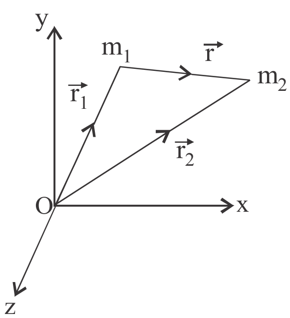
7

Gravitation

Diagram Based Questions :

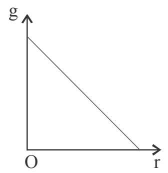
1. In the figure, the direction of gravitational force on m_1 due to m_2 is along

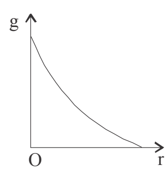


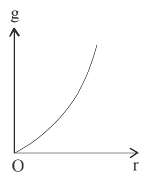
(a) $\vec{r}_1$ (b) $\vec{r}_2$

(c) $\vec{r}$ (d) $-\vec{r}$

2. Which of the following graphs shows the correct variation of acceleration due to gravity with the height above the earth's surface?

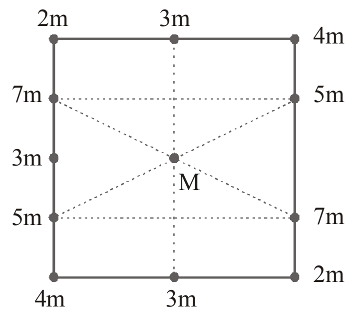
(a) 

(b) 

(c) 

(d) None of these

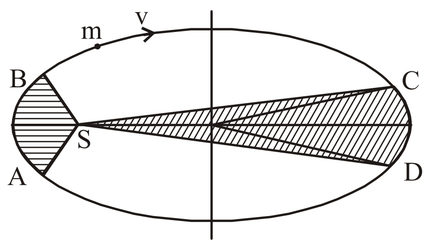
3. A central particle M is surrounded by a square array of other particles, separated by either distance d or distance $d/2$ along the perimeter of the square. The magnitude of the gravitational force on the central particle due to the other particles is



(a) $\frac{9\,GMm}{d^2}$ (b) $\frac{5\,GMm}{d^2}$

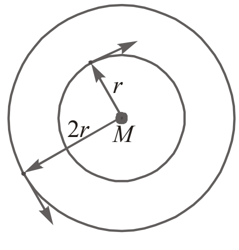
(c) $\frac{3\,GMm}{d^2}$ (d) $\frac{GMm}{d^2}$

4. 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



(a) $t_1 = 4t_2$ (b) $t_1 = 2t_2$
(c) $t_1 = t_2$ (d) $t_1 > t_2$

5. Two satellites of masses m and $2m$ are revolving around a planet of mass M with different speeds in orbits of radii r and $2r$ respectively. The ratio of minimum and maximum forces on the planet due to satellites is



(a) $\frac{1}{2}$

(b) $\frac{1}{4}$

(c) $\frac{1}{3}$

(d) None of these

Solution

1. **(c)** As m_2 attracts m_1 towards itself, $\therefore$ force is along $\vec{r}$.

2. **(b)** Acceleration due to gravity with height h varies as

$$g \propto \frac{1}{r^2}$$

(when r = R + h). Thus variation of g and r is a parabolic curve.

3. **(c)** $F = \frac{GM(3m)}{d^2} = \frac{3GMm}{d^2}$.

4. **(b)** According to Kepler's law, the areal velocity of a planet around the sun always remains constant.

SCD : $A_1 - t_1$ (areal velocity constant)

SAB : $A_2 - t_2$

$$\frac{A_1}{t_1} = \frac{A_2}{t_2},$$

$$t_1 = t_2 \cdot \frac{A_1}{A_2}, \qquad \text{(given } A_1 = 2A_2\text{)}$$

$$= t_2 \cdot \frac{2A_2}{A_2} \qquad \therefore \quad t_1 = 2t_2$$

5. **(c)**

$$F_{min} = \frac{GMm}{r^2} - \frac{GM(2m)}{(2r)^2}$$

$$= \frac{GMm}{2r^2}$$

and

$$F_{max} = \frac{GMm}{r^2} + \frac{GM(2m)}{(2r)^2}$$

$$= \frac{3}{2}\frac{GMm}{r^2}.$$

$$\therefore \quad \frac{F_{min}}{F_{max}} = \frac{1}{3}.$$