GRAVITATION

LEVEL-BOOST

NEWTON'S LAW OF GRAVITATION
$F = G\frac{m_1m_2}{R^2}$

1. Two particles of equal mass go round a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is

(a) $v = \frac{1}{2R}\sqrt{\frac{1}{Gm}}$ (b) $v = \sqrt{\frac{Gm}{2R}}$ (c) $v = \frac{1}{2}\sqrt{\frac{Gm}{R}}$ (d) $v = \sqrt{\frac{4Gm}{R}}$

2. Force between two objects of equal masses is F. If 25% mass of one object is transferred to the other object than the new force will be

(a) F/4 (b) 3 F/4 (c) 15/16 F (d) F

3. Three equal masses of 1 kg each are placed at the vertices of an equilateral triangle PQR and a mass of 2 kg is placed at the centroid O of the triangle which is at a distance of √2 m from each of the vertices of the triangle. The force, in newton, acting on the mass of 2 kg is

(a) 2 (b) √2 (c) 1 (d) zero

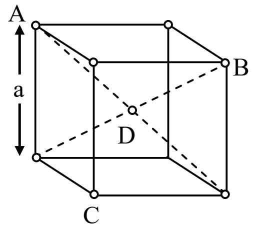
4. Two point of masses A and B having masses in the ratio 4 : 3 are separated by a distance of 1 m. When another point mass C of mass M is placed in between A and B, the force between A and C is $1/3^{rd}$ of the force between B and C. Then the distance of C from A is

(a) 2/3 m (b) 1/3 m (c) 1/4 m (d) 2/7 m

5. Four particles of equal mass M move along a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is -

(A) $\frac{GM}{R}$ (B) $\sqrt{\left[2\sqrt{2}\ \frac{GM}{R}\right]}$ (C) $\sqrt{\left[\frac{GM}{R}(2\sqrt{2}+1)\right]}$ (D) $\sqrt{\left[\frac{GM}{R}\left(\frac{2\sqrt{2}+1}{4}\right)\right]}$

6. Four identical masses m each are kept at points A, B, C & D shown in figure. Gravitational force on mass at point D (body centre) is -



(A) $\frac{3\ Gm^2}{a^2}$ (B) $\frac{12\,Gm^2}{a^2}$

(C) $\frac{4\,Gm^2}{a^2}$ (D) $\frac{4\,Gm^2}{3a^2}$

7. Three uniform sphere of mass M and radius R each are kept in such a way that each touches the other two. The magnitude of gravitational force on any of the spheres due to other two is–

(A) $\frac{\sqrt{3}}{4}\frac{GM^2}{R^2}$ (B) $\frac{3}{2}\frac{GM^2}{R^2}$ (C) $\frac{\sqrt{3}GM^2}{R^2}$ (D) $\frac{\sqrt{3}GM}{R^2}$

8. Two particles each of mass m are placed at A and C as such AB = BC = L. The gravitational force on the third particle placed at D at a distance L metre on the perpendicular bisector of the line AC, is –

(A) $\frac{Gm^2}{\sqrt{2}L^2}$ along BD (B) $\frac{Gm^2}{\sqrt{2}L^2}$ along DB (C) $\frac{Gm^2}{L^2}$ along AC (D) none of these

9. Two identical solid copper spheres of radius R are placed in contact with each other. The gravitational attraction between the, is proportional to

(a) R^2 (b) R^{-2} (c) R^4 (d) R^{-4}

10. Mass M is divided into two parts xM and (1 – x)M. For a given separation, the value of x for which gravitational attraction between the two placed becomes maximum us

(a) 1/2 (b) 3/5 (c) 1 (d) 2

ACCELERATION DUE TO GRAVITY

At earth surface, $g = \frac{GM}{R^2}$

At height h from surface, $g' = \begin{cases} \frac{GM}{(R+h)^2} = g\left(\frac{R}{R+h}\right)^2 \\ g\left(1-\frac{2h}{R}\right), \text{ for } h \ll R \end{cases}$

At depth h from surface, $g' = g\left(1-\frac{h}{R}\right)$

effect due to rotation of earth, $g' = (g - \omega^2 R\cos^2\lambda)$

1. If the change in the value of 'g' at a height h above the surface of the earth is the same as at a depth x below it, then (both x and h being much smaller than the radius of the earth)

(a) x = h (b) x = 2h (c) x = h/2 (d) $x = h^2$

2. If the earth is supposed to be a sphere R, if g_{30} is value of acceleration due to gravity at latitude of 30^o and g at the equator, the value of $g - g_{30^0}$ is

(a) $1/4\omega^2R$ (b) $3/4\omega^2R$ (c) ω^2R (d) $1/2\omega^2R$

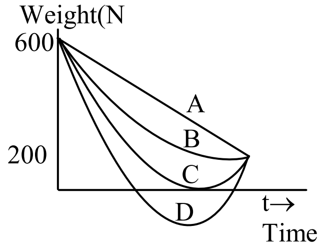
3. The radius of the earth is 6400 km and g = 10 m/sec². In order that a body of 5 kg weighs zero at the equator, the angular speed of the earth is

(a) 1/80 radian/sec (b) 1/400 radian/sec
(c) 1/800 radian/sec (d) 1/1600 radian/sec

4. The height vertically above the earth's surface at which the acceleration due to gravity becomes 1% of its value at the surface is

(a) 8 R (b) 9 R (c) 10 R (d) 20 R

5. Imagine the acceleration due to gravity on earth is $10 m/s^2$ and on mars is $4 m/s^2$. A traveller of mass 60kg goes from earth to mars by a rocket moving with constant velocity. If effect of other planets is assumed to be negligible, which one of the following graphs shown the variation of weight of traveller with time –



(A) A

(B) B

(C) C

(D) D

6. A body of mass m and radius r falls on earth from a great height. If M is mass and R is the radius of earth while $r = \frac{R}{100}$ then the acceleration of the body when it hits the earth is : (acceleration due to gravity at earth surface is g)

(A) g (B) 0.98 g (C) $\frac{g}{0.98}$ (D) 9.8 g

7. The acceleration due to the gravity on the moon is one sixth that on earth. If the average density of moon is three fifth that of earth, the moon's radius in terms of earth's radius R_e is -

(A) $0.16\ R_e$ (B) $0.27\ R_e$ (C) $0.32\ R_e$ (D) $0.36\ R_e$

GRAVITATIONAL FIELD INTENSITY

Due to point mass, $I = \frac{Gm}{r^2}$

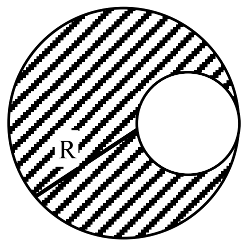
Due to hollow sphere, $I = \begin{cases} \frac{Gm}{r^2}, & \text{for } r \geq R \\ 0, & \text{for } r < R \end{cases}$

Due to solid sphere, $I = \begin{cases} \frac{Gm}{r^2}, & \text{for } r \geq R \\ \frac{Gm}{R^3} r, & \text{for } r < R \end{cases}$

1. The gravitational field in a region is 10 N/kg $(\hat{i} - \hat{j})$. Then the work done by gravitational force to shift slowly a particle of mass 1kg from point (1m, 1m) to a point (2m, –2m) is -

(A) 10 J (B) –10J (C) –40J (D) + 40 J

2. A spherical hole is made in a solid sphere of radius R. The mass of the sphere before hollowing was M. The gravitational field at the centre of the hole due to the remaining mass is –



(A) zero (B) $\frac{GM}{8R^2}$

(C) $\frac{GM}{2R^2}$ (D) $\frac{GM}{R^2}$

3. The magnitude of the gravitational field at distances r_1 and r_2 from the centre of a uniform sphere of radius R and mass M are F_1 and F_2 respectively. Then-

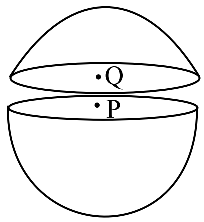
(A) $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 < R$ and $r_2 < R$ (B) $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $r_1 > R$ and $r_2 > R$

(C) $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 > R$ and $r_2 > R$ (D) $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $r_1 < R$ and $r_2 < R$

4. Two concentric shells of uniform density have masses M_1 and M_2 and their radii are R_1 and R_2 respectively. A particle of mass m is placed at a distance d from the centre, such that $R_2 > d > R_1$. The net force on the particle is -

(A) $\frac{GM_1m}{d^2}$ (B) $\frac{G(M_1+M_2)m}{d^2}$ (C) $\frac{G(M_1+M_2)m}{(d-R_1)(R_2-d)}$ (D) zero

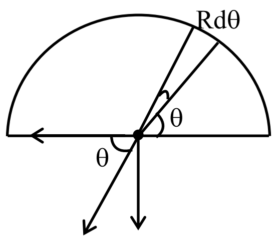
5. A spherical shell is cut into two pieces along a chord as shown in figure . If I denote the gravitational field strength , then for points P and Q -



(A) $I_P > I_Q$ (B) $I_P < I_Q$

(C) $I_P = I_Q = 0$ (D) $I_P = I_Q \neq 0$

6. Find the field strength at the centre of a thin semicircular ring of radius R and mass M as shown in figure. Take the linear mass density λ kg/m -



(A) $\frac{G\lambda}{R}$ (B) $\frac{4G\lambda}{R}$ (C) $\frac{2G\lambda}{R}$ (D) $\frac{G\lambda}{2R}$

GRAVITATIONAL POTENTIAL

Due to point mass, $V = -\left(\frac{Gm}{r}\right)$

Due to hollow sphere, $V = \begin{cases} -\left(\frac{Gm}{r}\right), & \text{for } r \geq R \\ -\left(\frac{Gm}{R}\right), & \text{for } r < R \end{cases}$

Due to solid sphere, $V = \begin{cases} -\left(\frac{Gm}{r}\right), & \text{for } r \geq R \\ -\left(\frac{Gm}{R}\right)\left\{\frac{3}{2} - \frac{r^2}{2R^2}\right\}, & \text{for } r < R \end{cases}$

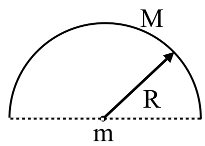
1. A particle of mass m is situated at the centre of a spherical shell of same mass and radius a. The magnitude of the gravitational potential at a point situated at a/2 distance from the centre will be

(a) $\frac{4GM}{a}$ (b) $\frac{GM}{a}$ (c) $\frac{2GM}{a}$ (d) $\frac{3GM}{a}$

2. There is a concentric hole of radius R in a solid sphere of radius 2R. Mass of remaining portion is M, then the gravitational potential at centre is

(A) $\frac{-5GM}{7R}$ (B) $\frac{-7GM}{14R}$ (C) $\frac{-3GM}{7R}$ (D) $\frac{-9GM}{14R}$

3. A particle of mass m is placed on the centre of a fixed uniform semi-circular ring of radius R and mass M as shown. Then work required to displace the particle slowly from centre of ring to infinity is : (Assume only gravitational interaction of ring and particle)



(A) $\frac{GMm}{R}$ (B) $-\frac{GMm}{R}$

(C) $\frac{GMm}{\pi R}$ (D) $-\frac{GMm}{\pi R}$

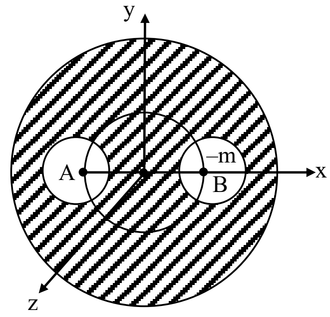
4. The gravitational field due to a mass distribution is $E = \frac{A}{x^2}$ in x-direction. Here, A is a constant. Taking the gravitational potential to be zero at infinity, potential at **x** is –

(A) $\frac{2A}{x}$ (B) $\frac{2A}{x^3}$ (C) $\frac{A}{x}$ (D) $\frac{A}{2x^2}$

5. A person brings a mass of 1kg from infinity to a point A. Initially the mass was at rest but it moves at a speed of 2m/s as it reaches A. The work done by the person on the mass is –3J. The potential at A is-

(A) –3J/kg (B) –2 J/kg (C) –5 J/kg (D) none of these

6. A solid sphere of uniform density and radius 4 units is located with its centre at the origin O of coordinates. Two spheres of equal radii 1 unit, with their centres at A(–2, 0, 0) and B(2, 0, 0) respectively, are taken out of the solid leaving behind spherical cavities as shown in the figure. Then



(A) the gravitational force due to this object at the origin is zero

(B) the gravitational potential is the same at all points of the circle $y^2 + z^2 = 36$

(C) the gravitational potential is the same at all points on the circle $y^2 + z^2 = 4$

(D) All of these

7. The gravitational potential at height h above the earth's surface is -5.12×10^7 J/kg and acceleration due to gravity at this point is 6.4 m s^2. If radius of the earth is 6400 km, the value of h is :

(A) 1200 km (B) 1600 km (C) 1800 km (D) 2400 km.

GRAVITATIONAL POTENTIAL ENERGY
of two points mass, $U = -G\left(\frac{m_1 m_2}{r}\right)$

1. A body of mass 'm' is taken from the earth's surface to the height equal to twice the radius (R) of the earth. The change of potential energy of body will be

(a) $\frac{1}{3}mgR$ (b) mg2R (c) $\frac{2}{3}mgR$ (d) 3mgR

2. Two bodies of masses m_1 and m_2 are initially at rest placed infinite distance apart. They are then allowed to move towards each other under mutual gravitational attraction. Their relative velocity when they are r distance apart is –

(A) $\sqrt{\frac{2G(m_1+m_2)}{r}}$ (B) $\sqrt{\frac{2Gm_1m_2}{(m_1+m_2)r}}$ (C) $\sqrt{\frac{G(m_1+m_2)}{r}}$ (D) $\sqrt{\frac{Gm_1m_2}{(m_1+m_2)r}}$

3. What should be the velocity of a body thrown vertically upwards from the surface of earth (mass M and radius R) so that it may reach at a height of 7R from the surface ?

(A) $\sqrt{\frac{20GM}{11R}}$ (B) $\sqrt{\frac{20GM}{9R}}$ (C) $\sqrt{\frac{17GM}{9R}}$ (D) $\sqrt{\frac{7GM}{4R}}$

4. A point P lies on the axis of a ring of mass M and radius a, at a distance a from its centre C. A small particle starts from P and reaches C under gravitational attraction only. Its speed at C will be -

(A) $\sqrt{\frac{2GM}{a}}$ (B) $\sqrt{\frac{2GM}{a}\left(1-\frac{1}{\sqrt{2}}\right)}$ (C) $\sqrt{\frac{2GM}{a}\left(\sqrt{2}-1\right)}$ (D) zero

5. Three particles of mass m each are placed at three corners of an equilateral triangle of side 'a'. The work which should be done on this system to increase the side of the triangle to '2a' is–

(A) $\frac{3Gm^2}{a}$ (B) $\frac{3Gm^2}{2a}$ (C) $\frac{Gm^2}{2a}$ (D) $\frac{3Gm^2}{4a^2}$

6. The masses of moon and earth are 7.36×10^{22} kg and 5.98×10^{24}kg respectively and their mean separation is 3.82×10^5 km. The energy required to break the earth-moon system is -

(A) 12.4×10^{32} J (B) 7.68×10^{28}J (C) 5.36×10^{24}J (D) 2.96×10^{20} J

7. Three particles each of mass 100gm are brought from a very large distance to the vertices of an equilateral triangle whose side is 20cm in length. The required work done will be -

(A) 0.33×10^{-11} joule

(B) -0.33×10^{-11} joule

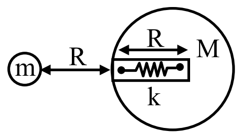
(C) 1.0×10^{-11} joule

(D) -1.00×10^{-11} joule

8. A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force to take the particle far away from the sphere (you may take $G = 6.67 \times 10^{-11}$ Nm^2 / kg^2)

(A) 13.34×10^{-10} J (B) 3.33×10^{-10} J (C) 6.67×10^{-9} J (D) 6.67×10^{-10} J

9. A small ball of mass 'm' is released at a height 'R' above the earth surface, as shown in the given figure. The maximum depth of the ball to which it goes is R/2 inside the earth through a narrow groove before coming to rest momentarily. The groove, contains an ideal spring of spring constant k and natural length R. The value of k, if R is the radius of earth and M mass of earth, is -



(A) $\frac{3GMm}{R^3}$ (B) $\frac{6GMm}{R^3}$

(C) $\frac{9GMm}{R^3}$ (D) none of these

10. A ring of mass m_1 and radius R is fixed in space at some location. An external agent brings a point mass m_2 from infinite to centre of the ring. Work done by the external agent will be -

(A) $-\frac{Gm_1m_2}{R}$ (B) $\frac{Gm_1m_2}{R}$ (C) $\frac{G\sqrt{m_1^2+m_2^2}}{R}$ (D) $\frac{Gm_1m_2}{R(m_1+m_2)}$

ESCAPE VELOCITY

$$V_e = \begin{cases} \sqrt{2gR}, \text{ from surface of earth} \\ \sqrt{2gR\left(\dfrac{R}{R+h}\right)}, \text{ from height h from surface of earth} \end{cases}$$

1. The escape velocity from earth is v_{es}. A body is projected with velocity $2v_{es}$ with what constant velocity will it move in the inter planetary space

(a) v_{es} (b) $3v_{es}$ (c) $\sqrt{3}v_{es}$ (d) $\sqrt{5}v_{es}$

2. A body is projected vertically upwards from the surface of a planet of radius R a velocity equal to half the escape velocity for that planet. The maximum height attained by the body is

(a) R/3 (b) R/2 (c) R/4 (d) R/5

3. The kinetic energy needed to projected a body of mass m from the earth surface (radius R) to infinity is

(a) mgR/2 (b) 2 mgR (c) mgR (d) mgR/4

4. The earth is assumed to be a sphere radius R. A platform is arranged at a height R from the surface of the Earth. The escape velocity of a body from this platform is fv, where v is its escape velocity from the surface of the Earth. The value of f is

(a) $\frac{1}{3}$ (b) $\frac{1}{2}$ (c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}}$

5. The ratio of the radii of planets P_1 and P_2 is X. The ratio of acceleration due to the gravity on them is Y. The ratio of the escape velocities from them will be–

(A) XY (B) $\sqrt{\frac{X^2}{Y}}$ (C) $\sqrt{XY}$ (D) $\sqrt{XY^2}$

6. The masses and the radii of earth and moon are respectively M_e, R_e and M_m, R_m. The distance between the centres is r. At what minimum velocity a particle of mass m be projected from the mid point of the distance between their centres so that it may escape into space ?

(A) $\sqrt{\frac{4G}{r}(M_e + M_m)}$ (B) $\frac{4G}{r}\sqrt{(M_e + M_m)}$

(C) $\sqrt{\frac{2G}{r}(M_e + M_m)}$ (D) $\frac{2G}{r}\sqrt{(M_e + M_m)}$

7. Escape velocity of a 1kg body on a planet is 100m/s. Potential energy of body at that planet is-

(A) – 5000 J (B) – 1000 J (C) – 2400 J (D) – 10000 J

8. A particle is projected vertically upward from the surface of earth (radius R_e) with a kinetic energy equal to half of the minimum vlaue needed for it to escape. The height to which it rises above the surface of earth is

(A) $h = R_e$ (B) $h = 2R_e$ (C) $h = R_e/2$ (D) $h = 3R_e$

9. 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 earth will be - (Neglect air resistance)

(A) $\frac{1-k^2}{R}$ (B) $\frac{R}{1-k^2}$ (C) $R(1-k^2)$ (D) $\frac{R}{1+k^2}$

10. The earth's radius is R and acceleration due to gravity at its surface is g. The minimum speed with which the body must be thrown to reach a height of R/4 above the surface of the earth is -

(A) $\sqrt{\frac{2gR}{5}}$ (B) $\sqrt{\frac{gR}{3}}$ (C) $\sqrt{gR}$ (D) $\sqrt{2gR}$

11. A rocket is fired from inside a deep mine, so as to escape the earth's gravitational field. The minimum velocity to be imparted to the rocket is

(a) Exactly the same as the escape velocity of fire from the earth's surface

(b) A little more than the escape velocity of fire from the earth's surface

(c) A little less than the escape velocity of fire from the earth's surface

(d) Infinity

12. The mass of a spaceship is 1000 kg. It is to be launched from the earth's surface out into free space. The value of 'g' and 'R' (radius of earth) are $10 m/s^2$ and 6400 km respectively. The required energy for this work will be

(a) 6.4×10^{11} Joules (b) 6.4×10^{8} Joules

(c) 6.4×10^{9} Joules (d) 6.4×10^{10} Joules

MOTION OF SATELLITE

Orbital velocity: $V_o = \sqrt{\frac{gR^2}{R+h}}$ Time period: $T = 2\pi\sqrt{\frac{(R+h)^3}{gR^2}}$

Energy of satellite: $E = -\frac{1}{2}G\left(\frac{Mm}{R+h}\right)$ K.E. = – E ; P.E. = 2E

Binding energy of satellite = –E

1. The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is v. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is-

(A) $\frac{3}{2}$ v (B) $\sqrt{\frac{3}{2}}$ v (C) $\sqrt{\frac{2}{3}}$ v (D) $\frac{2}{3}$ v

2. Energy required to move a satellite of mass m from an orbit of radius 2R to 3R is

(a) GMm/12R (b) GMm/3R (c) GMm/8R (d) GMm/6R

3. What is the minimum energy required to launch a satellite of mass m from the surface of the earth of mass M and radius R in a circular orbit at an altitude of 2R

(a) $\frac{5GmM}{6R}$ (b) $\frac{2GmM}{3R}$ (c) $\frac{GmM}{2R}$ (d) $\frac{GmM}{3R}$

4. A satellite is moving around the earth with speed v in a circular orbit of radius r. If the orbit is decreases by 1% its speed will

(a) Increase by 1% (b) Increase by 0.5 %

(c) Decrease 1% (d) Decrease by 0.5%

5. An artificial satellite of mass 'm' revolves around the earth near to its surface then its binding energy is [Re, g are radius and acceleration due to gravity respectively of the earth]

(a) $\frac{1}{2}mgR_e$ (b) $-\frac{1}{2}mgR_e$ (c) mg R_e (d) –mg R_e

6. A geo-stationary satellite is orbiting the earth at a height of 6 R above the surface of earth, R being the radius of earth. The time period of another satellite at a height of 2.5 R from the surface of earth is

(a) 10 hr (b) $(6\sqrt{2})$hr (c) 6 hr (d) $6/\sqrt{2}$ hr

7. A satellite with kinetic energy E_k is revolving round the earth in a circular orbit. How much more kinetic energy should be given to it so that it may just escape into outer space

(a) E_k (b) 2 E_k (c) 1/2 E_k (d) 3 E_k

8. A satellite moves round the earth in a circular orbit of radius R making one revolution per day. A second satellite moving win a circular orbit, moves round the earth once in 8 days. The radius of the orbit of the second satellite is

(a) 8 R (b) 4 R (c) 2 R (d) R

9. A satellite is launched into a circular orbit of radius R around earth while a second satellite is launched into an orbit of radius 1.02 R. The percentage difference in the time period is -

(A) 0.7 (B) 1.0 (C) 1.5 (D) 3.0

10. A satellite of mass m moves around the earth in a circular orbit with speed v. The potential energy of the satellite is -

(A) mv^2 (B) – mv^2 (C) $\frac{3}{2}$ mv^2 (D) – $\frac{3}{2}$ mv^2

11. Two satellites A and B, the ratio of their masses being 3 : 1, are in the circular orbits of radii r and 4r. The ratio of total mechanical energy of A to that of B is -

(A) $\frac{1}{3}$ (B) 3 (C) $\frac{3}{4}$ (D) 12

12. A satellite whose mass is m, is orbiting around the earth at a height R above the earth's surface. If the intensity of gravitational field at the earth's surface is g and radius of earth is R, then the kinetic energy of the satellite will be -

(A) mgR/4 (B) mgR/2 (C) mgR (D) 2 mgR

13. Suppose the gravitational force varies inversely as the n^{th} power of distance. Then the time period of a planet in circular orbit of radius 'R' around the sun will be proportional to –

(A) $R^{\left(\frac{n+1}{2}\right)}$ (B) $R^{\left(\frac{n-1}{2}\right)}$ (C) R^n (D) $R^{\left(\frac{n-2}{2}\right)}$

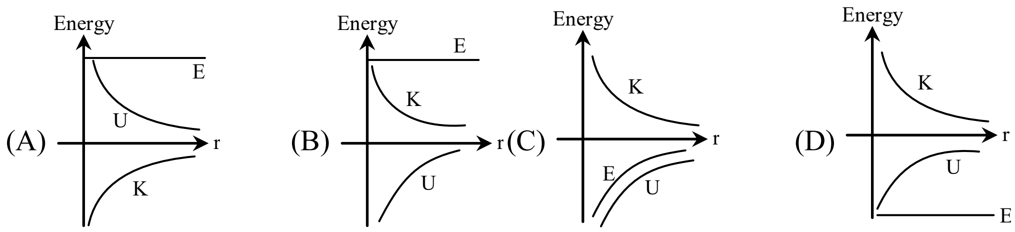
14. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the earth. The height of satellite above the surface of earth is (where R = radius of earth)

(A) R (B) 2R (C) 3R (D) 4R

15. A Geostationary satellite is revolving around the earth. To make it escape from gravitational field of earth, its velocity must be increased -

(A) 100 % (B) 41.4% (C) 50% (D) 59.6%

16. The correct graph representing the variation of total energy(E), kinetic energy(K) & potential energy (u) of a satellite with its distance from the centre of earth is -



KEEPLER'S LAW OF PLANETARY MOTION

Areal velocity: $\frac{\Delta A}{\Delta t} = \frac{L}{2m} = \text{cons}\tan\text{t}$

Time period (T): $T^2 \alpha a^3$, for elliptical orbit

$T^2 \alpha r^3$, for circular orbit

1. A planet moving around the sun sweeps area A_1 in 2 days, A_2 in 3 days and A3 in 6 days. Then the relation between A_1, A_2 and A_3 is

(a) $3A_1 = 2A_2 = A_3$ (b) $2A_1 = 3A_2 = 6A_3$

(c) $3A_1 = 2A_2 = 6A_3$ (d) $6A_1 = 3A_2 = 2A_3$

2. A planet is moving in an elliptical orbit. If T, V, E and L are respectively its kinetic energy, potential energy, total energy and magnitude of angular momentum, then which of the following statements is true ?

(A) T is conserved

(B) V is always positive

(C) E is always negative

(D) L is conserved but the direction of vector $\vec{L}$ will continuously change

3. A planet of mass m is moving in an elliptical path about the sun. Its maximum and minimum distances from the sun are r_1 and r_2 respectively. If M_S is the mass of sun then the angular momentum of this planet about the centre of sun will be -

(A) $\sqrt{\frac{2GM_s}{(r_1 + r_2)}}$ (B) $2GM_S m \sqrt{\frac{r_1 r_2}{(r_1 + r_2)}}$ (C) $m\sqrt{\frac{2GM_s r_1 r_2}{(r_1 + r_2)}}$ (D) $\sqrt{\frac{2GM_s m(r_1 + r_2)}{r_1 r_2}}$

4. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth. Then-

(A) The acceleration of S is always directed towards the centre of the earth

(B) The angular momentum of about the centre of the earth changes in direction , but its magnitude remains constant

(C) The total mechanical energy of S varies periodically with time

(D) The linear momentum of remains constant in magnitude

5. One satellite is revolving round the earth in an elliptical orbit. Its speed will :

(A) be same at all the points of orbit

(B) be maximum at the point farthest from the earth

(C) be maximum at the point nearest from the earth

(D) depend on mass of satellite.

6. A planet of mass m moves around the sun of mass M in an elliptical orbit. The maximum and minimum distance of the planet from the sun are r_1 and r_2 respectively. The time period of the planet is proportional to

(A) $r_1^{3/2}$ (B) $r_2^{3/2}$ (C) $(r_1 + r_2)^{3/2}$ (D) $(r_1 - r_2)^{3/2}$

ANSWERS

NEWTON'S LAW OF GRAVITATION

1.	(c)	2.	(c)	3.	(d)	4.	(a)	5.	(d)	6.	(d)	7.	(a)
8.	(b)	9.	(c)	10.	(a)								

ACCELERATION DUE TO GRAVITY

1.	(b)	2.	(b)	3.	(c)	4.	(b)	5.	(c)	6.	(b)	7.	(b)

GRAVITATIONAL FIELD INTENSITY

1.	(d)	2.	(c)	3.	(a)	4.	(a)	5.	(d)	6.	(c)

GRAVITATIONAL POTENTIAL

1.	(d)	2.	(d)	3.	(a)	4.	(c)	5.	(c)	6.	(d)	7.	(b)

GRAVITATIONAL POTENTIAL ENERGY

1.	(c)	2.	(a)	3.	(d)	4.	(b)	5.	(b)	6.	(b)	7.	(d)
8.	(d)	9.	(d)	10.	(a)								

ESCAPE VELOCITY

1.	(c)	2.	(a)	3.	(c)	4.	(d)	5.	(c)	6.	(a)	7.	(a)
8.	(a)	9.	(b)	10.	(a)	11.	(b)	12.	(d)				

MOTION OF SATELLITE

1.	(c)	2.	(a)	3.	(a)	4.	(b)	5.	(a)	6.	(b)	7.	(a)
8.	(c)	9.	(d)	10.	(b)	11.	(d)	12.	(a)	13.	(a)	14.	(a)
15.	(b)	16.	(c)										

KEEPLER'S LAW OF PLANETARY MOTION

1.	(a)	2.	(c)	3.	(c)	4.	(a)	5.	(c)	6.	(c)