Angular motion

$$K_{rot} = \frac{1}{2} I \omega^2$$

$$\vec{L} = I \vec{\omega}$$

$$\frac{d\vec{L}}{dt} = \vec{\tau}_{net}$$

Linear momentum

$$K_{CM} = \frac{1}{2} M v_{cm}^2$$

$$\vec{p} = m\vec{v}_{cm}$$

$$\frac{d\vec{p}}{dt} = \vec{F}_{net} = 0$$

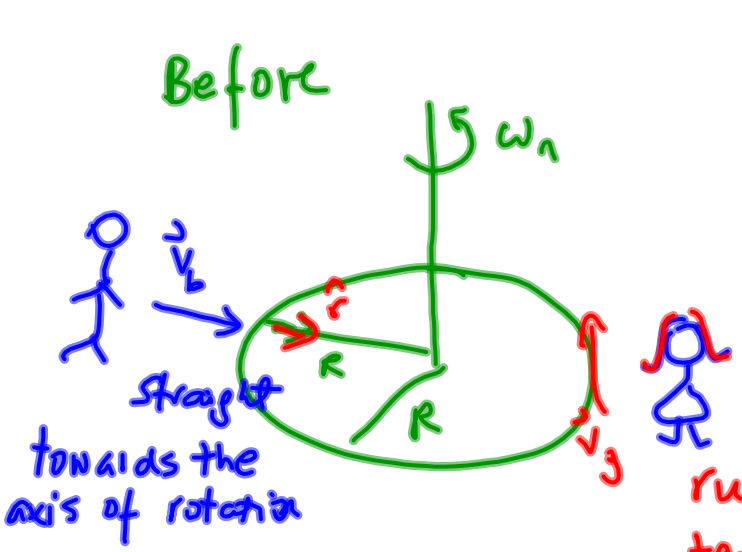
cons. of linear momentum

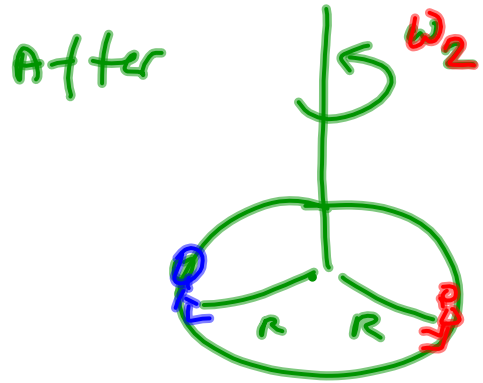
Angular momentum

$$\vec{L} \equiv \vec{r} \times \vec{p} \quad [kgm^2/s]$$

$$\vec{\tau} \equiv \vec{r} \times \vec{F} \quad [Nm]$$

Ex





$R = 1.3\ m$

$I = 240\ kgm^2$

$\omega_1 = 1.15\ rad/s$

$m_b = 28\ kg$ $\quad v_b = 2.5\ m/s$

$m_g = 32\ kg$ $\quad v_g = 3.7\ m/s$

$\omega_2 = ?$

$L_{before} = L_{after}$

$L = I\omega$

$L = \vec{r} \times \vec{p}$

- treat the kids as particles $(I = mR^2)$

$$I\omega_1 + m_g v_g R = I\omega_2 + I_{boy}\omega_2 + I_{girl}\omega_2$$

$L_{boy} = r \cdot m\vec{v} \cdot \sin\theta$

$\theta = 0^\circ$

$L_{boy} = 0$

$\omega_g = \frac{v_g}{R}$ $\omega_b = \frac{v_b}{R}$

$L_{girl} = R \cdot m\vec{v}_{girl} \sin\theta$

$\theta = 90^\circ$

merry-go-round

$$I\omega_1 + m_g v_g R = I\omega_2 + m_b R^2 \omega_2 + m_g R^2 \omega_2$$

$$\omega_2 = \frac{I\omega_1 + m_g v_g R}{I + R^2(m_b + m_g)}$$

$$= 1.26 \text{ rad/s}$$