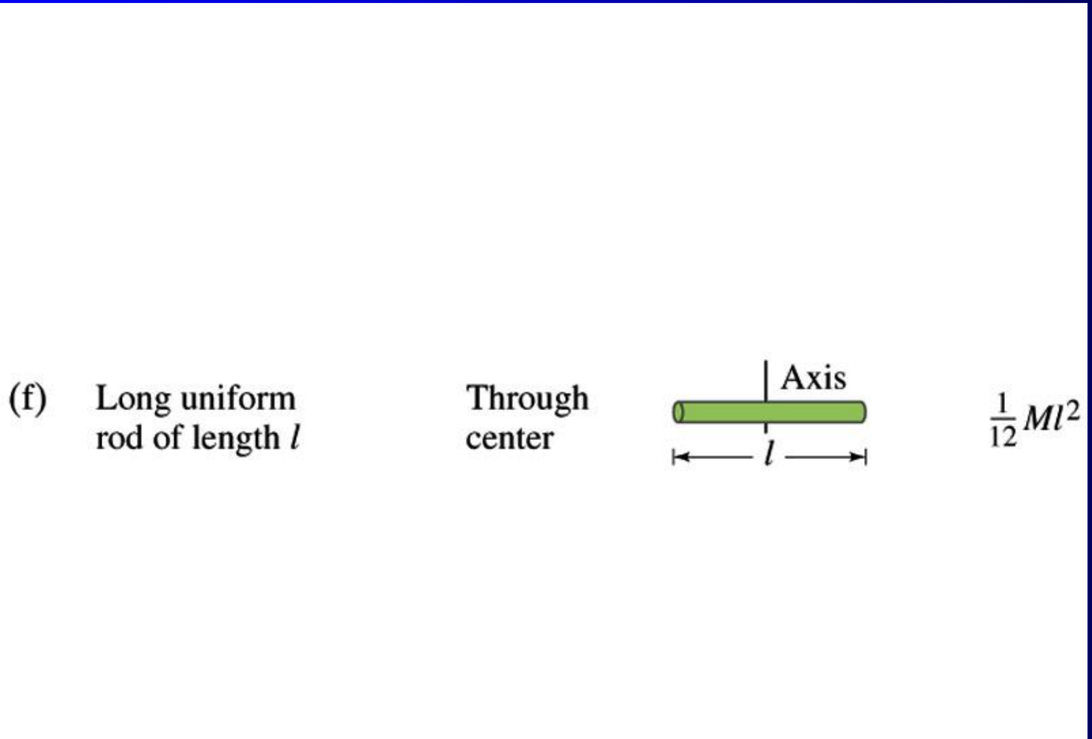
Calculating Moments of Inertia

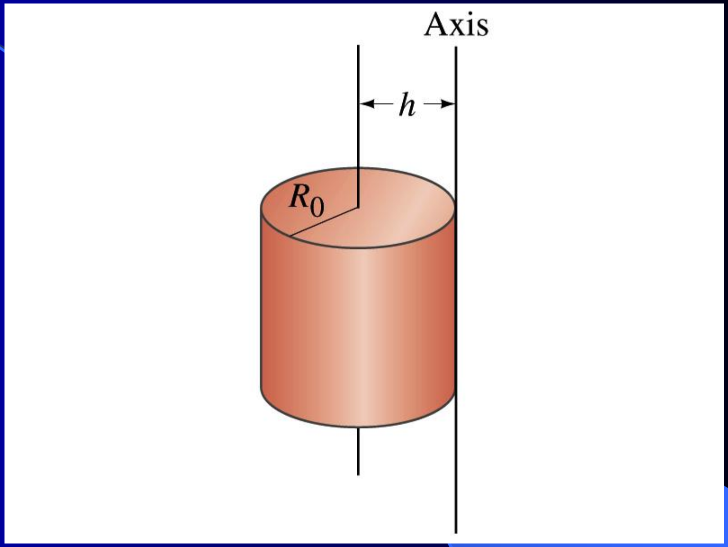
$$I = \Sigma m_i R_i^2$$

$$I = \Sigma m_i R_i^2 = 1/12\ M\ l^2$$

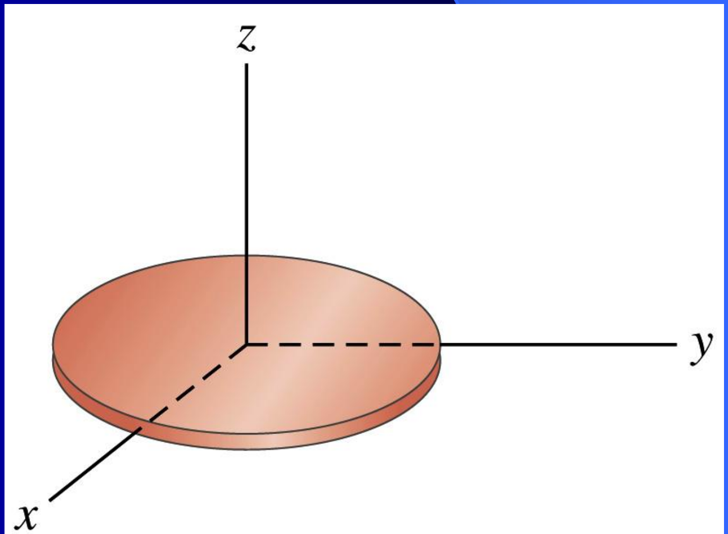


A few helpful theorems

- Parallel Axis Theorem
  - $I = I_{CM} + M h^2$



- Perpendicular Axis Theorem
  - $I_z = I_x + I_y$
  - Only valid if flat object!



Angular Momentum

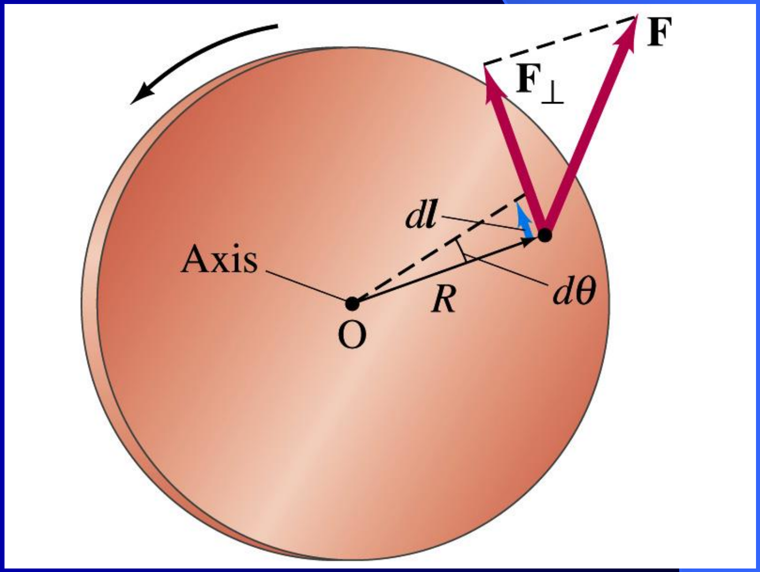
Angular Momentum	Momentum
$L = I\omega$	$p = mv$
$\Sigma\tau = I\alpha = \Delta L/\Delta t$	$\Sigma F = ma = \Delta p/\Delta t$
$\Sigma\tau=0 \Rightarrow L=\text{const.}$	$\Sigma F=0 \Rightarrow p=\text{const.}$

Total Angular Momentum is conserved if $\Sigma\tau=0$.

Note: $\mathbf{L} = I\,\boldsymbol{\omega}$, Angular Momentum is a vector

Rotating Kinetic Energy

- $K = \Sigma(1/2 m_i v_i^2) = \Sigma(1/2\ m_i R_i^2\ \omega^2)$
  $= ½\ \Sigma(m_i R_i^2)\ \omega^2 = ½\ I\ \omega^2$
- Rotational Kinetic Energy: $½\ I\ \omega^2$
- $W = \mathbf{F}\ \Delta\mathbf{l} = F_\perp R\ \Delta\theta$
  $= \tau\ \Delta\theta$
- $W = 1/2\ I\ \omega_2^2 - 1/2\ I\ \omega_1^2$



Rotation and Translation

- Translation: $K = \frac{1}{2} mv^2$
- Rotation: $K = \frac{1}{2} I\omega^2$
- Both (e.g. rolling):

  $K = \frac{1}{2} mv_{CM}^2 + \frac{1}{2} I\omega^2$