Shiksha Classes Bhandara

CHAPTER TEST

Subject : Physics **Topic : Gravitation** **M.M. : 100**

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 If the radius of the earth were to shrink by one per cent, its mass remaining the same, the value of g on the earth's surface would

(A) increase by 0.5% (B) increase by 2%
(C) decrease by 0.5% (D) decrease by 2%.

Q.2 Mass of moon is 1/81 times that of earth and its radius is 1/4 , the earth's radius. If escape velocity at surface of earth is 11.2 km/sec, then its value at surface of moon is:

(A) 0.14 km/sec (B) 0.5 km/sec
(C) 2.5 km/sec (D) 5 km/sec.

Q.3 A particle is suspended from a spring and it stretches the spring by 1 cm on the surface of earth. The same particle will stretch the same spring at a placed 800 Km above earth surface by

(A) 0.39 cm (B) 0.79 cm
(C) 0.49 cm (D) 0.89 cm

Q.4 The little prince (the main character of the novel written by antoine de saint-Exupery) lives on the spherical planet named B-612, the density of which is 5200 kg/m^3. The Little Prince noticed that if he quickens his pace, he feels himself lighter. When he reached the speed of 2 m/s he became weightless, and began to orbit about the planet as a satellite. What is escape speed on the surface of planet.

(A) $2\sqrt{2}$ m/s (B) 2 m/s
(C) $4\sqrt{2}$ m/s (D) $8\sqrt{2}$ m/s

Q.5 A magnetic storm from sun can disrupt a satellite as well as move it, either toward or away from Earth radially. Ground-based engineers start it back in a new circular orbit at the new position. Due to the storm –

(A) The period of a satellite displaced further away is more than the previous period.
(B) The mechanical energy of a satellite displaced towards earth is more than the previous energy.
(C) The speed of a satellite displaced further away is more than the previous speed.
(D) The angular momentum of a satellite displaced towards earth is more than the previous angular momentum

Q.6 A straight rod of length extends L from x = a to x = L + a. The gravitational force exerted on a point mass m at x = 0 if the mass per unit length of the rod is A + Bx^2, is

(A) $GmA\left[\frac{1}{a+L}-\frac{1}{a}+BL\right]$
(B) $Gm\left[\frac{A}{a}-\frac{A}{a+L}+BL\right]$
(C) $GmA\left[\left(\frac{1}{a+L}-\frac{1}{a}\right)-BL\right]$
(D) $GmA\left[\left(\frac{1}{a}-\frac{1}{a+L}\right)-BL\right]$

Q.7 Two thin rings each of radius R are coaxially placed at a distance R. The rings have a uniform mass distribution and have mass m_1 and m_2 respectively. Then the work done in moving a mass m from centre of one ring to that of the other is

(A) zero
(B) $\frac{Gm\,(m_1-m_2)\,(\sqrt{2}-1)}{\sqrt{2}R}$
(C) $\frac{Gm\,(\sqrt{2})\,(m_1-m_2)}{R}$
(D) $\frac{Gm m_1(\sqrt{2}+1)}{m_2 R}$

Q.8 In older times, people used to think that the earth was flat. Imagine that the earth is indeed not a sphere of radius R, but an infinite plate of thickness H. What value of H is needed to allow the same gravitational acceleration to be experienced as on the surface of the actual earth ? (Assume that the earth's density is uniform and equal in the two models

(A) 2R/3 (B) 4R/3
(C) 8R/3 (D) R/3

Q.9 A man of mass m starts falling towards a planet of mass M and radius R. As he reaches near to the surface, he realizes that he will pass through a small hole in the planet. As he enters the hole, he sees that the planet is really made of two pieces a spherical shell of negligible thickness of mass 2M/3 and a point mass M/3 at the centre. Change in the force of gravity experienced by the man is –

(A) $\frac{2}{3}\frac{GMm}{R^2}$ (B) 0
(C) $\frac{1}{3}\frac{GMm}{R^2}$ (D) $\frac{4}{3}\frac{GMm}{R^2}$

Q.10 In a certain region of space gravitational field is given by E = – (K/r). Taking the reference point to be at r = r_0 with V = V_0, the potential is –

(A) $V = V_0 \ln\left(\frac{r}{r_0}\right)$ (B) $V = V_0 e^{-r/r_0}$
(C) $V = V_0 + K\ln\frac{r}{r_0}$ (D) $V = V_0 e^{+r/r_0}$

Q.11 When a satellite in a circular orbit around the earth enters the atmospheric region, it encounters small air resistance to its motion. Then –

(1) its kinetic energy increases
(2) its kinetic energy decreases

(3) its angular momentum about the earth decreases
(4) its period of revolution around the earth increases
Correct options are –

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

Q.12 A spherical uniform planet is rotating about its axis. The velocity of a point on its equator is V. Due to the rotation of planet about its axis the acceleration due to gravity g at equator is 1/2 of g at poles. The escape velocity of a particle on the pole of planet in terms of V.

(A) $V_e = 2V$ (B) $V_e = V$
(C) $V_e = V/2$ (D) $V_e = \sqrt{3}V$

Q.13 Let ω be the angular velocity of the earth's rotation about its axis. Assume that the acceleration due to gravity on the earth's surface has the same value at the equator and the poles. An object weighed at the equator gives the same reading as a reading taken at a depth d below earth's surface at a pole (d << R). The value of d is –

(A) $\frac{\omega^2 R^2}{g}$ (B) $\frac{\omega^2 R^2}{2g}$
(C) $\frac{2\omega^2 R^2}{g}$ (D) $\frac{\sqrt{Rg}}{g}$

Q.14 The kinetic energy of a satellite in an orbit close to the surface of the earth is E. What should be its kinetic energy so that it escapes from the gravitational field of the earth ?

(A) $\sqrt{2}E$ (B) 2E
(C) $2\sqrt{2}E$ (D) 4E

Q.15 A point P lies on the axis of a fixed ring of mass M and radius R, at a distance 2R from its centre O. A small particle starts from P and reaches O under gravitational attraction only. Its speed at O will be –

(A) zero (B) $\sqrt{\frac{2GM}{R}}$
(C) $\sqrt{\frac{2GM}{R}(\sqrt{5}-1)}$ (D) $\sqrt{\frac{2GM}{R}(1-\frac{1}{\sqrt{5}})}$

Q.16 Assuming the earth to be a sphere of uniform density the acceleration due to gravity then choose the correct option–

(A) at a point outside the earth is inversely proportional to the square of its distance from the centre
(B) at a point outside the earth is inversely proportional to its distance from the centre
(C) at a point inside is proportional to its distance from the centre.
(D) Both (A) and (C)

Q.17 If the radius of the earth be increased by a factor of 5, by what factor its density be changed to keep the value of 'g' same –

(A) 1/25 (B) 1/5
(C) $1/\sqrt{5}$ (D) 5

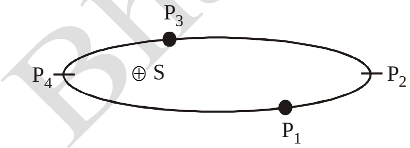
Q.18 A satellite can be in a geostationary orbit around earth at a distance r from the centre. If the angular velocity of earth about its axis doubles, a satellite can now be in a geostationary orbit around earth if its distance from the centre is–

(A) $\frac{r}{2}$ (B) $\frac{r}{2\sqrt{2}}$
(C) $\frac{r}{(4)^{1/3}}$ (D) $\frac{r}{(2)^{1/3}}$

Q.19 In side a hollow spherical shell –

(A) everywhere gravitational potential is zero
(B) everywhere gravitational field is zero
(C) everywhere gravitational potential is same
(D) everywhere gravitational field is same

Q.20 The figure shows a planet in elliptical orbit around the sun S. Where is the kinetic energy of the planet maximum ?



(A) P_1 (B) P_2
(C) P_3 (D) P_4

For Q.21-Q.25 :
The answer to each question is a NUMERICAL VALUE.

Q.21 A cavity of radius R/2 is made inside a solid sphere of radius R. The centre of the cavity is located at a distance R/2 from the centre of the sphere. The gravitational force on a particle of mass 'm' at a distance R/2 from the centre of the sphere on the line joining both the centres of sphere and cavity is (3mg / X). Find the value of X.
(opposite to the centre of gravity)
[Here $g = GM/R^2$, where M is the mass of the sphere]

Q.22 Two satellites have their masses in the ratio of 3 : 1. The radii of their circular orbits are in the ratio of 1 : 4. The ratio of total mechanical energy of A and B is X : 1. Find the value of X.

Q. 23 A satellite of mass m, initially at rest on the earth, is launched into a circular orbit at a height equal to the radius of the earth. The minimum energy required is $\frac{X}{4}mgR$. Find the value of X.

Q.24 A planet revolves about the sun is elliptical orbit. The areal velocity $\left(\frac{dA}{dt}\right)$ of the planet is 4.0×10^{16} m²/s. The least distance between planet and the sun is 2×10^{12}m. Then the maximum speed of the planet in km/s is –

Q.25 Two planets A and B have the same material density. If the radius of A is twice that of B, then the ratio of the escape velocity v_A/v_B is –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