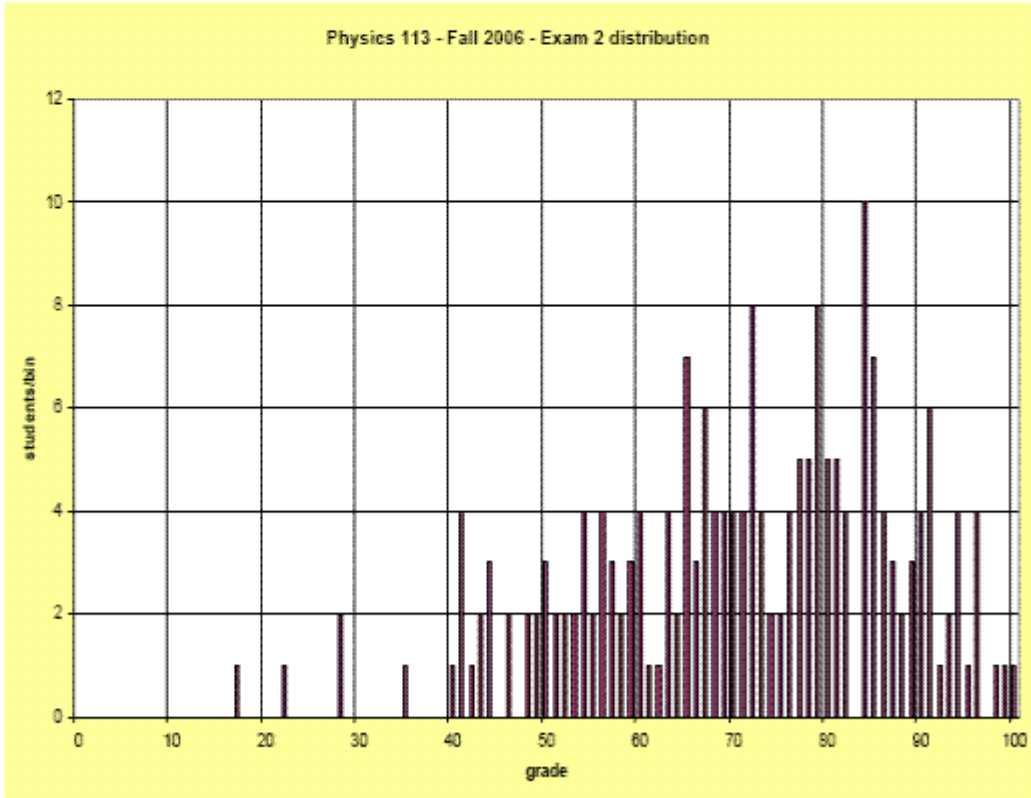
Physics 113 - November 2, 2006

Exam 2 graded — mean grade ~ 71

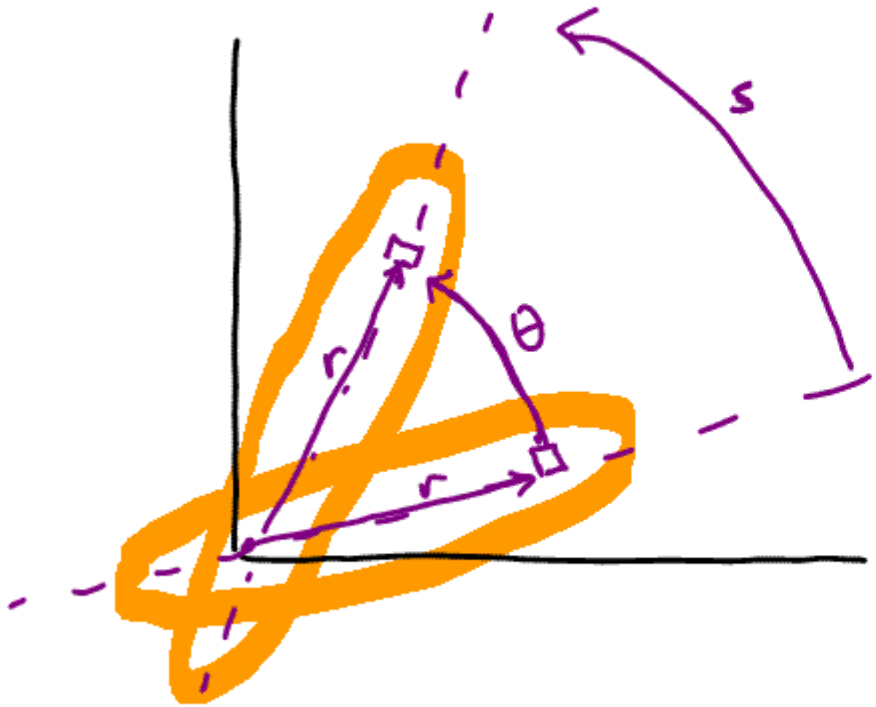
distribution + Solns on web



Will return at the end of class

Last time

Rotational Motion



radians

$$S = r\theta$$

$$V = r\omega = r\, d\theta/dt$$

$$a = r\alpha = r\, \frac{d\omega}{dt}$$

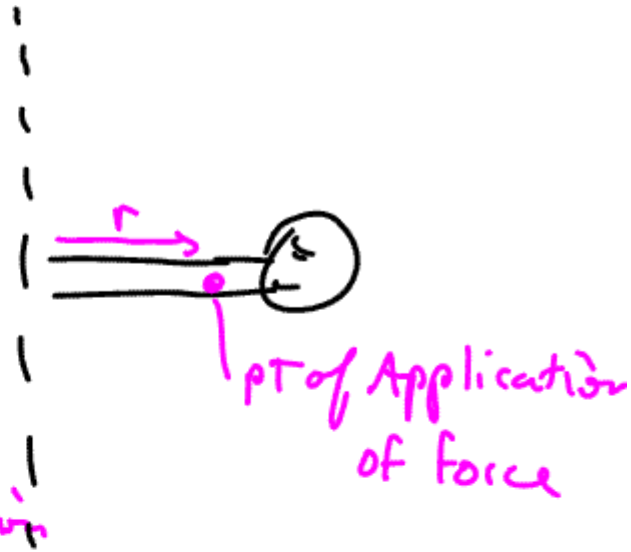
$$= r\, d^2\theta/dt^2$$

Linear	angular
general	
$x - x_0 = \int v\,dt$	$\theta - \theta_0 = \int \omega\,dt$
$v - v_0 = \int a\,dt$	$\omega - \omega_0 = \int \alpha\,dt$
constant a	constant α
$v = v_0 + at$	$\omega = \omega_0 + \alpha t$
$x = x_0 + v_0 t + \frac{1}{2} a t^2$	$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$
$v^2 = v_0^2 + 2a(x - x_0)$	$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
$x - x_0 = \frac{1}{2}(v + v_0)t$	$\theta - \theta_0 = \frac{(\omega + \omega_0)}{2} t$

$$F = ma$$

$$\Rightarrow \quad F = m r \alpha$$

$$\Rightarrow \quad rF = (mr^2)\alpha$$



rF: Angular Force

mr^2: Angular Mass → moment of inertia

α: Angular Acceleration

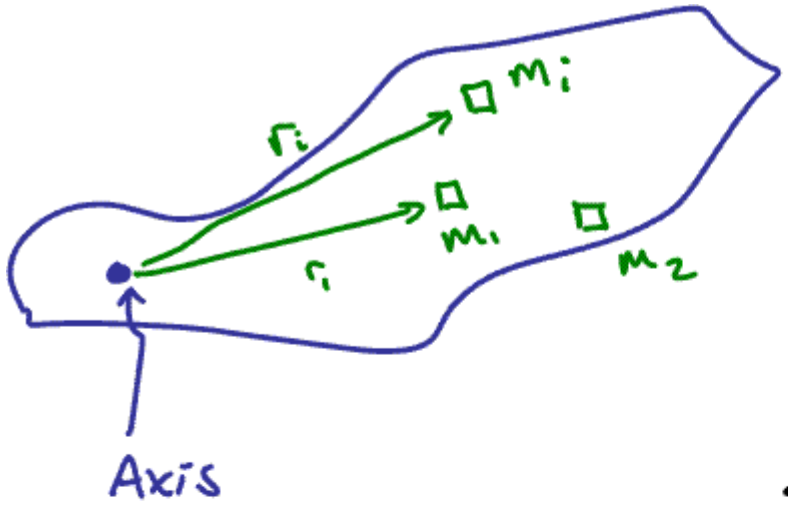
↳ gives Angular Accel

$$\vec{L} = \underline{I}\,\alpha$$

$\vec{L}$: Torque

$\underline{I}$: moment of inertia

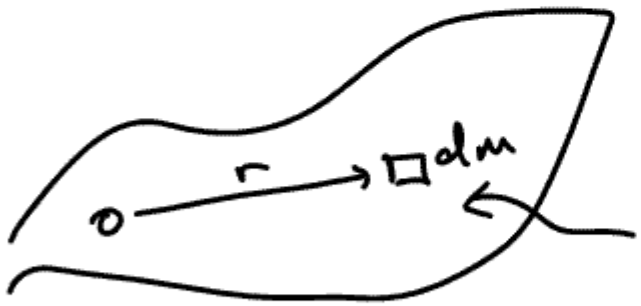
α: Angular Acceleration



$$\tau = I\alpha$$

$$(rF) = (mr^2)\alpha$$

$$\Sigma(rF)_i = \Sigma(mr^2)_i\,\alpha$$



$$dI = r^2 dm$$

$$\int dI = \int r^2 dm$$

$$I = \int_{Vol} r^2 dm$$

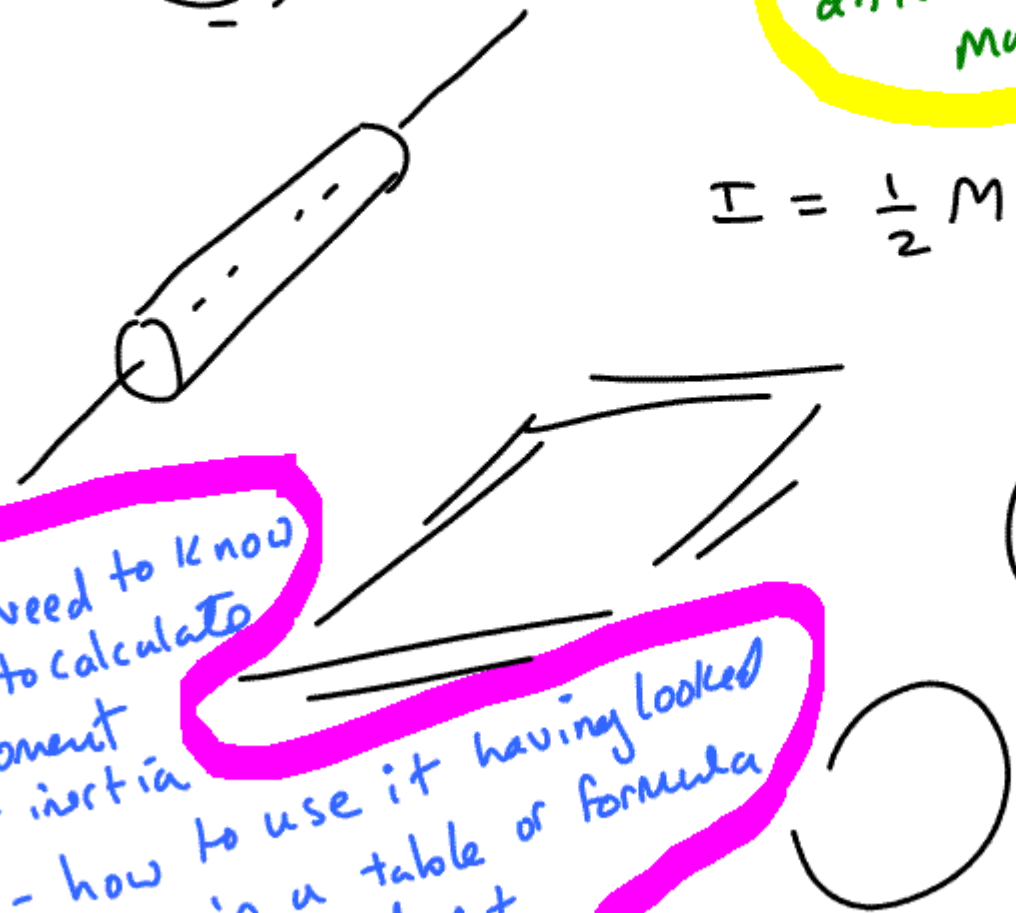
$$\rho\, dV$$

$I = MR^2$

different shapes
different distributions of mass about axis of rotation

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

have Different Moments of Inertia



You will need to know
How to calculate
a Moment
of inertia
-and- how to use it having looked it up in a table or formula sheet

$$KE = \sum \tfrac{1}{2} m_i v_i^2$$

$$= \sum \tfrac{1}{2} m_i r^2 \omega^2$$

$$= \sum \tfrac{1}{2} \underbrace{m_i r^2}_{I} \omega^2$$

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

ROTATIONAL Kinetic Energy

Solid Homogeneous cylinder

rolling w/out slipping

mass = 50 kg

R = 15 cm

V = 6 m/s

$$E_{TOT} = \underbrace{(KE + PE)}_{\text{init}} = \underbrace{(KE + PE)}_{\text{Final}}$$

$KE \downarrow 0$ (initial)

$PE \downarrow 0$ (final, at top)

$$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$$