1 7/23

Review: Static Equilibrium
For a particle

- $F_{net} = 0$

For an extended object

- $F_{net} = 0$
- $\tau_{net} = 0$

$$\tau = r \times F = I\alpha$$

For linear momentum $\vec{P} = m\vec{v}$, for angular momentum, $\vec{L} = I\omega$

$$\begin{aligned} \vec{\tau} &= r \times F \\ \vec{L} &= \vec{r} \times \vec{P} \\ L = \vec{r} \times m\vec{v} &= mvrsin(\theta) \\ L_{max} &= mvr \ (v = r\omega) \\ &= (mr \times r)\omega = Iom\vec{e}ga \end{aligned}$$

Practice: Rotating Disk What is the angular momentum about the axle of a 2.0 kg, 4.0 cm diameter disk rotating at 600 rpm
Known: m, d, ω, Want: L

$$\begin{aligned} L &= I\omega \\ I &= \frac{1}{2}mR^2 \\ I &= \frac{1}{2}m(^d/_2)^2 \\ I = \frac{1}{2}m\frac{d^2}{4} = \frac{1}{8}md^2 L &= \frac{1}{8}md^2\omega \\ L &= 0.025 \text{ kg m}^2/\text{s} \end{aligned}$$

$$\vec{\tau}_{net} = I\alpha = \sum \tau_i = \sum \vec{r}_i \times \vec{F}_i$$

In the absence of external torques: $I\alpha = \dfrac{d(I\vec{\omega})}{dt} = 0$, $I\vec{\omega} = L =$ constant

Example: Krunchy on a Turntable

Krunchy of mass m rides on a disk of mass $6m$ and radius R as shown. The disk rotates bround its central axis at angular speed 1.5 rad s^{-1}