

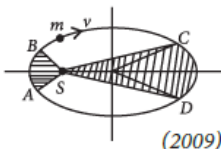
## KEPLER'S LAW

### 1st and 2nd law

1. The figure shows elliptical orbit of a planet  $m$  about the sun  $S$ . The shaded area  $SCD$  is twice the shaded area  $SAB$ . If  $t_1$  is 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.  $t_1 = 4t_2$       B.  $t_1 = 2t_2$   
 C.  $t_1 = t_2$       D.  $t_1 > t_2$

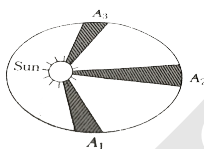
[NEET 2009]



(2009)

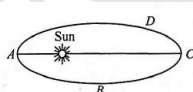
2. A planet moving around sun sweeps area  $A_1$  in 2 days,  $A_2$  in 3 days and  $A_3$  in 6 days. Then the relation between  $A_1$ ,  $A_2$  and  $A_3$  is

- A.  $3A_1 = 2A_2 = A_3$   
 B.  $2A_1 = 3A_2 = 6A_3$   
 C.  $3A_1 = 2A_2 = 6A_3$   
 D.  $6A_1 = 3A_2 = 2A_3$  [CET 2012]



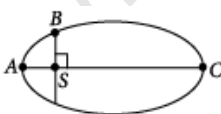
3. A planet revolves round the Sun in an elliptical orbit. The linear speed of the planet will be maximum at

- A.  $D$       B.  $B$       C.  $A$   
 D.  $C$       [CET 2009]



4. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions  $A$ ,  $B$  and  $C$  are  $K_A$ ,  $K_B$  and  $K_C$ , respectively.  $AC$  is the major axis and  $SB$  is perpendicular to  $AC$  at the position of the Sun  $S$  as shown in the figure. Then

- A.  $K_A < K_B < K_C$   
 B.  $K_A > K_B > K_C$   
 C.  $K_B < K_A < K_C$   
 D.  $K_B > K_A > K_C$  [NEET 2018]



### 3rd law

5. The period of revolution of planet A around the sun is 8 times that of B. The distance of A from the sun is how many times greater than that of B from the sun?

- A. 4      B. 5      C. 2      D. 3      [NEET 1997]

6. The distance of two planets from the sun are  $10^{13}$  m and  $10^{12}$  m respectively. The ratio of time periods of the planets is

- A.  $\sqrt{10}$       B.  $10\sqrt{10}$       C. 10      D.  $1/\sqrt{10}$   
 [NEET 1994, 1988]

7. A satellite in a circular orbit of radius  $R$  has a period of 4 hours. Another satellite with orbital radius  $3R$  around the same planet will have a period (in hours)

- A. 16      B. 4      C.  $4\sqrt{27}$       D.  $4\sqrt{8}$       [CET 2006]

8. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

- A. 172 earth days      B. 124 earth days      C. 88 earth days      D. 225 earth days      [NEET 2025]

9. A planet takes 200 days to complete one revolution around the Sun. If the distance of the planet from the Sun is reduced to one fourth of the original distance, how many days will it take to complete one revolution?

- A. 20      B. 50      C. 100      D. 25      [JEE Main 2024]

10. If a satellite orbiting the Earth is 9 times closer to the Earth than the Moon, what is the time period of rotation of the satellite? Given rotational time period of Moon = 27 days and gravitational attraction between the satellite and the Moon is neglected.

- A. 3 days      B. 27 days      C. 81 days      D. 1 day  
 [JEE Main 2025]

### Miscellaneous

11. When a planet revolves around the Sun, in general, for the planet

- A. linear momentum and linear velocity are constant.  
 B. linear momentum and aerial velocity are constant.  
 C. kinetic and potential energy of the planet are constant.  
 D. angular momentum about the Sun and aerial velocity of the planet are constant.      [CET 2023]

12. A planet moving along an elliptical orbit is closest to the sun at a distance  $r_1$  and farthest away at a distance of  $r_2$ . If  $v_1$  and  $v_2$  are the linear velocities at these points respectively then the ratio  $\frac{v_1}{v_2}$  is
- A.  $(r_1/r_2)^2$       B.  $r_2/r_1$       C.  $(r_2/r_1)^2$   
 D.  $r_1/r_2$       [NEET 2011]
13. If  $r_p, v_p, L_p$  and  $r_a, v_a, L_a$  are radial distances and angular momenta of a planet at perihelion and aphelion of its elliptical orbit around the sun respectively, then
- A.  $r_p > r_a, v_p > v_a, L_a > L_p$   
 B.  $r_p < r_a, v_p > v_a, L_a = L_p$   
 C.  $r_p > r_a, v_p < v_a, L_a = L_p$   
 D.  $r_p < r_a, v_p < v_a, L_a < L_p$       [CET 2025]
14. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
- Assertion (A): The angular speed of the moon in its orbit about the Earth is more than the angular speed of the Earth in its orbit about the Sun.
- Reason (R): The moon takes less time to move around the Earth than the time taken by the Earth to move around the Sun.
- In the light of the above statements, choose the most appropriate answer:
- A. Both (A) and (R) are correct but (R) is not the correct explanation of (A)  
 B. (A) is correct but (R) is not correct  
 C. Both (A) and (R) are correct and (R) is the correct explanation of (A)  
 D. (A) is not correct but (R) is correct [JEE Main 2024]
15. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
- Assertion (A): The radius vector from the Sun to a planet sweeps out equal areas in equal intervals of time and thus areal velocity of the planet is constant.
- Reason (R): For a central force field, the angular momentum is a constant.
- A. A is not correct but R is correct      B. Both A and R are correct but R is not the correct explanation of A  
 C. Both A and R are correct and R is the correct explanation of A      D. A is correct but R is not correct [JEE Main 2025]
16. The largest and the shortest distance of the earth from the sun are  $r_1$  and  $r_2$ . Its distance from the sun when it is at perpendicular to the major-axis of the orbit drawn from the sun is
- A.  $\frac{r_1 + r_2}{4}$       B.  $\frac{r_1 + r_2}{r_1 - r_2}$       C.  $\frac{2r_1 r_2}{r_1 + r_2}$   
 D.  $\frac{r_1 + r_2}{3}$       [NEET 1988]

## LAW OF GRAVITATION

1. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will
- A. move towards each other      B. move away from each other      C. will become stationary  
 D. keep floating at the same distance between them.      [NEET 2017]
2. If the mass of a body is  $M$  on the surface of the earth, the mass of the same body on the surface of the moon is
- A.  $M$       B. zero      C.  $M/6$       D.  $6M$       [CET 2015]
3. Gravitational force is required for
- A. stirring of liquid      B. convection      C. conduction      D. radiation      [NEET 2000]
4. Two spheres of masses  $m$  and  $M$  are situated in air and the gravitational force between them is  $F$ . If the space around the masses is now filled with a liquid of specific gravity 3, the gravitational force will now be
- A.  $3F$       B.  $F$       C.  $F/3$       D.  $F/9$       [NEET 2003]
5. A body of weight 72 N moves from the surface of earth at a height half of the radius of earth, then gravitational force exerted on it will be

- A. 36 N    B. 32 N    C. 144 N    D. 50 N  
[NEET 2000]

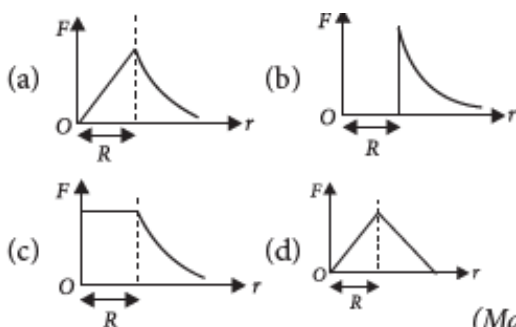
6. A body has a weight of 80 N on the surface of the Earth. It is taken to a height equal to the radius of the Earth. The gravitational force acting on it will be:

- A. 20 N    B. 40 N    C. 10 N    D. 80 N

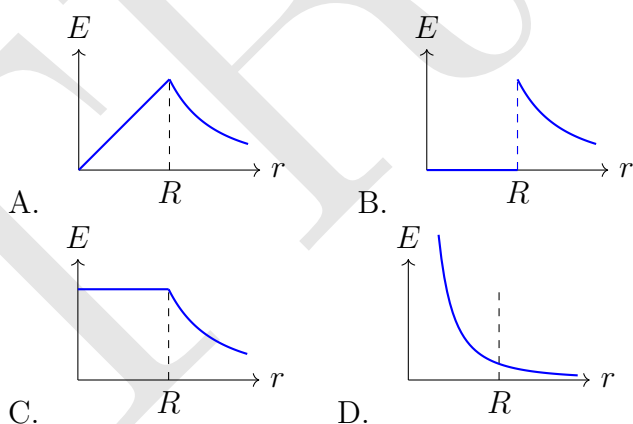
7. The weight of a satellite on the surface of the Earth is 54 N. If it is raised to a height equal to twice the radius of the Earth, the gravitational force acting on it becomes:

- A. 6 N    B. 9 N    C. 12 N    D. 18 N

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



9. Which one of the following plots represents the variation of the gravitational field  $E$  on a particle with distance  $r$  due to a uniform solid sphere of radius  $R$  ( $r$  is measured from the centre of the sphere)?



10. Two particles of equal mass  $m$  go around a circle of radius  $R$  under the action of their mutual gravitational attraction. The speed of each particle is

- A.  $\frac{1}{2}\sqrt{\frac{Gm}{R}}$     B.  $\sqrt{\frac{4Gm}{R}}$     C.  $\frac{1}{2}\sqrt{\frac{Gm}{R}}$   
D.  $\sqrt{\frac{Gm}{R}}$     [NEET 1995]

11. If the gravitational force between two objects were proportional to  $1/R$  (and not as  $1/R^2$ ), where  $R$  is the distance between them, then a particle in circular path (under such force) would have its orbital speed  $v$ , proportional to

- A.  $R$     B.  $R^0$  (independent of  $R$ )    C.  $1/R^2$   
D.  $1/R$     [NEET 1994, 1989]

12. Kepler's third law states that square of period of revolution ( $T$ ) of a planet around the sun, is proportional to third power of average distance  $r$  between sun and planet i.e.  $T^2 = Kr^3$  here  $K$  is constant. If the masses of sun and planet are  $M$  and  $m$  respectively then as per Newton's law of gravitation the force of attraction between them is  $F = \frac{GMm}{r^2}$ , here  $G$  is gravitational constant.

The relation between  $G$  and  $K$  is described as

- A.  $K = G$     B.  $K = \frac{1}{G}$     C.  $GK = 4\pi^2$   
D.  $GK = 4\pi^2$     [2015 Cancelled]

13. Two bodies of masses 8 kg are placed at the vertices  $A$  and  $B$  of an equilateral triangle  $ABC$ . A third body of mass 2 kg is placed at the centroid  $G$  of the triangle. If  $AG = BG = CG = 1$  m, where should a fourth body of mass 4 kg be placed so that the resultant force on the 2 kg body is zero?

- A. At  $C$   
B. At a point  $P$  on the line  $CG$  such that  $PG = \frac{1}{\sqrt{2}}$  m  
C. At a point  $P$  on the line  $CG$  such that  $PG = 0.5$  m  
D. At a point  $P$  on the line  $CG$  such that  $PG = 2$  m    [CET 2021]

14. Four identical particles of mass  $m$  are kept at the four corners of a square. If the gravitational force exerted on one of the masses by the other masses is

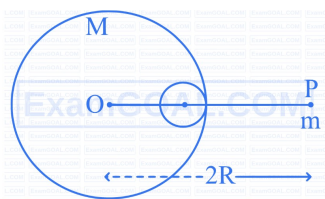
$$\left(\frac{2\sqrt{2} + 1}{32}\right) \frac{Gm^2}{L^2},$$

the length of the side of the square is:

A.  $4L$  B.  $3L$  C.  $2L$  D.  $\frac{L}{2}$  [JEE Main 2024]

15. A small point of mass  $m$  is placed at a distance  $2R$  from the centre  $O$  of a big uniform solid sphere of mass  $M$  and radius  $R$ . The gravitational force on  $m$  due to  $M$  is  $F_1$ . A spherical part of radius  $R/3$  is removed from the big sphere as shown, and the gravitational force on  $m$  due to the remaining part of  $M$  is found to be  $F_2$ .

The ratio  $F_1 : F_2$  is:



A. 11 : 10 B. 12 : 11 C. 16 : 9 D. 12 : 9 [JEE Main 2025]

16. A light planet is revolving around a massive star in a circular orbit of radius  $R$  with period of revolution  $T$ . If the force of attraction between the

planet and star is proportional to  $R^{-3/2}$ , then choose the correct option:

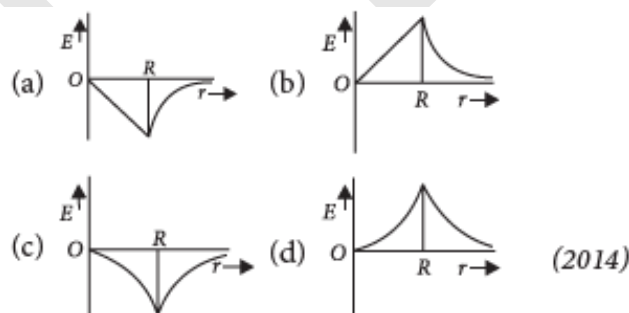
A.  $T^2 \propto R^{7/2}$  B.  $T^2 \propto R^3$  C.  $T^2 \propto R^{5/2}$   
D.  $T^2 \propto R^{3/2}$  [JEE Main 2024]

### Gravitational intensity

17. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is

A. 0.05 N/kg B. 50 N/kg C. 20 N/kg  
D. 180 N/kg [NEET 2022 Phase 1]

18. Dependence of intensity of gravitational field ( $E$ ) of earth with distance  $r$  from centre of earth is correctly represented by [NEET 2014]

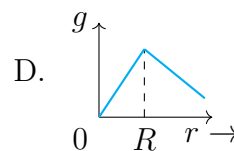
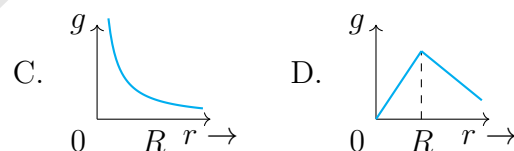
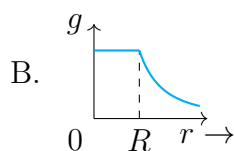
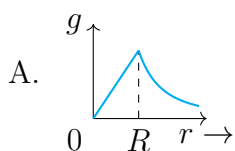


## ACCELERATION DUE TO GRAVITY

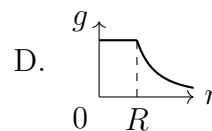
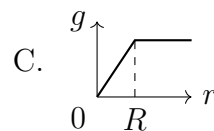
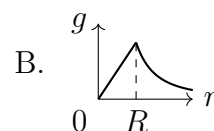
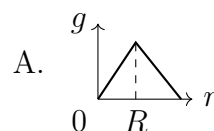
1. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct?

A. Raindrops will fall faster. B. Walking on the ground would become more difficult.  
C. Time period of a simple pendulum on the Earth would decrease. D.  $g$  on the Earth will not change. [NEET 2018]

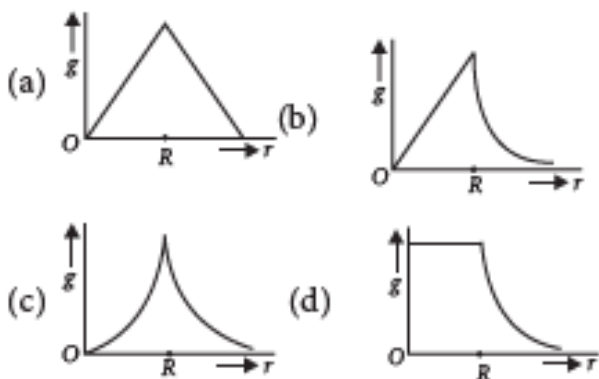
2. Variation of acceleration due to gravity ( $g$ ) with distance  $x$  from the centre of the earth is best represented by ( $R \rightarrow$  Radius of the earth)



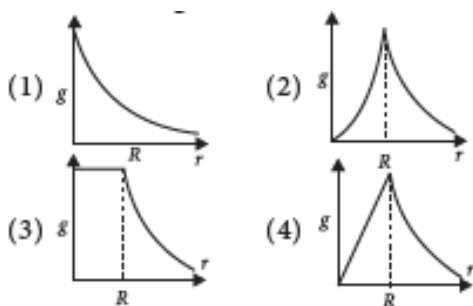
3. Which of the following graphs correctly represents the variation of  $g$  on the Earth?



4. Starting from the centre of the earth having radius  $R$ , the variation of  $g$  (acceleration due to gravity) is shown by



5. 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  $R$  and of uniform density is as shown in figures. The correct figure is



The correct figure is

- (a) (4) (b) (1) (c) (2) (d) (3)

(Mains 2010)

6. A spherical planet has a mass  $M_p$  and diameter  $D_p$ . A particle of mass  $m$  falling freely near the surface of this planet will experience an acceleration due to gravity, equal to

A.  $\frac{4GM_p}{D_p^2}$  B.  $\frac{GM_p m}{D_p^2}$  C.  $\frac{GM_p}{D_p^2}$   
 D.  $\frac{4GM_p m}{D_p^2}$  [NEET 2012]

7. What will be the formula of mass of the earth in terms of  $g$ ,  $R$  and  $G$ ?

A.  $\frac{R}{g}$  B.  $\frac{gR^2}{G}$  C.  $\frac{g^2 R}{G}$  D.  $\frac{Gg}{R}$  [NEET 1996]

8. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on planet B. A man jumps to a height of 2 m on the surface of A. What is the height of jump by the same person on the planet B?

A. (2/9) m B. 18 m C. 6 m D. (2/3) m [NEET 2003]

9. The radius of earth is about 6400 km and that of mars is 3200 km. The mass of the earth is about 10 times mass of mars. An object weighs 200 N on the surface of earth. Its weight on the surface of mars will be

A. 20 N B. 8 N C. 80 N D. 40 N [NEET 1994]

10. The acceleration due to gravity on the surface of Earth is  $g$ . If the diameter of the Earth reduces to half of its original value and the mass remains constant, then the acceleration due to gravity on the surface of Earth would be:

A.  $\frac{g}{4}$  B.  $2g$  C.  $\frac{g}{2}$  D.  $4g$  [JEE Main 2024]

11. The mass of a planet is  $\frac{1}{10}$ th that of the earth and its diameter is half that of the earth. The acceleration due to gravity on that planet is:  
 A.  $19.6 \text{ m s}^{-2}$  B.  $9.8 \text{ m s}^{-2}$  C.  $4.9 \text{ m s}^{-2}$   
 D.  $3.92 \text{ m s}^{-2}$  [NEET 2024]

12. An astronaut on a strange planet finds that acceleration due to gravity is twice as that on the surface of earth. Which of the following could explain this?

- A. Radius of the planet is half as that of earth, but the mass is the same as that of earth.  
 B. Both the mass and radius of the planet are twice as that of earth.  
 C. Both the mass and radius of the planet are half as that of earth.  
 D. Mass of the planet is half as that of earth, but radius is same as that of earth. [CET 2010]

13. The acceleration due to gravity  $g$  and mean density  $\rho$  of the earth are related by which of the following relations? (where  $G$  is the gravitational constant and  $R$  is the radius of earth.)

A.  $\rho = \frac{3g}{4\pi GR}$  B.  $\rho = \frac{3g}{4\pi GR^3}$  C.  $\rho = \frac{4\pi GR^2}{3G}$  D.  $\rho = \frac{4\pi GR^3}{3G}$  [NEET 1995]

14.  $R$  is the radius of the earth and  $g$  is the acceleration due to gravity on the earth surface. Then the mean density of the earth will be:

A.  $\frac{\pi R G}{12g}$     B.  $\frac{3\pi R}{4gG}$     C.  $\frac{3g}{4\pi R G}$     D.  $\frac{4\pi G}{3gR}$   
 [NEET 2023 Manipur]

15. Imagine a new planet having the same density as that of earth but its radius is 3 times bigger than the radius of earth. If the acceleration due to gravity on the surface of earth is  $g$ , then that on the surface of new planet is

A.  $g = g/9$     B.  $g = 27g$     C.  $g = 9g$   
 D.  $g = 3g$     [NEET 2005]

16. If the density of a newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the planet would be

A.  $2R$     B.  $4R$     C.  $\frac{1}{4}R$     D.  $\frac{1}{2}R$     [NEET 2004]

### Height

17. What is the value of acceleration due to gravity at a height equal to half the radius of the Earth, from its surface?

A.  $4.4 \text{ m s}^{-2}$     B.  $6.5 \text{ m s}^{-2}$     C. zero  
 D.  $9.8 \text{ m s}^{-2}$     [CET 2024]

18. The height at which the weight of a body becomes  $\left(\frac{1}{16}\right)^{\text{th}}$  its weight on the surface of earth (radius  $R$ ) is

A.  $5R$     B.  $15R$     C.  $3R$     D.  $4R$     [NEET 2012]

19. A body weighs 72 N on the surface of the earth. What is the gravitational force on it, at a height equal to half the radius of the earth?

A. 48 N    B. 32 N    C. 30 N    D. 24 N  
 [NEET 2020]

20. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is:

A. 32 N    B. 36 N    C. 16 N    D. 27 N [NEET 2025]

21. A 90 kg body placed at  $2R$  distance from the surface of Earth experiences gravitational pull of: ( $R =$  radius of Earth,  $g = 10 \text{ m s}^{-2}$ )

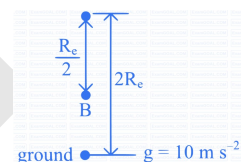
A. 300 N    B. 225 N    C. 100 N    D. 120 N  
 [JEE Main 2024]

22. The acceleration due to gravity becomes  $(g/2)$  where  $g =$  acceleration due to gravity on the surface of the earth at a height equal to

A.  $4R$     B.  $R/4$     C.  $2R$     D.  $R/2$     [CET 2007]

23. An object of mass 100 kg falls from point  $A$  to  $B$  as shown in figure. The change in its weight, corrected to the nearest integer is ( $R_E$  is the radius of the earth)

A. 49 N    B. 89 N    C. 5 N  
 D. 10 N    [NEET 2024]



24.  $R$  is the radius of the Earth and the acceleration due to gravity on the surface of Earth is  $g = \pi^2 \text{ m s}^{-2}$ . The length of the second's pendulum at a height  $h = 2R$  from the surface of Earth will be:

A.  $\frac{1}{9} \text{ m}$     B.  $\frac{8}{9} \text{ m}$     C.  $\frac{2}{9} \text{ m}$     D.  $\frac{4}{9} \text{ m}$     [JEE Main 2024]

### Depth

25. The value of acceleration due to gravity at a depth of 1600 km is equal to [Radius of earth = 6400 km]

A.  $9.8 \text{ m s}^{-2}$     B.  $4.9 \text{ m s}^{-2}$     C.  $7.35 \text{ m s}^{-2}$   
 D.  $19.6 \text{ m s}^{-2}$     [CET 2017]

26. A body weighs 200 N on the surface of the earth. How much will it weigh half way down to the centre of the earth?

A. 100 N    B. 150 N    C. 200 N    D. 250 N  
 [NEET 2019]

27. Assuming Earth to be a sphere of uniform mass density, a body weighs 300 N on the surface of Earth. How much would it weigh at depth  $R/4$  below the surface of Earth?

A. 75 N    B. 375 N    C. 300 N    D. 225 N  
 [JEE Main 2024]

### Height and depth mixed

28. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth below the surface of earth. Then  
 A.  $d = 1$  km    B.  $d = \frac{3}{2}$  km    C.  $d = 2$  km  
 D.  $d = \frac{1}{2}$  km    [NEET 2017]
29. The value of acceleration due to gravity at a height of 10 km from the surface of earth is  $x$ . At what depth inside the earth is the value of the

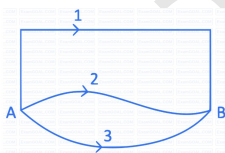
acceleration due to gravity has the same value  $x$ ?

- A. 10 km    B. 15 km    C. 5 km    D. 20 km  
 [CET 2020]

30. At what distance above and below the surface of the Earth will a body have the same weight? (Take radius of Earth as  $R$ )  
 A.  $\frac{\sqrt{3}R - R}{2}$     B.  $\frac{R}{2}$     C.  $\frac{\sqrt{5}R - R}{2}$     [JEE  
 Main 2024]    D.  $\sqrt{5}R - R$

## GRAVITATIONAL POTENTIAL ENERGY

1. A gravitational field is present in a region and a mass is shifted from  $A$  to  $B$  through different paths as shown. If  $W_1$ ,  $W_2$  and  $W_3$  represent the work done by the gravitational force along the respective paths, then :  
 A.  $W_1 < W_2 < W_3$   
 B.  $W_1 = W_2 = W_3$   
 C.  $W_1 > W_2 > W_3$   
 D.  $W_1 > W_3 > W_2$     [NEET 2022 Phase 2]



2. A mass  $m$  on the surface of the Earth is shifted to a target equal to the radius of the Earth. If  $R$  is the radius and  $M$  is the mass of the Earth, then work done in this process is

- A.  $\frac{mgR}{2}$     B.  $mgR$     C.  $2mgR$     D.  $\frac{mgR}{4}$   
 [CET 2018]

3. A body of mass  $m$  is placed on earth's surface which is taken from earth surface to a height of  $h = 3R$ , then change in gravitational potential energy is

- A.  $\frac{mgR}{4}$     B.  $\frac{2}{3}mgR$     C.  $\frac{3}{4}mgR$     D.  $\frac{mgR}{2}$   
 [NEET 2003]

4. The work done to raise a mass  $m$  from the surface of the earth to a height  $h$ , which is equal to the radius of the earth, is

- A.  $\frac{3}{2}mgR$     B.  $mgR$     C.  $2mgR$     D.  $\frac{1}{2}mgR$   
 [NEET 2019]

5. 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 in the potential energy of body will be

- A.  $3mgR$     B.  $\frac{1}{3}mgR$     C.  $mg2R$   
 D.  $\frac{2}{3}mgR$     [NEET 2013]

### Gravitational Potential

6. A planet is moving in an elliptical orbit around the sun. If  $T$ ,  $V$ ,  $E$  and  $L$  stand respectively for its kinetic energy, gravitational potential energy, total energy and magnitude of angular momentum about the centre of force, which of the following is correct?

- A.  $T$  is conserved.  
 B.  $V$  is always positive.  
 C.  $E$  is always negative.  
 D.  $L$  is conserved but direction of vector  $L$  changes continuously. [NEET 1990]

7. At what height from the surface of earth the gravitational potential and the value of  $g$  are  $-5.4 \times 10^7$  J kg $^{-1}$  and 6.0 m s $^{-2}$  respectively? Take radius of earth as 6400 km.

- A. 1400 km    B. 2000 km    C. 2600 km  
 D. 1600 km    [NEET-I 2016]

8. The gravitational potential at a point above the surface of Earth is  $-5.12 \times 10^7$  J kg $^{-1}$  and the acceleration due to gravity at that point is 6.4 m s $^{-2}$ . Assume the mean radius of Earth to be 6400 km. The height of this point above the Earth's surface is:

- A. 1600 km      B. 1200 km      C. 540 km  
D. 1000 km      [JEE Main 2024]

9. Two bodies of mass  $m$  and  $9m$  are placed at a distance  $R$ . The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be ( $G =$  gravitational constant):

- A.  $-\frac{12Gm}{R}$       B.  $-\frac{16Gm}{R}$       C.  $-\frac{20Gm}{R}$   
D.  $-\frac{8Gm}{R}$       [NEET 2023]

10. Infinite number of bodies, each of mass 2 kg are situated on  $x$ -axis at distances 1 m, 2 m, 4 m, 8 m, ... respectively, from the origin. The resulting gravitational potential due to this system at the origin will be

- A.  $-\frac{4}{3}G$       B.  $-4G$       C.  $-G$       D.  $-\frac{8}{3}G$   
[NEET 2013]

11. 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 distance  $a/2$  distance from the centre, will be

- A.  $\frac{GM}{a}$       B.  $\frac{2GM}{a}$       C.  $\frac{3GM}{a}$       D.  $\frac{4GM}{a}$   
[JEE Main 2011, 2010]

12. In a gravitational field, the gravitational potential is given by,  $V = -\frac{K}{x}$  (J/Kg). The gravitational field intensity at point (2, 0, 3) m is

A.  $+\frac{K}{4}$       B.  $+\frac{K}{2}$       C.  $-\frac{K}{2}$       D.  $-\frac{K}{4}$   
[NEET 2022 Phase 2]

13. Match List-I with List-II:

List-I		List-II	
A	Gravitational constant	I	$[LT^{-2}]$
B	Gravitational potential energy	II	$[L^2T^{-2}]$
C	Gravitational potential	III	$[ML^2T^{-2}]$
D	Acceleration due to gravity	IV	$[M^{-1}L^3T^{-2}]$

A. A-IV, B-III, C-II, D-I

B. A-II, B-IV, C-III, D-I

C. A-I, B-III, C-IV, D-II

D. A-III, B-II, C-I, D-IV      [JEE Main 2025]

14. Match List-I with List-II.

	List-I		List-II
(a)	Gravitational constant ( $G$ )	(i)	$[L^2T^{-2}]$
(b)	Gravitational potential energy	(ii)	$[M^{-1}L^3T^{-2}]$
(c)	Gravitational potential	(iii)	$[LT^{-2}]$
(d)	Gravitational intensity	(iv)	$[ML^2T^{-2}]$

Choose the correct answer from the options given below.

A. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

B. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

C. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

D. (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)  
[NEET 2022 Phase 1]

## ESCAPE SPEED

1. A particle of mass  $m$  is thrown upwards from the surface of the earth with a velocity  $u$ . The mass and the radius of the earth are, respectively,  $M$  and  $R$ .  $G$  is gravitational constant and  $g$  is acceleration due to gravity on the surface of the earth. The minimum value of  $u$  is such that the particle does not return back to earth, is

- A.  $\left(\frac{GM}{R}\right)^{1/2}$       B.  $\left(\frac{8GM}{R}\right)^{1/2}$

C.  $\left(\frac{2GM}{R}\right)^{1/2}$       D.  $\left(\frac{4GM}{R}\right)^{1/2}$       [NEET 2001]

2. The escape velocity of a sphere of mass  $m$  is given ( $G =$  Universal gravitational constant;  $M_e =$  Mass of the earth and  $R_e =$  Radius of earth)

- A.  $\sqrt{\frac{2GM_e}{R_e}}$       B.  $\sqrt{\frac{2GM_e}{R_e}}$       C.  $\sqrt{\frac{GM_e}{R_e}}$

- D.  $\sqrt{\frac{2GM_e + R_e}{R_e}}$  [NEET 1999]
3. For a planet having mass equal to mass the earth but radius is one fourth of radius of the earth. The escape velocity for this planet will be  
A. 11.2 km/s B. 22.4 km/s C. 5.6 km/s  
D. 44.8 km/s [NEET 2000]
4. The escape velocity of a body on the surface of the earth is 11.2 km/s. If the earth's mass increases to twice its present value and radius of the earth becomes half, the escape velocity becomes  
A. 22.4 km/s B. 44.8 km/s C. 5.6 km/s  
D. 11.2 km/s [NEET 1997]
5. Escape velocity of a body from Earth is  $11.2 \text{ km s}^{-1}$ . If the radius of a planet is one third the radius of Earth and its mass is one sixth that of Earth, the escape velocity from the planet is:  
A.  $7.9 \text{ km s}^{-1}$  B.  $8.4 \text{ km s}^{-1}$  C.  $4.2 \text{ km s}^{-1}$   
D.  $11.2 \text{ km s}^{-1}$  [JEE Main 2024]
6. Earth has mass 8 times and radius 2 times that of a planet. If the escape velocity from the Earth is  $11.2 \text{ km s}^{-1}$ , the escape velocity (in  $\text{km s}^{-1}$ ) from the planet will be:  
A. 8.4 B. 11.2 C. 5.6 D. 2.8 [JEE Main 2025]
7. The escape velocity from earth is 11.2 km/s. If a body is to be projected in a direction making an angle  $45^\circ$  to the vertical, then escape velocity is  
A.  $11.2 \times 2 \text{ km/s}$  B. 11.2 km/s  
C.  $11.2/\sqrt{2} \text{ km/s}$  D.  $11.2\sqrt{2} \text{ km/s}$  [NEET 1993]
8. For a satellite escape velocity is 11 km/s. If the satellite is launched at an angle of  $60^\circ$  with the vertical, then escape velocity will be  
A. 11 km/s B.  $11\sqrt{3} \text{ km/s}$  C.  $\frac{11}{\sqrt{3}} \text{ km/s}$   
D. 33 km/s [NEET 1989]
9. A space station is at a height equal to the radius of the Earth. If  $v_e$  is the escape velocity on the surface of the Earth, the same on the space station is \_\_\_\_\_ times  $v_e$   
A.  $\frac{1}{2}$  B.  $\frac{1}{4}$  C.  $\frac{1}{\sqrt{2}}$  D.  $\frac{1}{\sqrt{3}}$  [CET 2018]
10. The mass of the moon is  $\frac{1}{144}$  times the mass of a planet and its diameter is  $\frac{1}{16}$  times the diameter of the planet. If the escape velocity on the planet is  $v$ , the escape velocity on the moon will be:  
A.  $\frac{v}{4}$  B.  $\frac{v}{6}$  C.  $\frac{v}{12}$  D.  $\frac{v}{3}$  [JEE Main 2024]
11. The escape velocity for earth is  $v$ . A planet having 9 times mass that of earth and radius 16 times that of earth, has the escape velocity of:  
A.  $\frac{v}{3}$  B.  $\frac{2v}{3}$  C.  $\frac{3v}{4}$  D.  $\frac{9v}{4}$  [NEET 2024 Re-Examination]
12. The earth is assumed to be a sphere of 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  $v_e$ , where  $v$  is its escape velocity from the surface of the Earth. The value of  $\frac{v_e}{v}$  is  
A.  $1/2$  B.  $\sqrt{2}$  C.  $1/\sqrt{2}$  D.  $1/3$  [NEET 2006]
13. The escape velocity from the Earth's surface is  $v$ . The escape velocity from the surface of another planet having a radius four times that of Earth and the the same mass density is :  
A.  $4v$  B.  $v$  C.  $2v$  D.  $3v$  [NEET 2021]
14. The radius of a planet is twice the radius of earth. Both have almost equal average mass-densities. If  $v_p$  and  $v_E$  are escape velocities of the planet and the earth, respectively then  
A.  $v_p = 1.5 v_E$  B.  $v_p = 2 v_E$  C.  $v_E = 3 v_p$   
D.  $v_p = 1.5 v_p$  [Karnataka NEET 2013]
15. The ratio of escape velocity at earth ( $v_e$ ) to escape velocity at a planet ( $v_p$ ) whose radius and mean density are twice that of earth is  
A. 1 : 4 B. 1 :  $2\sqrt{2}$  C. 1 : 2 D. 1 : 2 [NEET-I 2016]
16. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass =  $5.98 \times 10^{24} \text{ kg}$ ) have to be compressed to be a black hole?  
A.  $10^{-9} \text{ m}$  B.  $10^{-6} \text{ m}$  C.  $10^{-2} \text{ m}$   
D. 100 m [NEET 2014]

### Conservation Of Energy

17. To project a body of mass  $m$  from Earth's surface to infinity, the required kinetic energy is (assume radius of Earth =  $R_E$ , acceleration due to gravity =  $g$ ):
- A.  $\frac{1}{2}mgR_E$       B.  $4mgR_E$       C.  $mgR_E$   
 D.  $2mgR_E$       [JEE Main 2024]
18. With what velocity should a particle be projected so that its height becomes equal to radius of earth?
- A.  $\left(\frac{GM}{R}\right)^{1/2}$       B.  $\left(\frac{8GM}{R}\right)^{1/2}$   
 C.  $\left(\frac{2GM}{R}\right)^{1/2}$       D.  $\left(\frac{4GM}{R}\right)^{1/2}$       [NEET 2001]
19. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
- Assertion (A): The kinetic energy needed to project a body of mass  $m$  from Earth's surface to infinity is  $\frac{1}{2}mgR$ , where  $R$  is the radius of Earth.
- Reason (R): The maximum potential energy of a body is zero when it is projected to infinity from Earth's surface.
- A. A is false but R is true      B. Both A and R are true and R is the correct explanation of A  
 C. A is true but R is false      D. Both A and R are true but R is NOT the correct explanation of A      [JEE Main 2025]
20. A particle of mass  $m$  is at rest at height  $3R$  from the surface of earth, where  $R$  is radius of earth and  $M$  is mass of earth. The minimum speed with return back, it should be projected, so that it does not return back, ( $g$  is acceleration due to gravity on the surface of earth)
- A.  $\left(\frac{GM}{2R}\right)^{1/2}$       B.  $\left(\frac{gR}{4}\right)^{1/2}$       C.  $\left(\frac{2g}{R}\right)^{1/2}$   
 D.  $\left(\frac{GM}{R}\right)^{1/2}$       [Karnataka NEET 2013]
21. An object is kept at rest at a distance of  $3R$  above the Earth's surface where  $R$  is Earth's radius. The minimum speed with which it must be projected so that it does not return to Earth is: (Assume  $M$  = mass of Earth,  $G$  = universal gravitational constant)
- A.  $\sqrt{\frac{3GM}{R}}$       B.  $\sqrt{\frac{2GM}{R}}$       C.  $\sqrt{\frac{GM}{2R}}$   
 D.  $\sqrt{\frac{GM}{R}}$       [JEE Main 2025]
22. The escape velocity of a body on the earth surface is 11.2 km/s. If the same body is projected upward with velocity 22.4 km/s, the velocity of this body at infinite distance from the centre of the earth will be:
- A.  $11.2\sqrt{2}$  km/s      B. Zero      C. 11.2 km/s  
 D.  $11.2\sqrt{3}$  km/s      [NEET 2023 Manipur]
23. A particle of mass 'm' is projected with a velocity  $v = kV_e$  ( $k < 1$ ) from the surface of the earth. ( $V_e$  = escape velocity) The maximum height above the surface reached by the particle is :
- A.  $\frac{Rk^2}{1-k^2}$       B.  $R\left(\frac{k}{1-k^2}\right)^2$   
 C.  $R\left(\frac{k}{1+k^2}\right)^2$       D.  $\frac{R^2k}{1+k}$       [NEET 2021]

### EARTH SATELLITE

1. 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 linear momentum of  $S$  remains constant in magnitude.  
 B. the acceleration of  $S$  is always directed towards the centre of the earth  
 C. the angular momentum of  $S$  about the centre of the earth changes in direction, but its magnitude remains constant  
 D. the total mechanical energy of  $S$  varies periodically with time      [NEET 2015]
2. The mean radius of earth is  $R$ , its angular speed on its own axis is  $\omega$  and the acceleration due to

gravity at earth's surface is  $g$ . What will be the radius of the orbit of a geostationary satellite?

- A.  $(R^2g/\omega^2)^{1/3}$  B.  $(Rg/\omega^2)^{1/3}$   
 C.  $(R^2\omega^2/g)^{1/3}$  D.  $(R^2g/\omega)^{1/3}$  [NEET 1992]

### ORBITAL VELOCITY

3. The radii of circular orbits of two satellites A and B are  $4R$  and  $R$ , respectively. If the speed of satellite A is  $3V$ , then the speed of satellite B will be

- A.  $\frac{3V}{4}$  B.  $6V$  C.  $12V$  D.  $\frac{3V}{2}$  [NEET 2010]

4. Two satellites A and B go round a planet in circular orbits having radii  $4R$  and  $R$  respectively. If the speed of A is  $3v$ , the speed of B will be:

- A.  $6v$  B.  $\frac{4}{3}v$  C.  $3v$  D.  $12v$  [JEE Main 2024]

5. If  $v_e$  is escape velocity and  $v_o$  is orbital velocity of a satellite for orbit close to the earth's surface, then these are related by

- A.  $v_o = \sqrt{2}v_e$  B.  $v_o = v_e$  C.  $v_e = \sqrt{2}v_o$   
 D.  $v_e = \sqrt{2}v_o$  [JEE Main 2012]

6. A remote-sensing satellite (of 500 kg) revolves in a circular orbit at a height of  $0.25 \times 10^6$  m above the surface of earth. The earth's radius is  $6.38 \times 10^6$  m and  $g = 9.8 \text{ m s}^{-2}$ , then the orbital speed of the satellite is

- A.  $9.13 \text{ km s}^{-1}$  B.  $6.67 \text{ km s}^{-1}$   
 C.  $7.76 \text{ km s}^{-1}$  D.  $8.56 \text{ km s}^{-1}$  [NEET 2015]

### TIME PERIOD

7. A satellite A of mass  $m$  is at a distance of  $r$  from the centre of the earth. Another satellite B of mass  $2m$  is at a distance of  $2r$  from the earth's centre. Their time periods are in the ratio of

- A.  $1 : 2$  B.  $1 : 16$  C.  $1 : 32$  D.  $1 : 2\sqrt{2}$  [NEET 1993]

8. A geostationary satellite is orbiting the earth at a height of  $5R$  above the surface of the earth,  $R$  being the radius of the earth. The time period of another satellite in hours at a height of  $2R$  from the surface of the earth is

- A. 5 B. 10 C.  $6\sqrt{2}$  D.  $\frac{6}{\sqrt{2}}$  [NEET 2012]

9. Two satellites of mass  $m$  and  $9m$  are orbiting a planet in orbits of radius  $R$ . Their periods of revolution will be in the ratio of

- A.  $9 : 1$  B.  $3 : 1$  C.  $1 : 1$  D.  $1 : 3$  [CET 2011]

10. The time period of a geostationary satellite is 24 h, at a height  $6R_e$  ( $R_e$  is radius of earth) from surface of earth. The time period of another satellite whose height is  $2.5R_e$  from surface will be

- A.  $6\sqrt{2}$  h B.  $12\sqrt{2}$  h C.  $\frac{24}{2.5}$  h D.  $\frac{12}{2.5}$  h [Odisha NEET 2019]

11. A satellite is orbiting just above the surface of the earth with period  $T$ . If  $d$  is the density of the earth and  $G$  is the universal constant of gravitation, the quantity  $\frac{3\pi}{Gd}$  represents:

- A.  $T^2$  B.  $T^3$  C.  $\sqrt{T}$  D.  $T$  [NEET 2023]

12. Two planets A and B having masses  $m_1$  and  $m_2$  move around the Sun in circular orbits of radii  $r_1$  and  $r_2$  respectively. If angular momentum of A is  $L$  and that of B is  $3L$ , the ratio of their time periods  $\left(\frac{T_A}{T_B}\right)$  is:

- A.  $\left(\frac{r_2}{r_1}\right)^{3/2}$  B.  $27\left(\frac{m_1}{m_2}\right)^3$  C.  $\left(\frac{r_1}{r_2}\right)^3$   
 D.  $\frac{1}{27}\left(\frac{m_2}{m_1}\right)^3$  [JEE Main 2024]

13. A satellite is launched into a circular orbit of radius  $R$  around the Earth. A second satellite is launched into an orbit of radius  $1.03R$ . The time period of revolution of the second satellite is larger than the first one approximately by:

- A. 3% B. 2.5% C. 4.5% D. 9% [JEE Main 2025]

14. A satellite revolving around a planet in stationary orbit has time period 6 hours. The mass of the planet is one-fourth the mass of Earth. The radius of orbit of the planet is:

- (Given: radius of geostationary orbit for Earth =  $4.2 \times 10^4$  km)

- A.  $1.68 \times 10^5$  km    B.  $1.4 \times 10^4$  km    C.  $8.4 \times 10^4$  km  
D.  $1.05 \times 10^4$  km    [JEE Main 2024]
15. What is a period of revolution of earth satellite? Ignore the height of satellite above the surface of earth. Given : (1) The value of gravitational acceleration  $g = 10 \text{ m s}^{-2}$ . (2) Radius of earth  $R_E = 6400 \text{ km}$ . Take  $\pi = 3.14$ .
- A. 83.73 minutes    B. 85 minutes    C. 90 minutes  
D. 156 minutes    [CET 2014]
16. Correct formula for height of a satellite from Earth's surface is:
- A.  $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{1/3} - R$     B.  $\left(\frac{T^2 R^2 g}{4\pi}\right)^{1/2} - R$   
C.  $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{-1/3} + R$     D.  $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{1/3} - R$   
[JEE Main 2024]
- C. The kinetic energies of the two satellites are equal.
- D. The time period of  $S_1$  is four times that of  $S_2$ .    [NEET 2007]
21. A satellite of mass  $m$  is orbiting the earth (of radius  $R$ ) at a height  $h$  from its surface. The total energy of the satellite in terms of  $g_0$ , the value of acceleration due to gravity at the earth's surface, is
- A.  $\frac{mg_0 R^2}{2(R+h)}$     B.  $\frac{mg_0 R^2}{2(R+h)}$     C.  $\frac{2mg_0 R^2}{R+h}$   
D.  $-\frac{2mg_0 R^2}{R+h}$     [NEET-II 2016]
22. The additional kinetic energy to be provided to a satellite of mass  $m$  revolving around a planet of mass  $M$ , to transfer it from a circular orbit of radius  $R_1$  to another orbit of radius  $R_2$  ( $R_2 > R_1$ ), is

## ENERGY PROBLEMS

17. The satellite of mass  $m$  is orbiting the earth in a circular orbit with a velocity  $v$ . What will be its total energy?
- A.  $(3/4)mv^2$     B.  $(1/2)mv^2$     C.  $mv^2$   
D.  $-(1/2)mv^2$     [NEET 1991]
18. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is
- A.  $1/2$     B.  $1/\sqrt{2}$     C.  $2$     D.  $\sqrt{2}$     [NEET 2005]
19. A satellite is orbiting close to the earth and has a kinetic energy  $K$ . The minimum extra kinetic energy required by it to just overcome the gravitational pull of the earth is
- A.  $\sqrt{3}K$     B.  $K$     C.  $2\sqrt{2}K$     D.  $2K$     [CET 2019]
20. 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.
- A.  $GmM \left(\frac{1}{R_1^2} - \frac{1}{R_2^2}\right)$     B.  $GmM \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$   
C.  $2GmM \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$     D.  $\frac{1}{2}GmM \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$   
[JEE Main 2010]
23. The total energy of a satellite in a circular orbit at a distance  $(R+h)$  from the center of the earth varies as [ $R$  is the radius of the earth and  $h$  is the height of the orbit from Earth's surface]
- A.  $-\frac{1}{(R+h)}$     B.  $\frac{1}{(R+h)^2}$     C.  $-\frac{1}{(R+h)^2}$   
D.  $\frac{1}{(R+h)}$     [CET 2025]
24. The minimum energy required to launch a satellite of mass  $m$  from the surface of earth of mass  $M$  and radius  $R$  in a circular orbit at an altitude of  $2R$  from the surface of the earth is:
- A.  $\frac{5GmM}{6R}$     B.  $\frac{2GmM}{3R}$     C.  $\frac{GmM}{2R}$   
D.  $\frac{GmM}{3R}$     [NEET 2024]
25. An astronaut takes a ball of mass  $m$  from Earth to space. He throws the ball into a circular orbit about Earth at an altitude of 318.5 km. From Earth's surface to the orbit, the change in total mechanical energy of the ball is
- $$x \frac{GMm}{21R_E}.$$
- The value of  $x$  is: (Take  $R_E = 6370 \text{ km}$ )

A. 12 B. 11 C. 9 D. 10 [JEE Main 2024]

26. A satellite of  $10^3$  kg mass is revolving in a circular orbit of radius  $2R$ . If  $\frac{10^4 R}{6}$  J energy is supplied to the satellite, it will revolve in a new circular orbit of radius (use  $g = 10 \text{ m s}^{-2}$ ,  $R =$  radius of Earth):

A.  $4R$  B.  $6R$  C.  $2.5R$  D.  $3R$  [JEE Main 2024]

27. Match List I with List II:

List I		List II	
A	Kinetic energy of planet	I	$-\frac{GMm}{a}$
B	Gravitational potential energy of sun-planet system	II	$\frac{GMm}{2a}$
C	Total mechanical energy of planet	III	$\frac{Gm}{r}$
D	Escape energy at surface of planet for unit mass	IV	$-\frac{GMm}{2a}$

(Where  $a =$  radius of planet orbit,  $r =$  radius of planet,  $M =$  mass of Sun,  $m =$  mass of planet)

- A. (A)-(II), (B)-(I), (C)-(IV), (D)-(III)  
 B. (A)-(I), (B)-(II), (C)-(III), (D)-(IV)  
 C. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)  
 D. (A)-(I), (B)-(IV), (C)-(II), (D)-(III) [JEE Main 2024]