Gravitation

1. Three uniform spheres of mass M and radius R each are kept in such a way that each touches the other two. The magnitude of the gravitational force on any of the spheres due to the other two is

(a) $\frac{\sqrt{3}}{4}\frac{GM^2}{R^2}$ (b) $\frac{3}{2}\frac{GM^2}{R^2}$ (c) $\frac{\sqrt{3}GM^2}{R^2}$ (d) $\frac{\sqrt{3}}{2}\frac{GM^2}{R^2}$

2. Let g be the acceleration due to gravity at earth's surface and K be the rotational kinetic energy of the earth. Suppose the earth's radius decreases by 2% keeping all other quantities same, then

(a) g decreases by 2% and K decreases by 4% (b) g decreases by 4% and K increases by 2%

(c) g increases by 4% and K decreases by 4% (d) g decreases by 4% and K increase by 4%

3. A pendulum clock is set to give correct time at the sea level. This clock is moved to hill station at an altitude of 2500m above the sea level. In order to keep correct time of the hill station, the length of the pendulum

(a) Has to be reduced (b) Has to be increased

(c) Needs no adjustment (d) Needs no adjustment but its mass has to be increased

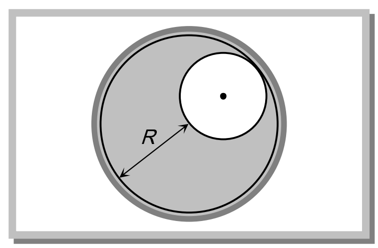
4. A tunnel is dug along the diameter of the earth. If a particle of mass m is situated in the tunnel at a distance x from the centre of earth then gravitational force acting on it, will be

(a) $\frac{GM_e m}{R_e^3}x$ (b) $\frac{GM_e m}{R_e^2}$ (c) $\frac{GM_e m}{x^2}$ (d) $\frac{GM_e m}{(R_e + x)^2}$

5. The acceleration due to gravity increases by 0.5% when we go from the equator to the poles. What will be the time period of the pendulum at the equator which beats seconds at the poles

(a) 1.950 s (b) 1.995 s (c) 2.050 s (d) 2.005 s

6. A spherical hole is made in a solid sphere of radius R. The mass of the sphere before hollowing was M. The gravitational field at the centre of the hole due to the remaining mass is



(a) Zero

(b) $\frac{GM}{8R^2}$

(c) $\frac{GM}{2R^2}$

(d) $\frac{GM}{R^2}$

7. A point P lies on the axis of a ring of mass M and radius a, at a distance a from its centre C. A small particle starts from P and reaches C under gravitational attraction only. Its speed at C will be

(a) $\sqrt{\frac{2GM}{a}}$ (b) $\sqrt{\frac{2GM}{a}\left(1-\frac{1}{\sqrt{2}}\right)}$ (c) $\sqrt{\frac{2GM}{a}(\sqrt{2}-1)}$ (d) Zero

8. A ball of mass m is fired vertically upwards from the surface of the earth with velocity nv_e, where v_e is the escape velocity and $n < 1$. Neglecting air resistance, to what height will the ball rise? (Take radius of the earth as R)

(a) R/n^2 (b) $R/(1-n^2)$ (c) $Rn^2/(1-n^2)$ (d) Rn^2

9. A satellite is revolving around a planet of mass M in an elliptical orbit of semi-major axis a. The orbital velocity of the satellite at a distance r from the focus will be

(a) $\left[GM\left(\frac{2}{r}-\frac{1}{a}\right)\right]^{1/2}$ (b) $\left[GM\left(\frac{1}{r}-\frac{2}{a}\right)\right]^{1/2}$ (c) $\left[GM\left(\frac{2}{r^2}-\frac{1}{a^2}\right)\right]^{1/2}$ (d) $\left[GM\left(\frac{1}{r^2}-\frac{2}{a^2}\right)\right]^{1/2}$

10. A space probe projected from the earth moves round the moon in a circular orbit at a distance equal to its radius $R_{moon} = \frac{R}{4}$ where R = radius of the earth. Its rocket launcher moves in circular orbit around the earth at a distance equal to R from its surface. The ratio of the times taken for one revolution by the probe and the rocket launcher is $\left(M_{moon} = \frac{M}{80}, \text{where } M = \text{mass of the earth}\right)$

(a) $\sqrt{3}:2$ (b) $\sqrt{5}:2$ (c) 1 : 1 (d) $2:\sqrt{3}$

11. If the angular velocity of a planet about its own axis is halved, the distance of geostationary satellite of this planet from the centre of the planet will become

(a) $(2)^{1/3}$ times (b) $(2)^{3/2}$ times (c) $(2)^{2/3}$ times (d) 4 times

12. A mass *m* is raised from the surface of the earth to a point distant $\beta R(\beta > 1)$ from the centre of the earth and then put into a circular orbit to make it an artificial satellite. The total work done to complete this job is

(a) $mgR(2\beta - 1)$ (b) $mgR(2\beta + 1)$ (c) $mgR(\beta + 1)$ (d) $mgR\dfrac{2\beta - 1}{2\beta}$

13. Two planets at mean distance d_1 and d_2 from the sun and their frequencies are n_1 and n_2 respectively then

(a) $n_1^2 d_1^2 = n_2 d_2^2$ (b) $n_2^2 d_2^3 = n_1^2 d_1^3$ (c) $n_1 d_1^2 = n_2 d_2^2$ (d) $n_1^2 d_1 = n_2^2 d_2$

14. Earth needs one year to complete one revolution round the sun. If the distance between sun and earth is doubled then the period of revolution of earth will become

(a) $2\sqrt{2}$ yrs (b) 8 yrs (c) $\frac{1}{2}$ yrs (d) 1 yrs

15. A body placed at a distance *R₀* form the centre of earth, starts moving from rest. The velocity of the body on reaching at the earth's surface will be (R_e = radius of earth and M_e = mass of earth)

(a) $GM_e\left(\frac{1}{R_e} - \frac{1}{R_0}\right)$ (b) $2GM_e\left(\frac{1}{R_e} - \frac{1}{R_0}\right)$ (c) $GM_e\sqrt{\frac{1}{R_e} - \frac{1}{R_0}}$ (d) $\sqrt{2GM_e\left(\frac{1}{R_e} - \frac{1}{R_0}\right)}$