbital radius R.

4. Shown are several cuves (fig. (a), (b), (c), (d), (e), (f)]. Explain with reason, which ones amongst them can be possible trajectories

traced by a projectile (neglect air friction).

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5. An object of mass m is raised from the surface of the earth to a height equal to the radius of the earth, that is, taken from a distance R to 2R from the centre of the earth. What is the gain in its potential energy ?

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6. A mass m is placed at P a distance h along the normal through the centre O of a thin circular ring of mass M and radius r Fig. If the mass is removed futher away such that OP becomes $2h$, by what factor the force of gravitational will decrease, if $h = r$?
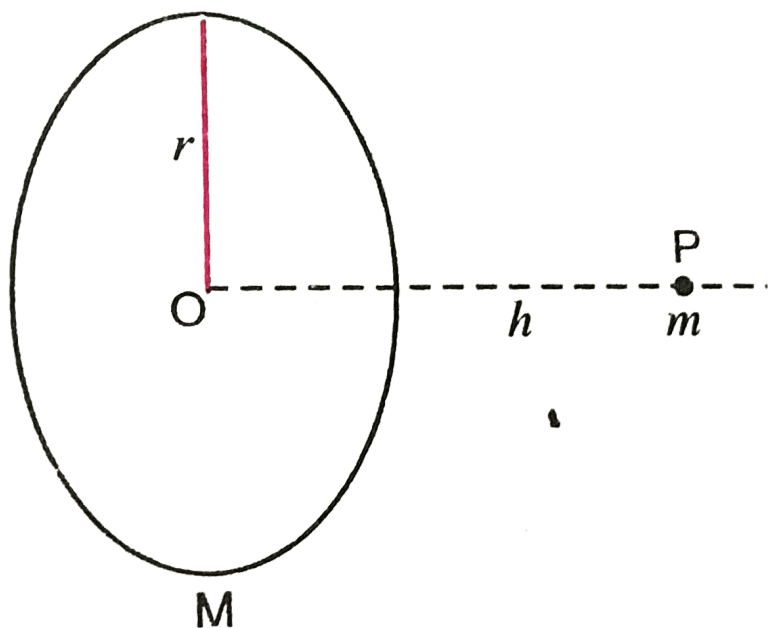
Long Answer Type Question

1. A star like the sun has serveral bodies moving around it at different distance. Consider that all of them are moving in circular orbits. Let r be the distance of the body from the centre of the star and let its linear velocity be v, angular velocity ω, kinetic energy K, gravitational potential energy U, total energy E and angular momentum L. As the radius r of the orbit increase, determine which of the above quantities increase and which ones decrease.

2. Six point masses of mass m each are at the vertices of a regular hexagon of side l. Calculate the force on any of the masses.

3. A satellite is to be placed in equatorial geostationary orbit around earth for communication.

(a) Calculate height of such a satellite.

(b) Find out the minimum number of satellites that are needed to cover entire earth so that at least one satellites is visible from any point on the equator.

$$\left[M = 6 \times 10^{24} kg, R = 6400 km, T = 24h, G = 6.67 \times 10^{-11} SI units\right]$$

4. Earth's orbit is an ellipse with eccentricity 0.0167. Thus, the earth's distance from the sun and speed as it moves around the sun varies from day-to-day. This means that the length of the solar day is not constant through the year. Assume that the earth's spin axis is normal to its day. A day should be taken from noon to noon. Does this explain variation of length of the during the year ?

5. A satellite is in an elliptical orbit around the earth with aphelion of $6R$ and perihelion of $2R$ where $R = 6400km$ is the radius of the earth. Find eccentricity of the orbit. Find the velocity of the satellite at apogee and perigee. What should be done if this satellite has to be transferred to a circular orbit of radius $6R$? $\left[G = 6.67 \times 10^{-11} SI \text{ units and } M = 6 \times 10^{24} kg\right]$