Phys 2110-3 11/15/10

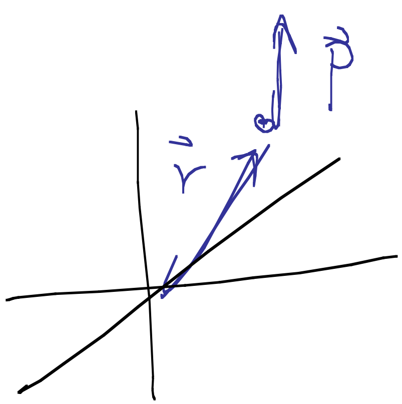
Note Title 11/15/2010

Chap 11

vector nature $\vec{\omega}, \vec{\alpha}, \vec{\tau}$

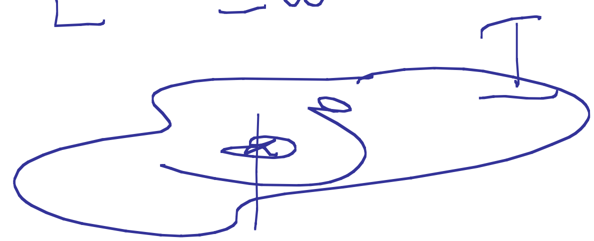
Angular momentum

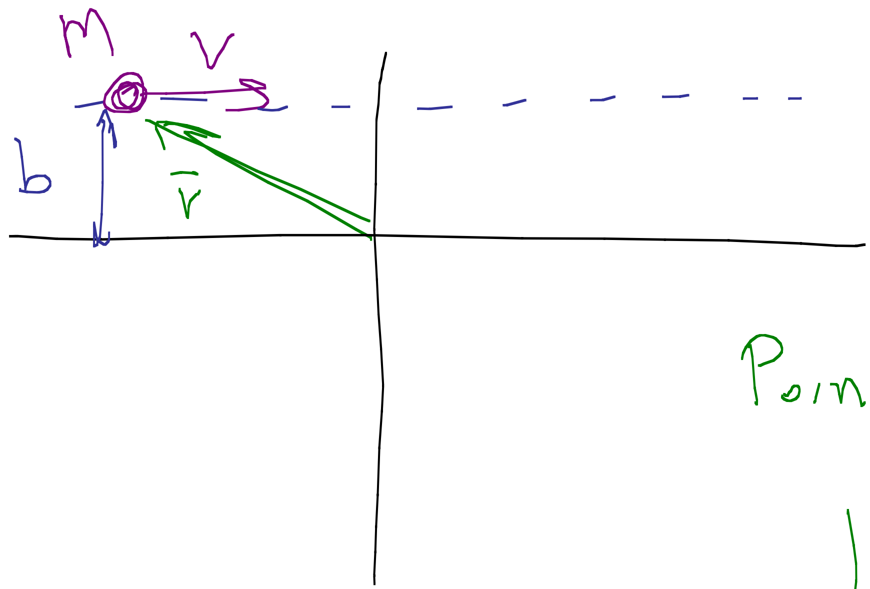
$p = mv \implies L = I\omega$



$\vec{L} = \vec{r} \times \vec{p}$

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



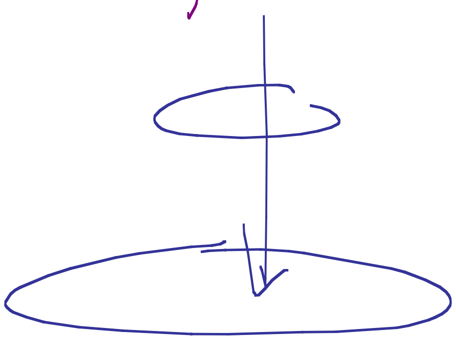


$$\vec{L} = \vec{r} \times \vec{p}$$

Points into page,

$$L = mvb$$

System w/o external torque, total ang mom is conserved.

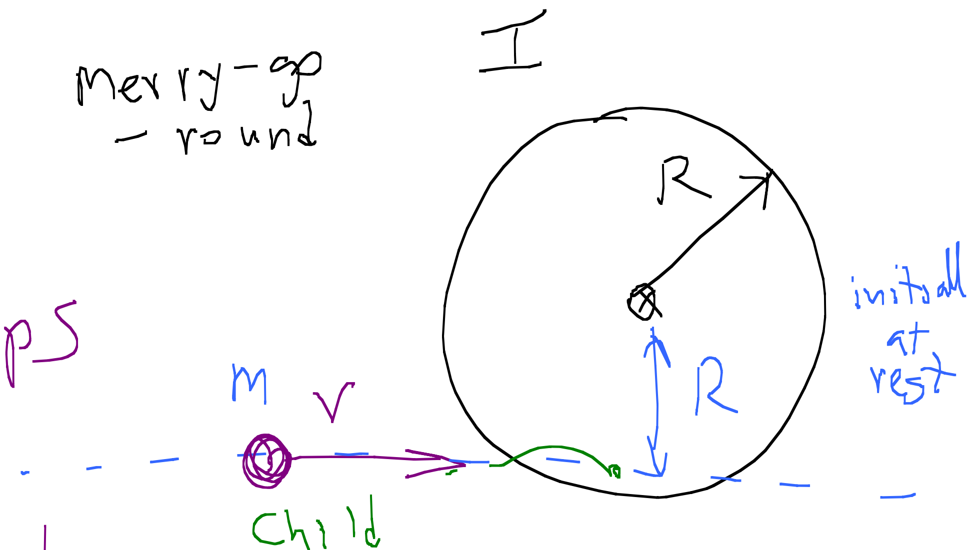


$$I_1 \omega_1 = I_2 \omega_2$$

p. 179, similar.

Child runs up to it tangentially, hops onto the edge.

What is final angular velocity of system.



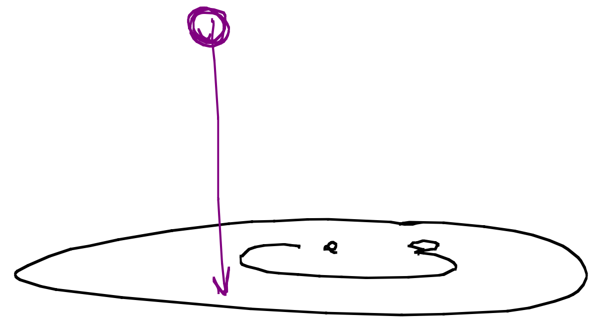
$L = I\omega$

External Torques around axis: None

Angular mom is conserved

$L_1 = mvR \qquad L_2 = (I + mR^2)\,\omega$

$$\omega = \frac{mvR}{(I + mR^2)}$$



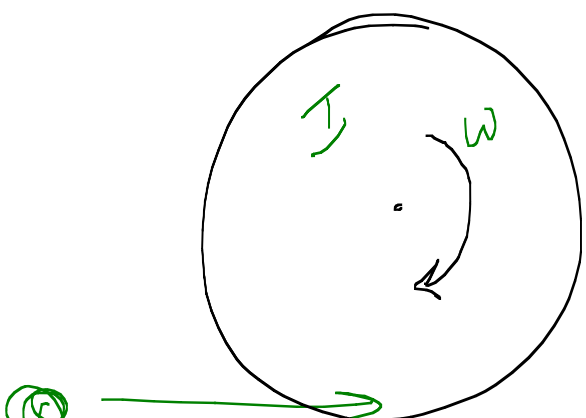
Homework:

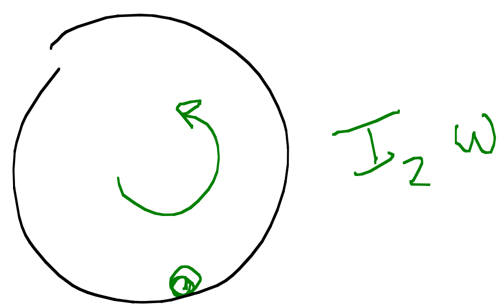
Bird feeder

Lump of crud falls onto turntable

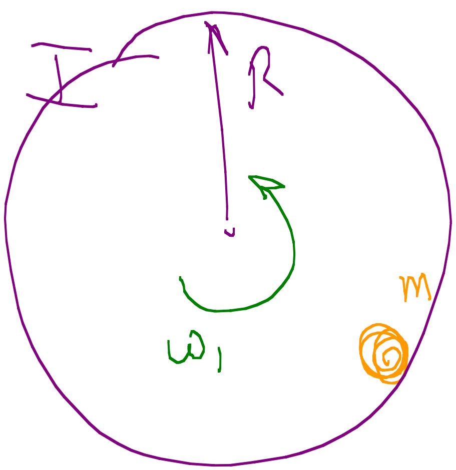
It has no ang. mom initially.

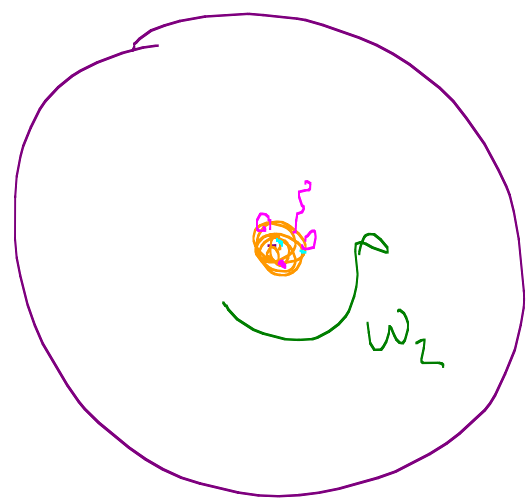
Changes mom of inertia.





11.<10 A turntable of radius 25 cm a rot. inertia 0.0154 kg m^2 spins freely at 22.0 rpm about axis, 19.5 g mouse on outer edge. The mouse to center. Find a) new rotation speed work done by mouse. (?)





$$I_1 = (0.0154\ kg\,m^2) + (0.0195\ kg)(0.25\ m)^2$$

$$I_{dist} + mr^2$$

$$= 0.0166\ kg\,m^2$$

$$I_2 = 0.0154\ kg\,m^2 + 0$$

$$\omega_1 = 22.0\ rpm = 2.304\ rad/s$$

$$I_1\omega_1 = I_2\omega_2$$

$$\Longrightarrow \omega_2 = 2.48\ rad/s = 23.7\ rpm$$

E not conserved.

$$E_1 = K_1 = \frac{1}{2} I_1 \omega_1^2 = 0.04405\,J$$

$$E_2 = K_2 = \frac{1}{2} I_2 \omega_2^2 = 0.0473\,J$$

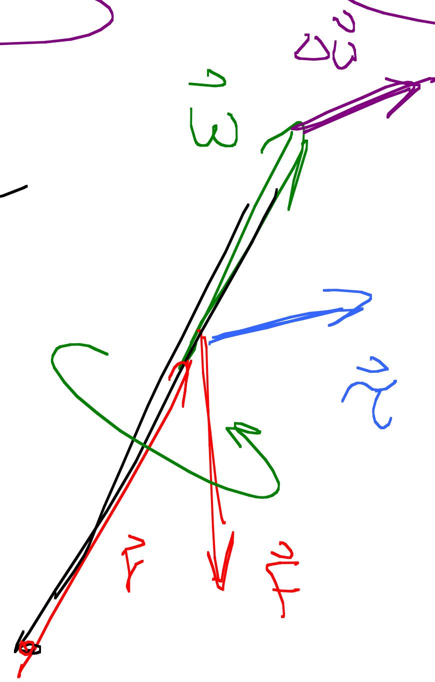
$$\Delta K = +3.3 \times 10^{-3}\,J = 3.3\,mJ$$

Diff in energy came from mouse!

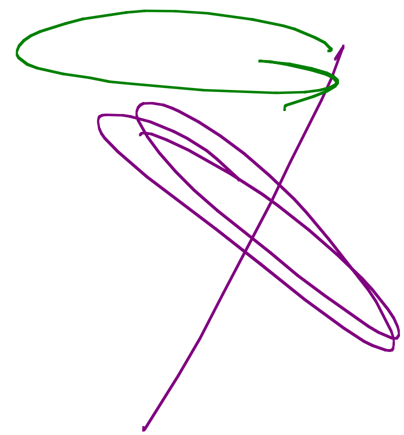
End of chapter, cultural stuff

p. 180

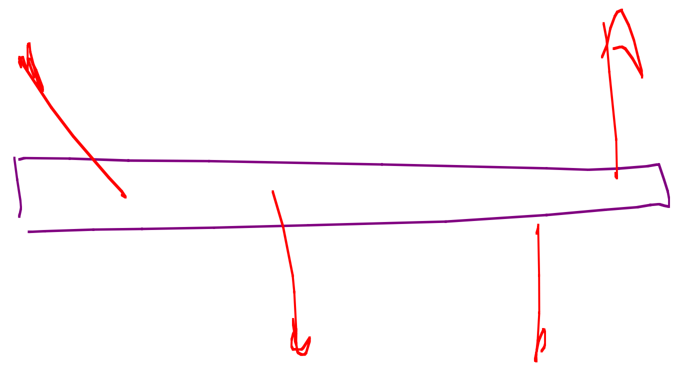
Gyroscope



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



Skip Chap 12



$\sum \vec{F} = \vec{0}$

$\sum \tau = 0$

Static Equilibrium.

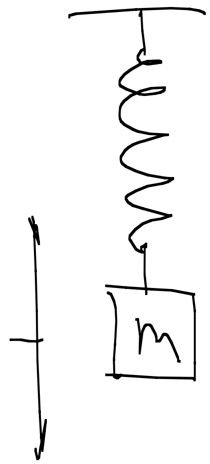
Take Statics!

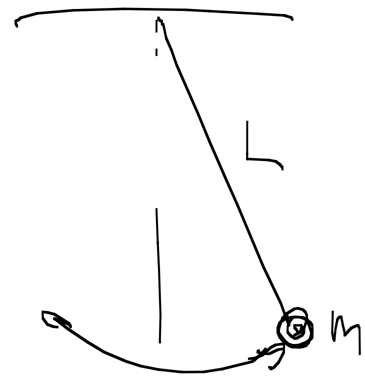
Ch 13 Oscillations

Motion is back-and-forth.

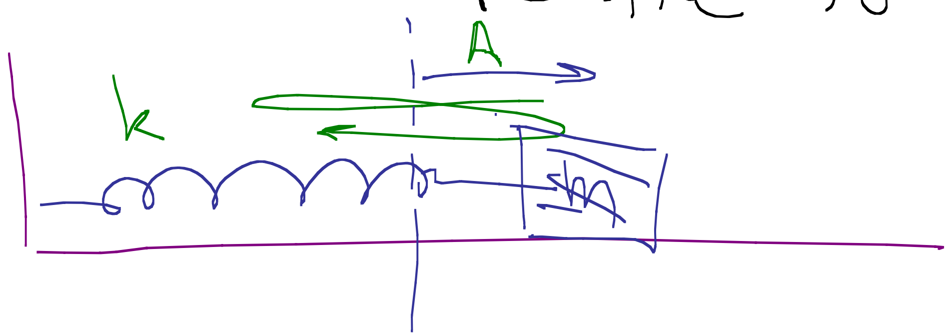
Examples:

Small motion.



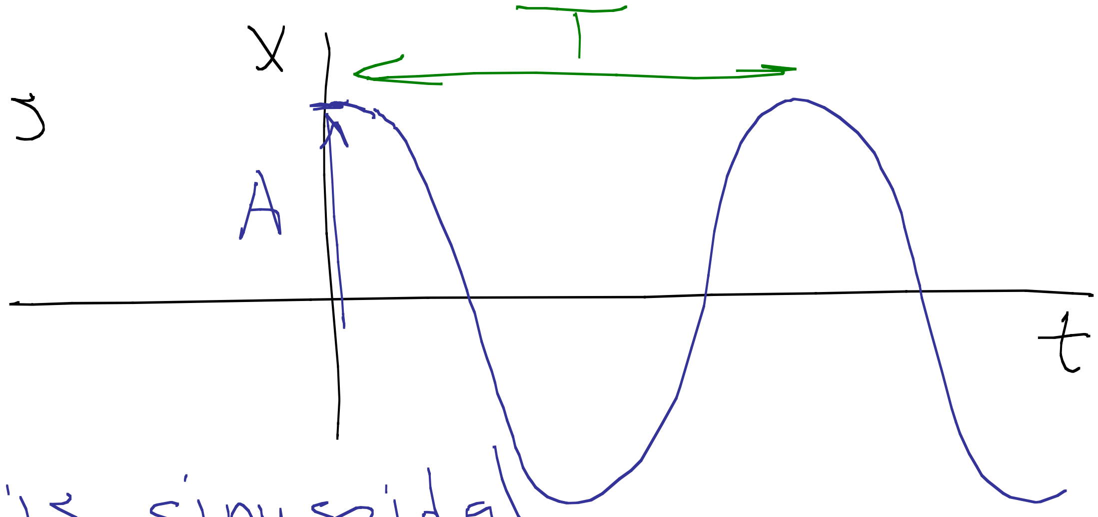


How does the rapidity of back-and-forth motion relate to physical parameters?



Study motion!

Plot this



It is sinusoidal.

T = period of motion : seconds

$f = \frac{1}{T}$ $\quad \cancel{sec}^{-1}$ $\quad \frac{osc}{sec} = \frac{cycle}{sec} = Hz$

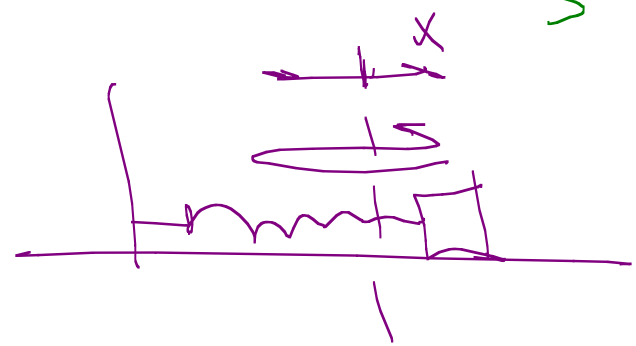
Hertz

A = Amplitude of motion.

If each cycle <u>corresponds to</u> 2π radians

ω = angular frequency $= 2\pi f$ $\quad$ rad/sec $\quad$ 1/s

Solve problem math'ly.



$$F_x = -kx = m a_x$$
$$= m \frac{d^2x}{dt^2}$$

Divide by stuff

$$\frac{d^2x}{dt^2} = -\underbrace{\left(\frac{k}{m}\right)}_{\omega^2} x = -\omega^2 x$$

$$\frac{d^2x}{dt^2} = -\omega^2 x \qquad x(t)$$

$$x = C_1 \sin(\omega t) + C_2 \cos(\omega t)$$

C's are constants (lengths)

$$x(0) = A \qquad C_2 = A$$

$$x'(0) = 0 \qquad x' = C_1 \omega \cos(\omega t) - \omega C_2 \sin(\omega t)$$

$$\rightarrow C_1 = 0$$

$$x(t) = A\cos(\omega t) \qquad \text{(Solved D.E.)}$$