ANGULAR MOMENTUM

FRITTY P F
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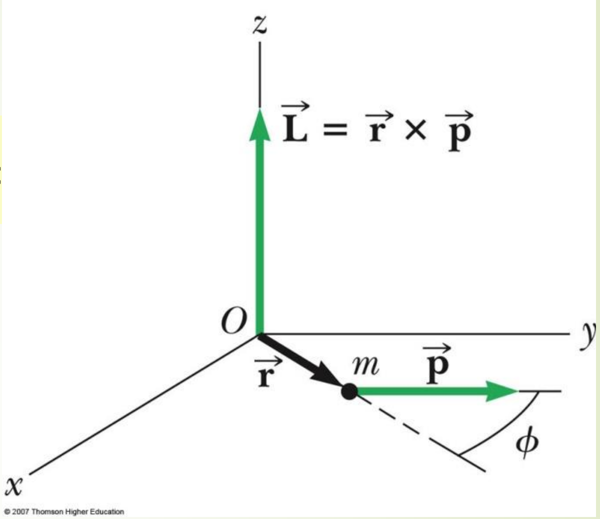
Angular Momentum

- Tells you how difficult it is to stop a rotating object.
- The product of an object’s moment of inertia and its angular velocity
- $L = I\omega$
- Objects of equal mass but different shapes can have different moments of inertia.

Angular Momentum II

- Angular momentum of a particle

$$L = I\omega = mr^2\omega = mv_\perp r = mvr\sin\phi =$$



- Angular momentum of a particle

$$\mathbf{L} = \mathbf{r}\times\mathbf{p} = m(\mathbf{r}\times\mathbf{v})$$

  - **r** is the particle's instantaneous position vector
  - **p** is its instantaneous linear momentum

Angular momentum III

- Angular momentum of a system of particles

$$\mathbf{L}_{\text{net}} = \mathbf{L}_1 + \mathbf{L}_2 + \ldots + \mathbf{L}_n = \sum_{all\ i} \mathbf{L}_i = \sum_{all\ i} \mathbf{r}_i \times \mathbf{p}_i$$

  - angular momenta add as vectors
  - be careful of sign of each angular momentum

Example: calculating angular momentum for particles

Two objects are moving as shown in the figure_. What is their total angular momentum about point O?

$$\mathbf{L}_{\text{net}} = \mathbf{L}_1 + \mathbf{L}_2 = \mathbf{r}_1 \times \mathbf{p}_1 + \mathbf{r}_2 \times \mathbf{p}_2$$

$$|L_{\text{net}}| = r_1 m v_1 \sin\theta_1 - r_2 m v_2 \sin\theta_2$$

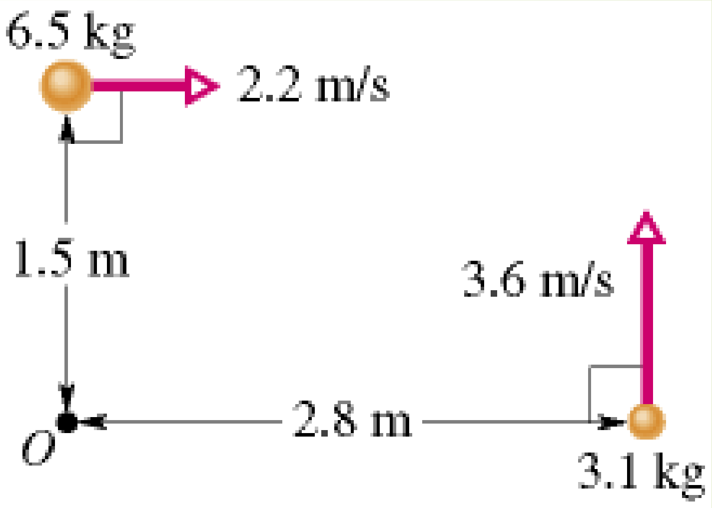
$$= r_1 m v_1 - r_2 m v_2$$

$$= 2.8 \times 3.1 \times 3.6 - 1.5 \times 6.5 \times 2.2$$

$$= 31.25 - 21.45 = 9.8 \text{ kg m}^2/\text{s}$$

Direction of L is out of screen.

m_2



Newton's Second Law for Rotation

- A net torque exerted on an object equals the rate of change of the object's angular momentum.
- $\tau = \Delta L / \Delta t$

Conservation of Angular Momentum

- The angular momentum of a closed system is constant if no net external torque acts on the system.

THANKYOU