1. Three identical point masses, each of mass 1 kg lie in the x–y plane at points (0,0) (0, 0.2m) and (0.2m, 0) respectively. The gravitational force on the mass at the origin is :–

(1) $1.67 \times 10^{-11}\ (\hat{i}+\hat{j})$ N
(2) $3.34 \times 10^{-10}\ (\hat{i}+\hat{j})$ N
(3) $1.67 \times 10^{-9}\ (\hat{i}+\hat{j})$ N
(4) $3.34 \times 10^{-10}\ (\hat{i}-\hat{j})$ N

2. Four particles of masses m, 2m, 3m and 4m are kept in sequence at the corners of a square of side a. The magnitude of gravitational force acting on a particle of mass m placed at the centre of the square will be :

(1) $\frac{24m^2G}{a^2}$ (2) $\frac{6m^2G}{a^2}$
(3) $\frac{4\sqrt{2}Gm^2}{a^2}$ (4) Zero

3. During the journey of space ship from earth to moon and back, the maximum fuel is consumed :-

(1) Against the gravitation of earth in return journey
(2) Against the gravitation of earth in onward journey
(3) Against the gravitation of moon while reaching the moon
(4) None of the above

4. The mass of the moon is 1% of mass of the earth. The ratio of gravitational pull of earth on moon to that of moon on earth will be :

(1) 1 : 1 (2) 1 : 10 (3) 1 : 100 (4) 2 : 1

5. If the distance between the centres of earth and moon is D and mass of earth is 81 times that of moon. At what distance from the centre of earth gravitational field will be zero :

(1) $\frac{D}{2}$ (2) $\frac{2D}{3}$
(3) $\frac{4D}{5}$ (4) $\frac{9D}{10}$

6. Mars has a diameter of approximately 0.5 of that of earth, and mass of 0.1 of that of earth. The surface gravitational field strength on mars as compared to that on earth is a factor of –

(1) 0.1 (2) 0.2
(3) 2.0 (4) 0.4

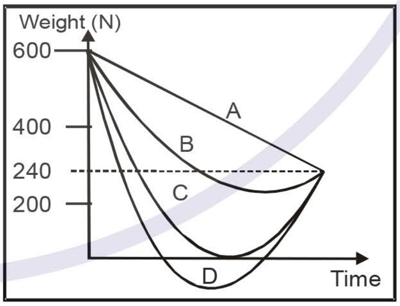
7. A stone dropped from a height 'h' reaches the Earth's surface in 1 s. If the same stone is taken to Moon and dropped freely from the same height then it will reach the surface of the Moon in a time (The 'g' of Moon is 1/6 times that of Earth) :–

(1) $\sqrt{6}$ seconds (2) 9 seconds
(3) $\sqrt{3}$ seconds (4) 6 seconds

8. At which height from the earth's surface does the acceleration due to gravity decrease by 75% of its value at earth's surface ?

(1) 6400 Km (2) 3200 Km
(3) 1600 Km (4) 12800 Km

9. Suppose the acceleration due to gravity at the earth's surface is $10 m/s^2$ and at the surface of mars it is $4.0 m/s^2$. A 60kg passenger goes from the earth to the mars in a spaceship moving with a constant velocity. Neglect all other objects in the sky. Which part of figure best represent the weight (Net gravitational force) of the passenger as a function of time :

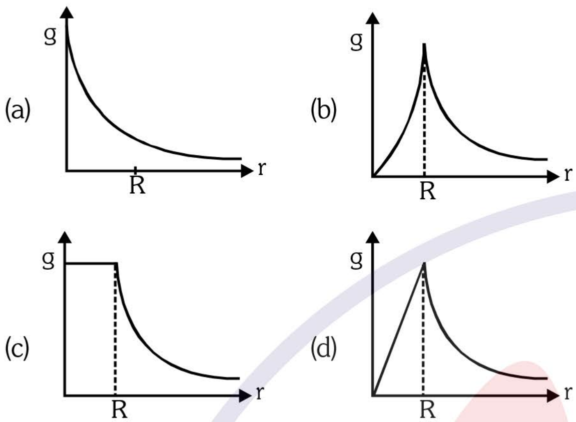


(1) A (2) B (3) C (4) D

10. Acceleration due to gravity at earth's surface is 'g' ms^{-2}. Find the effective value of acceleration due to gravity at a height of 32 km from sea level : (R_e = 6400 Km)

(1) 0.5 g ms^{-2} (2) 0.99 g ms^{-2}
(3) 1.01 g ms^{-2} (4) 0.90 g ms^{-2}

11. 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 figure below :-



The correct figure is :-

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

12. One can easily "weigh the earth" by calculating the mass of earth using the formula (in usual notation)

(1) $\frac{G}{g}R_E^2$ (2) $\frac{g}{G}R_E^2$ (3) $\frac{g}{G}R_E$ (4) $\frac{G}{g}R_E^3$

13. The value of 'g' reduces to half of its value at surface of earth at a height 'h', then :-

(1) h = R (2) h = 2R

(3) $h=\left(\sqrt{2}+1\right)R$ (4) $h=\left(\sqrt{2}-1\right)R$

14. If the earth stops rotating suddenly,the value of g at a place other than poles would :-

(1) Decrease

(2) Remain constant

(3) Increase

(4) Increase or decrease depending on the position of earth in the orbit round the sun

15. Gravitation on moon is $1/6^{th}$ of that on earth. When a balloon filled with hydrogen is released on moon then, this :-

(1) Will rise with an acceleration less then $\left(\frac{g}{6}\right)$

(2) Will rise with acceleration $\left(\frac{g}{6}\right)$

(3) Will fall down with an acceleration less than $\left(\frac{5g}{6}\right)$

(4) Will fall down with acceleration $\left(\frac{g}{6}\right)$

16. When the radius of earth is reduced by 1% without changing the mass, then the acceleration due to gravity will

(1) increase by 2% (2) decrease by 1.5%

(3) increase by 1% (4) decrease by 1%

17. Weight of a body of mass m decreases by 1% when it is raised to height h above the earth's surface. If the body is taken to a depth h in a mine, then in its weight will

(1) decrease by 0.5% (2) decrease by 2%

(3) increase by 0.5% (4) increase by 1%

18. Read the following statements :

S_1 : An object shall weigh more at pole than at equator when weighed by using a physical balance.

S_2 : It shall weigh the same at pole and equator when weighed by using a physical balance.

S_3 : It shall weigh the same at pole and equator when weighed by using a spring balance.

S_4 : It shall weigh more at the pole than at equator when weighed using a spring balance.

Which of the above statements is /are correct ?

(1) S_1 and S_2 (2) S_1 and S_4

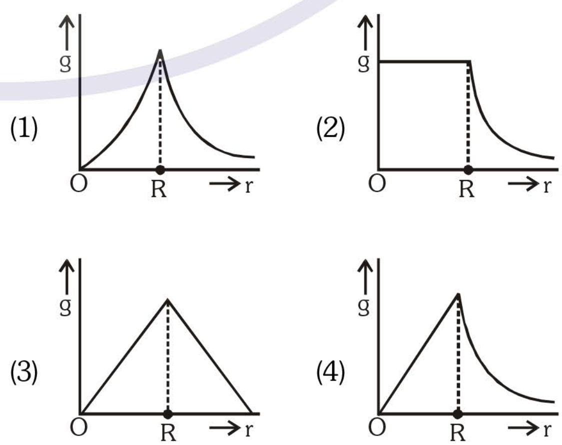
(3) S_2 and S_3 (4) S_2 and S_4.

19. 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 aceleration due to gravity, equal to :-

(1) GM_p/D_p^2 (2) $4GM_pm/D_p^2$

(3) $4GM_p/D_p^2$ (4) GM_pm/D_p^2

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



21. If the mass of the Earth were six times smaller and the universal gravitational constant were six time larger in magnitude, which of the following is ***not*** correct ?

(1) Raindrops will fall faster

(2) Walking on the ground would become more difficult

(3) Time period of a simple pendulum on the Earth would decrease

(4) 'g' on the Earth will not change

22. The intensity of gravitational field at a point situated at a distance 8000 km from the centre of Earth is 6.0 N/kg. The gravitational potential at that point in N-m/kg will be :–

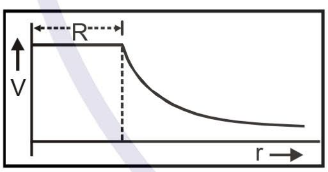
(1) 6 (2) 4.8×10^7

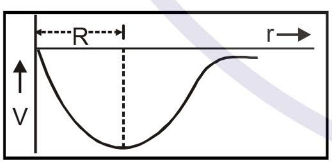
(3) 8×10^5 (4) 4.8×10^2

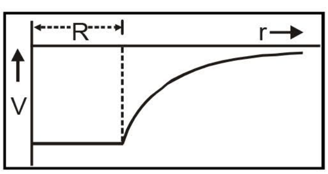
23. A particle of mass M is situated at the centre of a spherical shell of same mass and radius a. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be :-

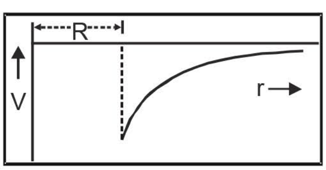
(1) $-\frac{4GM}{a}$ (2) $-\frac{3GM}{a}$ (3) $-\frac{2GM}{a}$ (4) $-\frac{GM}{a}$

24. Which of the following curve expresses the variation of gravitational potential with distance for a hollow sphere of radius R :

(1)


(2)


(3)


(4)


25. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J/kg^2 and 6.0 m/s^2 respectively ? Take the radius of earth as 6400 km :

(1) 1600 km (2) 2600 km

(3) 1400 km (4) 2000 km

26. If M_e is the mass of earth and M_m is the mass of moon ($M_e = 81\ M_m$). The potential energy of an object of mass m situated at a distance R from the centre of earth and r from the centre of moon, will be :-

(1) $-GmM_m\left(\frac{R}{81}+r\right)\frac{1}{R^2}$ (2) $-GmM_e\left(\frac{81}{r}+\frac{1}{R}\right)$

(3) $-GmM_m\left(\frac{81}{R}+\frac{1}{r}\right)$ (4) $GmM_m\left(\frac{81}{R}-\frac{1}{r}\right)$

27. A body of mass m is situated at a distance $4R_e$ above the Earth's surface, where R_e is the radius of Earth. What minimum energy should be given to the body so that it may escape ?

(1) mgR_e (2) $2mgR_e$

(3) $\frac{mgR_e}{5}$ (4) $\frac{mgR_e}{16}$

28. The ratio of radii of two satellites is p and the ratio of their acceleration due to gravity is q. The ratio of their escape velocities will be :

(1) $\left(\frac{q}{p}\right)^{1/2}$ (2) $\left(\frac{p}{q}\right)^{1/2}$ (3) pq (4) $\sqrt{pq}$

29. 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 = 5.98×10^{24} kg) have to be compressed to be a black hole ?

(1) 10^{-9} m (2) 10^{-6} m (3) 10^{-2} m (4) 100 m

30. A particle falls on earth :
(i) from infinity, (ii) from a height 10 times the radius of earth. The ratio of the velocities gained on reaching at the earth's surface is :

(1) $\sqrt{11} : \sqrt{10}$ (2) $\sqrt{10} : \sqrt{11}$

(3) 10 : 11 (4) 11 : 10

31. Escape velocity of a body from earth is 11.2 km/s. Escape velocity, when thrown at an angle of 45° from horizontal will be :-

(1) 11.2 km/s (2) 22.4 km/s

(3) $11.2/\sqrt{2}$ km/s (4) $11.2\sqrt{2}$ km/s

32. The escape velocity from the earth is 11.2 km/s the mass of another planet is 100 times of mass of earth and its radius is 4 times the radius of earth. The escape velocity for the planet is :-

(1) 56.0 km/s (2) 280 km/s
(3) 112 km/s (4) 11.2 km/s

33. A projectile is fired verticaly upward from the surface of earth with a velocity KV_e, where V_e is the escape velocity and $K < 1$. Neglecting air resistance, the maximum height to which it will rise measured from the centre of the earth is : (Where are R = radius of earth) :-

(1) $\frac{R}{1-K^2}$ (2) $\frac{R}{K^2}$

(3) $\frac{1-K^2}{R}$ (4) $\frac{K^2}{R}$

34. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are thrice as that of earth is :-

(1) 1 : 3 (2) $1 : 3\sqrt{3}$
(3) 1 : 9 (4) $1 : \sqrt{3}$

35. If the gravitational force were to vary inversely as m^{th} power of the distance, then the time period of a planet in circular orbit of radius r around the Sun will be proportional to :-

(1) $r^{-3m/2}$ (2) $r^{3m/2}$
(3) $r^{m+1/2}$ (4) $r^{(m+1)/2}$

36. Two satellites A and B, having ratio of masses 3 : 1 are in circular orbits of radius r and 4r. Calculate the ratio of total mechanical energies of A to B.

(1) 4 : 1 (2) 12 : 1 (3) 1 : 12 (4) 6 : 1

37. A satellite of earth of mass 'm' is taken from orbital radius 2R to 3R, then minimum work done is :-

(1) $\frac{GMm}{6R}$ (2) $\frac{GMm}{12R}$

(3) $\frac{GMm}{24R}$ (4) $\frac{GMm}{3R}$

38. The relay satellite transmits the television programme continuously from one part of the world to another because its :

(1) Period is greater than the period of rotation of the earth about its axis
(2) Period is less than the period of rotation of the earth about its axis
(3) Period is equal to the period of rotation of the earth about its axis
(4) Mass is less than the mass of earth

39. Two identical satellites are at the heights R and 7R from the earth's surface. Then which of the following statement is incorrect :–
(R = Radius of the earth)

(1) Ratio of total energy of both is 5
(2) Ratio of kinetic energy of both is 4
(3) Ratio of potential energy of both 4
(4) Ratio of total energy of both is 4

40. 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 ?

(1) The kinetic energies of the two satellites are equal
(2) The time period of S_1 is four times that of S_2
(3) The potential energies of earth and satellite in the two cases are equal
(4) S_1 and S_2 are moving with the same speed

41. The radii of circular orbits of two satellites A and B of the earth, are 4R and R, respectively. If the speed of satellite A is 3v, then the speed of satellite B will be :-

(1) 3v/2 (2) 3v/4 (3) 6v (4) 12v

42. A remote - sensing satellite of earth revolves in a circular orbit at a height of 0.25×10^6 m above the surface of earth. If earth's radius is 6.38×10^6 m and g=9.8 ms^{-2}, then the orbital speed of the satellite is :

(1) 6.67 km s^{-1} (2) 7.76 km s^{-1}
(3) 8.56 km s^{-1} (4) 9.13 km s^{-1}

43. Two solid spherical planets of equal radii R having masses 4M and 9M their centre are separated by a distance 6R. A projectile of mass m is sent from the planet of mass 4 M towards the heavier planet. What is the distance r of the point from the centre of lighter planet where the gravitational force on the projectile is zero ?

(1) 1.4 R (2) 1.8 R (3) 1.5 R (4) 2.4 R

44. An earth's satellite is moving in a circular orbit with a uniform speed v. If the gravitational force of the earth suddenly disappears, the satellite will :-

(1) vanish into outer space

(2) continue to move with velocity v in original orbit

(3) fall down with increasing velocity

(4) fly off tangentially from the orbit with velocity v

45. One projectile after deviating from its path starts moving round the earth in a cirular path of radius equal to nine times the radius of earth R. Its time period will be :-

(1) $2\pi\sqrt{\frac{R}{g}}$ (2) $27\times 2\pi\sqrt{\frac{R}{g}}$

(3) $\pi\sqrt{\frac{R}{g}}$ (4) $0.8\times 3\pi\sqrt{\frac{R}{g}}$

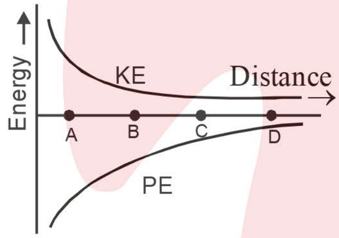
46. Potential energy and kinetic energy of a two particle system under imaginary force field are shown by curves KE and PE. respectively in figure. This system is bound at :

(1) only point A

(2) only point D

(3) only point A, B, and C

(4) All points A, B, C and D



47. If the length of the day is T, the height of that TV satellite above the earth's surface which always appears stationary from earth, will be :

(1) $h=\left[\frac{4\pi^2GM}{T^2}\right]^{1/3}$ (2) $h=\left[\frac{4\pi^2GM}{T^2}\right]^{1/2}-R$

(3) $h=\left[\frac{GMT^2}{4\pi^2}\right]^{1/3}-R$ (4) $h=\left[\frac{GMT^2}{4\pi^2}\right]^{1/3}+R$

48. A communication satellite of earth which takes 24 hrs. to complete one circular orbit eventually has to be replaced by another satellite of double mass. If the new satellites also has an orbital time period of 24 hrs, then what is the ratio of the radius of the new orbit to the original orbit ?

(1) 1 : 1 (2) 2 : 1

(3) $\sqrt{2}:1$ (4) 1 : 2

49. The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is v_0. The orbital velocity of satellite orbiting at an altitude of half of the radius is :-

(1) $\frac{3}{2}v_0$ (2) $\frac{2}{3}v_0$

(3) $\sqrt{\frac{2}{3}}v_0$ (4) $\sqrt{\frac{3}{2}}v_0$

50. 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:-

(1) $\frac{2mg_0R^2}{R+h}$ (2) $-\frac{2mg_0R^2}{R+h}$

(3) $\frac{mg_0R^2}{2(R+h)}$ (4) $-\frac{mg_0R^2}{2(R+h)}$

51. A planet is revolving round the sun. Its distance from the sun at Apogee is r_A and that at Perigee is r_p. The mass of planet and sun is m and M respectively, v_A and v_P is the velocity of planet at Apogee and Perigee respectively and T is the time period of revolution of planet round the sun.

(a) $T^2=\frac{\pi^2}{2Gm}(r_A+r_P)^2$ (b) $T^2=\frac{\pi^2}{2GM}(r_A+r_P)^3$

(c) $v_Ar_A=v_Pr_P$ (d) $v_A<v_P$, $r_A>r_P$

(1) a, b, c (2) a, b, d

(3) b, c, d (4) all

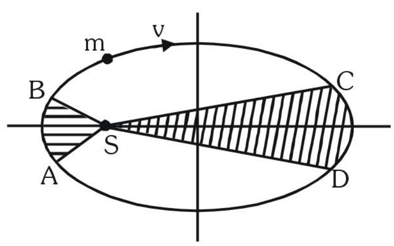
52. The figure shows elliptical orbit of a planet m about the sun S. The shaded area SCD is twice the shaded area SAB. If t_1 is the time for the planet to move from C to D and t_2 is the time to move from A to B then :-

(1) $t_1 = t_2$

(2) $t_1 < t_2$

(3) $t_1 = 4t_2$

(4) $t_1 = 2t_2$



53. 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 :-

(1) $(r_1/r_2)^2$ (2) r_2/r_1 (3) $(r_2/r_1)^2$ (4) r_1/r_2

54. 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,

(1) the acceleration of S is always directed towards the centre of the earth.

(2) the angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant.

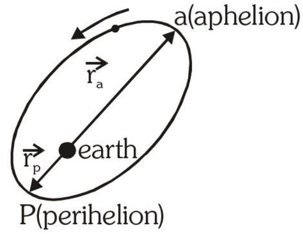
(3) the total mechanical energy of S varies periodically with time.

(4) the linear momentum of S remains constant in magnitude.

55. The maximum and minimum distances of a comet from the sun are 8×10^{12} m and 1.6×10^{12} m respecting. If its velocity when it is nearest to the sun is 60 m/sec then what will be its velocity in m/s when it is farthest ?

(1) 12 (2) 60 (3) 112 (4) 6

56. Consider a satellite orbiting the earth as shown in the figure below. Let L_a and L_p represent the angular momentum of the satellite about the earth when at aphelion and perihelion respectively. Consider the following relations.



(i) $\vec{L}_a = \vec{L}_P$ (ii) $\vec{L}_a = -\vec{L}_P$

(iii) $\vec{r}_a \times \vec{L}_a = \vec{r}_P \times \vec{L}_P$

Which of the above relations is/are true ?

(1) (i) only (2) (ii) only

(3) (iii) only (4) (i) and (iii)

57. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will :-

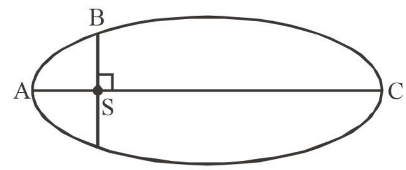
(1) Move towards each other.

(2) Move away from each other.

(3) Will become stationary

(4) Keep floating at the same distance between them.

58. The speed of a planet in an elliptical orbit about the Sun, at positions A, B and C are V_A, V_B and V_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



(1) $V_A < V_B < V_C$ (2) $V_A > V_B > V_C$

(3) $V_B < V_A < V_C$ (4) $V_B > V_A > V_C$

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**3**	**2**	**1**	**4**	**4**	**1**	**1**	**3**	**2**	**4**	**2**	**4**	**3**	**4**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**1**	**1**	**4**	**3**	**4**	**4**	**2**	**2**	**3**	**2**	**3**	**3**	**4**	**3**	**1**
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	**1**	**1**	**1**	**2**	**4**	**2**	**2**	**3**	**1**	**4**	**3**	**2**	**1**	**4**	**2**
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58		
Ans.	**3**	**3**	**1**	**3**	**4**	**3**	**4**	**2**	**1**	**1**	**1**	**4**	**2**		