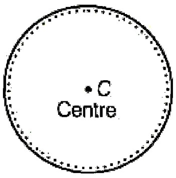
PHYSICS

Section A

1. (4)

A bangle is in the form of a ring as shown in the adjacent diagram. The centre of mass lies at the centre, which is outside the body (boundary).



2. (3)

Centre of mass of a system lies towards the part of the system, having bigger mass. In the above diagram, lower part is heavier hence CM of the system lies below the horizontal diameter.

3. (4)
4. (4)
5. (3)
6. (1)

7. (3)

Net external force on the system is zero hence centre of mass remains unchanged.

8. (2)

The position vector of centre of mass

$$r = \frac{m_1 r_1 + m_2 r_2}{m_1 + m_2}$$

$$= \frac{1(\hat{i}+2\hat{j}+\hat{k})+3(-3\hat{i}-2\hat{j}+\hat{k})}{1+3}$$

$$= \frac{1}{4}(-8\hat{i}-4\hat{j}+4\hat{k}) = -2\hat{i}-\hat{j}+\hat{k}$$

9. (2)

As we know that radius of gyration

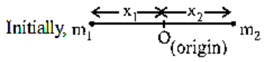
$$k = \sqrt{\frac{I}{m}}$$

So, for two different cases

$$\frac{k_{ring}}{k_{disc}} = \sqrt{\frac{I_{ring}}{I_{disc}}} = \sqrt{\frac{MR^2}{\frac{1}{2}MR^2}}$$

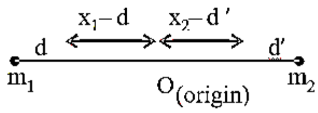
$$\therefore \frac{k_{ring}}{k_{disc}} = \sqrt{2} \Rightarrow \frac{k_{disc}}{k_{ring}} = \frac{1}{\sqrt{2}}$$

10. (3)



$$0 = \frac{m_1(-x_1)+m_2x_2}{m_1+m_2} \Rightarrow m_1x_1 = m_2x_2 \quad \ldots(1)$$

Let the particles is displaced through distanced away fromcentre of mass



$$\therefore 0 = \frac{m_1(d-x_1)+m_2(x_2-d')}{m_1+m_2} \Rightarrow m_1x_1 = m_2x_2$$

$$\Rightarrow 0 = m_1d - m_1x_1 + m_2x_2 - m_2d'$$

$$\Rightarrow d' = \frac{m_1}{m_2}d$$