GRAVITATION

1. Two satellites *A* and *B* go round a planet *P* in circular orbits having radii 4*R* and *R* respectively. If the speed of the satellite *A* is 3V, the speed of the satellite *B* will be

(a) 12 V (b) 6 V

(c) $\frac{4\text{V}}{3}$ (d) $\frac{3\text{ V}}{2}$

2. The escape velocity on the surface of the earth is 11.2 km/s. What would be the escape velocity on the surface of another planet of the same mass but 1/4 times the radius of the earth?

(a) 44.8 km/s (b) 22.4 km/s (c) 5.6 km/s (d) 11.2 km/s

3. If a body is to be projected vertically upwards from earth's surface to reach a height of 10*R* from surface of earth, (where *R* is the radius of earth), the velocity required to do so is

(a) $\sqrt{\left(\frac{24}{11} g R\right)}$ (b) $\sqrt{\left(\frac{22}{11} g R\right)}$ (c) $\sqrt{\left(\frac{20}{11} g R\right)}$ (d) $\sqrt{\left(\frac{18}{11} g R\right)}$

4. If a spring balance having frequency *f* is taken on moon (having $g' = g / 6$) it will have a frequency of

(a) $6f$ (b) $f / \sqrt{6}$ (c) $\sqrt{6} f$ (d) f

5. Two identical spheres, each with radius *r* are placed so that their centres are at a distance of 6*r*. The gravitational force of attraction between them will be proportional to

(a) r^2 (b) r^{-2} (c) r^4 (d) r^6

6. The ratio of potential energy of an earth satellite to its total mechanical energy is

(a) 1 : 2 (b) 2 : 1 (c) 4 : 1 (d) 1 : 1

6. The force of gravitation is

(a) repulsive (b) strong

(c) conservative (d) non-conservative

8. If R is the radius of earth, ω is its angular velocity and g_p is the value of acceleration due to gravity at the poles, then effective value of acceleration due to gravity at the latitude $\lambda = 60^0$ will be equal to

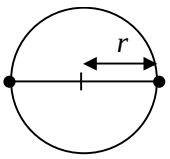
(a) $g_p - \frac{1}{4}R\omega^2$ (b) $g_p - \frac{3}{4}R\omega^2$ (c) $g_p - R\omega^2$ (d) $g_p + \frac{1}{4}R\omega^2$

9. The depth d at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times the value at the surface, is (R = radius of the earth)

(a) $\frac{R}{n}$ (b) $R\left(\frac{n-1}{n}\right)$ (c) $\frac{R}{n^2}$ (d) $R\left(\frac{n}{n+1}\right)$

10. Two particles of equal mass move in a circle of radius r under the action of their mutual gravitational attraction. If the mass of each particle is M, the speed of each particle is

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



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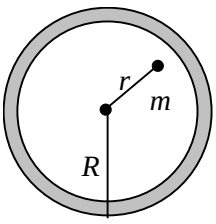
11. A mass m is placed in the cavity inside a uniform hollow sphere of mass M as shown in the figure. What is the gravitational force on the mass m?

(a) $\frac{GMm}{R^2}$ (b) $\frac{GMm}{r^2}$

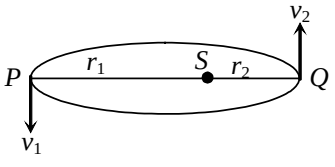
(c) $\frac{GMm}{(R-r)^2}$ (d) zero



12. Two satellites A and B go around a planet in circular orbits having radii 4R and R, respectively. If the speed of satellite A is 3v, then speed of satellite B is

(a) $\frac{3v}{2}$ (b) $\frac{4v}{2}$ (c) $6v$ (d) $12\ v$

13. A planet is moving in an elliptical path around the sun as shown in figure. Speed of planet in positions P and Q are v_1 and v_2 respectively with $SP = r_1$ and $SQ = r_2$ then v_1/v_2 is equal to



(a) $\frac{r_1}{r_2}$ (b) $\frac{r_2}{r_1}$

(c) consonant (d) $\left(\frac{r_1}{r_2}\right)^2$

14. The height of the point vertically above the earth's surface at which the acceleration due to gravity becomes 1% of its value at the surface is (R is the radius of the earth)

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

15. The distance of the centres of moon and earth is D. The mass of the earth is 81 times the mass of the moon. At what distance from the centre of the earth, the gravitation force will be zero?

(a) $D/2$ (b) $2D/3$ (c) $4D/3$ (d) $9D/10$

16. The acceleration due to gravity on the surface of the moon is $\frac{1}{6}^{\text{th}}$ of that on the surface of earth and the diameter of the moon is one-fourth that of earth. The ratio of escape velocities on earth and moon will be

(a) $\frac{\sqrt{6}}{2}$ (b) $\sqrt{24}$ (c) 3 (d) $\frac{\sqrt{3}}{2}$

17. The value of acceleration due to gravity at a height R from surface of the earth is (R = radius of the earth and g = acceleration due to gravity on earth surface)

(a) zero (b) $\sqrt{g}$ (c) $\frac{g}{4}$ (d) $\frac{g}{2}$

18. The period of a satellite in a circular orbit around a planet is independent of

(a) the mass of the planet (b) the radius of the orbit

(c) the mass of the satellite (d) all of three parameters given in options *a*, *b* and *c*

19. The time period of artificial satellite in a circular orbit of radius R is T. The radius of the orbit in which time period is 8T is

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

20. A body is projected with escape velocity 11.2 km/s from earth's surface. If the body is projected in a direction 30^0 angle to the vertical, its escape velocity in this case will be

(a) 11.2 km/s (b) $11.2 \times \frac{1}{2}$ km/s (c) $11.2\left(\frac{\sqrt{3}}{2}\right)$ km/s (d) none of these

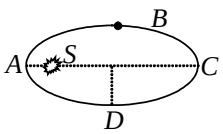
21. The gravitational force of attraction between two spherical bodies, each of mass 100 kg, if the distance between their centres is 100 m, is ($G = 6.67 \times 10^{-11}$ Nm^2 kg^{-2})

(a) 6.67×10^{-11} N (b) 6.67×10^{-9} N (c) 6.67 (d) none of these

22. When a satellite going round the earth in a circular orbit at a distance from a proton with kinetic energy E. To escape to infinity, the energy which must be supplied to the electron is

(a) E (b) $2E$ (c) $0.5\,E$ (d) $\sqrt{2}E$

23. A planet revolves in elliptical orbit around the sun shown in the figure. The linear speed of the planet will be maximum at



(a) A (b) B
(c) C (d) D

24. The gravitational force between two point masses m_1 and m_2 at separation r is given by $F = k\frac{m_1 m_2}{r^2}$. The constant k

25. The weight of a body at the centre of the earth will be

(a) zero (b) $MgRe$ (c) $\frac{MgR_e}{2}$ (d) infinity

26. A planet of mass M is revolving round the sun in an elliptical orbit. If its angular momentum is J then the area swept per second by the line joining planet to sun will be

(a) $\frac{JM}{2}$ (b) $\frac{J}{M}$ (c) $\frac{J}{2M}$ (d) JM

27. The gravitational mass of a body on the earth is M. The inertial mass of the same body on the moon will be

(a) zero (b) 6 M (c) M (d) $M/6$

28. Two spheres of same radius and same material are placed in contact with each other. The gravitational force between them is

(a) $F \propto R^2$ (b) $F \propto R^6$ (c) $F \propto R^4$ (d) $F \propto 1/R^2$

29. An artificial satellite moving in a circular orbit around the earth has a total energy E_0 (KE+PE). Its PE is

(a) $-E_0$ (b) 1.5 E_0 (c) $2E_0$ (d) E_0

30. A geostationary satellite orbits around the earth in a circular orbit of radius 36000 km. Then period of spy satellite orbiting a few hundred kilometers above the earth's surface (R_{earth} =6400 km) will approximately be

(a) 1/2 h (b) h (c) 2 h (d) 4 h

31. Two bodies of masses $M_1 = m$ and $M_2 = 4m$ are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is

(a) zero (b) $-\frac{4Gm}{r}$ (c) $-\frac{6Gm}{r}$ (d) $-\frac{9Gm}{r}$

32. Two spheres (identical) of mass m and radius R are separated by $3R$ from their centres. The force between them is proportional to

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

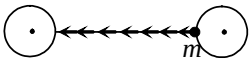
33. Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space around the masses is now filled with a liquid of specific gravity 3. The gravitational force will now be

(a) $F/9$ (b) $3F$ (c) F (d) $F/3$

34. At a height above the surface of the earth equal to the radius of the earth the acceleration due to gravity (acceleration due to gravity on the surface of the earth = g) will be

(a) zero (b) $\sqrt{g}$ (c) $\frac{g}{4}$ (d) $\frac{g}{2}$

35. Two identical spherical masses are kept at some distance as shown. Potential energy when a mass m is taken from surface of one sphere to the other



(a) increases continuously
(b) decreases continuously
(c) first increases then decreases
(d) first decreases then increases

36. A body of mass m is dropped from a height nR above the surface of the earth (here R is the radius of the earth). The speed at which the body hits the surface of the earth is

(a) $\sqrt{\frac{2gR}{(n+1)}}$ (b) $\sqrt{\frac{2gR}{(n-1)}}$ (c) $\sqrt{\frac{2gRn}{(n-1)}}$ (d) $\sqrt{\frac{2gRn}{(n+1)}}$

37. Two balls A and B are thrown vertically upwards from the same location on the surface of the earth with velocities $2\sqrt{\frac{gR}{3}}$ and $\sqrt{\frac{2gR}{3}}$ respectively, where R is the radius of the earth and g is the acceleration due to gravity on the surface of the earth. The ratio of the maximum height attained by A to that attained by B is

(a) 2 (b) 4 (c) 8 (d) $4\sqrt{2}$

38. If the distance between the earth and the sun were half its present value, the number of days in a year would have been

(a) 64.5 (b) 129 (c) 182.5 (d) 730

39. Two particles of mass m and 2 m are at the distance D apart. Under the mutual gravitational force they start moving towards each other. The acceleration of their center of mass when they are at $D/2$ is equal to

(a) $\frac{2Gm}{D^2}$ (b) $\frac{4Gm}{D^2}$ (c) $\frac{8Gm^2}{D^2}$ (d) zero

40. Two particle of masses 4 kg and 8 kg are separated by a distance of 12 m. If they are moving towards each other under the influence of a mutual force of attraction, then the two particles will meet each other at a distance of

(a) 6 m from 8 kg mass (b) 2 m from 8 kg mass
(c) 4 m from 8 kg mass (d) 8 m from 8 kg mass

41. Two satellites A and B go around the earth in circular orbits at heights of R_A and R_B respectively from the surface of the earth. Assuming earth to be a uniform sphere of radius R_e, the ratio of the magnitudes of their orbital velocities is:

(a) $\sqrt{\frac{R_B}{R_A}}$ (b) $\frac{R_B + R_e}{R_A + R_e}$ (c) $\sqrt{\frac{R_B + R_e}{R_A + R_e}}$ (d) $\left(\frac{R_A}{R_B}\right)^2$

42. A satellite of mass m is orbiting around the earth at a height h above the surface of the earth. Mass of the earth is M and its radius is R. The angular momentum of the satellite is independent of

(a) m (b) M (c) h (d) none of these

43. Two concentric shells have masses M and m and their radii are R and r respectively, where $R > r$. What is the gravitation potential at their common centre?

(a) $-\frac{GM}{R}$ (b) $-\frac{GM}{r}$ (c) $-G\left[\frac{M}{R} - \frac{m}{r}\right]$ (d) $-G\left[\frac{M}{R} + \frac{m}{r}\right]$

44. If a man at the equator would weight (3/5)th of his weight, then the angular speed of the earth would be

(a) $\sqrt{\frac{2}{5}\frac{g}{R}}$ (b) $\sqrt{\frac{g}{R}}$ (c) $\sqrt{\frac{R}{g}}$ (d) $\sqrt{\frac{2}{5}\frac{R}{g}}$

45. A satellite orbiting around earth of radius R is shifted to an orbit of radius $2R$. How many times the time taken for one revolution increase?

(a) 8 times (b) 2 times (c) 2.5 times (d) 2.8 times