

↳ Centre of mass of two particle system

$$\vec{r}_{cm} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2}$$

↳ Centre of mass of n particle system

$$\vec{r}_{cm} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2 + \dots + m_n \vec{r}_n}{m_1 + m_2 + \dots + m_n}$$

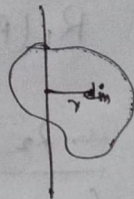
↳ Moment of Inertia

• Kinetic energy of rotational motion: $\frac{1}{2} (\sum m_i r_i^2) \omega^2$

$$\text{Moment of inertia } (I) = \sum m_i r_i^2$$

Moment of inertia of system of particle

$$I = \int r^2 dm$$

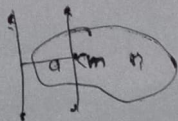


↳ Radius of gyration (k)

$$k = \sqrt{\frac{I}{M}} \Rightarrow I = M k^2$$

↳ Parallel axis Theorem

$$I = I_{cm} + M a^2$$

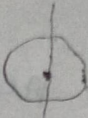

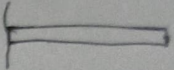

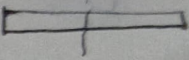
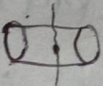
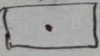


↳ Perpendicular axis Theorem

$$I_m = I_1 + I_2$$

Note: - only applicable for two dimensional body

Moment of inertia Table

- | | | | | |
|----------------------------|---|--|-------------------------|---|
| 1. Circular ring | Mr^2 |  | 8. Rod | |
| 2. Circular disc | $\frac{Mr^2}{2}$ |  | • $I = \frac{Md^2}{3}$ |  |
| 3. Right circular cylinder | $\frac{Mr^2}{2}$ |  | • $I = \frac{Ml^2}{12}$ |  |
| 4. Solid cylinder | $\frac{Mr^2}{4} + \frac{Md^2}{12}$ |  | | |
| 5. Solid sphere | $\frac{2}{5} MR^2$ | | | |
| 6. Hollow sphere | $\frac{2}{3} MR^2$ | | | |
| 7. Rectangle | $M\left(\frac{a^2}{12} + \frac{b^2}{12}\right)$ |  | | |