Phys 2110-5 11/12/12

Note Title 11/12/2012

Chap 11

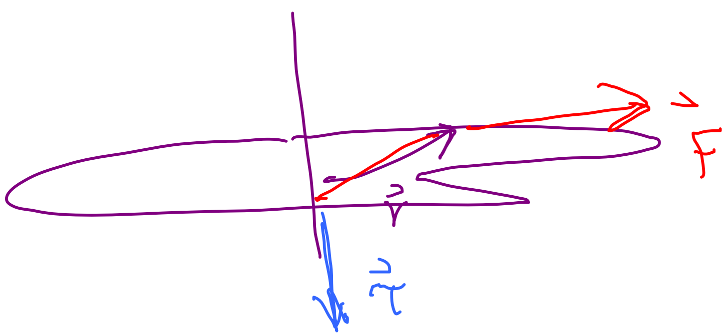
Vectors

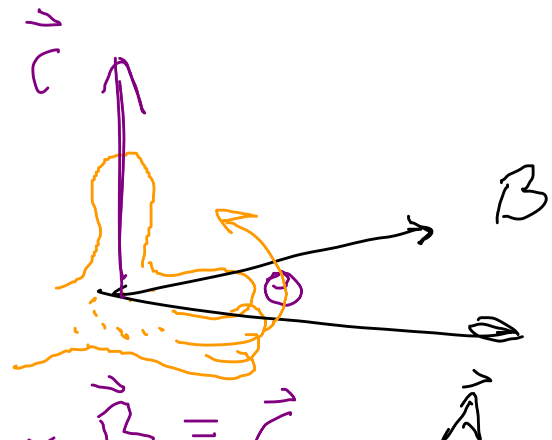
$\vec{\alpha}$

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

$$\vec{\alpha}_{avg} = \frac{\Delta\vec{\omega}}{\Delta t}$$

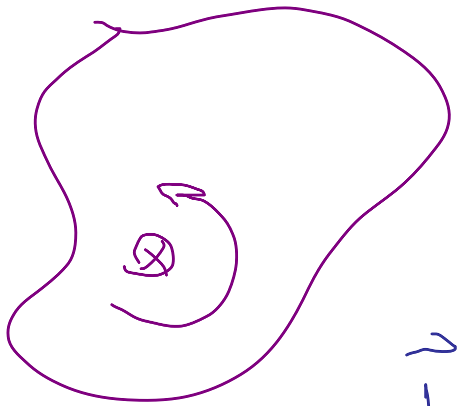
$$\vec{\tau} = \vec{r} \times \vec{F}$$





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

$$|\vec{A} \times \vec{B}| = AB|\sin\theta|$$



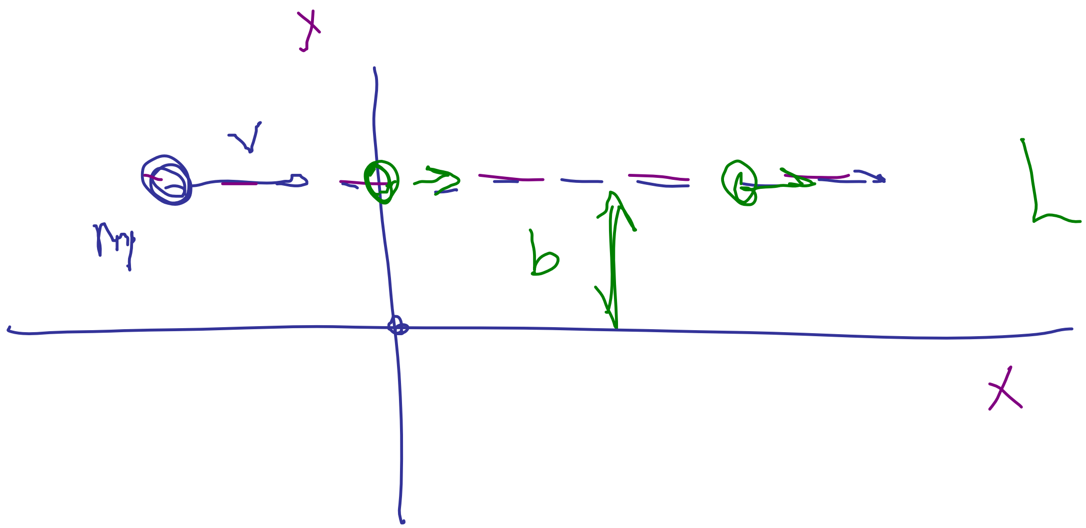
$$p_x = m v_x$$

$$L = I\omega$$

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

Angular moment

$$kg\,\frac{m^2}{s} = J \cdot s$$



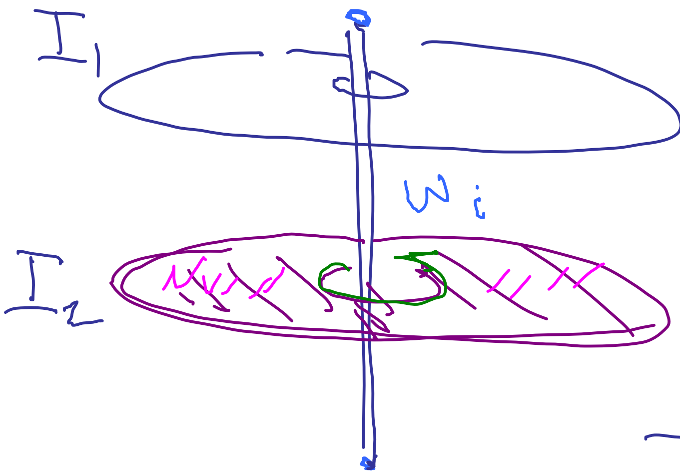
$$L = mvb$$

direction is <u>into</u> page

$\vec{L}$ ..huh.. what is it good for?

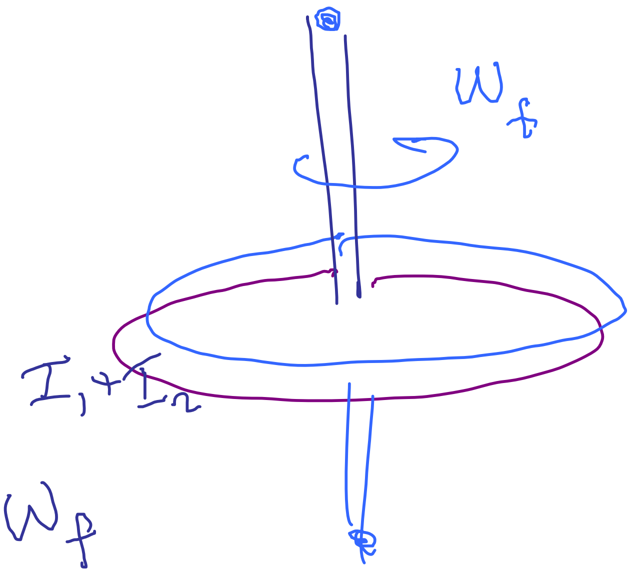
If there is no net external torques then total ang. mom. stays same.

Rotational collisions.

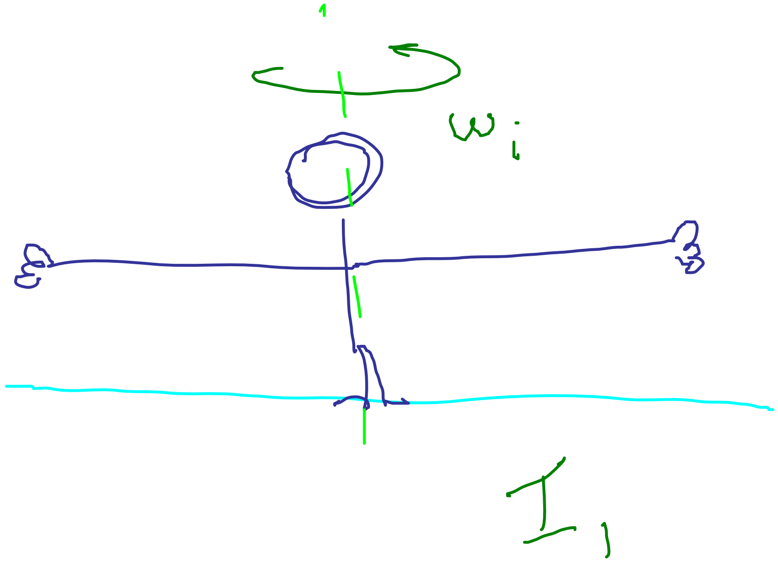


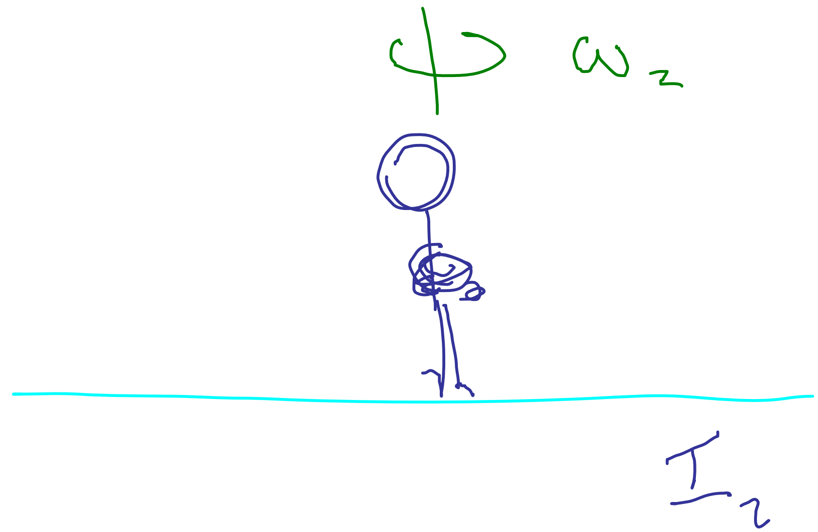
Two disks one rotating

Drop top disk



$$I_2 \omega_i = (I_1+I_2)\,\omega_f$$





No ext ang. mom.

L is conserved :

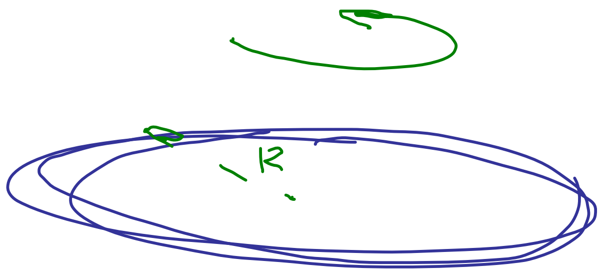
$$I_1 \omega_1 = I_2 \omega_2$$

$$\omega_2 = \frac{I_1}{I_2}\, \omega_1$$

$\frac{I_1}{I_2} > 1$

$$\omega_2 > \omega_1$$

11.23 A 640-g hoop 90 cm in diameter rot'ing at 170 rpm. What it's ang. mom.



$$L = I\omega$$

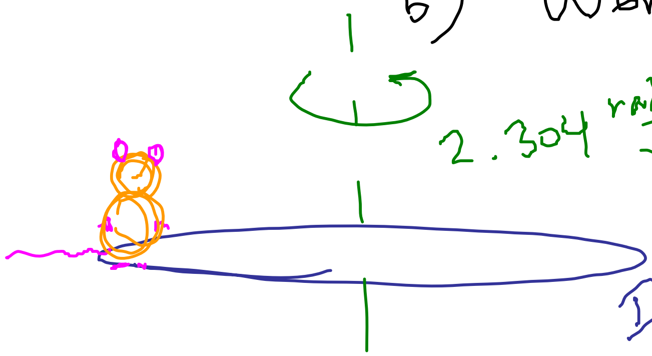
$$\omega \longrightarrow \text{rad/s}$$

$$I = MR^2 \quad \text{do it} \quad L = 2.3\ \text{J}\cdot\text{s}$$

11.38 Turntable of radius 25 cm and rot'l inertia 0.0154 kg m².
spinning freely 22.0 rpm.
19.5 g mouse on outer edge. Mouse walks from edge to center.

a) New rot'l speed

b) Work done by mouse



$2.304 \frac{rad}{s}$

$I_{1,Tot} = I_{disk} + I_m$

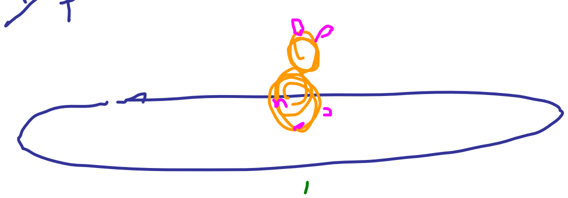
$\approx 0.0166 \ kg \, m^2$

mr^2

$I = 0.0154 \ kg \, m^2$

$I_f = 0.0154 \ kg \, m^2$

ω



$$I_1 \omega_1 = I_2 \omega_2$$

$$\omega_2 = \frac{I_1 \omega_1}{I_2} = 23.7 \text{ rpm}$$

Compute KEs

$$K_1 = \frac{1}{2} I_1 \omega_1^2 = 0.0441 \text{ J}$$

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

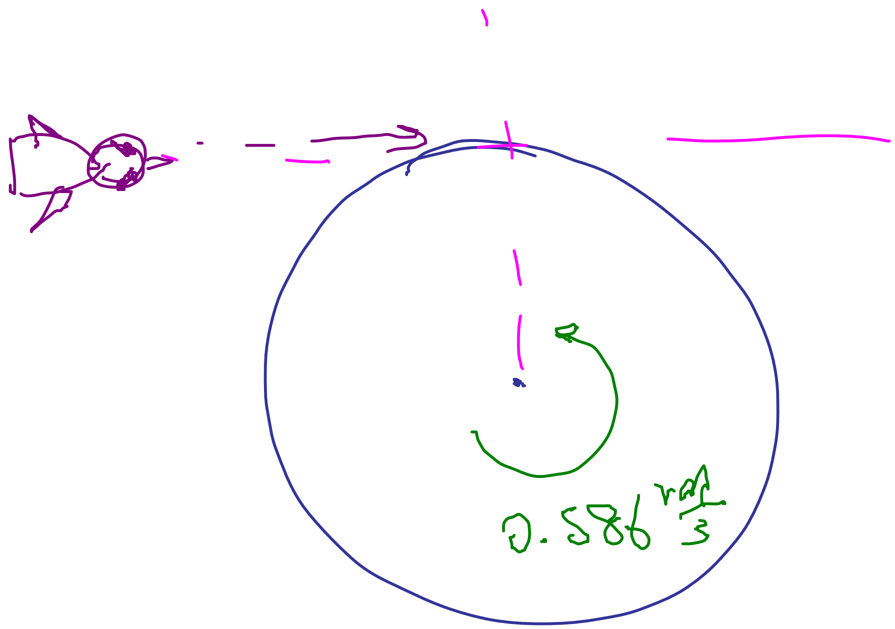
$$\Rightarrow \quad \Delta K = 3.3 \times 10^{-3} \text{ J}$$

$$W_{mouse}$$

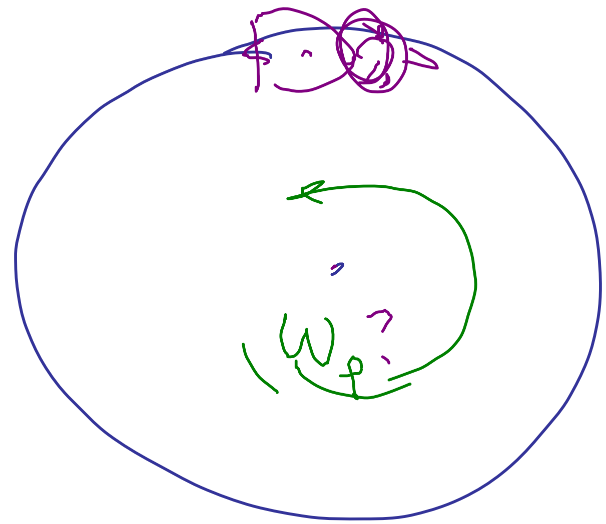
11.25

L stays same.

11.43 A circular 19 cm in radius, rot inertia 0.12 kg m². Suspended, rot'ing at 5.6 rpm. 140 g birds lands on rim, comes in tangent to rim at 1.1 m/s in direction opp. feeder's rotation. What rotation rate afterwards?



I_{feeder}



$$L_{Total} = I_{feed}\,\omega - m_{bird} V (R) \quad -mvb$$

$$= 4.106 \times 10^{-2} \frac{kg\, m^2}{s}$$

$$L_{aft} = \left(I_{feed} + MR^2\right)\omega_f$$

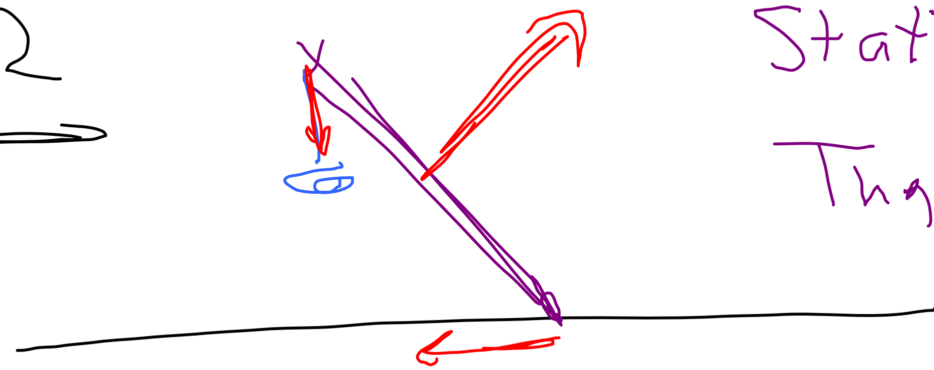
same

$$\omega_f = +0.329 \frac{rad}{s} \;\ldots$$

More examples of rot'ns & cons. of ang. mom

include axes changing dir.

Chap 12



Static Equilibrium.

Things that don't move.

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

$$\sum \tau = 0$$

Omit.

Chap 13 Oscillations