Physics Formula Sheet

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

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CHAPTER 9

Rotational Motion

Moment of inertia

$$I = \sum mr^2 = \int r^2\,dm, \qquad I = MK^2 \ (K = \text{radius of gyration})$$

AXIS THEOREMS

$$I = I_{cm} + Md^2 \ (\text{parallel}); \qquad I_z = I_x + I_y \ (\text{perpendicular, plane bodies})$$

STANDARD (ABOUT THE CENTRAL AXIS)

$$\text{ring } MR^2; \qquad \text{disc } \tfrac{1}{2}MR^2; \qquad \text{solid sphere } \tfrac{2}{5}MR^2; \qquad \text{hollow sphere } \tfrac{2}{3}MR^2$$

$$\text{rod about centre } \tfrac{1}{12}ML^2; \qquad \text{about end } \tfrac{1}{3}ML^2; \qquad \text{ring about diameter } \tfrac{1}{2}MR^2;$$

$$\text{disc about diameter } \tfrac{1}{4}MR^2$$

Torque and rotational dynamics

$$\vec{\tau} = \vec{r} \times \vec{F}, \qquad \tau = I\alpha, \qquad W = \int \tau\,d\theta, \qquad P = \tau\omega$$

KINETIC ENERGY

$$K = \tfrac{1}{2}I\omega^2$$

Angular momentum

$$\vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}, \qquad \vec{\tau} = \frac{d\vec{L}}{dt}$$

CONSERVATION

$$\tau_{\text{ext}} = 0 \ \Rightarrow \ I_1\omega_1 = I_2\omega_2$$

Rolling motion

WITHOUT SLIPPING

$$v_{cm} = \omega R, \qquad K = \tfrac{1}{2} M v^2 \left(1 + \frac{K^2}{R^2}\right)$$

DOWN AN INCLINE

$$a = \frac{g \sin\theta}{1 + K^2/R^2}, \qquad \mu_{\min} = \frac{\tan\theta}{1 + R^2/K^2}$$

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