Exercise - I (Conceptual Questions) Build Up Your Understanding

NEWTON'S LAW OF GRAVITATION & GRAVITATIONAL FIELD

1. Newton's law of gravitation :
(1) is not applicable outside the solar system
(2) is used to govern the motion of satellites only
(3) control the rotational motion of satellites and planets
(4) control the rotational motion of electrons in atoms

PGR001

2. Mass particles of 1 kg each are placed along x-axis at x = 1, 2, 4, 8, ...∞. Then gravitational force on a mass of 3kg placed at origin is (G = universal gravitational constant) :-
(1) 4G (2) $\frac{4G}{3}$ (3) 2G (4) ∞

PGR002

3. Gravitational force between two masses at a distance 'd' apart is 6N. If these masses are taken to moon and kept at same separation, then the force between them will become :
(1) 1 N (2) $\frac{1}{6}$N (3) 36 N (4) 6 N

PGR003

4. The value of universal gravitational constant G depends upon :
(1) Nature of material of two bodies
(2) Heat constant of two bodies
(3) Acceleration of two bodies
(4) None of these

PGR004

5. Three identical bodies (each mass M) are placed at vertices of an equilateral triangle of arm L, keeping the triangle as such by which angular speed the bodies should be rotated in their gravitational fields so that the triangle moves along circumference of circular orbit :
(1) $\sqrt{\frac{3GM}{L^3}}$ (2) $\sqrt{\frac{GM}{L^3}}$
(3) $\sqrt{\frac{GM}{3L^3}}$ (4) $3\sqrt{\frac{GM}{L^3}}$

PGR005

6. 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

PGR006

7. The tidal waves in the seas are primarily due to :
(1) The gravitational effect of the sun on the earth
(2) The gravitational effect of the moon on the earth
(3) The rotation of the earth
(4) The atmospheric effect of the earth itself

PGR007

8. 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

PGR008

9. 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) $\frac{9D}{10}$

PGR009

10. 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

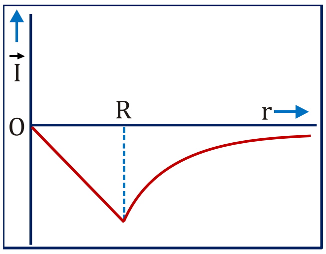
(2) continue to move with velocity v in original orbit

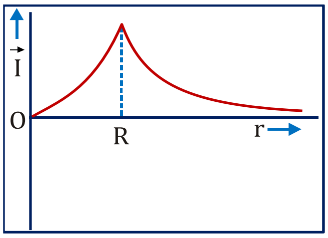
(3) fall down with increasing velocity

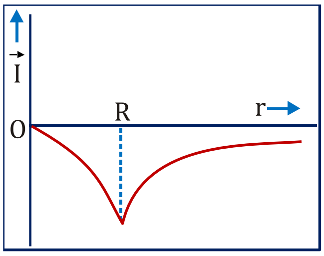
(4) fly off tangentially from the orbit with velocity v

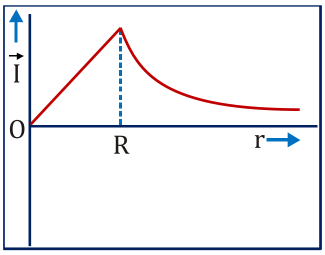
PGR010

11. Following curve shows the variation of intensity of gravitational field $(\vec{I})$ with distance from the centre of solid sphere(r) :

(1) 

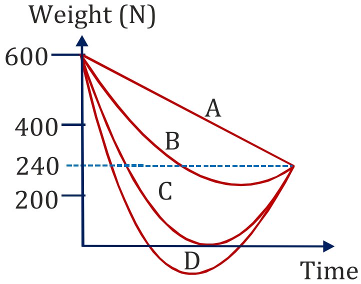
(2) 

(3) 

(4) 

PGR011

12. 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

PGR012

13. Assume that a tunnel is dug through earth from North pole to south pole and that the earth is a non-rotating, uniform sphere of density ρ. The gravitational force on a particle of mass m dropped into the tunnel when it reaches a distance r from the centre of earth is

(1) $\left(\frac{3}{4\pi}mG\rho\right)r$ (2) $\left(\frac{4\pi}{3}mG\rho\right)r$

(3) $\left(\frac{4\pi}{3}mG\rho\right)r^2$ (4) $\left(\frac{4\pi}{3}m^2G\rho\right)r$

PGR013

14. 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

PGR014

15. 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 $\sqrt{2}$ m from each of the vertices of the triangle. The force, in newton, acting on the mass of 2 kg is :-

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

PGR015

16. 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) $\frac{G}{g}R_E^3$

PGR016

ACCELERATION DUE TO GRAVITY

17. Acceleration due to gravity at the centre of the earth is :-

(1) g (2) $\frac{g}{2}$
(3) zero (4) infinite

PGR017

18. The value of 'g' on earth surface depends :-
(1) only an earth's structure
(2) only an earth's rotational motion
(3) on above both
(4) on none these and is same

PGR018

19. 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) $h=(\sqrt{2}+1)R$ (4) $h=(\sqrt{2}-1)R$

PGR019

20. At some planet 'g' is 1.96 m/sec^2. If it is safe to jump from a height of 2m on earth, then what should be corresponding safe height for jumping on that planet:-
(1) 5m (2) 2m (3) 10m (4) 20m

PGR020

21. 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

PGR021

22. Diameter and mass of a planet is double that earth. Then time period of a pendulum at surface of planet is how much times of time period at earth surface :-

(1) $\frac{1}{\sqrt{2}}$ times (2) $\sqrt{2}$ times
(3) Equal (4) None of these

PGR022

23. Gravitation on moon is 1/6th 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 $\left(\frac{g}{6}\right)$

PGR023

24. The acceleration due to gravity g and mean density of earth ρ are related by which of the following relations ? [G = gravitational constant and R = radius of earth] :

(1) $\rho=\frac{4\pi gR^2}{3G}$ (2) $\rho=\frac{4\pi gR^3}{3G}$
(3) $\rho=\frac{3g}{4\pi gR}$ (4) $\rho=\frac{3g}{4\pi gR^3}$

PGR024

25. More amount of sugar is obtained in 1kg weight:
(1) At North pole
(2) At equator
(3) Between pole and equator
(4) At South pole

PGR025

26. When you move from equator to pole, the value of acceleration due to gravity (g) :-
(1) increases
(2) decreases
(3) remains the same
(4) first increases then decreases

PGR026

27. 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%

PGR027

28. 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%

PGR028

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

(1) 0.5g m/s^2 (2) 0.99g m/s^2
(3) 1.01g m/s^2 (4) 0.90g m/s^2

PGR029

30. 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

PGR030

31. Imagine a new planet having the same density as that of earth but its radius is 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the surface of the new planet is g', then :

(1) g' = 3g (2) g' = g/9
(3) g' = 9g (4) g'=27 g

PGR031

32. The change in the value of 'g' at a height 'h' above the surface of the earth is same as at a depth 'd'. If 'd' and 'h' are much smaller than the radius of earth, then which one of the following is correct?

(1) d = h (2) d = 2h
(3) $d = \frac{3h}{2}$ (4) d = h/2

PGR032

33. If the rotational speed of earth is increased then weight of a body at the equator

(1) increases (2) decreases
(3) becomes double (4) does not changes

PGR033

34. A body weighs W newton at the surface of the earth. Its weight at a height equal to half the radius of the earth will be :

(1) $\frac{W}{2}$ (2) $\frac{2W}{3}$ (3) $\frac{4W}{9}$ (4) $\frac{W}{4}$

PGR034

35. The imaginary angular velocity of the earth for which the effective acceleration due to gravity at the equator shall be zero is equal to

(1) 1.25×10^{-3} rad/s (2) 2.50×10^{-3} rad/s
(3) 3.75×10^{-3} rad/s (4) 5.0×10^{-3} rad/s

[Take g = $10m/s^2$ for the acceleration due to gravity if the earth were at rest and radius of earth equal to 6400 km.]

PGR035

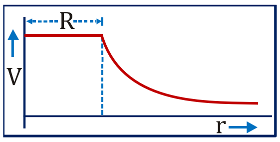
GRAVITATIONAL POTENTIAL ENERGY & POTENTIAL

36. Two different masses are dropped from same heights. When these just strike the ground, the following is same :

(1) kinetic energy (2) potential energy
(3) linear momentum (4) acceleration

PGR036

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

(1)


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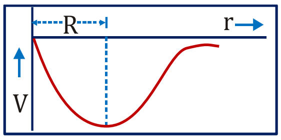
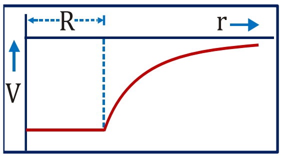
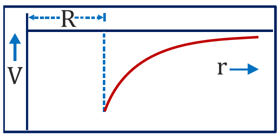


(3)


(4)


PGR037

38. Gravitational potential difference between surface of a planet and a point situated at a height of 20m above its surface is 2 J/kg. If gravitational field is uniform, then the work done in taking a 5kg body upto height 4 meter above surface will be :
(1) 2 J (2) 20 J (3) 40 J (4) 10 J
PGR038

39. 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) $-GmM_m\left(\frac{R}{81}+r\right)$ (2) $-GmM_e\left(\frac{81}{r}+\frac{1}{R}\right)$
(3) $-GmM_m\left(\frac{81}{R}+\frac{1}{r}\right)$ (4) $GmM_m\left(\frac{81}{r}-\frac{1}{R}\right)$
PGR039

40. The gravitational potential energy is maximum at:
(1) infinity
(2) the earth's surface
(3) The centre of the earth
(4) Twice the radius of the earth
PGR040

41. A missile is launched with a velocity less than the escape velocity. Sum of its kinetic energy and potential energy is :-
(1) Positive
(2) Negative
(3) May be negative or positive depending upon its initial velocity
(4) Zero
PGR041

42. A body attains a height equal to the radius of the earth when projected from earth' surface. The velocity of the body with which it was projected is :
(1) $\sqrt{\frac{GM}{R}}$ (2) $\sqrt{\frac{2GM}{R}}$
(3) $\sqrt{\frac{5}{4}\frac{GM}{R}}$ (4) $\sqrt{\frac{3GM}{R}}$
PGR042

43. The gravitational potential energy of a body at a distance r from the center of the earth is U. The force at that point is :
(1) $\frac{U}{r^2}$ (2) $\frac{U}{r}$ (3) Ur (4) Ur^2
PGR043

44. A particle falls from infinity to the earth. Its velocity on reaching the earth surface is :
(1) 2Rg (2) Rg
(3) $\sqrt{Rg}$ (4) $\sqrt{2Rg}$
PGR044

45. A projectile of mass m is thrown vertically up with an initial velocity v from the surface of earth (mass of earth = M). If it comes to rest at a height h, the change in its potential energy is
(1) GMmh/R(R + h) (2) $GMmh^2/R(R+h)^2$
(3) GMmhR/R(R + h) (4) GMm/hR(R+h)
PGR045

46. Two small and heavy spheres, each of mass M, are placed a distance r apart on a horizontal surface. The gravitational potential at the mid-point on the line joining the centre of the spheres is :-
(1) Zero (2) $-\frac{GM}{r}$
(3) $-\frac{2GM}{r}$ (4) $-\frac{4GM}{r}$
PGR046

47. An artificial satellite moving in a circular orbit around the earth has a total (kinetic + potential) energy E_0. Its potential energy is :-
(1) $-E_0$ (2) E_0
(3) $-2E_0$ (4) $2E_0$
PGR047

48. A particle of mass m is moving in a horizontal circle of radius R under a centripetal force equal to $-\frac{A}{r^2}$ (A = constant). The total energy of the particle is :-
(Potential energy at very large distance is zero)
(1) $\frac{A}{R}$ (2) $-\frac{A}{R}$ (3) $\frac{A}{2R}$ (4) $-\frac{A}{2R}$
PGR048

ESCAPE VELOCITY

49. Potential energy of a 3kg body at the surface of a planet is – 54J, then escape velocity will be:
(1) 18 m/s (2) 162 m/s
(3) 36 m/s (4) 6 m/s

PGR049

50. Escape velocity of a 1kg body on a planet is 100 m/s. Potential energy of body at that planet is:
(1) –5000J (2) –1000J
(3) –2400J (4) –10000J

PGR050

51. 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) $\sqrt{pq}$

PGR051

52. 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

PGR052

53. 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

PGR053

54. Body is projected vertically upward from the surface of the earth with a velocity equal to half the escape velocity. If R is radius of the earth, the maximum height attained by the body is :-
(1) $\frac{R}{6}$ (2) $\frac{R}{3}$ (3) $\frac{2}{3}R$ (4) R

PGR054

PLANETARY MOTION & WEIGHTLESSNESS

55. Binding energy of moon and earth is :-
(1) $\frac{GM_eM_m}{r_{em}}$ (2) $\frac{GM_eM_m}{2r_{em}}$
(3) $-\frac{GM_eM_m}{r_{em}}$ (4) $-\frac{GM_eM_m}{2r_{em}}$

PGR055

56. Two artificial satellites A and B are at a distance r_A and r_B above the earth's surface. If the radius of earth is R, then the ratio of their speed will be :-
(1) $\left(\frac{r_B+R}{r_A+R}\right)^{1/2}$ (2) $\left(\frac{r_B+R}{r_A+R}\right)^{2}$
(3) $\left(\frac{r_B}{r_A}\right)^{2}$ (4) $\left(\frac{r_B}{r_A}\right)^{1/2}$

PGR056

57. The average radii of orbits of mercury and earth around the sun are 6×10^7 km and 1.5×10^8 km respectively. The ratio of their orbital speeds will be :-
(1) $\sqrt{5}:\sqrt{2}$ (2) $\sqrt{2}:\sqrt{5}$
(3) 2.5 : 1 (4) 1 : 25

PGR057

58. A body is dropped by a satellite in its geo-stationary orbit :
(1) it will burn on entering in to the atmosphere
(2) it will remain in the same place with respect to the earth
(3) it will reach the earth is 24 hours
(4) it will perform uncertain motion

PGR058

59. Two ordinary satellites are revolving round the earth in same elliptical orbit, then which of the following quantities is conserved :-
(1) Velocity
(2) Angular velocity
(3) Angular momentum
(4) None of above

PGR059

60. Kepler's second law is a consequence of :-
(1) conservation of kinetic energy
(2) conservation of linear momentum
(3) conservation of angular momentum
(4) conservation of speed

PGR060

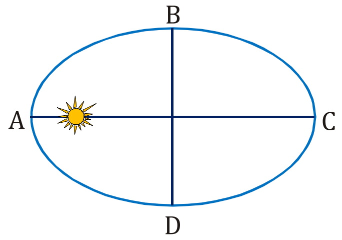
61. One projectile after deviating from its path starts moving round the earth in a circular path of radius equal to nine times the radius of earth R. Its time period will be :-

(1) $2\pi\sqrt{\frac{R}{g}}$ (2) $27\times2\pi\sqrt{\frac{R}{g}}$

(3) $\pi\sqrt{\frac{R}{g}}$ (4) $0.8\times3\pi\sqrt{\frac{R}{g}}$

PGR061

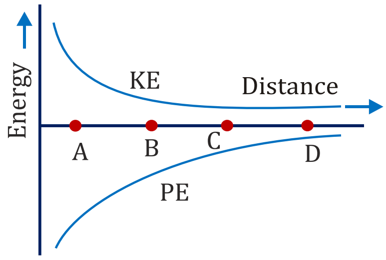
62. In adjoining figure earth goes around the sun in elliptical orbit on which point the orbital speed is maximum :



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

PGR062

63. Potential energy and kinetic energy of a two particles 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

PGR063

64. 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) $\frac{GMm}{3R}$

PGR064

65. If a graph is plotted between T^2 and r^3 for a planet then its slope will be :-

(1) $\frac{4\pi^2}{GM}$ (2) $\frac{GM}{4\pi^2}$ (3) 4π GM (4) Zero

PGR065

66. 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) $v_A r_A = v_P r_P$

(d) $v_A < v_P$, $r_A > r_P$

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

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

PGR066

67. A satellite launching station should be :

(1) near the equatorial region
(2) near the polar region
(3) on the polar axis
(4) all locations are equally good

PGR067

68. A space shuttle is launched in a circular orbit near the earth's surface. The additional velocity be given to the space - shuttle to get free from the influence of gravitational force, will be :

(1) 1.52 km/s (2) 2.75 km/s

(3) 3.28 km/s (4) 5.18 km/s

PGR068

69. A satellite is moving in a circular orbit around earth with a speed v. If its mass is m, then its total energy will be :

(1) $\frac{3}{4}mv^2$ (2) mv^2

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

PGR069

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

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

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

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

PGR070

71. If two bodies of mass M and m are revolving around the centre of mass of the system in circular orbit of radii R and r respectively due to mutual interaction. Which of the following formula is applicable :-

(1) $\frac{GMm}{(R+r)^2}=m\omega^2 r$ (2) $\frac{GMm}{R^2}=m\omega^2 r$

(3) $\frac{GMm}{r^2}=m\omega^2 r$ (4) $\frac{GMm}{R^2+r^2}=m\omega^2 r$

PGR071

72. Two satellites of same mass m are revolving round of earth (mass M) in the same orbit of radius r. Rotational directions of the two are opposite therefore, they can collide. Total mechanical energy of the system (both satellites and earths) is (m << M) :-

(1) $-\frac{GMm}{r}$ (2) $-\frac{2GMm}{r}$

(3) $-\frac{GMm}{2r}$ (4) Zero

PGR072

73. A planet of mass m is moving in an elliptical orbit about the sun (mass of sun = M). The maximum and minimum distances of the planet from the sun are r_1 and r_2 respectively. The period of revolution of the planet will be proportional to :

(1) $r_1^{3/2}$ (2) $r_2^{3/2}$

(3) $(r_1-r_2)^{3/2}$ (4) $(r_1+r_2)^{3/2}$

PGR073

74. If the satellite is stopped suddenly in its orbit which is at a distance radius of earth from earth's surface and allowed to fall freely into the earth. The speed with which it hits the surface of earth will be :

(1) 7.919 m/s (2) 7.919 km/s

(3) 11.2 m/s (4) 11.2 km/s

PGR075

75. A planet is moving in an elliptical orbit. If T, U, E and L are its kinetic energy, potential energy, total energy and magnitude of angular momentum respectively, then which of the following statement is true :-

(1) T is conserved

(2) U is always positive

(3) E is always negative

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

PGR076

76. The gravitational force between two bodies is directly proportional to $\frac{1}{R}$ (not $\frac{1}{R^2}$), where 'R' is the distance between the bodies. Then the orbital speed for this force in circular orbit is proportional to :-

(1) $1/R^2$ (2) R° (3) R (4) 1/R

PGR077

77. What will be velocity of a satellite revolving around the earth at a height h above surface of earth if radius of earth is R :-

(1) $R^2\sqrt{\frac{g}{R+h}}$ (2) $R\frac{g}{(R+h)^2}$

(3) $R\sqrt{\frac{g}{R+h}}$ (4) $R\sqrt{\frac{R+h}{g}}$

PGR078

78. Two artificial satellites of masses m_1 and m_2 are moving with speeds v_1 and v_2 in orbits of radii r_1 and r_2 respectively. If $r_1 > r_2$ then which of the following statements in true :-

(1) $v_1 = v_2$ (2) $v_1 > v_2$

(3) $v_1 < v_2$ (4) $v_1/r_1 = v_2/r_2$

PGR079

79. Orbital radius of a satellite S of earth is four times that of a communication satellite C. Period of revolution of S is :-

(1) 4 days (2) 8 days

(3) 16 days (4) 32 days

PGR080

80. If a satellite is revolving very close to the surface of earth, then its orbital velocity does not depend upon:-

(1) Mass of satellite (2) Mass of earth
(3) Radius of earth (4) Orbital radius

PGR081

81. 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

PGR082

82. The minimum projection velocity of a body from the earth's surface so that it becomes the satellite of the earth ($R_e = 6.4 \times 10^6$ m).

(1) 11×10^3 m/s (2) 8×10^3 m/s
(3) 6.4×10^3 m/s (4) 4×10^3 m/s

PGR083

83. 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/s then what will be its velocity in m/s when it is farthest?

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

PGR085

84. A satellite of mass m goes round the earth along a circular path of radius r. Let m_E be the mass of the earth and R_E its radius then the linear speed of the satellite depends on.

(1) m, m_E and r (2) m, R_E and r
(3) m_E only (4) m_E and r

PGR086

85. Near the earth's surface time period of a satellite is 1.4 hrs. Find its time period if it is at the distance '4R' from the centre of earth :-

(1) 32 hrs. (2) $\left(\frac{1}{8\sqrt{2}}\right)$ hrs.
(3) $8\sqrt{2}$ hrs. (4) 16 hrs.

PGR087

86. 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

PGR088

87. Escape velocity for a projectile at earth's surface is V_e. A body is projected form earth's surface with velocity 2 V_e. The velocity of the body when it is at infinite distance from the centre of the earth is :-

(1) V_e (2) $2V_e$
(3) $\sqrt{2}\,V_e$ (4) $\sqrt{3}\,V_e$

PGR089

88. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is :-

(1) 2 (2) 1/2
(3) $\frac{1}{\sqrt{2}}$ (4) $\sqrt{2}$

PGR090

89. 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) $\sqrt{\frac{3}{2}}v_0$

PGR091

90. The earth revolves around the sun in one year. If distance between them becomes double, the new time period of revolution will be :-

(1) $4\sqrt{2}$ years (2) $2\sqrt{2}$ years
(3) 4 years (4) 8 years

PGR092

91. A satellite of mass m revolves in a circular orbit of radius R a round a planet of mass M. Its total energy E is :-

(1) $-\dfrac{GMm}{2R}$

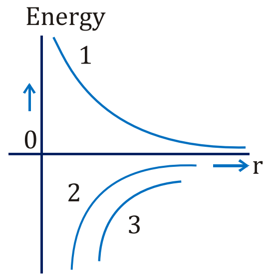
(2) $+\dfrac{GMm}{3R}$

(3) $-\dfrac{GMm}{R}$

(4) $+\dfrac{GMm}{R}$

PGR093

92. A satellite is orbiting earth at a distance r. Variations of its kinetic energy, potential energy and total energy, is shown in the figure. Of the three curves shown in figure, identify the type of mechanical energy they represent.



(1) 1 Potential, 2 Kinetic, 3 Total
(2) 1 Total, 2 Kinetic, 3 Potential
(3) 1 Kinetic, 2 Total, 3 Potential
(4) 1 Potential, 2 Total, 3 Kinetic

PGR094

93. The mean distance of mars from sun is 1.5 times that of earth from sun. What is approximately the number of years required by mars to make one revolution about sun ?

(1) 2.35 years (2) 1.85 years
(3) 3.65 years (4) 2.75 years

PGR095

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	1	4	4	1	3	2	2	4	4	1	3	2	4	4
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	2	3	3	4	3	3	2	4	3	2	1	1	1	2	1
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	1	2	2	3	1	4	3	1	3	1	2	1	2	4	1
Question	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	4	4	4	4	1	4	1	1	2	2	1	1	2	3	3
Question	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Answer	2	1	3	2	1	3	1	3	4	3	1	1	4	2	3
Question	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Answer	2	3	3	2	1	1	2	1	4	3	1	4	2	3	2
Question	91	92	93												
Answer	1	3	2												

Exercise - II (Previous Year Questions) AIPMT/NEET

AIPMT 2014

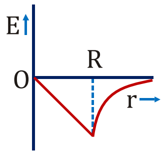
1. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98×10^{24} kg) have to be compressed to be a black hole?

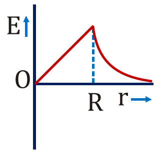
(1) 10^{-9} m (2) 10^{-6} m

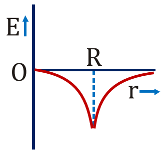
(3) 10^{-2} m (4) 100 m

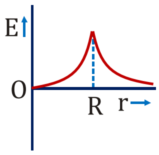
PGR108

2. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by :-

(1) 

(2) 

(3) 

(4) 

PGR109

AIPMT 2015

3. 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 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:

(1) $GMK = 4\pi^2$ (2) K = G

(3) $K = \frac{1}{G}$ (4) $GK = 4\pi^2$

PGR110

Re-AIPMT 2015

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,

(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.

PGR111

5. 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 $g = 9.8\ m/s^2$, then the orbital speed of the satellite is :

(1) 6.67 km/s (2) 7.76 km/s

(3) 8.56 km/s (4) 9.13 km/s

PGR112

NEET-I 2016

6. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J/kg and $6.0\ m/s^2$ respectively?

Take the radius of earth as 6400 km :

(1) 2600 km (2) 1600 km

(3) 1400 km (4) 2000 km

PGR113

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

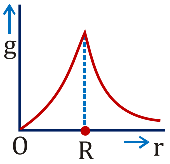
(1) 1 : 2 (2) $1 : 2\sqrt{2}$

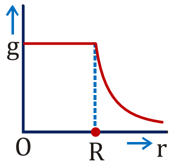
(3) 1 : 4 (4) $1 : \sqrt{2}$

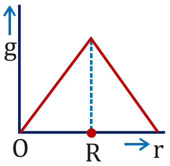
PGR114

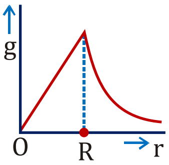
NEET-II 2016

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

(1) 

(2) 

(3) 

(4) 

PGR115

9. 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) $\dfrac{2mg_0R^2}{R+h}$ (2) $-\dfrac{2mg_0R^2}{R+h}$

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

PGR116

NEET(UG) 2017

10. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then :-

(1) d = 1 km (2) d = $\dfrac{3}{2}$ km

(3) d = 2 km (4) d = $\dfrac{1}{2}$ km

PGR117

11. 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.

PGR118

NEET(UG) 2018

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

(1) Raindrops will fall faster

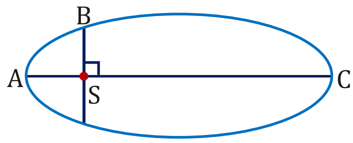
(2) Walking on the ground would become more difficult

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

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

PGR119

13. 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



(1) $K_A < K_B < K_C$ (2) $K_A > K_B > K_C$

(3) $K_B < K_A < K_C$ (4) $K_B > K_A > K_C$

PGR120

NEET(UG) 2019

14. 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 ?

(1) 150 N (2) 200 N

(3) 250 N (4) 100 N

PGR121

15. 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 :

(1) mgR (2) 2 mgR

(3) $\dfrac{1}{2}$ mgR (4) $\dfrac{3}{2}$ mgR

PGR122

NEET(UG) 2019 (Odisha)

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

(1) $6\sqrt{2}$ h (2) $12\sqrt{2}$ h

(3) $\dfrac{24}{2.5}$ h (4) $\dfrac{12}{2.5}$ h

PGR123

17. Assuming that the gravitational potential energy of an object at infinity is zero, the change in potential energy (final – initial) of an object of mass m, when taken to a height h from the surface of earth (of radius R), is given by,

(1) $-\frac{GMm}{R+h}$ (2) $\frac{GMmh}{R(R+h)}$

(3) mgh (4) $\frac{GMm}{R+h}$

PGR124

NEET (UG) 2020

18. 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?

(1) 24 N (2) 48 N

(3) 32 N (4) 30 N

PGR125

NEET (UG) 2020 (Covid-19)

19. What is the depth at which the value of acceleration due to gravity becomes 1/n times the value that at the surface of earth? (radius of earth = R)

(1) R/n^2 (2) $R(n-1)/n$

(3) $Rn/(n-1)$ (4) R/n

PGR126

NEET (UG) 2021

20. The escape velocity from the Earth's surface is υ. The escape velocity from the surface of another planet having a radius, four times that of Earth and same mass density is:

(1) υ (2) 2υ (3) 3υ (4) 4υ

PGR127

21. A particle of mass 'm' is projected with a velocity $\upsilon = kV_e$ (k < 1) from the surface of the earth. (V_e = escape velocity) The maximum height above the surface reached by the particle is :

(1) $R\left(\frac{k}{1-k}\right)^2$ (2) $R\left(\frac{k}{1+k}\right)^2$

(3) $\frac{R^2k}{1+k}$ (4) $\frac{Rk^2}{1-k^2}$

PGR128

NEET (UG) 2022

22. A body of mass 60g 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:

(1) 50 N/kg (2) 20 N/kg

(3) 180 N/kg (4) 0.05 N/kg

PGR129

23. 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 :

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

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

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

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

PGR130

RE-NEET (UG) 2022

24. 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:

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

PGR131

NEET (UG) 2023

25. 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) :

(1) $-\frac{12Gm}{R}$ (2) $-\frac{16Gm}{R}$

(3) $-\frac{20Gm}{R}$ (4) $-\frac{8Gm}{R}$

PGR140

26. 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 :

(1) T^2 (2) T^3 (3) $\sqrt{T}$ (4) T

PGR141

RE-NEET (UG) 2023

27. 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:

(1) $11.2\sqrt{2}$ km/s (2) Zero

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

PGR142

28. If 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 :

(1) $\frac{\pi RG}{12g}$ (2) $\frac{3\pi R}{4gG}$ (3) $\frac{3g}{4\pi RG}$ (4) $\frac{4\pi G}{3gR}$

PGR143

NEET (UG) 2024

29. 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 :

(1) 19.6 m s^{-2} (2) 9.8 m s^{-2}

(3) 4.9 m s^{-2} (4) 3.92 m s^{-2}

PGR144

30. 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 :

(1) $\frac{5GmM}{6R}$ (2) $\frac{2GmM}{3R}$

(3) $\frac{GmM}{2R}$ (4) $\frac{GmM}{3R}$

PGR145

RE-NEET (UG) 2024

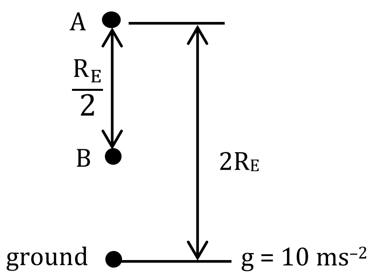
31. The escape velocity for earth is v. A planet having 9 times mass that of earth and radius, 16 times that of earth, has the escape velocity of :

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

(3) $\frac{3v}{4}$ (4) $\frac{9v}{4}$

PGR146

32. 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) :



(1) 49 N (2) 89 N

(3) 5 N (4) 10 N

PGR147

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	1	1	1	2	1	2	4	4	3	4	4	2	4	3
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	1	2	3	2	4	4	1	1	3	2	1	4	3	4	1
Question	31	32													
Answer	3	1													

Exercise - III (Analytical Questions) Master Your Understanding

1. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : An artificial satellite is moving in a circular orbit of the earth. If the gravitational pull suddenly disappears, then it moves with the same speed tangential to the original orbit.

Reason (R) : The orbital speed of a satellite decreases with the increase in radius of the orbit.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

PGR132

2. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : Total energy is conserved in moving a satellite to higher orbit.

Reason (R) : For a satellite change in potential energy and kinetic energy is same in magnitude and opposite in nature.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) Both **(A)** and **(R)** are false.

PGR133

3. Choose the correct statement(s) from the following:-

(A) The magnitude of the gravitational force between two bodies of mass 1 kg each and separated by a distance of 1 m is 9.8 N.

(B) Higher the value of escape velocity for a planet, higher is the abundance of lighter gases in its atmosphere.

(C) Force of friction arises due to gravitational attraction.

(D) The gravitational force of attraction between two bodies of ordinary mass is not noticeable because the value of the gravitational constant is extremely small.

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

PGR135

4. A satellite is moving round the earth in a circular orbit. The following statements are given :-

(i) It is moving with a constant velocity.

(ii) It has no acceleration.

(iii) It's angular momentum w.r.t. centre of the earth remains conserved.

(iv) Its distance from center must be equal to $\sqrt{2}$ times of earth's radius.

The correct option is :-

(1) i & ii are true

(2) i, iii & iv are true

(3) only iii is true

(4) i & iv are true

PGR136

5. Consider the following statement for a satellite S moving in an elliptical orbit around the earth (mass of satellite is negligibly small compared to earth)

I: The acc. of S is always towards earth.

II: The total mechanical energy of S varies periodically with time.

III: The linear momentum of 'S' remain constant in magnitude.

The correct sequence of true (T) and false (F) for the above statement is :-

(1) TTF (2) TFT (3) TFF (4) FFF

PGR137

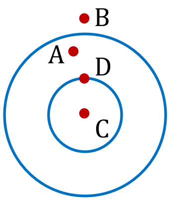
6. A satellite is in a circular equatorial orbit of radius 7000 km around the earth. If it is transferred to a circular orbit of double of radius :-

Column - I		Column - II	
(A)	Angular momentum	(P)	Increases
(B)	Area of earth covered by satellite signal	(Q)	Decreases
(C)	Potential energy	(R)	Becomes double
(D)	Kinetic energy	(S)	Becomes half

(1) (A) $\rightarrow$ Q; (B) $\rightarrow$ P; (C) $\rightarrow$ P, R; (D) $\rightarrow$ Q, S
(2) (A) $\rightarrow$ P; (B) $\rightarrow$ P; (C) $\rightarrow$ P; (D) $\rightarrow$ Q, S
(3) (A) $\rightarrow$ Q; (B) $\rightarrow$ Q; (C) $\rightarrow$ P, S; (D) $\rightarrow$ P, R
(4) (A) $\rightarrow$ P; (B) $\rightarrow$ Q; (C) $\rightarrow$ P; (D) $\rightarrow$ P, R

PGR138

7. Two concentric spherical shells of non-zero masses are as shown in the figure :-



Column - I		Column - II	
(A)	Potential at A	(P)	Greater than B
(B)	Gravitational field at A	(Q)	Less than B
(C)	As one moves from C to D	(R)	Potential remains constant
(D)	As one moves from D to A	(S)	Gravitational field decreases
		(T)	Data insufficient

(1) (A) $\rightarrow$ P; (B) $\rightarrow$ Q; (C) $\rightarrow$ R; (D) $\rightarrow$ S
(2) (A) $\rightarrow$ Q; (B) $\rightarrow$ T; (C) $\rightarrow$ R; (D) $\rightarrow$ S
(3) (A) $\rightarrow$ P; (B) $\rightarrow$ Q; (C) $\rightarrow$ S; (D) $\rightarrow$ R
(4) (A) $\rightarrow$ Q; (B) $\rightarrow$ P; (C) $\rightarrow$ S; (D) $\rightarrow$ R

PGR139

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4	5	6	7
Answer	2	4	4	3	3	2	2

Important Notes