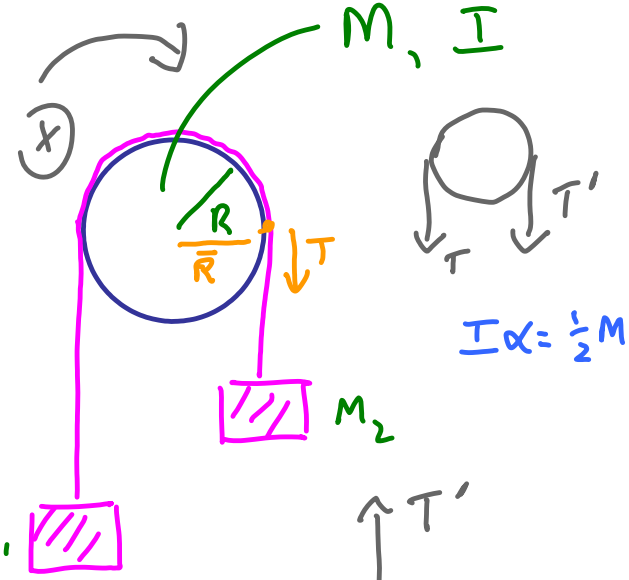
Physics 113 - November 6, 2012

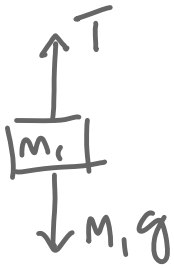
Last Time

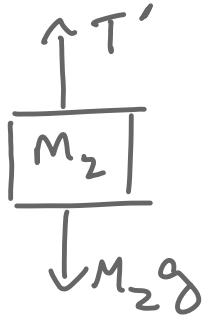


$I\alpha = \frac{1}{2}MR^2\frac{a}{R}$

$= T'R - TR$

$m_1 a = T - m_1 g$



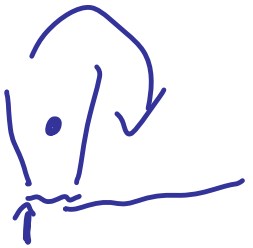


$M_2 a = M_2 g - T'$

Please vote!
We need the voice of the young and educated to be heard!

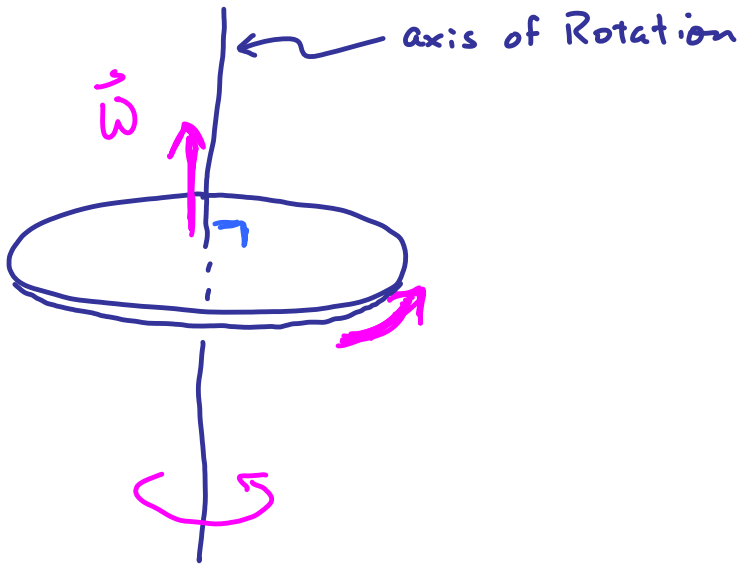
a few Moments of Reflection

Rotation & You



Rotational dynamics (chapter 11)

... rotation w/ vectors



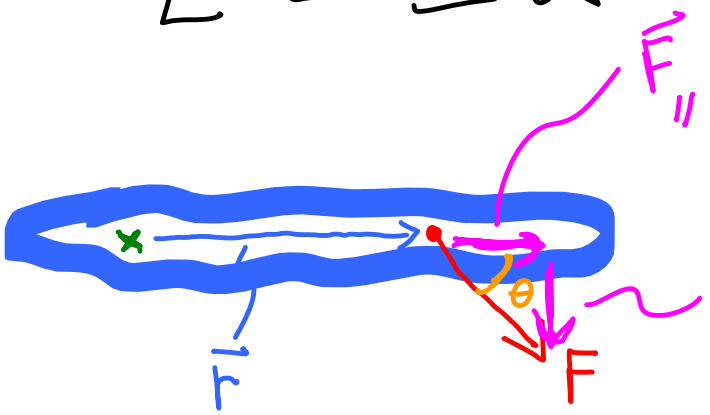
If $\vec{\omega}$ increasing w/ time

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

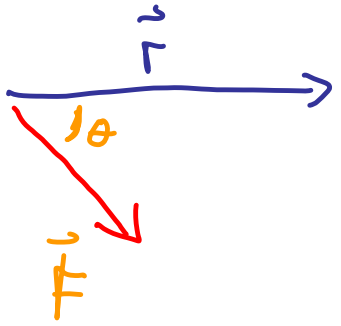
If $\vec{\omega}$ is decreasing w/ time

$\vec{\alpha}$ is vector in a direction opposite of $\vec{\omega}$

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



$$\vec{F}_{\perp} = \vec{F}\sin\theta$$

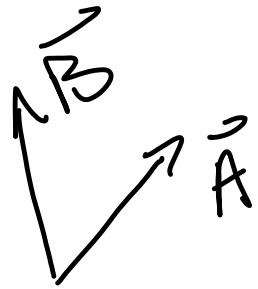


"dot" Scalar product

$$\vec{r}\cdot\vec{F} = |\vec{r}||\vec{F}|\cos\theta$$

cross product

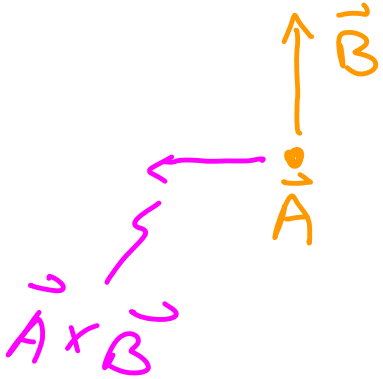
$$\vec{r}\times\vec{F} = |\vec{r}||\vec{F}|\sin\theta$$ into paper



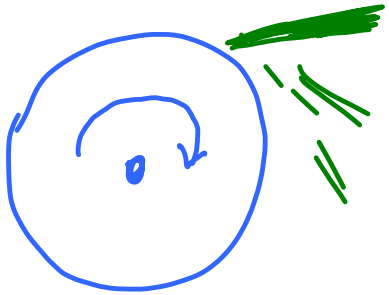
$$\vec{A} \times \vec{B}$$

• vector going out of paper

× vector going into paper

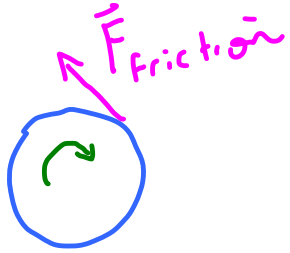


$$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$$

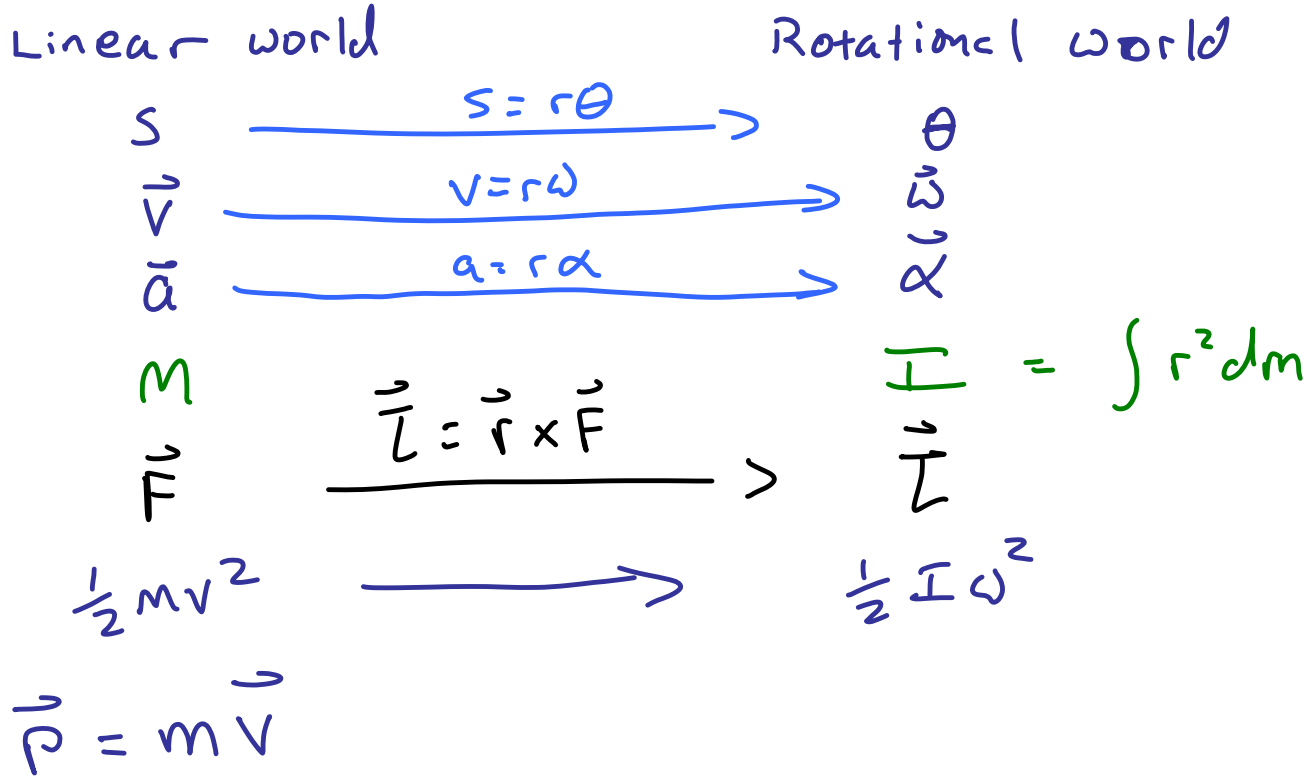


what is the direction of $\vec{\alpha}$

up
down
Right
left
in
out
along $\vec{F}$



$\vec{\omega}$ is into screen
$\vec{F}$ gives torque that is in opposite direction of $\vec{\omega}$
$\vec{\alpha}$ is out of screen


Linear world
Rotational world
s
$s = r\theta$
θ
$\vec{v}$
$v = r\omega$
$\vec{\omega}$
$\vec{a}$
$a = r\alpha$
$\vec{\alpha}$
m
$I = \int r^2 dm$
$\vec{F}$
$\vec{\tau} = \vec{r} \times \vec{F}$
$\vec{\tau}$
$\frac{1}{2} m v^2$
$\frac{1}{2} I \omega^2$
$\vec{p} = m\vec{v}$

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

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

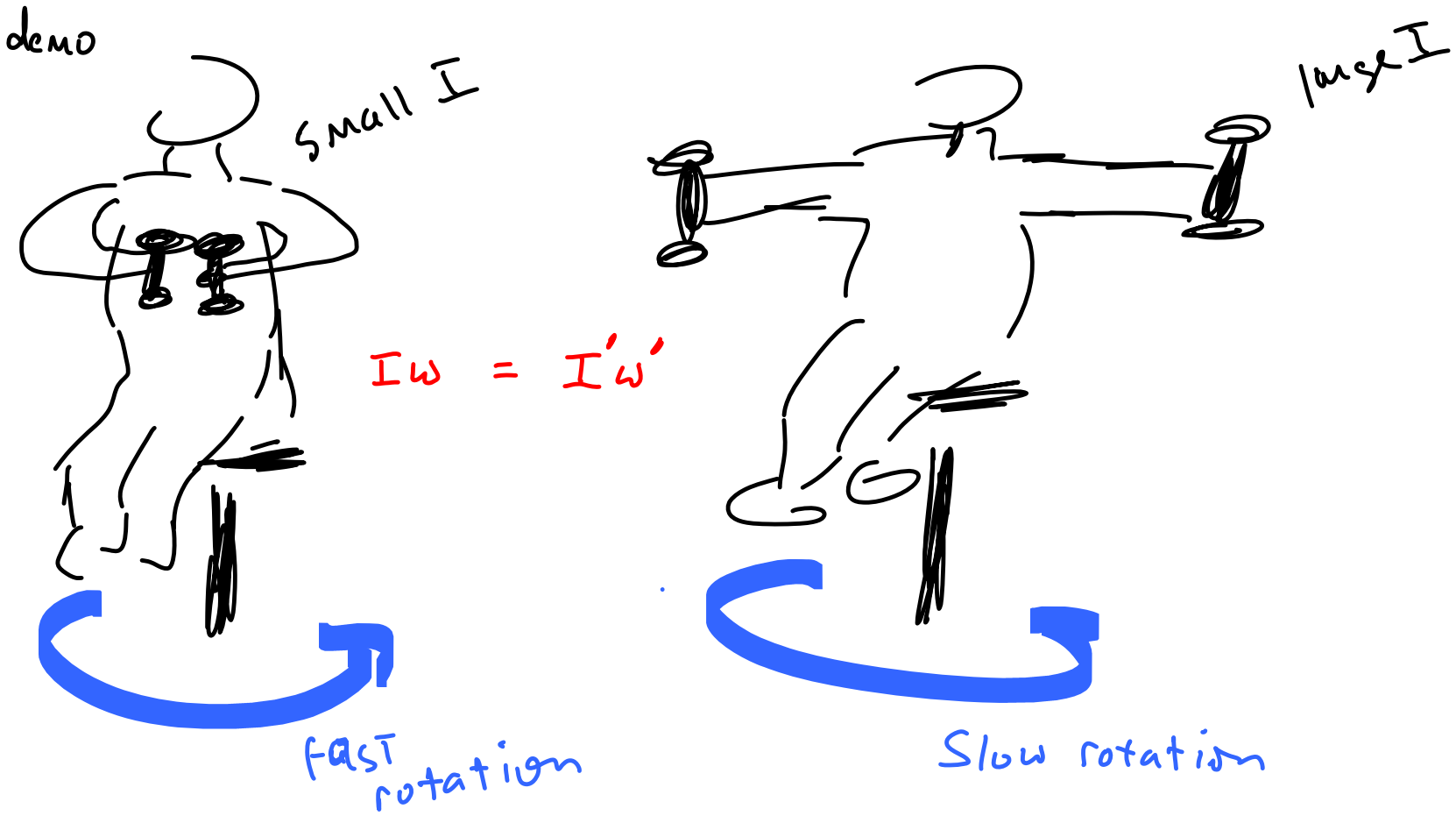
$I \quad \omega$

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

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

Angular momentum is conserved in an "isolated" (no external torque) system

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


demo
small I
large I
$I\omega = I'\omega'$
fast rotation
Slow rotation