PHYSICS

BOOKS - NCERT FINGERTIPS PHYSICS (HINGLISH)

GRAVITATION

Kepler Laws

1. Which of the following orbits is a possible orbit for a planet?
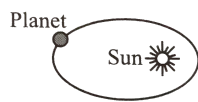
(a)

A.

(b)
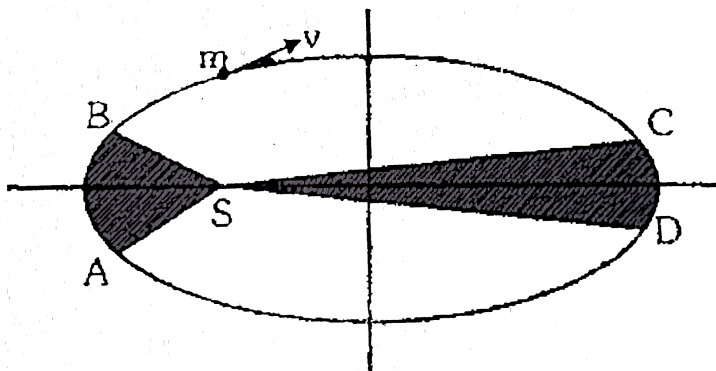
B.

(c)

C.

(d)

Planet

Sun

D.

Answer: D

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2. Kepler's second law is a consequenc of

A. conservation of energy

B. conservation of linear momentum

C. conservation of angular momentum

D. conservation of mass

Answer: C

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3.

The figure shows elliptical orbit of a planet m about the sun S. the shaded area SCD is twice the shaded area SAB. If t_1 be the time for the planet to move from C to D and t_2 is the time to move from A to B, then:

A. $t_1 = t_2$

B. $t_1 = 2t_2$

C. $t_1 = 4t_2$

D. $t_1 > t_2$

Answer: B

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4. The aeral velocity and the angular moementum of the planet are related by which of the following relationos? (where m_p is the same mass of the planet)

A. $\dfrac{\Delta \vec{t}}{\Delta t} = \dfrac{\vec{L}}{2m_p}$

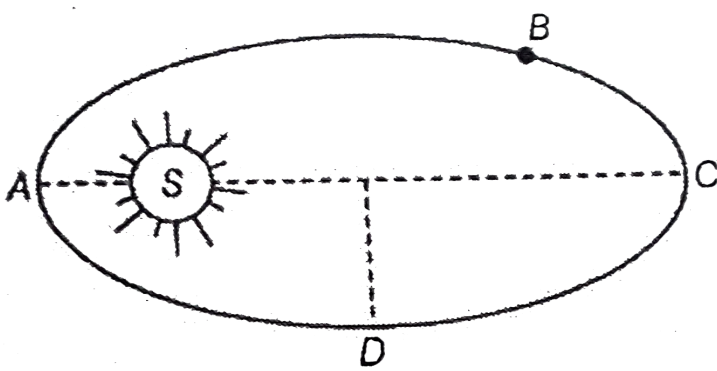B. $\dfrac{\Delta \vec{t}}{\Delta t} = \dfrac{\vec{L}}{m_p}$

C. $\dfrac{\Delta \vec{t}}{\Delta t} = \dfrac{2\vec{L}}{m_p}$

D. $\dfrac{\Delta \vec{t}}{\Delta t} = \dfrac{\vec{L}}{\sqrt{2}m_p}$

Answer: A

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5. A planet revolves in elliptical orbit around the sun. (see figure). The linear speed of the planet will be maximum at

A. A

B. B

C. C

D. D

Answer: A

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6. Which of the following Kepler's laws is also known as harmonic law?

A. First law

B. Second law

C. Third law

D. None of these

Answer: C

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7. If a graph is plotted between T^2 and r^3 for a planet, then its slope will be be (where M_S is the mass of the sun)

A. $\dfrac{4\pi^2}{GM_S}$

B. $\dfrac{GM_S}{4\pi}$

C. $4\pi GM_S$

D. GM_S

Answer: A

8. A geostationary satellite is orbiting the earth at a height of 6R above the surface of the earth, where R is the radius of the earth. The time period of another satellite at a height of 2.5 R from the surface of the earth is ...... hours.

A. $3\sqrt{2}h$

B. $1.5\sqrt{2}h$

C. $6\sqrt{2}h$

D. $12\sqrt{2}h$

Answer: C

9. Assuming that earth and mars move in circular orbits around the sun, with the martian orbit being 1.52 times the orbital radius of the earth. The length of the martian year is days is

A. $(1.52)^{2/3} \times 365$

B. $(1.52)^{3/2} \times 365$

C. $(1.52)^2 \times 365$

D. $(1.52)^3 \times 365$

Answer: B

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10. A saturn year is 29.5 times the earth year. How far is the saturn from the sun if the earth is 1.5×10^8 away from the sun?

A. 1.4×10^6 km

B. 1.4×10^7 km

C. 1.4×10^8 km

D. 1.4×10^9 km

Answer: D

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11. The period of moon's rotation around the earth is approx. 29 days. IF moon's mass were 2 fold its present value and all other things remain unchanged, the period of Moon's rotation would be nearly

A. $29\sqrt{2}$ days

B. $\dfrac{29}{\sqrt{2}}$ days

C. 29×2 days

D. 29 days

Answer: D

12. Average distance of the earth from the sun is L_1. If one year of the earth =D days, one year of another planet whose average distance from the sun is L_2 will be

A. $D\left(\dfrac{L_2}{L_1}\right)^{1/2}$ days

B. $D\left(\dfrac{L_2}{L_1}\right)^{3/2}$ days

C. $D\left(\dfrac{L_2}{L_1}\right)^{2/3}$ days

D. $D\left(\dfrac{L_2}{L_1}\right)$ days

Answer: B

13. A planet revolves around the sun in elliptical orbit of eccentricity 'e'. If 'T' is the time period of the planet then the time spent by the planet between the end of the minor axis and close to the sun is

A. $\dfrac{T\pi}{2e}$

B. $T\left(\dfrac{2e}{\pi} - 1\right)$

C. $\dfrac{Te}{2\pi}$

D. $T\left(\dfrac{1}{4} - \dfrac{e}{2\pi}\right)$

Answer: D

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14. A planet revolves around the sun in an elliptical orbit. If v_p and v_a are the velocities of the planet at the perigee and apogee respectively, then the eccentricity of the elliptical orbit is given by :

A. $\dfrac{v_p}{v_a}$

B. $\dfrac{v_a - v_p}{v_a + v_p}$

C. $\dfrac{v_p + v_a}{v_p - v_a}$

D. $\dfrac{v_p - v_a}{v_p + v_a}$

Answer: D

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15. An artificial satellite is in an elliptical orbit around the earth with aphelion of $6R$ and perihelion of $2R$ where R is radius of the earth $= 6400km$. Calculate the eccentricity of the elliptical orbit.

A. $\dfrac{1}{2}$

B. $\dfrac{1}{3}$

C. $\dfrac{1}{4}$

D. $\dfrac{1}{6}$

Answer: A

16. In the question number 15, the ratio of the velocity of the satellite

at apogee and perigee is

A. $\dfrac{1}{2}$

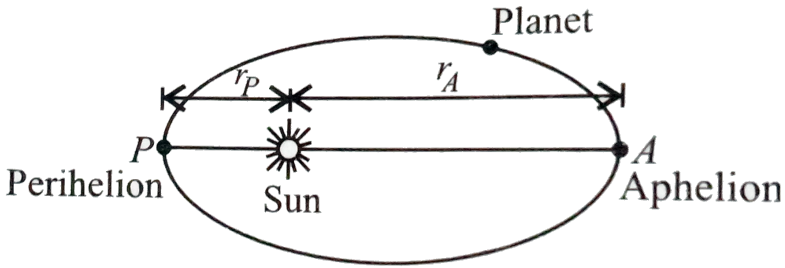B. $\dfrac{1}{3}$

C. $\dfrac{1}{4}$

D. $\dfrac{1}{6}$

Answer: B

17. A planet orbits the sun in an elliptical path as shown in the figure. Let v_p and v_A be spped of the planet when at perohelion and aphelion respectively. Which of the following relations is correct ?

A. $\dfrac{r_p}{r_A} = \dfrac{v_A}{v_p}$

B. $\dfrac{r_p}{r_A} = \dfrac{v_p}{v_A}$

C. $\dfrac{r_p}{r_A} = \sqrt{\dfrac{v_p}{v_A}}$

D. $\dfrac{r_p}{r_A} = \sqrt{\dfrac{v_A}{v_p}}$

Answer: A

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1. Which of the following statements is correct regarding the gravitational force?

    A. The gravitational force is dependent on the intervening

       medium.

    B. The gravitational force is a non-consevative force.

    C. The gravitational force forms action- reaction pair.

    D. The gravitational force is a non-central force.

Answer: C

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2. Match the Column I with Column II

	Column I		Column II
(A)	Kepler's first law	(p)	$T^2 \propto a^3$
(B)	Kepler's second law	(q)	Inverse square law
(C)	Kepler's third law	(r)	Orbit of planet is elliptical
(D)	Newton's law of gravitation	(s)	Law of conservation of angular momentum

A. A-s,B-p,C-q,D-r

B. A-p,B-q,C-r,D-s

C. A-r,B-s,C-p,D-q

D. A-s,B-p,C-q,D-s

Answer: C

3. A mass m is placed at point P lies on the axis of a ring of mass M and radius R at a distance R from its centre. The gravitational force on mass M is

A. $\dfrac{GMm}{\sqrt{2}R^2}$

B. $\dfrac{GMm}{2R^2}$

C. $\dfrac{GMm}{2\sqrt{2}R^2}$

D. $\dfrac{GMm}{4R^2}$

Answer: C

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4. Two sphere of masses m and M are situated in air and the gravitational force between them is F. The space around the masses in now filled with a liquid of specific gravity 3. The gravitational force will now be

A. 3F

B. F

C. $\dfrac{F}{3}$

D. $\dfrac{F}{9}$

Answer: B

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5. A point mass m is placed inside a spherical shell of radius R and mass M at a distance $\dfrac{R}{2}$ form the centre of the shell. The gravitational force exerted by the shell on the point mass is

A. $\dfrac{GMm}{R^2}$

B. $\dfrac{2GMm}{R^2}$

C. zero

D. $\dfrac{4Mm}{R^2}$

Answer: C

6. Two stars of mass m_1 and m_2 are parts of a binary star system. The radii of their orbits are r_1 and r_2 respectively, measured from the centre of mass of the system. The magnitude of gravitational force m_1 exerts on m_2 is

A. $\dfrac{m_1 m_2 G}{(r_1 + r_2)^2}$

B. $\dfrac{m_1 G}{(r_1 + r_2)^2}$

C. $\dfrac{m_2 G}{(r_1 + r_2)^2}$

D. $\dfrac{G(m_1 + m_2)}{(r_1 + r_2)^2}$

Answer: A

7. Two identical spheres each of mass M and Radius R are separated by a distance 10R. The gravitational force on mass m placed at the midpoint of the line joining the centres of the spheres is

A. zero

B. $\dfrac{2GMm}{25R^2}$
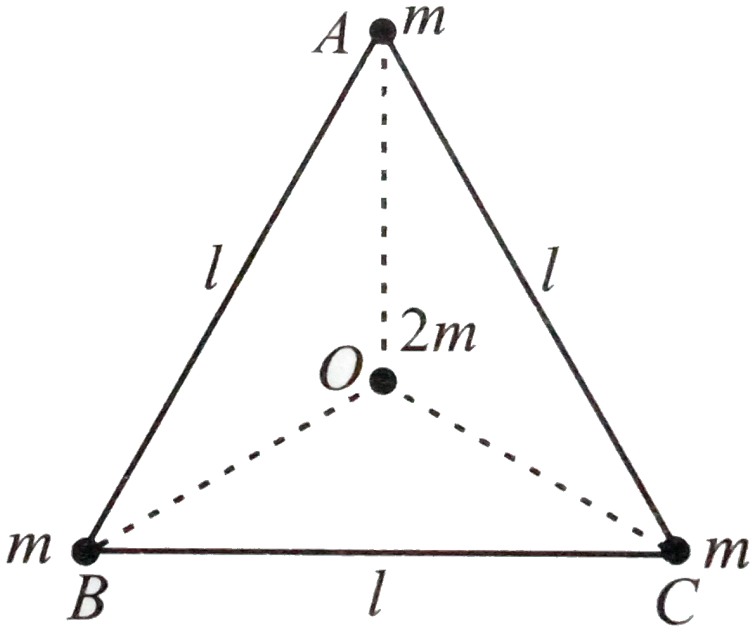
C. $\dfrac{GMm}{25R^2}$

D. $\dfrac{GMm}{100R^2}$

Answer: A

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8. Three masses each of mass m are placed at the vertices of an equilateral triangles ABC of side l as shown in figure. The force acting

on a mass 2m placed at the centroid O of the triangle is

A. zero

B. $\dfrac{3Gm^2}{l^2}$

C. $\dfrac{5Gm^2}{l^2}$

D. $\dfrac{7Gm^2}{l^2}$

Answer: A

9. In the question number 25, if the mass placed at vertex A is doubled, then the force acting on the mass 2m placed at the centroid O is

A. zero

B. $\dfrac{2Gm^2}{l^2}$

C. $\dfrac{5Gm^2}{l^2}$

D. $\dfrac{6Gm^2}{l^2}$

Answer: D

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10. 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.

A. $\dfrac{Gm^2}{l^2}\left[\dfrac{5}{4} + \dfrac{1}{\sqrt{3}}\right]$

B. $\dfrac{Gm^2}{l^2}\left[\dfrac{3}{4}+\dfrac{1}{\sqrt{3}}\right]$

C. $\dfrac{Gm^2}{l^2}\left[\dfrac{5}{4}-\dfrac{1}{\sqrt{3}}\right]$

D. $\dfrac{Gm^2}{l^2}\left[\dfrac{3}{4}-\dfrac{1}{\sqrt{3}}\right]$

Answer: A

11. Two point masses A and B having masses in the ratio $4:3$ are separated by a distance of 1m. When another point mass C of mass M is placed in between A and B, the force between A and C is $\left(\dfrac{1}{3}\right)^{rd}$ of the force between B and C. Then the distance C from A is

A. $\dfrac{2}{3}m$

B. $\dfrac{1}{3}m$

C. $\dfrac{1}{4}m$

D. $\dfrac{2}{7}m$

Answer: A

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12. A research satellite of mass $200kg$ circles the earth in an orbit of average radius $3R/2$, where R is the radius of the earth. Assuming the gravitational pull on the mass of $1kg$ on the earth's surface to be $10N$, the pull on the satellite will be

A. 890 N

B. 889 N

C. 885 N

D. 892 N

Answer: B

13. The mass of moon 1% of mass of earth. The ratio of gravitational pull of earth on moon and that of moon on earth will be

    A. $1:1$

    B. $1:10$

    C. $1:100$

    D. $2:1$

Answer: A

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14. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. if the

gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$, then

A. T^2 is proportional to R^2

B. T^2 is proportional to $R^{7/2}$

C. T^2 is proportional to $R^{3/3}$

D. T^2 is proportional to $R^{3.75}$

Answer: B

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The Gravitational Constant

1. Which of the following statement is correct regarding the universal gravitational constant G ?

A. G has same value in all system of units.

B. The value of G is same everywhere in the universe.

C. The value of G was first experimentally determined by Johannes

    Kepler

D. G is a vector quantity.

Answer: B

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2. Mass of the earth has been determined through

A. use of Kepler's $\dfrac{T^2}{R^3}$ constancy law

B. sampling the density of earth's crust and using earth's radius

C. Cavandish's determination of G and using earth's radius and g

    at its surface

D. use of periods of satellite at different heights above earth's surface.

Answer: C

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Acceleration Due To Gravity

1. Radius of earth is 6400 km and that of mars is 3200 km. Mass of mars is 0.1 that of earth's mass. Then the acceleration due to gravity on mars is nearly

A. $1m/s^2$

B. $2.5m/s^2$

C. $4m/s^2$

D. $5m/s^2$

Answer: C

2. The ratio of radii of earth to another planet is $2/3$ and the ratio of their mean densities is $4/5$. If an astronaut can jump to a maximum height of $1.5m$ on the earth, with the same effort, the maximum height he can jump on the planet is

    A. 1 m

    B. 0.8 m

    C. 0.5 m

    D. 1.25 m

Answer: B

3. 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 earth will not change.

   C. Raindrops will fall much faster.

   D. Airplanes will have to travel much faster.

Answer: B

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4. If M is the mass of the earth and R its radius, then ratio of the gravitational acceleration and the gravitational constant is

   A. $\dfrac{R^2}{M}$

   B. $\dfrac{M}{R^2}$

C. MR^2

D. $\dfrac{M}{R}$

Answer: B

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5. The acceleration due to gravity g and density of the earth ρ are related by which of the following relations? (where G is the gravitational constant and R_E is the radius of the earth)

A. $\rho = \dfrac{4\pi G R_E}{3g}$

B. $\rho = \dfrac{3g}{4\pi G R_E}$

C. $\rho = \dfrac{3G}{4\pi g R_E}$

D. $\rho = \dfrac{4\pi g R_E}{3G}$

Answer: B

6. The mass of the moon is $\dfrac{1}{8}$ of the earth but the gravitational pull is $\dfrac{1}{6}$ earth It is due to the fact that .

    A. moon is the satellite of the earth

    B. the radius of the earth is (8/6) of the moon

    C. the radius of the earth is $\left(\sqrt{8/6}\right)$ of the moon

    D. the radius of the moon is (6/8) of the earth

Answer: C

Acceleration Due To Gravity Below And Above The Surface Of Earth

1. Value of g is

A. maximum at poles

B. maximum at equator

C. same everywhere

D. minimum at poles

Answer: A

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2. Earth is flattened at the poles and budges at the eqator. This is due to the fact that

A. the earth revolves around the sun in an elliptical orbit

B. the angular velocity of spinning about its axis is more at the equator

C. the centrifugal force is more at the equator than at poles.

D. none of these.

Answer: C

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3. The acceleration due to gravity at the pols and the equator is g_p and g_e respectively. If the earth is a sphere of radius R_E and rotating about its axis with angular speed ω and $g_p - g_e$ given by

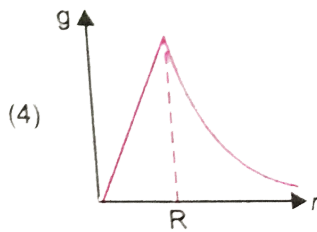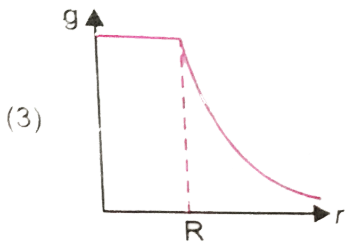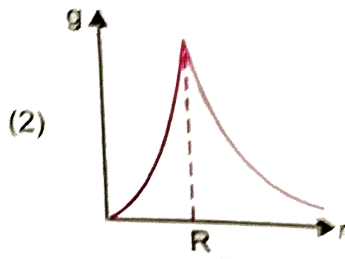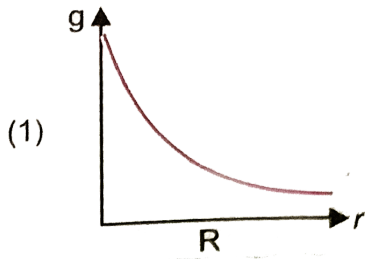A. $\dfrac{\omega^2}{R_E}$

B. $\dfrac{\omega^2}{R_E^2}$

C. $\omega^2 R_E^2$

D. $\omega^2 R_E$

Answer: D

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4. The dependence of acceleration due to gravity g on the distance r from the centre of the earth, assumed to be a sphere of radius R of uniform density is as shown in Fig. below:

(1)

(2)

(3)

(4)

The correct figure is

A. (i)

B. (ii)

C. (iii)

D. (iv)

Answer: D

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5. Which of the following statement is correct ?

    A. Acceleration due to gravity increase with increasing altitude.

    B. Acceleration due to gravity increase with increasing depth.

    C. Acceleration due to gravity increase with increasing latitude.

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

       earth.

Answer: C

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6. A body hanging from a spring strethces it by 1cm at the earth's surface. How much will the same body stretch the spring at a place 1600km above the earth's surface? (Radius of the earth 6400km)

    A. 1.28 cm

    B. 0.64 cm

    C. 3.6 cm

    D. 0.12 cm

Answer: B

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7. A body weighs 250N on the surface of the earth. How much will it weighs half way down to the centre of the earth?

    A. 125 N

B. 150 N

C. 175 N

D. 250 N

Answer: A

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8. A body weighs 72 N on the surface of the earth. What is the gravitational force on it due to earth at a height equal to half the radius of the earth from the surface

A. 16 N

B. 28 N

C. 32 N

D. 72 N

Answer: C

Gravitational Potential Energy

1. Two spheres each of mass M and radius R are separated by a distance of r. The gravitational potential at the midpoint of the line joining the centres of the spheres is

A. $-\dfrac{GM}{r}$

B. $-\dfrac{2GM}{r}$

C. $-\dfrac{GM}{2r}$

D. $-\dfrac{4GM}{r}$

Answer: D

2. A particle of mass M is placed at the centre of a spherical shell of same mass and radius a. What will be the magnitude of the gravitational potential at a point situated at a/2 distance from the centre ?

A. $-\dfrac{3GM}{a}$

B. $-\dfrac{2GM}{a}$

C. $-\dfrac{GM}{a}$

D. $-\dfrac{4GM}{a}$

Answer: A

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3. A particle of mass m is placed at the centre of a unifrom spherical shell of mass 3 m and radius R The gravitational potential on the

surface of the shell is .

A. $-\dfrac{GM}{R}$

B. $-\dfrac{3GM}{R}$

C. $-\dfrac{4GM}{R}$

D. $-\dfrac{2GM}{R}$

Answer: C

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4. Four particles each of mass m are placed at the vertices of a

square of side l. the potential at the centre of square is

A. $-\dfrac{\sqrt{2}Gm^2}{l}\left(2-\dfrac{1}{\sqrt{2}}\right)$

B. $-\dfrac{2Gm^2}{l}\left(2+\dfrac{1}{\sqrt{2}}\right)$

C. $-\dfrac{\sqrt{2}Gm^2}{l}\left(\sqrt{2}-\dfrac{1}{\sqrt{2}}\right)$

D. $-\dfrac{2Gm^2}{l}\left(\sqrt{2} - \dfrac{1}{\sqrt{2}}\right)$

Answer: B

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5. In the question number 51 , the potential at the centre is

A. $-2\dfrac{Gm}{l}$

B. $3\sqrt{2}\dfrac{Gm}{l}$

C. $-2\sqrt{2}\dfrac{Gm}{l}$

D. $-4\sqrt{2}\dfrac{Gm}{l}$

Answer: D

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6. The change in the gravitational potential energy when a body of a mass m is raised to a height nR above the surface of the earth is (here R is the radius of the earth)

A. $\dfrac{mgR}{n}$

B. $nmgR$

C. $mgR\left(\dfrac{n}{n-1}\right)$

D. $mgR\left(\dfrac{n}{n+1}\right)$

Answer:

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7. The mass of the earth is $6 \times 10^{24} kg$ and that of the moon is $7.4 \times 10^{22} kg$. The potential energy of the system is $-7.79 \times 10^{28} J$. The mean distance between the earth and moon is $\left(G = 6.67 \times 10^{-11} Nm^2 kg^{-2}\right)$

A. $3.8 \times 10^8 m$

B. $3.37 \times 10^6 m$

C. $7.60 \times 10^4 0 m$

D. $1.9 \times 10^2 m$

Answer: A

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Escape Speed

1. The escape velocity of a body form the earth depends on

(i) the mass of the body.

(ii) the location from where it is projected.

(iii) the direction of projection.

(iv) the height of the location form where the body is launched.

A. (i) and (ii)

B. (ii) and (iv)

C. (i) and (iii)

D. (iii) and (iv)

Answer: B

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2. The escape velocity from the surface of the earth is (where R_E is the radius of the earth)

A. $\sqrt{2gR_E}$

B. $\sqrt{gR_E}$

C. $2\sqrt{gR_E}$

D. $\sqrt{3gR_E}$

Answer: A

3. If v_e is escape velocity and v_0, is orbital velocity of satellite for orbit close to the earth's surface. Then are related by

A. $v_o = \sqrt{2}v_e$

B. $v_o = v_e$

C. $v_e = \dfrac{v_o}{2}$

D. $v_e = \sqrt{2}v_o$

Answer: D

4. A projectile is fired vertically upwards from the surface of the earth with a velocity Kv_e, where v_e is the escape velocity and $K < 1$. If R is the radius of the earth, the maximum height to which it will rise measured from the centre of the earth will be (neglect air resistance)

A. $\dfrac{R_E}{1 - k^2}$

B. $\dfrac{R_E}{k^2}$

C. $\dfrac{1 - k^2}{R_E}$

D. $\dfrac{k^2}{R_E}$

Answer: A

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5. Two uniform soild spheres of equal radii R but mass M and $4M$ have a centre to centre separation $6R$, as shows in Fig. (a) The two spheres are held fixed. A projectile of mass m is projected from the

surface of the sphere of mass M directly towards the centre of teh second. Obtain an expression for the minimum speed v of the projectile so that it reaches the surface of second sphere.
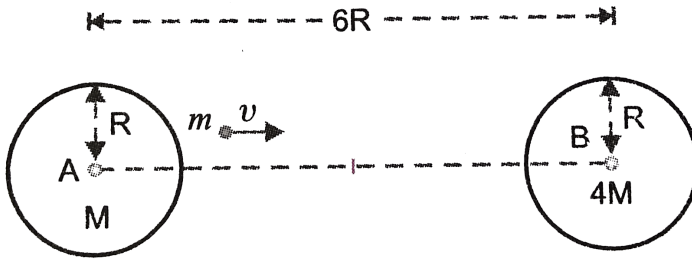
A.
$$\sqrt{\frac{4}{5}\frac{GM}{R}}$$

B.
$$\sqrt{\frac{5}{4}\frac{GM}{R}}$$

C.
$$\sqrt{\frac{3}{5}\frac{GM}{R}}$$

D.
$$\sqrt{\frac{5}{3}\frac{GM}{R}}$$

Answer: C

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6. The escape speed of a body on the earth's surface is $11.2 kms^{-1}$. A body is projected with thrice of this speed. The speed of the body when it escape the gravitational pull of earth is

A. $11.2 kms^{-1}$

B. $22.4\sqrt{2} kms^{-1}$

C. $\dfrac{22.4}{\sqrt{2}} kms^{-1}$

D. $22.4\sqrt{3} kms^{-1}$

Answer: B

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7. The escape velocity of 10g body from the earth is 11.2 kms^{-1}. Ignoring air resistance, the escape velocity of 10 kg of the iron ball from the earth will be

A. $0.0112 kms^{-1}$

B. $0.112 kms^{-1}$

C. $11.2 kms^{-1}$

D. $0.56 kms^{-1}$

Answer: C

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Earth Satellite

1. Which of the following statement is correct but satellites ?

A. A satellite cannot move in a stable orbit in a plane passing

through the earth's centre.

B. Geostationary satellites are launched in the equatorial plane.

C. We can use just one geostationary satellite for global communication around the globe.

D. The speed of satellite increase with an increase in the radius of its orbit.

Answer: B

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2. The time period of an artificial satellite in a circular orbit of radius R is 2 days and its orbital velocity is v_0. If time period of another satellite in a circular orbit is 16 days then

A. its radius of orbit is 4R and orbital velocity is v_0

B. its radius of orbit is 4R and orbital velocity is $\dfrac{v_0}{2}$

C. its radius of orbit is 2R and orbital velocity is v_0

D. its radius of orbit is 2R and orbital velocity is $\dfrac{v_0}{2}$

Answer: B

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3. The time period T of the moon of planet mars (mass M_m) is related to its orbital radius R as (G=gravitational constant)

A. $T^2 = \dfrac{4\pi^2 R^3}{GM_m}$

B. $T^2 = \dfrac{4\pi^2 GR^3}{M_m}$

C. $T^2 = \dfrac{4\pi R^3 G}{M_m}$

D. $T^2 = 4\pi M_m GR^3$

Answer: A

4. A synchronous satellite goes around the earth one in every 24 h. What is the radius of orbit of the synchronous satellite in terms of the earth's radius ? (Given: Mass of the earth , $M_E = 5.98 \times 10^{24} kg$, radius of the earth, $R_E = 6.37 \times 10^6 m$, universal constant of gravitational , $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$)

A. $2.4R_E$

B. $3.6R_E$

C. $4.8R_E$

D. $6.6R_E$

Answer: D

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Energy Of An Orbiting Satellite

1. Match the Column I with Column II

For a satellite in circular orbit

Column I		Column II
(A) Kinetic energy	(p)	$-\dfrac{GM_E m}{2r}$
(B) Potential energy	(q)	$\sqrt{\dfrac{GM_E}{r}}$
(C) Total energy	(r)	$-\dfrac{GM_E m}{r}$
(D) Orbital velocity	(s)	$\dfrac{GM_E m}{2r}$

(where M_E is the mass of the earth , m is the mass of the satellite

and r is the radius of the orbit)

A. A-r, B-s,C-q,D-p

B. A-q,B-p,C-r,D-s

C. A-p,B-q,C-s,D-r

D. A-s,B-r,C-p,D-q

Answer: D

2. A satellite is orbiting the earth in a circular orbit of radius r. Its

A. Knetic enegy varies as r

B. angular momentum varies as $\dfrac{1}{\sqrt{r}}$
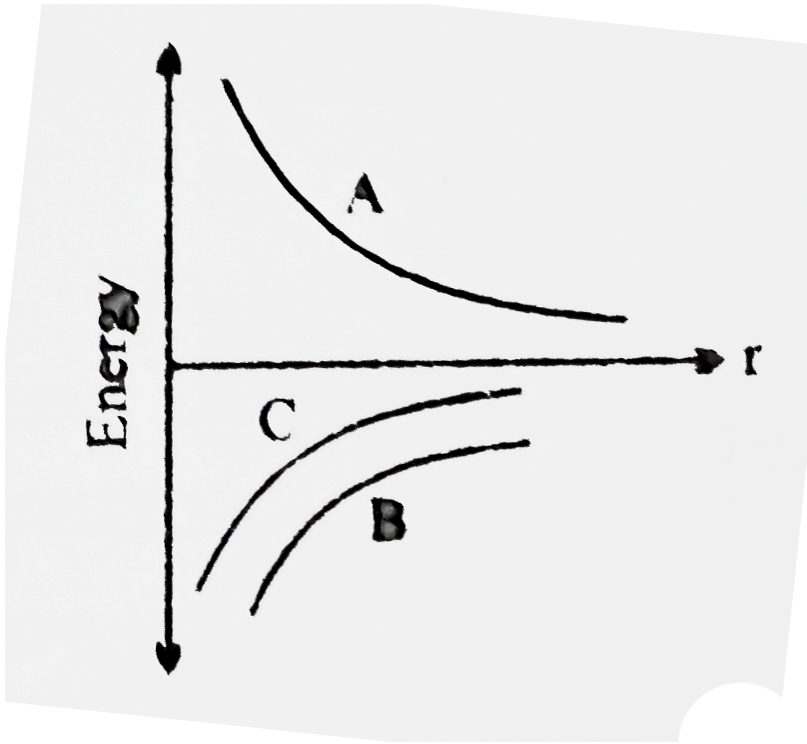
C. linear momentum varies as $\dfrac{1}{r}$

D. frequency of revolution varies as $\dfrac{1}{r^{3/2}}$

Answer: D

3. The figure shows the variation of energy with the orbit radius of a body in circular planetary motion. Find the correct statements about

the curves A, B and C

A. A shows the kinetic energy, B shows the total energy and C the

potential energy of the satellite

B. A and b are kinetic energy and potential energy respectively

and C the total energy of the satellite.

C. A and B are the potentital energy and kinetic energy

respectively and C the total energy of the satellite .

D. C and A are the kinetic and potential energies and B the total

energy of the satellite .

Answer: B

4. Two satellites of earth S_1 and S_2 are moving in the same orbit. The

mass of S_1 is four times the mass of S_2. Which one of the following

statements is true?

A. The potential energies of earth and satellite in the two cases

are equal .

B. S_1 and S_2 are moving with the same speed.

C. The kinetic energies of the two satellites are equal .

D. The time period of S_1 is four times that S_2.

Answer: B

5. In motion of an object under the gravitational influence of another object. Which of the following quantities is not conserved ?

    A. Angular momentum

    B. Mass of an object

    C. Total mechanical energy

    D. Linear momentum

Answer: D

6. A comet orbits the Sun in a highly elliptical orbit. Does the comet have a constant (a) linear speed (b) angular speed (c) angular momentum (d) kinetic energy (e) potential energy (f) total energy throughout its orbit? Neglect any mass loss of the comet when it comes very close to the Sun.

A. (i),(ii),(iii)

B. (iii),(iv),(v)

C. (iii) and (vi)

D. (ii),(iii) and (vi)

Answer: C

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7. A satellite of mass m is in a circular orbit of radius $2R_E$ about the earth. The energy required to transfer it to a circular orbit of radius

$4R_E$ is (where M_E and R_E is the mass and radius of the earth respectively)

A. $\dfrac{GM_Em}{2R_E}$

B. $\dfrac{GM_Em}{4R_E}$

C. $\dfrac{GM_Em}{8R_E}$

D. $\dfrac{GM_Em}{16R_E}$

Answer: C

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8. in the previous question, the change in potential energy.

A. $\dfrac{GM_Em}{2R_E}$

B. $\dfrac{GM_Em}{4R_E}$

C. $\dfrac{GM_Em}{8R_E}$

D. $\dfrac{GM_Em}{16R_E}$

Answer: B

9. The additional kinetic energy to be provided to a satellite of mass m revolving around a planet of mass M, to transfer it forms a circular orbit of radius R_1 to another of radius $R_2(R_2 > R_1)$ is

A. $GmM\left(\dfrac{1}{R_1^2} - \dfrac{1}{R_2^2}\right)$

B. $GmM\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

C. $2GmM\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

D. $\dfrac{1}{2}GmM\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

Answer: D

10. A satellite of a mass m orbits the earth at a height h above the surface of the earth. How much energy must be expended to rocket the satellite out of earth's gravitational influence? (where M_E and R_E be mass and radius of the earth respectively)

A. $\dfrac{GM_E m}{4(R_E + h)}$

B. $\dfrac{GM_E m}{2(R_E + h)}$

C. $\dfrac{GM_E m}{(R_E + h)}$

D. $\dfrac{2GM_E m}{(R_E + h)}$

Answer: B

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11. For a satellite moving in a circular orbit around the earth, the ratio of its potential energy to kinetic energy is

A. 1

B. -1

C. 2

D. -2

Answer: D

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12. An artificial satellite moving in a circular orbit around the earth has a total energy E_0. Its potential energy is

A. $-E_0$

B. E_0

C. $2E_0$

D. $-2E_0$

Answer: C

13. A rocket is launched vertically from the surface of earth with an initial velocity v. How far above the surface of earth it will go? Neglect the air resistance.

A. $\dfrac{R_E v^2}{gR_E - v^2}$

B. $\dfrac{R_E v^2}{gR_E + v^2}$

C. $\dfrac{R_E v^2}{2gR_E - v^2}$

D. $\dfrac{R_E v^2}{2gR_E + v^2}$

Answer: C

14. An asteroid of mass m is approaching earth, initially at a distance $10R_E$ with speed v_i. It hits earth with a speed v_f (R_E and M_E are radius and mass of earth),. Then

A. $v_f^2 = v_i^2 + \dfrac{2Gm}{R_E}\left(1 + \dfrac{1}{10}\right)$

B. $v_f^2 = v_i^2 + \dfrac{2GM_E}{R_E}\left(1 + \dfrac{1}{10}\right)$

C. $v_f^2 = v_i^2 + \dfrac{2GM_E}{R_E}\left(1 - \dfrac{1}{10}\right)$

D. $v_f^2 = v_i^2 + \dfrac{2Gm}{R_E}\left(1 - \dfrac{1}{10}\right)$

Answer: C

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15. Two stars each of mass M and radius R are approaching each other for a head-on collision. They start approaching each other when their separation is $r >> R$. If their speed at this separation are negligible, the speed v with which they collide would be

A. $v = \sqrt{GM\left(\dfrac{1}{R} - \dfrac{1}{r}\right)}$

B. $v = \sqrt{GM\left(\dfrac{1}{2R} - \dfrac{1}{r}\right)}$

C. $v = \sqrt{GM\left(\dfrac{1}{R} + \dfrac{1}{r}\right)}$

D. $v = \sqrt{GM\left(\dfrac{1}{2R} + \dfrac{1}{r}\right)}$

Answer: B

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Geostationary And Polar Satellites

1. Which of the following statement is correct regarding a geostationary satellite?

A. A geostationary satellite goes around the earth in east-west direction.

B. A geostationary satellite goes around the earth in west-east direction.

C. The time -period of a geostationary satellite is 48 hours.

D. The angle between the equatorial plane and the orbital plane of geostationary satellite is $90°$

Answer: B

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2. Which one of the following statement is correct ?

A. The energy required to rocket an orbiting satellite out of earth's gravitational influence is more than the energy required to project a stationary object at the same height (as the statellite) out of earth's influence.

B. If the zero of potential energy is at infinity, the total energy of an orbiting satellite is negative of potential energy.

C. The first artificial satellite Sputnik I was launched in the year 1950.

D. The orbital speed of the SYNCOMS (Synchronous communications satellite) is $3.07 \times 10^2 ms^{-1}$.

Answer: D

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3. Which of the following statement is incorrect regarding the polar satellite ?

A. A polar satellite goes around the earth's pole in north-south direction.

B. Polar satellite are used to study topography of Moon, Venus and Mars.

C. A polar satellite is a high altitude satellite.

D. The time period of polar satellite is about 100 minutes.

Answer: C

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4. The orbit of geostationary satellite is circular, the time period of satellite depeds on (i) mass of the satellite, (ii) mass of earth, (iii) readius of the orbit and (iv) height of the satellite from the surface of the earth

A. (i) only

B. (i) and (ii)

C. (i),(ii) and (iii)

D. (ii),(iii) and (iv)

Answer: D

---

5. LANDSAT series of satellite move in near polar orbits at an altitude

of _____

    A. 3600 km

    B. 3000 km

    C. 918 km

    D. 512 km

Answer: C

6. Height of geostationary satellite is

A. 1000 km

B. 32000 km

C. 36000 km

D. 850 km

Answer: C

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7. 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.

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

A. $3.57 \times 10^{5} m$

B. $3.57 \times 10^{6} m$

C. $3.57 \times 10^{7} m$

D. $3.57 \times 10^{8} m$

Answer: C

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Weightlessness

1. An astronaut experiences weightlessness in a space satellite It is because .

A. the gravitational force is small at that location in space

B. the gravitational force is larger at that location in space

C. the astronaut experience no gravity.

D. the gravity force is infinitely large at that location in space.

Answer: C

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2. Feeling of weightlessness in a satellite is due to

A. zero gravitational acceleration

B. zero acceleration

C. zero mass

D. none of these.

Answer: A

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1. Two identical spheres of radius R made of the same material are kept at a distance d apart. Then the gravitational attraction between them is proportional to

    A. d^{-2}

    B. d^2

    C. d^4

    D. d

Answer: A

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2. The time interval between two successive noon when sun passes through zenith point (meridian) is known as

A. sidereal day

B. mean solar day

C. solar year

D. lunar month

Answer: B

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3. Which of the following planets has two moons phobos and deimos ?

A. Jupiter

B. Saturn

C. Mars

D. Earth

Answer: C

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4. Black Hole is

A. super surface of atmosphere
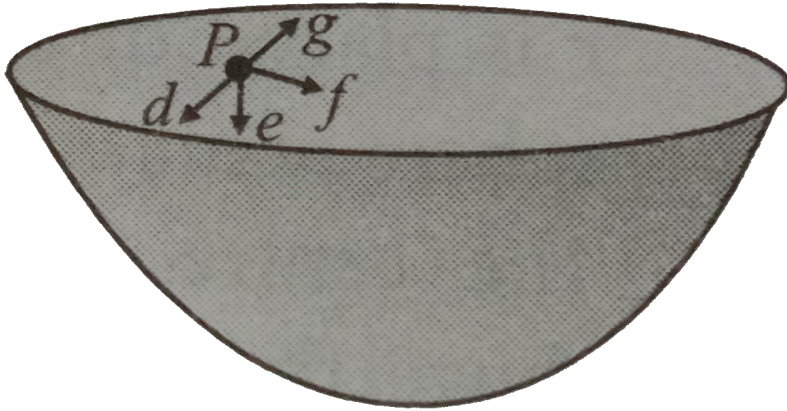
B. ozone layer

C. super dense planetary material none of these .

D.

Answer: C

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5. The direction of gravitational intensity at point P of a hemispherical shell of uniform mass desity is indicated by the arrow

A. d

B. e

C. f

D. g

Answer: B

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6. The angular speed of rotation of the earth is

A. $7.3 \times 10^{-5} rads^{-1}$

B. $7.3 \times 10^{-4} rads^{-1}$

C. $7.3 \times 10^{-6} rads^{-1}$

D. $7.3 \times 10^{-3} rads^{-1}$

Answer: A

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7. A non-homogeneous sphere of radius R has the following density

variation :

$$\rho \begin{cases} \rho_0 & r \leq R/3 \\ \rho_0/2 & (R/3) < r \leq (3R/4) \\ \rho_0/8 & (3R/4) < r \leq R \end{cases}$$

The gravitational field at a distance 2R from the centre of the sphere

is

A. $0.1\pi GR\rho_0$

B. $0.2\pi GR\rho_0$

C. $0.3\pi GR\rho_0$

D. $0.4\pi GR\rho_0$

Answer: A

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8. The gravitational field intensity at a point $10,000km$ from the centre of the earth is $4.8Nkg^{-1}$. The gravitational potential at that point is

A. $-4.8 \times 10^7 Jkg^{-1}$

B. $-2.4 \times 10^7 Jkg^{-1}$

C. $4.8 \times 10^6 Jkg^{-1}$

D. $3.6 \times 10^6 Jkg^{-1}$

Answer: A

9. A satellite is revolving in a circular orbit at a height 'h' from the earth's surface (radius of earth R, h ltltR). The minimum increase in its orbital velocity required, So that the satellite could escape from the erth's gravitational field, is close to :(Neglect the effect of atomsphere.)
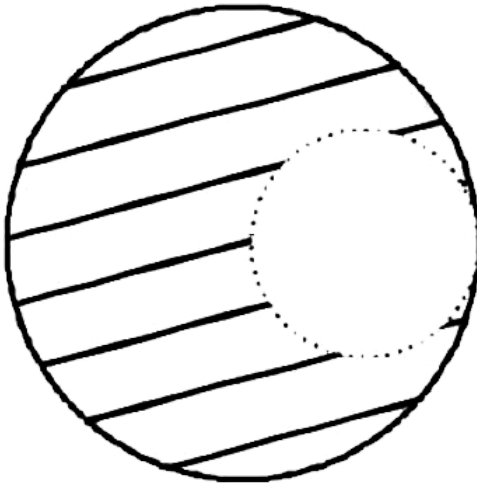
A. $\sqrt{2gR}$

B. $\sqrt{gR}$

C. $\sqrt{gR/2}$

D. $\sqrt{gR}\left(\sqrt{2}-1\right)$

Answer: D

10. From a solid sphere of mass M and radius R, a spherical portion of radius R/2 is removed, as shown in the figure Taking gravitational potential $V = 0$ at $r = \infty$, the potential at centre of cavity thus formed is: (G = gravitational constant)

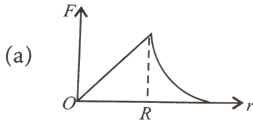A. $\dfrac{-2GM}{3R}$

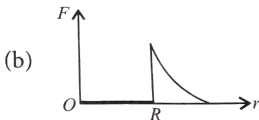B. $\dfrac{-2GM}{R}$

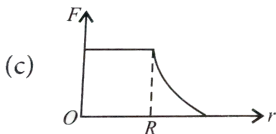C. $\dfrac{-GM}{2R}$

D. $\dfrac{-GM}{R}$

Answer: D

11. Which one of the following plots represents the variation of the gravitational field on a particle with distance r due to a thin spherical shell of raduis R? (r is measured from the centre of the spherical shell).
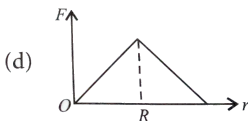
A.

(a)

B.

(b)

C.

(c)

D.

(d)

Answer: B

<div style="background:teal">Higher Order Thinking Skills</div>

1. A bullet is fired vertically upwards with a velocity v from the surface of a spherical planet when it reaches its maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}th$ of its value at the surface of the planet. If the escape velocity from the planet is $V_{escape} = v\sqrt{N}$, then the value of N is : (ignore energy loss due to atmosphere).

A. 2

B. 3

C. 4

D. 5

Answer: A

2. A larger spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M. The point masses are connected by rigid massless rod of length l and this assembly is free to move along the line connecting them. All three masses interact only through their mutual gravitational interaction. When the point mass nearer to M is at a distance r =3l form M, the tension in the rod is zero for $m = k\left(\dfrac{M}{288}\right)$. The value

of k is
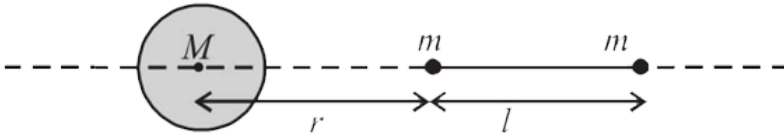
A. 5

B. 6

C. 7

D. 8

Answer: C

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3. Two satellites S_1 and S_2 revolve around a planet in coplanar circular orbits in the same sense their periods of revolution are 1 hour and 8hours respectively the radius of the orbit of S_1 is 10^4 km when S_1 is closest to S_2 the angular speed of S_2 as observed by an astronaut in S_1 is :

A. $\pi \times 10^4$

B. $-\pi \times 10^4$

C. $\pi \times 10^5$

D. $\pi \times 10^5$

Answer: B

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4. In the above example the angular velocity of S_2 as actually observed by an astronaut in S_1 is -

A. 3×10^{-4}

B. 3×10^{23}

C. 3×10^{-6}

D. 3×10^{-7}

Answer: A

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5. The ratio of the earth's orbital angular momentum (about the Sun) to its mass is $4.4 \times 10^{15} m^2 s^{-1}$. The area enclosed by the earth's orbit is approximately-_____m^(2).

A. 6.94×10^{22}

B. 6.94×10^{23}

C. 7.94×10^{22}

D. 7.94×10^{23}

Answer: A

6. A particle of mass m is subjected to an attractive central force of magnitude k/r^2, k being a constant. If at the instant when the particle is at an extreme position in its closed orbit, at a distance a from the centre of force, its speed is $\sqrt{k/2ma}$, if the distance of other extreme position is b. Find a/b.
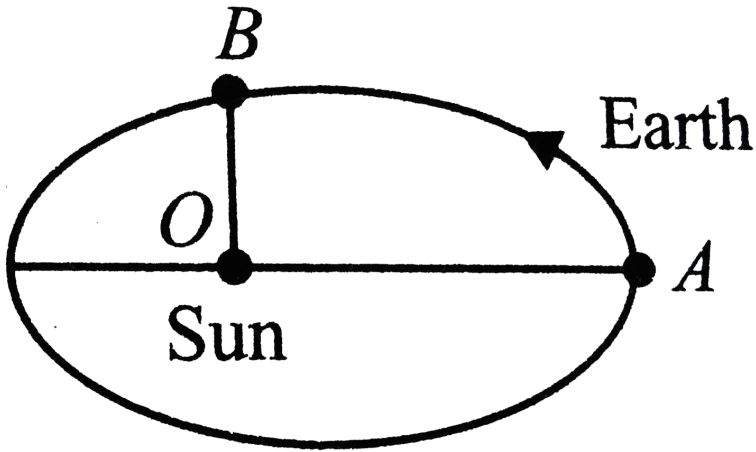
A. 2

B. 3

C. 4

D. 5

Answer: B

7. The earth moves around the Sun in an elliptical orbit as shown in Fig. The ratio $OA/OB = x$. The ratio of the speed of the earth at B to that at A is nearly

A. $\sqrt{x}$

B. x

C. $x\sqrt{x}$

D. x^2

Answer: B

8. A uniform ring of mas m and radius a is placed directly above a uniform sphere of mass M and of equal radius. The centre of the ring is at a distance $\sqrt{3}$ a from the centre of the sphere. Find the gravitational force exerted by the sphere on the ring.

A. $\dfrac{GMm}{8r^2}$

B. $\dfrac{GMm}{4r^2}$

C. $\sqrt{3}\dfrac{GMm}{8r^2}$

D. $\dfrac{GMm}{8r^3\sqrt{3}}$

Answer: C

9. Three particles are projected vertically upward from a point on the surface of earth with velocities

$$v_1 = \sqrt{\frac{2gR}{3}},\ v_2\sqrt{gR},\ v_3\sqrt{\frac{4gR}{3}}$$

respectively, where g is acceleation due to gravity on the surface of earth. If the maximum height attained are h_1, h_2 and h_3 respectively, then $h_1 : h_2 : h_3$ is

A. $1:2:3$

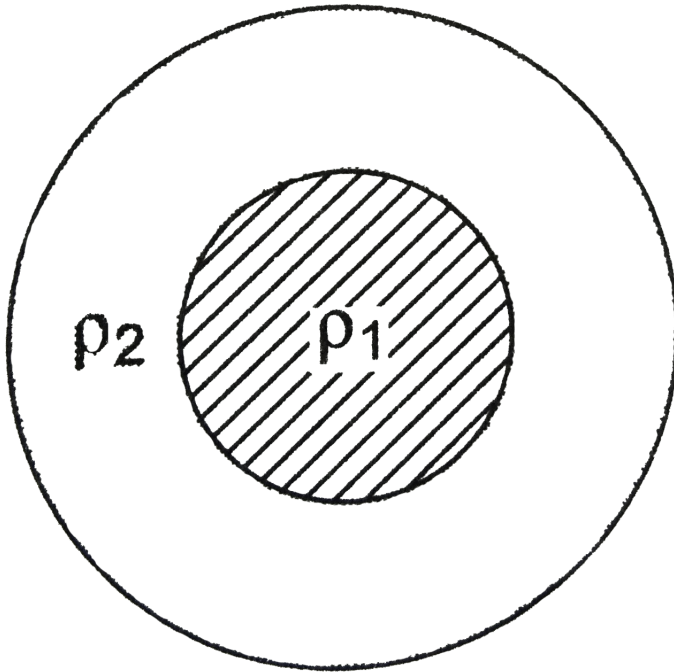B. $2:3:4$

C. $1:2:4$

D. $1:3:5$

Answer: C

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10. The density of the core a planet is ρ_1 and that of the outer shell is ρ_2. The radii of the core and that of the planet are R and $2R$ respectively. The acceleration due to gravity at the surface of the planet is same as at a depth R. Find the ratio of $\dfrac{\rho_1}{\rho_2}$

A. 2.3

B. 4.5

C. 3.2

D. 5.4

Answer: A

Ncert Exemplar

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. willl be directed towards the centre but not the same everywhere.

    B. will have the same value everywhere but not directed towards the centres.

C. will be same everywhere in magnitude directed towards the

centres.

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 earth and mercury is note 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.

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 torques 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.

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 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.

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 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 .

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 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.

Answer: D

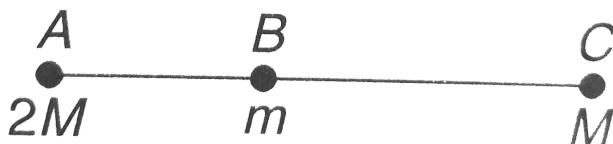▶ **Watch Video Solution**

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 the gravity on Earth is the same for all bodies and is due to the quality of gravitational mass and inertial mass.

D. Gravitational mass of a particle like proton can depend on the presence of neighbouring heavy objects but the inertial mass cannot .

Answer: D

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 .

Assertion And Reason

1. Assertion: The planet move slower when they are farther from the Sun than when they are nearer.

Reason : Angular velocity of a planet is a constant quantity.

A. If both assertion and reason are true and reason is the correct

   explanation of assertion

B. If both assertion and reason are truebut reason is not the

   correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: C

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2. Assertion : A central force is such that the force on the planet is

along the vector joining the sun and the planet.

Reason : Conservation of angular momentum is valid for any central

force.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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3. Assertion: The motion of a particle under the central force is always confined to a plane.

Reason: Angular momentum is always conserved in the motion under a central force.

A. If both assertion and reason are true and reason is the correct

explanation of assertion

B. If both assertion and reason are truebut reason is not the

correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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4. Assertion: The time period of revolution of a satellite close to surface of earth is smaller then that revolving away from surface of earth.

Reason: The square of time period of revolution of a satellite is directly proportional to cube of its orbital radius.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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5. Assertion: When distance between bodies is doubled and also mass of each body is also doubled, gravitational force between them remains the same.

Reason: According to Neweton's law gravitational, force is directely proportional to mass of bodies and inversely proportional to square of distance between them.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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6. Assertion : The principle of superposition is not valid for gravitational force.

Reason : Gravitational force is a conservative force.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer:

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7. Assertion: The gravitational force on a particle inside a spherical shell is zero.

Reason: The shell shields other bodies outside it form exerting gravitational forces on a particle inside.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: C

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8. Assertion : Gravitational force between two masses in air is F. If they are immersed in water, force will remain F

Reason : Gravitational force does not depend on the medium between the masses.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the

correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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9. Assertion: A man in a dosed cabin falling freely does not experience gravity.

Reason: Inertial and gravitational mass have equivalence.

A. If both assertion and reason are true and reason is the correct

explanation of assertion

B. If both assertion and reason are true but reason is not the

correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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10. Assertion : For a free falling object, the next external force is just the weight of the object .

Reason : In this case the downward acceleration of the object is equal to the acceleration due to gravity.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

11. Assertion: The total energy of a satellite is negative.

Reason: Gravitational potential energy of an object is negative.

A. If both assertion and reason are true and reason is the correct

explanation of assertion

B. If both assertion and reason are truebut reason is not the

correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

12. Assertion : Moon has no atmosphere.

Reason : The escape velocity for moon is less than that for earth.

A. If both assertion and reason are true and reason is the correct

explanation of assertion

B. If both assertion and reason are truebut reason is not the

correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

13. Assertion : The gravitational attraction of moon is much less than that of earth.

Reason : Moon is the neutral satellite of the earth.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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14. Assertion: A person sitting in an artificial satellite revolving around the earth feels weightless.

Reason: There is no gravitational force on the satellite.

- A. If both assertion and reason are true and reason is the correct explanation of assertion

- B. If both assertion and reason are truebut reason is not the correct explanation of assertion

- C. If assertion is true but reason is false

- D. If both assertion and reason are false.

Answer: A

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15. Assertion : Geostationary satellites appear fixed from any point on earth.

Reason : The time period of geostationary satellite is

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are truebut reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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