Physics Formula Sheet

Chapter by chapter, topic by topic. Written by the PadhoNa team for quick revision.

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CHAPTER 8

Center of Mass Momentum and Collision

Centre of mass

$$\vec{r}_{cm} = \frac{\sum m_i \vec{r}_i}{\sum m_i} = \frac{1}{M}\int \vec{r}\, dm$$

STANDARD BODIES

$$\text{semicircular ring } \frac{2R}{\pi}; \qquad \text{semicircular disc } \frac{4R}{3\pi}; \qquad \text{hemisphere (solid) } \frac{3R}{8};$$

$$\text{cone } \frac{h}{4} \text{ from base}$$

$$M\vec{a}_{cm} = \vec{F}_{\text{ext}}, \qquad \vec{p} = M\vec{v}_{cm}$$

Conservation of momentum

$$\vec{F}_{\text{ext}} = 0 \;\Rightarrow\; \sum m_i \vec{v}_i = \text{constant}$$

RECOIL

$$m_g v_g = -m_b v_b$$

VARIABLE MASS (ROCKET)

$$F = v_r \frac{dm}{dt}, \qquad v = u + v_r \ln \frac{m_0}{m}$$

Collisions

COEFFICIENT OF RESTITUTION

$$e = \frac{\text{velocity of separation}}{\text{velocity of approach}} = \frac{v_2 - v_1}{u_1 - u_2}$$

1-D COLLISION

$$v_1 = \frac{(m_1 - em_2)u_1 + (1+e)m_2u_2}{m_1+m_2}, \qquad v_2 = \frac{(m_2 - em_1)u_2 + (1+e)m_1u_1}{m_1+m_2}$$

ELASTIC, EQUAL MASSES

$$e = 1,\ m_1 = m_2 : \text{velocities exchange}$$

KE LOST IN A COLLISION

$$\Delta K = \frac{m_1 m_2}{2(m_1+m_2)}(u_1-u_2)^2(1-e^2)$$

BOUNCING BALL

$$h_n = e^{2n}h$$

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