Physics 113 - October 30, 2012

- Exam 2 graded
  Will say more
  at end of class

Happy Almost Halloween

Last Time

$s = r\theta$

$v = r\omega$

$a = r\alpha$

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

$$F = ma$$

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

← Angular Acceleration

$a = r\alpha$

↑ Torque

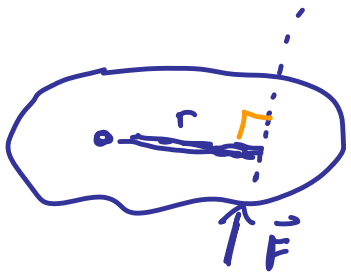
↑ Moment of Inertia

$\tau = rF$

$$I = \sum_i (mr^2)_i$$

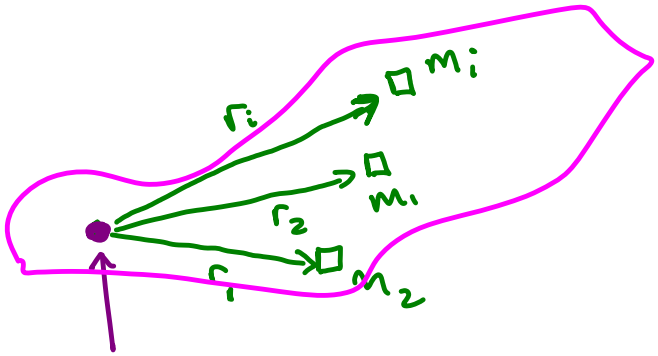
$$I = \int r^2 \, dm$$

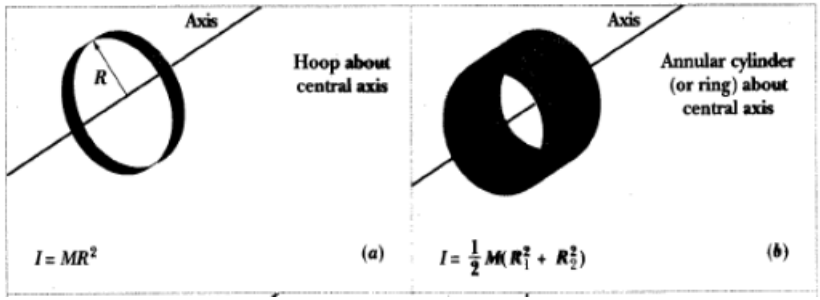
$$I = \int r^2 \rho \, dV$$



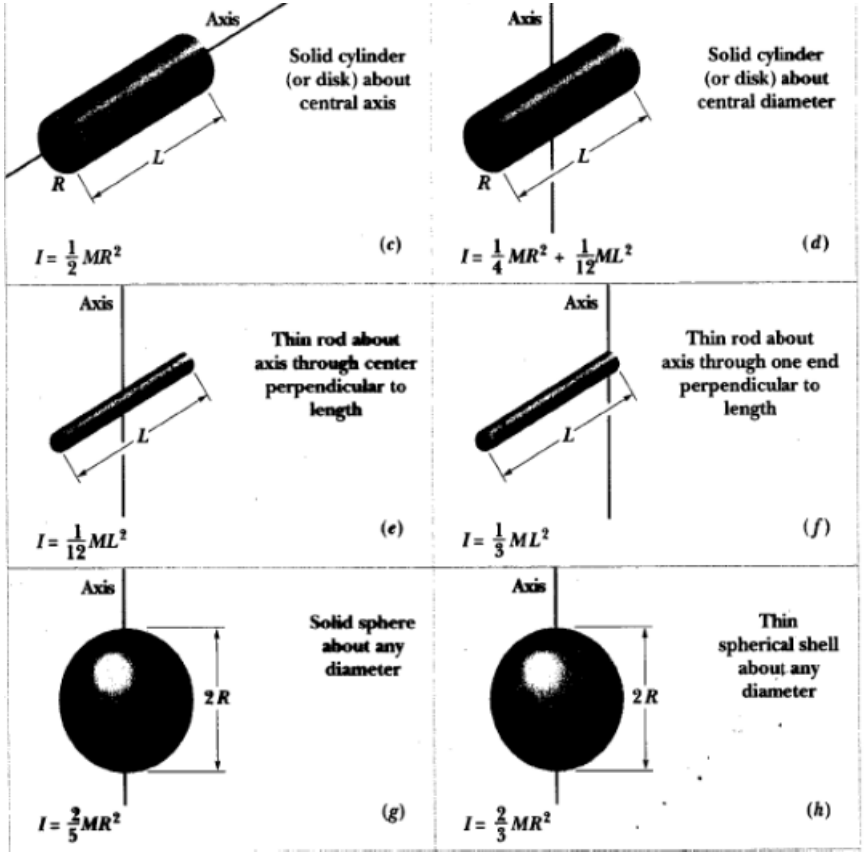
Vector equations

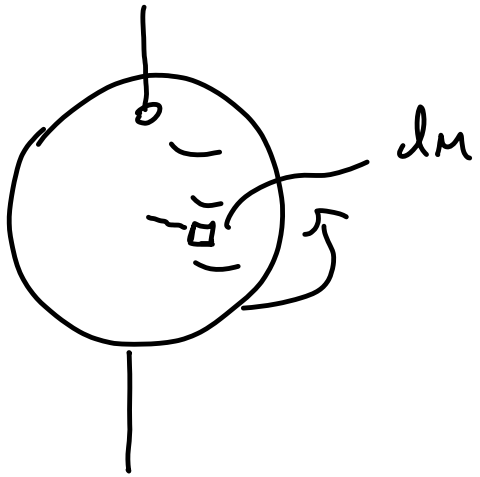
... Vector part coming soon





Tables of Moments of Inertia



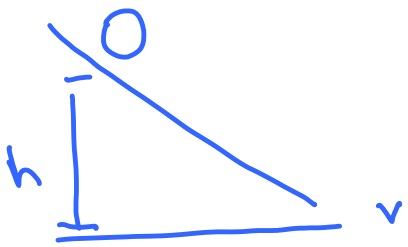


$$KE = \sum_i \frac{1}{2} m_i v_i^2$$

$$\frac{1}{2} m_i r_i^2 \omega_i^2$$

$$I$$

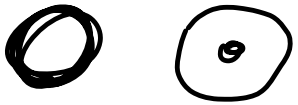
$$KE = \frac{1}{2} I \omega^2$$



$$mgh = \frac{1}{2}mv^2$$

$$V = \sqrt{2gh}$$

$$\tau = I\alpha$$



$I > I$

How far up ramp will wheel go?

What is h

cylinder (wheel) rotates w/o out slipping

use cons of Energy

$\frac{1}{2}mv^2 = mgh$

$h = \frac{v^2}{2g}$

Initial E = $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$ = Final KE = mgh

$\frac{1}{2}mv^2$: linear Translational KE

$\frac{1}{2}I\omega^2$: wheel, $I = mR^2$

$v = R\omega$

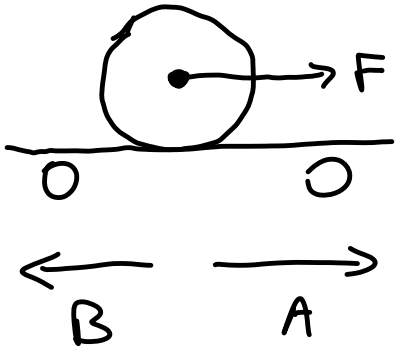
$\omega = \frac{v}{R}$

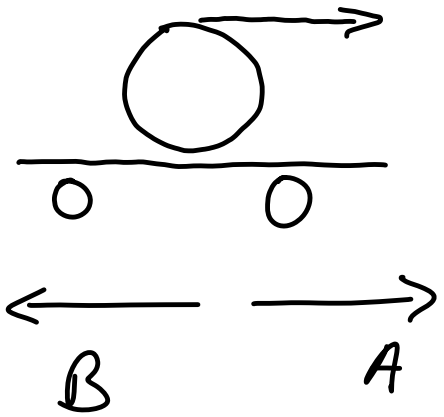
$\frac{1}{2}mR^2\frac{v^2}{R^2}$

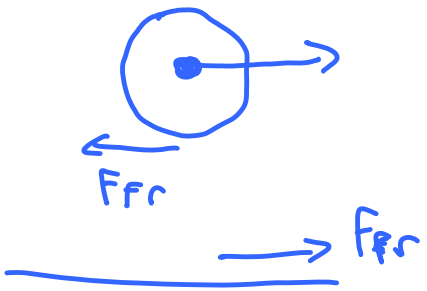
$\frac{1}{2}mv^2$

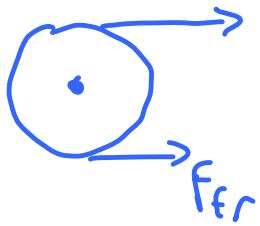
$E_{init} = mv^2 = mgh$

$h = \frac{v^2}{g}$



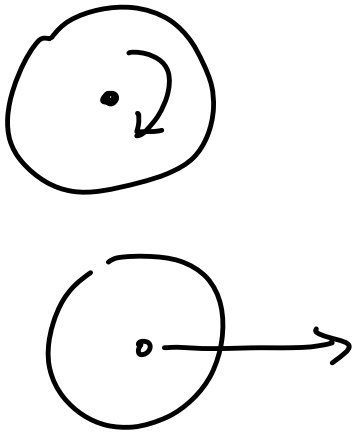




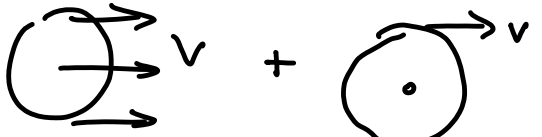


. . opposing Torque


ω
v



TOTAL KE Wheel Moving w/out Slipping

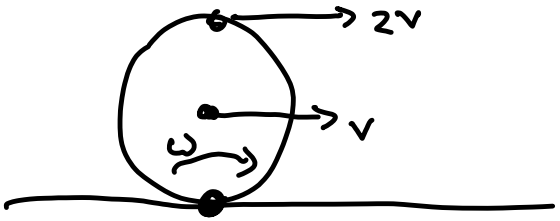
Total KE =  +

linear TRANS KE $\frac{1}{2}MV^2$

Rotation About c.m. $\frac{1}{2}I\omega^2$ $\frac{1}{2}\left(\frac{1}{2}MR^2\right)\frac{V^2}{R^2}$ $\frac{1}{4}MV^2$

$\frac{1}{2}MV^2 + \frac{1}{4}MV^2$

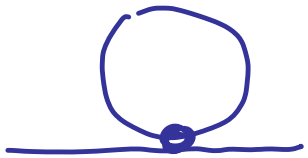
Tot KE = $\frac{3}{4}MV^2$



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

$\frac{1}{2}\left(\frac{3}{2} M r^2\right) \frac{v^2}{r^2}$

$\frac{3}{4} M v^2$

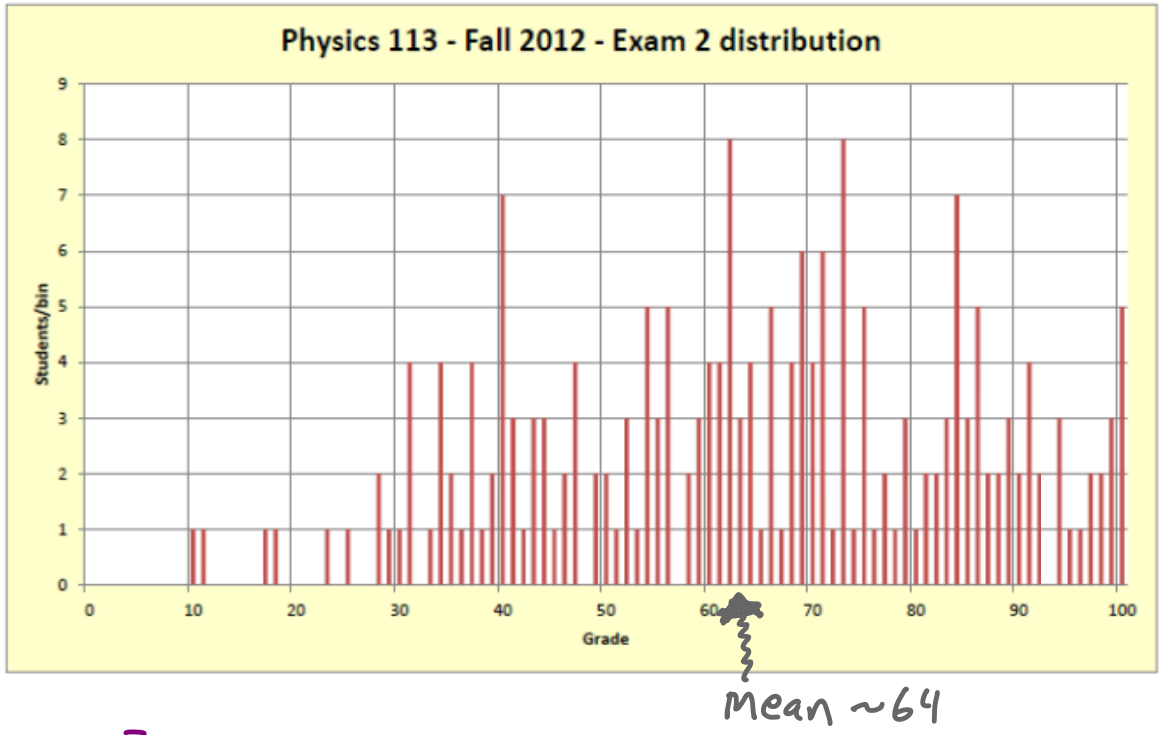


I ?

↳ $\frac{3}{2} M R^2$

Rather strange Distribution for P113

mean not unusual
flat distribution is rather unusual



Exam?

Consistent lack of prep?

Let up 'cause exam 1 went ok (or too much other stuff interfering)?