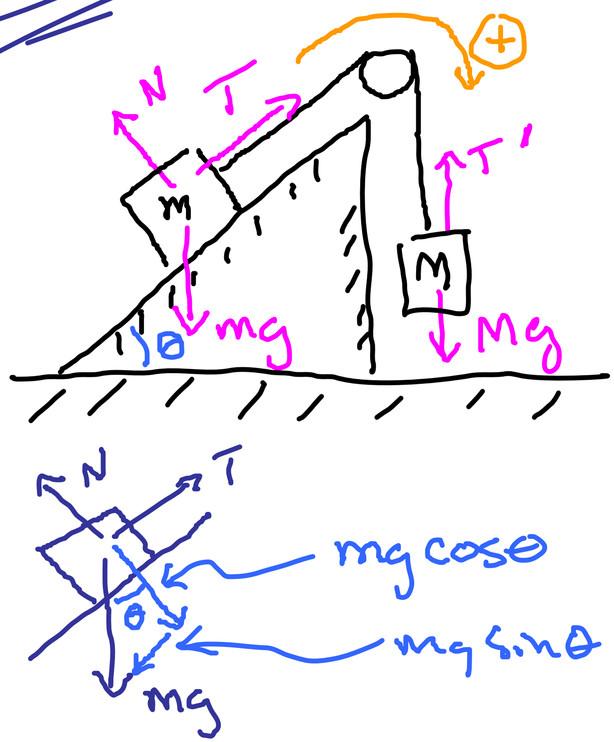
Physics 113 - November 7 2013

- EXAM 2 Tuesday 0800 Hubbell
- Still setting up Q+A session Room - Prob. Monday late afternoon
- We will have lecture on Tuesday as usual 

  We will probably do the STRANGEST stuff of the term that day

Last time

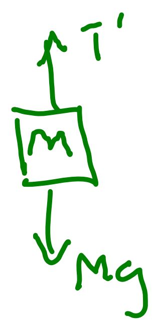
looked at Newton's Law problems w/ Mass



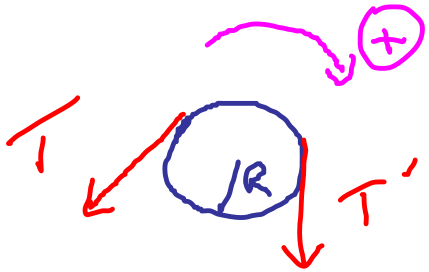
pulley has Mass ⟶ $I \neq 0$

$\perp$ direction $\Sigma F_{\perp} = 0 = N - mg\cos\theta$

// direction $\Sigma F_{\parallel} = ma = T - mg\sin\theta$



$\Sigma F = Ma = Mg - T'$



I, R

$\Sigma \tau = I\alpha$

$s = R\theta$

$a = R\alpha$

$I\alpha = RT' - RT$

$$I \frac{a}{R} = RT' - RT$$

$\frac{1}{2}MR^2$

$I_{cylinder} = \frac{1}{2}mr^2$

Find correct expression for a of M

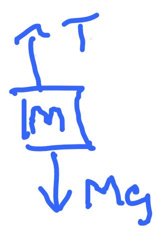
① g

② $\left(\frac{M-m}{M+m}\right)g$

③ $\left(\frac{1}{2}mr^2 + M\right)g$

④ $\left(\frac{2M}{2M+m}\right)g$

$I = \frac{1}{2}mr^2$



$\Sigma\tau : I\alpha = Tr$

$\frac{1}{2}mr^2 \frac{a}{r} = Tr$

$Ma = Mg - T$

$T = Mg - Ma$

$$a = \frac{T\,2}{m} = \frac{(Mg - Ma)\,2}{m} = 2\frac{M}{m}g - 2\frac{M}{m}a$$

$$\left(1 + \frac{2M}{m}\right)a = \frac{2Mg}{m}$$

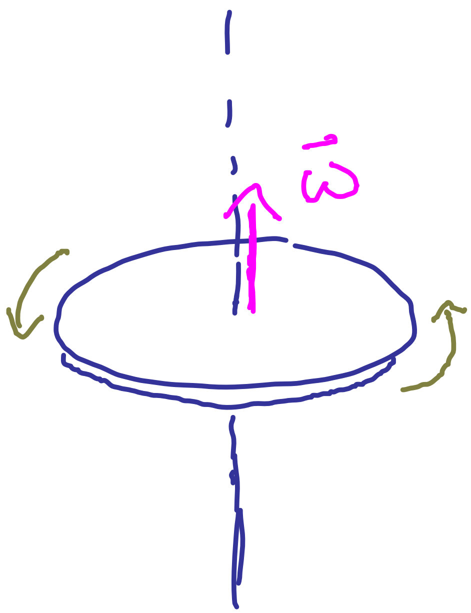
$$a = \frac{2M}{m}g\,\frac{1}{\left(1 - 2M/m\right)} = \frac{2Mg}{(m - 2M)}$$

a few Moments of Reflection

Rotation & You

Rotational Dynamics (chapt 11)

Right hand rule

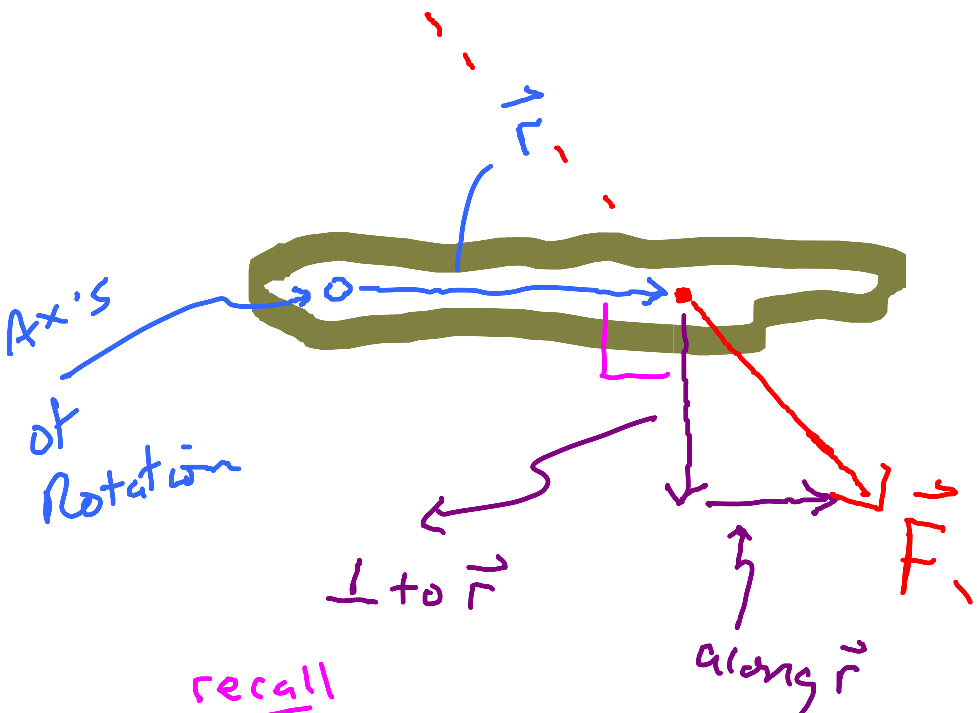


If $\vec{\omega}$ increasing w/ time

$\vec{\alpha}$ is a vector along $\vec{\omega}$

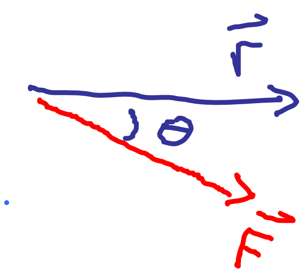
If $\vec{\omega}$ decreasing w/ time

$\vec{\alpha}$ in i the direction opposite to $\vec{\omega}$



$$\vec{\tau} = I\vec{\alpha}$$

only part of $\vec{F}$ important for rotation (produce an $\vec{\alpha}$) is part ⊥ to $\vec{r}$



$\vec{\tau} = \vec{r} \times \vec{F}$
$= rF\sin\theta$
$\vec{\tau}$ into board

recall

Work $\equiv \vec{F} \cdot \vec{S}$

dot product

$W = |\vec{F}||\vec{S}|\cos\theta$

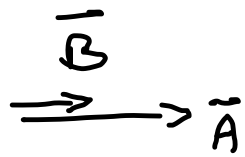
define $\vec{r} \times \vec{F} \equiv$ cross product

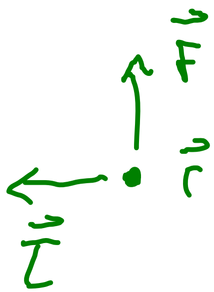
$\vec{\tau} \equiv \vec{r} \times \vec{F}$ $\quad |\vec{r} \times \vec{F}| = |\vec{r}||\vec{F}|\sin\theta$

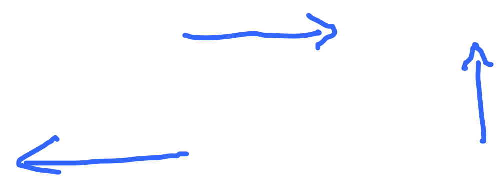
$$|\vec{B}\times\vec{A}| = |\vec{A}||\vec{B}|\sin\theta$$

Dir. given by RHR

$$\vec{A}\times\vec{B} = -\vec{B}\times\vec{A}$$







× into board

• out of board

Linear World

s	θ
$\vec{v}$	$\vec{\omega}$
$\vec{a}$	$\vec{\alpha}$
M	$I = \int r^2 dm$
$\vec{F}$	$\vec{\tau}$
KE $\frac{1}{2}mv^2$	$\frac{1}{2}I\omega^2$
$\vec{p} = m\vec{v}$	$\vec{L} \equiv I\vec{\omega}$

Angular Momentum $\equiv \vec{L} \equiv I\vec{\omega}$

$$\vec{F} = \frac{d\vec{p}}{dt} \sim m\frac{d\vec{v}}{dt} = m\vec{a}$$

$$\vec{\tau} = \frac{d\vec{L}}{dt} = I\frac{d\vec{\omega}}{dt} = I\vec{\alpha}$$

Conservation of Angular Momentum $\quad \Sigma I\omega_{start} = \Sigma I\omega_{end}$

$$\vec{L}_{start} = \vec{L}_{end}$$