DPP (GRAVITATION FORCE)

GRAVITATIONAL FORCE AND FIELD

1. If we ignore the presence of the sun, then there exists a point on the line joining the earth and the Moon where gravitational force is zero. The point is located from the moon at a distance of (Given that earth is 81 times heavier than moon and the separation between earth and moon 4×10^8 m) :

(A) 8×10^7 m (B) 4×10^6 m (C) 4×10^7 m (D) 8×10^6 m

2. Four similar particles of mass ma are orbiting in a circle of radius r in the same direction because of their mutual gravitational attractive force. Velocity of a particle is given by

(A) $\left[\frac{Gm}{r}\left(\frac{1+2\sqrt{2}}{4}\right)\right]^{\frac{1}{2}}$ (B) $\sqrt[3]{\frac{Gm}{r}}$

(C) $\sqrt{\frac{Gm}{r}(1+2\sqrt{2})}$ (D) $\left[\frac{1}{2}\frac{Gm}{r}\left(\frac{1+\sqrt{2}}{2}\right)\right]^{\frac{1}{2}}$

3. A certain triple-star system consists of two stars, each of mass ' m ' revolving about a central star of mass M in the same circular orbit of radius ' r '. The two stars are always at opposite ends of a diameter of the circular orbit. An expression for the period of revolution of the stars is :

(A) $\frac{4\pi r^{3/2}}{G(M+m)}$ (B) $\frac{4\pi r^{3/2}}{\sqrt{G(4M+m)}}$ (C) $\frac{4\pi r^{3/2}}{\sqrt{G(M+m)}}$ (D) $\frac{4\pi r^{3/2}}{G(4M+m)}$

4. An experiment using the Cavendish balance to measure the gravitational constant G found that a mass of 0.800 kg attracts another sphere of mass 4.00×10^{-3} kg with a force of 1.30×10^{-10} N when the distance between the centres of the spheres is 0.0400 m. The acceleration due to gravity at the earth's surface is 9.80 m/s^2 and the radius of the earth is 6380 km. The mass of the earth from these data is (approximately) –

(A) 8×10^{24} kg (B) 8×10^{23} kg (C) 6×10^{23} kg (D) 6×10^{24} kg

5 . A spherical hollow cavity is made in a lead sphere of radius R, such that its surface touches the outside surface of the lead sphere and passes through its centre. The mass of the sphere before hollowing was M. With what gravitational force will the hollowed-out lead sphere attract a small sphere of mass ' m ', which lies at a distance d from the centre of the lead sphere on the straight line connecting the centres of the spheres and that of the hollow, if d = 2R :

(A) $\frac{7GMm}{18R^2}$ (B) $\frac{7GMm}{36R^2}$ (C) $\frac{7GMm}{9R^2}$ (D) $\frac{7GMm}{72R^2}$

6. A straight rod of length ℓ extends from x = α to x = ℓ + α. If the mass per unit length is (a + bx^2). The gravitational force it exerts on a point mass m placed at x = 0 is given by

(A) $Gm\left(a\left(\frac{1}{\alpha}-\frac{1}{\alpha+\ell}\right)+b\ell\right)$ (B) $\frac{Gm(a+bx^2)}{\ell^2}$

(C) $Gm\left(\alpha\left(\frac{1}{a}-\frac{1}{a+\ell}\right)+b\ell\right)$ (D) $Gm\left(a\left(\frac{1}{\alpha+\ell}-\frac{1}{\alpha}\right)+b\ell\right)$

7. Two concentric shells of uniform density of mass M_1 and M_2 are situated as shown in the figure. The forces experienced by a particle of mass m when placed at positions A, B and C respectively are (given OA = p, OB = q and OC = r)

(A) zero, $G\dfrac{M_1 m}{q^2}$ and $G\dfrac{(M_1+m_2)m}{p^2}$

(B) $G\dfrac{(M_1+M_2)m}{p^2}$, $G\dfrac{(M_1+M_2)m}{q^2}$ and $G\dfrac{M_1 m}{r^2}$

(C) $G\dfrac{M_1 m}{q^2}$, $\dfrac{G(M_1+M_2)m}{p^2}$, $G\dfrac{M_1 m}{q^2}$ and zero

(D) $\dfrac{G(M_1+M_2)m}{p^2}$, $G\dfrac{M_1 m}{q^2}$ and zero

8. Three particles P, Q and R are placed as per given figure. Masses of P, Q and R are $\sqrt{3}$ m, $\sqrt{3}$ m and m respectively. The gravitational force on a fourth particle 'S' of mass m is equal to

(A) $\dfrac{\sqrt{3}\,GM^2}{2d^2}$ in ST direction only

(B) $\dfrac{\sqrt{3}\,Gm^2}{2d^2}$ in SQ direction and $\dfrac{\sqrt{3}\,Gm^2}{2d^2}$ in SU direction

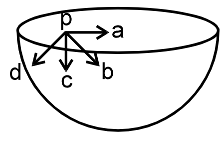
(C) $\dfrac{\sqrt{3}\,Gm^2}{2d^2}$ in SQ direction only

(D) $\dfrac{\sqrt{3}\,Gm^2}{2d^2}$ in SQ direction and $\dfrac{\sqrt{3}\,Gm^2}{2d^2}$ in ST direction

9. Solid spheres of same material and same radius 'r' are touching each other. If the density is 'ρ' then find out gravitational force between them.

10. Figure show a hemispherical shell. The direction of gravitational field intensity at point P will be along:

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



11. Gravitational field at the centre of a semicircle formed by a thin wire AB of mass m and length ℓ is :

(A) $\dfrac{Gm}{\ell^2}$ along +x axis
(B) $\dfrac{Gm}{\pi\ell^2}$ along +y axis

(C) $\dfrac{2\pi Gm}{\ell^2}$ along + x axis
(D) $\dfrac{2\pi Gm}{\ell^2}$ along + y axis

12. A uniform ring of mass m is lying at a distance $\sqrt{3}$ a from the centre of a sphere of mass M just over the sphere where a is the small radius of the ring as well as that of the sphere. Then gravitational force exerted is :

(A) $\dfrac{GMm}{8a^2}$ (B) $\dfrac{GMm}{3a^2}$ (C) $\sqrt{3}\dfrac{GMm}{a^2}$ (D) $\sqrt{3}\dfrac{GMm}{8a^2}$

13. In a spherical region, the density varies inversely with the distance from the centre. Gravitational field at a distance r from the centre is :

(A) proportional to r (B) proportional to $\frac{1}{r}$ (C) proportional to r^2 (D) same everywhere

14. In above problem, the gravitational potential is -

(A) proportional to r (B) proportional to $\frac{1}{r}$ (C) proportional to r^2 (D) same every where.

15.* Inside a uniform spherical shell :
(A) The gravitation potential is zero
(B) The gravitational field is zero
(C) The gravitational potential is same everywhere
(D) The gravitational field is same everywhere.

16. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. If the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$ then
(A) T^2 is proportional to R^3
(B) T^2 is proportional to $R^{7/2}$
(C) T^2 is proportional to $R^{3/2}$
(D) T^2 is proportiona to $R^{3.75}$

17. A solid sphere of uniform density and radius 4 units is located with its centre at the origin O of coordinates. Two spheres of equal radii 1 unit with their centres at A (–2, 0, 0) and B(2, 0, 0) respectively are taken out of the solid leaving behind spherical cavities as shown in the figure.

(A) The gravitational field due to this object at the origin is zero.
(B) The gravitational field at the point B(2, 0, 0) is zero
(C) The gravitational field at the point A(–2, 0, 0) is zero.
(D) The gravitational field at points A, O and B is zero.

ANSWER KEY

1.	C	**2.**	A	**3.**	B
4.	D	**5 .**	B	**6.**	A
7.	D	**8.**	C	**9.**	$\frac{4}{9}\pi^2\rho^2 Gr^4$
10.	C				
11.	D	**12.**	D	**13.**	D
14.	A	**15.***	BCD		
16.	B	**17.**	A		