Class Notes - Lecture 22 (Ihas) 5 November 2009

CQ1:

$\Sigma\vec{F}=0$ and $\Sigma\vec{\tau}=0$

$\vec{f}=30N$

All on final: Chapter 8

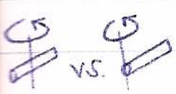
Linear → Rotation

Linear	Rotation
x	θ
m	I
v	ω
a	α
F	τ

(ω, α, τ: vectors)

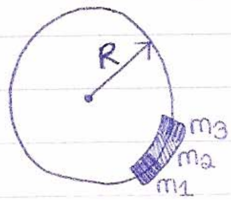
Torque & Angular Acceleration

$\Sigma\tau = I\alpha$, I = moment of inertia

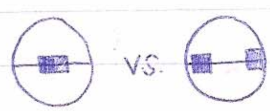


Demo: 2 people twist rods of equal mass - the rod with mass at end is harder to twist because it has a higher moment of inertia

For uniform ring: $I = \Sigma m_i r_i^2 = MR^2$



Demo:



↓I ↑I

Depends on distribution of the mass and axis of rotation.

Other moments of inertia: given on the exam

Look at **a** as: $m \to 0$ or ∞, $M \to 0$ or ∞

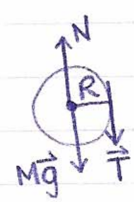
Newton's Second Law for Rotation

$\Sigma\tau = I\alpha$

$\Sigma F = ma$

$a = \alpha r = \frac{-mg}{(M/2)+m}$

and



Accelerating?

$T - mg = ma$ $\quad -\frac{1}{2}Ma - mg = ma$

$R\vec{T} = \frac{1}{2}MR^2\alpha$ $\quad -RT = \frac{1}{2}MRa$

CQ2: Torque applied?

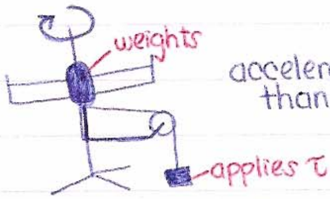
$\tau = -mgR$ $(= -TR)$

right hand rule: negative

Angular Momentum

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

Demo:



accelerates faster when mass is in the center than when masses are at the ends

$\vec{L}$ conserved no matter what!

Impulse: $\Sigma\tau = \Delta L / \Delta t$

If $\Sigma\tau = 0$, $L_i = L_f$ or $I_i\omega_i = I_f\omega_f$

Demo: Spin some wheel, give to person sitting in a chair, and as he turns the wheel, the chair will also rotate

$\uparrow\omega, \downarrow I$

Demo: Give weights to person in chair, spin chair – when he's holding weights in close, he'll spin faster than when he's holding his arms out (ie: the ice skater)

In an isolated system, what's conserved?

ME

L

Linear momentum

Rotational Kinetic Energy

$KE = \frac{1}{2} I\omega^2$

$W_{nc} = \Delta KE_t + \Delta KE_r + \Delta PE$