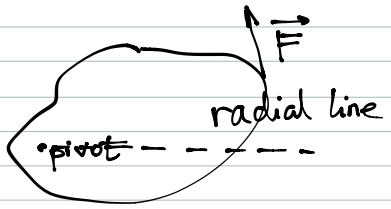
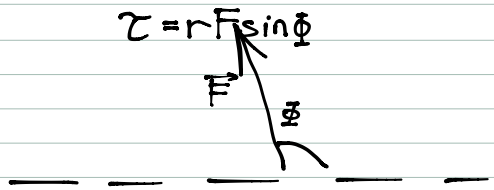
March 18th

Last lecture
Rotations & Equilibrium

This time
Vector discription of torque and angular momentum

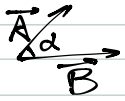




$\vec{\tau} = \vec{r} \times \vec{F}$
↓
vector / cross product

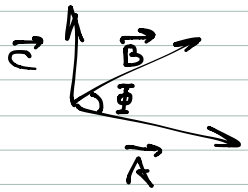
Recall : scalar / dot product of $\vec{A} \cdot \vec{B}$

$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\alpha$



$\vec{A} \times \vec{B} = \vec{C}$ = a new vector

$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\Phi$



"right-hand rule"

so for $\vec{\tau} = \vec{r} \times \vec{F}$ points out the page

with symbol $\odot \vec{\tau}$

($\otimes$ means points into)

$\omega = \frac{d\theta}{dt}$ = angular velocity

$v = \omega r$ speed of a part of wheel

The small part of wheel at S has velocity $\vec{v}$ and momentum $\vec{p} = m\vec{v}$ and an angular momentum $\vec{L} = \vec{r} \times \vec{p}$

$$\vec{F}_{NET} = \frac{d\vec{p}}{dt} \longleftrightarrow \vec{\tau}_{NET} = \frac{d\vec{L}}{dt}$$

I = momentum of inertial

$\vec{\omega}$ = direction given by curling fingers along rotation direction & using your thumb

Sitting in a chair with a wheel. $\vec{L}$ of the wheel is (L, up). inverts the wheel The $\vec{L}$ of system consisting of the person + the chair is ?

$\vec{L}_{TOTAL,\,INITIAL} = \vec{L}_{system,\,initial} + \vec{L}_{wheel,\,initial} = \vec{0} + (L, up) = (L, up)$

$\vec{L}_{TOTAL,\,FINAL} = \vec{L}_{system,\,final} + \vec{L}_{wheel,\,final}$

$\vec{L}_{final} = \vec{L}_{system,\,final} + (L, down) = (L, up) = \vec{L}_{initial}$

$\Rightarrow \vec{L}_{system,\,final} = (2L, up)$