ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

path to success

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PRE-MEDICAL

PHYSICS

ENTHUSIAST | LEADER | ACHIEVER

EXERCISE

Gravitation

ENGLISH MEDIUM

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

GR0001

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) ∞

GR0002

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

GR0003

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

GR0004

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) $3\sqrt{\frac{GM}{L^3}}$

GR0005

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

GR0006

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

GR0007

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

GR0008

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

GR0009

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

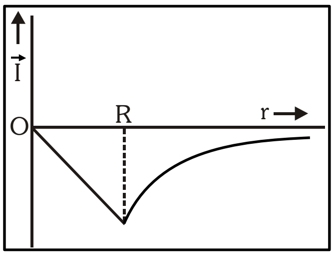
(2) continue to move with velocity v in original orbit

(3) fall down with increasing velocity

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

GR0010

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

(1)


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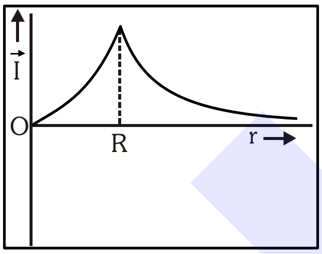
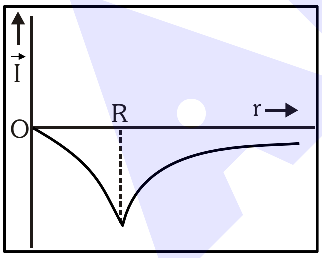


(3)


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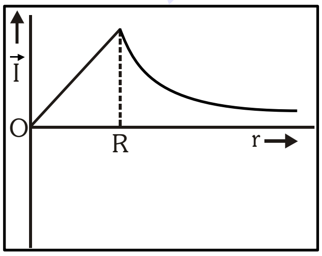
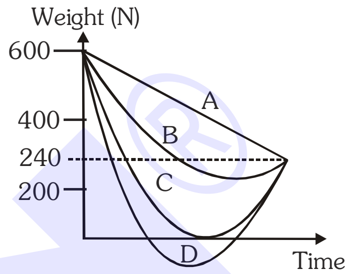


GR0011

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

GR0012

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

GR0013

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

GR0014

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

GR0015

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

GR0016

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

GR0017

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

GR0018

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) $h = (\sqrt{2}-1)R$

GR0019

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

GR0020

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

GR0021

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

GR0022

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 $\left(\frac{g}{6}\right)$

GR0023

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) $\rho = \frac{3g}{4\pi GR^3}$

GR0024

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

GR0025

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

GR0026

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%

GR0027

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%

GR0028

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) $0.90g\ m/s^2$

GR0029

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

GR0030

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

GR0031

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

GR0032

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

GR0033

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) $\frac{W}{4}$

GR0034

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

GR0035

GRAVITATIONAL POTENTIAL ENERGY & POTENTIAL

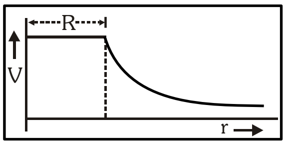
36. Two different masses are droped from same heights. When these just strike the ground, the following is same :

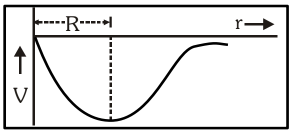
(1) kinetic energy (2) potential energy

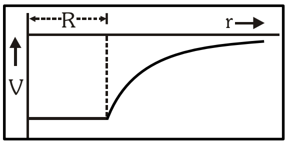
(3) linear momentum (4) acceleration

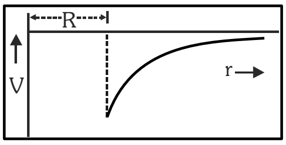
GR0036

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

(1) 

(2) 

(3) 

(4) 

GR0037

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

GR0038

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

GR0039

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

GR0040

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

GR0041

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) $\sqrt{\frac{3GM}{R}}$

GR0042

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

GR0043

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) $\sqrt{2Rg}$

GR0044

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)

GR0045

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) $-\frac{4GM}{r}$

GR0046

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) $2E_0$

GR0047

48. A particle of mass m is moving in a horizontal ciricle 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) $-\frac{A}{2R}$

GR0048

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

GR0049

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

GR0050

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) $\sqrt{pq}$

GR0051

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

GR0052

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

GR0053

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

GR0054

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) $-\frac{GM_eM_m}{2r_{em}}$

GR0055

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) $\left(\frac{r_B}{r_A}\right)^{1/2}$

GR0056

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

GR0057

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

GR0058

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

GR0059

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

GR0060

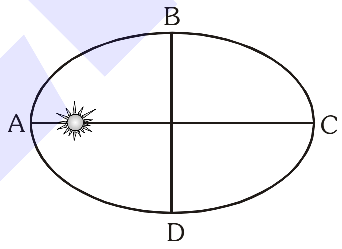
61. One projectile after deviating from its path starts moving round the earth in a cirular path of radius equal to nine times the radius of earth R. Its time period will be :-

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

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

GR0061

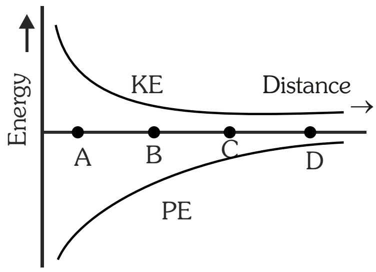
62. In adjoining figure earth goes around the sun in elliptical orbit. On which point the orbital speed is maximum :



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

GR0062

63. 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

GR0063

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

GR0064

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

GR0065

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

GR0066

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 eqaully good

GR0067

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

GR0068

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) $-\frac{1}{2}mv^2$

GR0069

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

GR0070

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

GR0071

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

GR0072

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

GR0073

74. 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

GR0074

75. 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

GR0075

76. 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

GR0076

77. 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) $1/R$

GR0077

78. 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) $R\sqrt{\frac{R+h}{g}}$

GR0078

79. 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) $v_1/r_1 = v_2/r_2$

GR0079

80. 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

GR0080

81. 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

GR0081

82. 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

GR0082

83. 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

GR0083

84. Geostationary satellite :-

(1) is situated at a great height above the surface of earth

(2) moves in equatorial plane

(3) have time period of 24 hours

(4) have time period of 24 hours and moves in equatorial plane

GR0084

85. 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

GR0085

86. 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

GR0086

87. 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) $\left(\dfrac{1}{8\sqrt{2}}\right)$hrs.

(3) $8\sqrt{2}$ hrs.

(4) 16 hrs.

GR0087

88. 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

GR0088

89. 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) $\sqrt{3}V_e$

GR0089

90. 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) $\dfrac{1}{\sqrt{2}}$ (4) $\sqrt{2}$

GR0090

91. 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) $\dfrac{3}{2}v_0$ (2) $\dfrac{2}{3}v_0$ (3) $\sqrt{\dfrac{2}{3}}v_0$ (4) $\sqrt{\dfrac{3}{2}}v_0$

GR0091

92. 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

GR0092

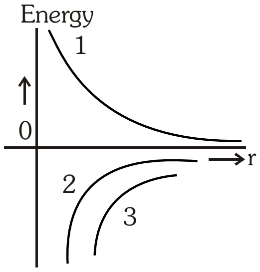
93. A satellite of mass m revolves in a circular orbit of radius R a round a planet of mass M. Its total energy E is :-

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

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

GR0093

94. 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

GR0094

95. 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

GR0095

EXERCISE-I (Conceptual Questions) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**1**	**4**	**4**	**1**	**3**	**2**	**2**	**4**	**4**	**1**	**3**	**2**	**4**	**4**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**2**	**3**	**3**	**4**	**3**	**3**	**2**	**4**	**3**	**2**	**1**	**1**	**1**	**2**	**1**
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	**1**	**2**	**2**	**3**	**1**	**4**	**3**	**1**	**3**	**1**	**2**	**1**	**2**	**4**	**1**
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	**4**	**4**	**4**	**4**	**1**	**4**	**1**	**1**	**2**	**2**	**1**	**1**	**2**	**3**	**3**
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	**2**	**1**	**3**	**2**	**1**	**3**	**1**	**3**	**4**	**3**	**1**	**1**	**4**	**3**	**2**
Que.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**2**	**4**	**1**	**4**	**3**	**1**	**4**	**2**
Que.	91	92	93	94	95										
Ans.	**3**	**2**	**1**	**3**	**2**										

EXERCISE-II (Previous Year Questions) AIPMT/NEET

AIPMT 2007

1. 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

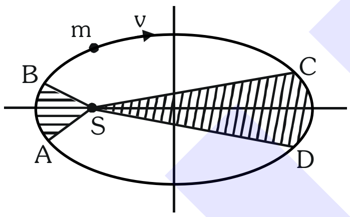
(3) The potential energies of earth and satellite in the two cases are equal

(4) S_1 and S_2 are moving with the same speed

GR0096

AIPMT 2009

2. 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) $t_1 = 2t_2$

GR0097

AIPMT 2010

3. 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

GR0098

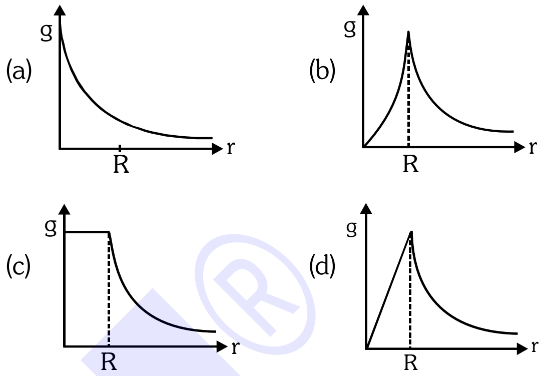
4. A particle of mass M is situated at the centre of a spherical shell of same mass and radius a. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be :-

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

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

GR0099

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 of uniform density, is as shown in figure below :-



The correct figure is :-

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

GR0100

6. 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 of radius $R_2(R_2 > R_1)$ is :-

(1) $GMm\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ (2) $2GMm\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(3) $\frac{1}{2}GMm\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ (4) $GMm\left(\frac{1}{R_1^2}-\frac{1}{R_2^2}\right)$

GR0101

AIPMT 2011

7. 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

GR0102

AIPMT Pre. 2012

8. 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 :-

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

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

GR0103

9. A geostationary satellite is orbiting the earth at a height of 5R above that 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 :-

(1) $6\sqrt{2}$ (2) $6/\sqrt{2}$ (3) 5 (4) 10

GR0104

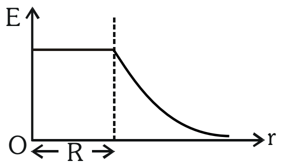
10. The height at which the weight of a body becomes $1/16^{th}$, its weight on the surface of earth (radius R), is :-

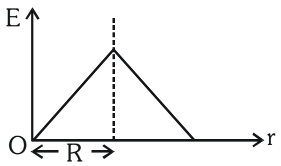
(1) 3R (2) 4R (3) 5R (4) 15R

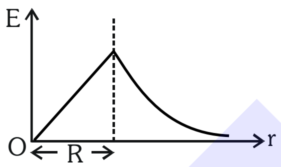
GR0105

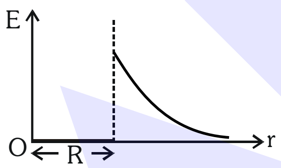
AIPMT Mains 2012

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

(1)


(2)


(3)


(4)


GR0106

12. If v_e is escape velocity and v_0 is orbital velocity of a satellite for orbit close to the earth's surface, then these are related by :

(1) $v_e = \sqrt{2v_0}$ (2) $v_e = \sqrt{2}v_0$

(3) $v_0 = \sqrt{2}v_e$ (4) $v_0 = v_e$

GR0107

AIPMT 2014

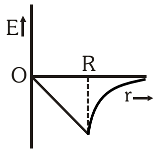
13. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98×10^{24} kg) have to be compressed to be a black hole ?

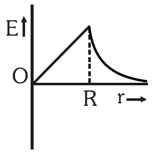
(1) 10^{-9} m (2) 10^{-6} m

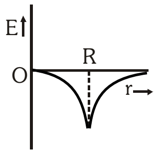
(3) 10^{-2} m (4) 100 m

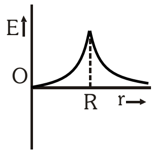
GR0109

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

(1)


(2)


(3)


(4)


GR0110

AIPMT 2015

15. 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) $GK = 4\pi^2$

GR0111

Re-AIPMT 2015

16. 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.

GR0112

17. 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

GR0113

NEET-I 2016

18. 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

GR0115

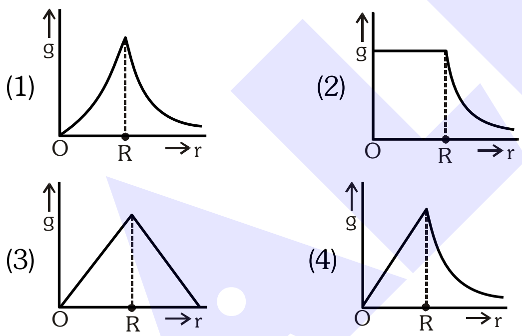
19. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is :-

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

GR0116

NEET-II 2016

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



GR0117

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:-

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

GR0118

NEET (UG) 2017

22. 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 = $\frac{3}{2}$ km
(3) d = 2 km (4) d = $\frac{1}{2}$ km

GR0120

23. 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.

GR0121

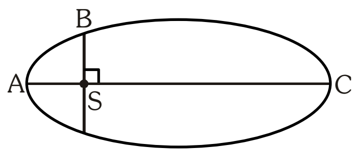
NEET (UG) 2018

24. 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 ?

(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

GR0123

25. 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) $K_B > K_A > K_C$

GR0124

NEET (UG) 2019

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 ?

(1) 150 N (2) 200 N
(3) 250 N (4) 100 N

GR0159

27. 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) $\frac{1}{2}$mgR (4) $\frac{3}{2}$mgR

GR0160

NEET (UG) 2019 (Odisha)

28. 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 2.5 R_E from surface will be,

(1) $6\sqrt{2}$ h (2) $12\sqrt{2}$ h
(3) $\frac{24}{2.5}$h (4) $\frac{12}{2.5}$h

GR0161

29. 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) $\frac{GMm}{R+h}$

GR0162

NEET (UG) 2020

30. 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

GR0163

NEET (UG) 2020 (Covid-19)

31. 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

GR0164

NEET (UG) 2021

32. 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) 2 υ (3) 3 υ (4) 4 υ

GR0165

33. 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) $\frac{Rk^2}{1-k^2}$

GR0166

NEET (UG) 2021(Paper-2)

34. Orbital velocity of an artificial satellite depends upon

I. Mass of the earth
II. Mass of the satellite
III. Radius of the earth

(1) I, II (2) I, III
(3) II, III (4) I, II, III

GR0167

NEET (UG) 2022

35. 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:

(1) 50 N/kg (2) 20 N/kg
(3) 180 N/kg (4) 0.05 N/kg

GR0168

NEET (UG) 2022 (Overseas)

36. Assuming the earth to be a sphere of uniform density, its acceleration due to gravity acting on a body:

(1) increases with increasing depth

(2) is independent of the mass of the earth

(3) is independent of the mass of the body

(4) increases with increasing altitude

GR0169

37. Two planets are in a circular orbit of radius R and 4R about a star. At a specific time, the two planets and the star are in a straight line. If the period of the closest planet in T, then the star and planets will again be in a straight line after a minimum time:

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

(3) 8 T (4) $(4)^2$ T

GR0170

Re-NEET (UG) 2022

38. 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) $+\frac{K}{4}$

GR0171

EXERCISE-II (Previous Year Questions) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**4**	**4**	**3**	**2**	**4**	**3**	**2**	**3**	**1**	**1**	**4**	**2**	**3**	**1**	**1**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**1**	**2**	**1**	**2**	**4**	**4**	**3**	**4**	**4**	**2**	**4**	**3**	**1**	**2**	**3**
Que.	31	32	33	34	35	36	37	38							
Ans.	**2**	**4**	**4**	**2**	**1**	**3**	**3**	**3**							

EXERCISE-III (Analytical Questions) — Master Your Understanding

1. Masses and radii of earth and moon are M_1, M_2 and R_1, R_2 respectively. The distance between their centre is 'd'. The minimum velocity given to mass 'M' from the mid point of line joining their centre so that it will escape :

(1) $\sqrt{\frac{4G(M_1+M_2)}{d}}$ (2) $\sqrt{\frac{4G}{d}\frac{M_1M_2}{(M_1+M_2)}}$

(3) $\sqrt{\frac{2G}{d}\left(\frac{M_1+M_2}{M_1M_2}\right)}$ (4) $\sqrt{\frac{2G}{d}(M_1+M_2)}$

GR0129

2. If R is the average radius of earth, ω is its angular velocity about its axis and g is the gravitational acceleration on the surface of earth then the cube of the radius of orbit of a geostationary satellite will be equal to :-

(1) $\frac{R^2g}{\omega}$ (2) $\frac{R^2\omega^2}{g}$ (3) $\frac{Rg}{\omega^2}$ (4) $\frac{R^2g}{\omega^2}$

GR0130

3. A geostationary satellite is orbiting the earth at a height of 6R from the earth's surface (R is the earth's radius). What is the period of rotation of another satellite at a height of 2.5 R from the earth surface ?

(1) $6\sqrt{2}$ hours (2) 10 hours

(3) $\frac{5\sqrt{5}}{\sqrt{3}}$ hours (4) none of the above

GR0131

4. A planet revolves around the sun in an elliptical orbit. If v_p and v_a are the velocities of the planet at the perigee and apogee respectively, then the eccentricity of the elliptical orbit is given by :

(1) $\frac{v_p}{v_a}$ (2) $\frac{v_a-v_p}{v_a+v_p}$

(3) $\frac{v_p+v_a}{v_p-v_a}$ (4) $\frac{v_p-v_a}{v_p+v_a}$

GR0132

5. 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 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

GR0133

6. 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.

GR0134

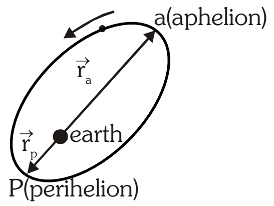
7. A small planet is revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force between the planet and the star were proportional to $R^{-5/2}$, then T would be proportional to

(1) $R^{3/2}$ (2) $R^{3/5}$

(3) $R^{7/2}$ (4) $R^{7/4}$

GR0135

8. 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)

GR0136

9. 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

GR0137

EXERCISE-III (Analytical Questions) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9
Ans.	1	4	1	4	4	4	4	1	1