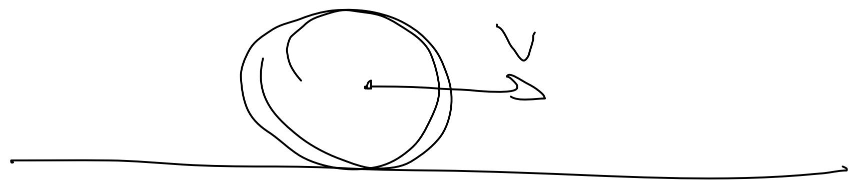
Phys 2110-4 3/30/12

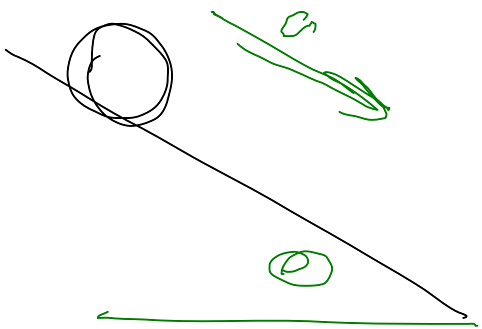
Note Title 3/30/2012

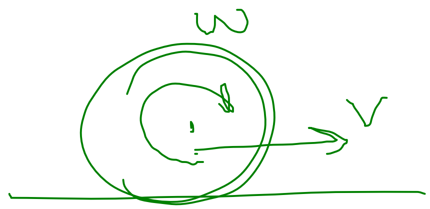
Chap 10: Rolling motion



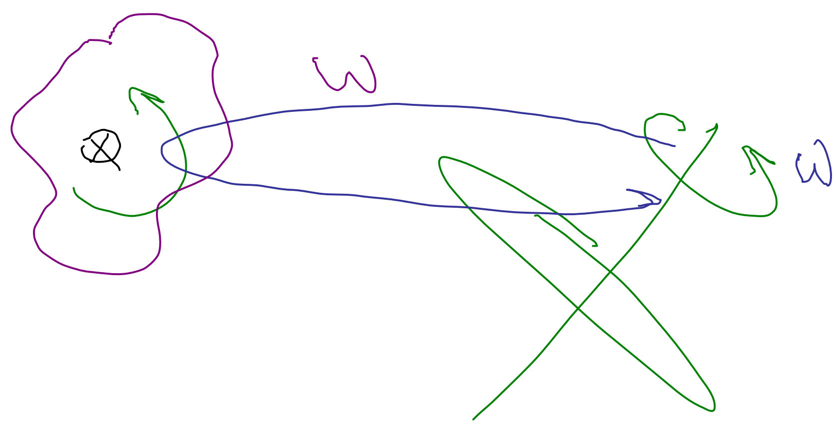
$$K_{rolling} = \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$$

$$\boxed{\begin{aligned} v &= \omega r \\ a &= \alpha r \end{aligned}}$$





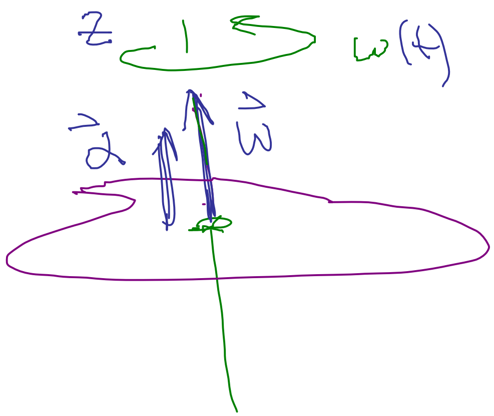
Chap 11



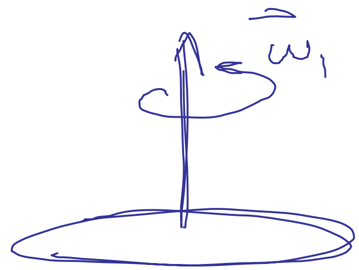
ω, α, τ

These are all <u>vectors</u>

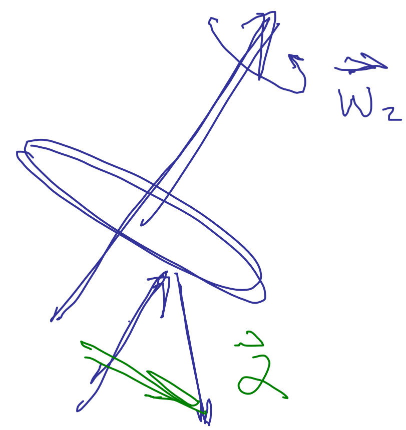
$$\vec{\alpha} = d\vec{\omega}/dt$$



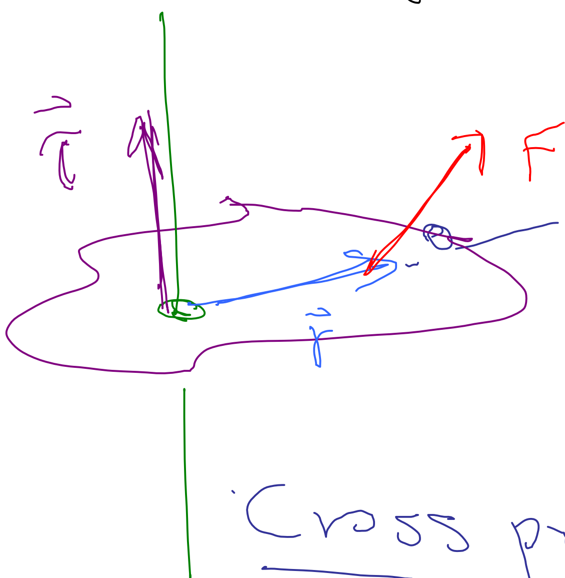
ω_z



$$\vec{\alpha} = \frac{1}{dt}(\vec{\omega}_2 - \vec{\omega}_1)$$



$\vec{\alpha} = \frac{d\vec{\omega}}{dt}$ $\vec{\alpha}$ given by torque, $\vec{\tau}$



$|\vec{\tau}| = rF\sin\theta$

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

Cross product of two vector

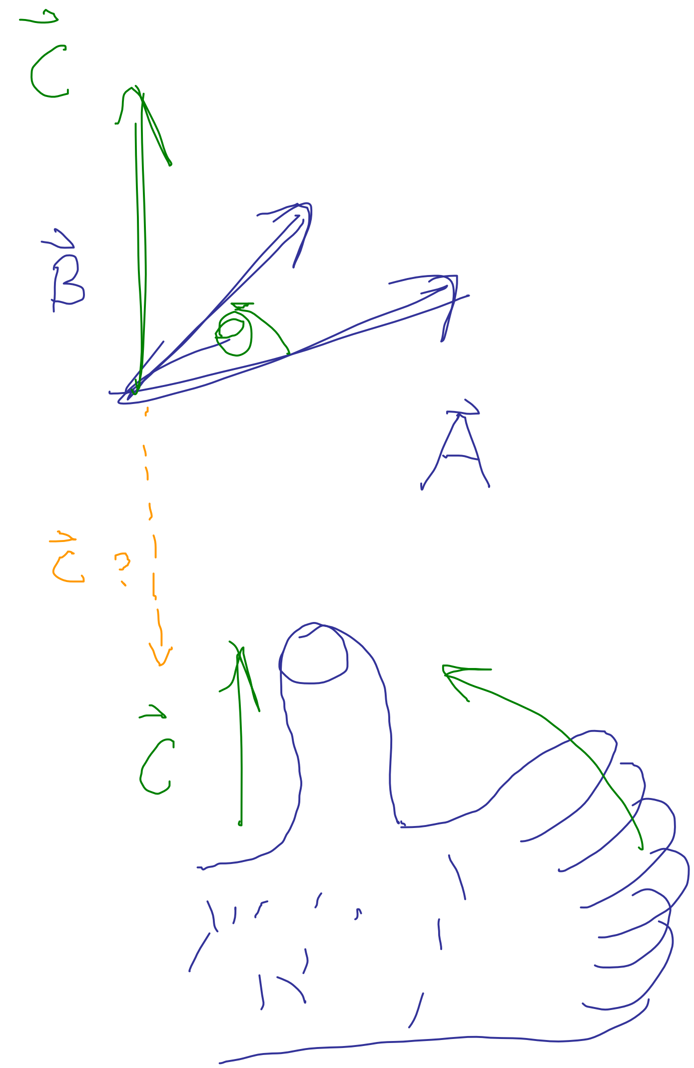
Crucial in Phys II EM, magnetic fields (3-dims)

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

Vector $\vec{C}$ is perp. to both

$$|\vec{C}| = |AB \sin\theta|$$

Dir of $\vec{C}$ is detd by rt-hand rule.



$$\vec{A}\cdot\vec{B} = AB\cos\theta$$

$$= A_x B_x + A_y B_y + \cdots$$

$$\vec{A}\times\vec{B} \neq \vec{B}\times\vec{A}$$

$$\vec{A}\times\vec{B} = (A_y B_z - A_z B_y)\,\hat{i} + (A_z B_x - A_x B_z)\,\hat{j} + (\; \cdots \;)\,\hat{k}$$

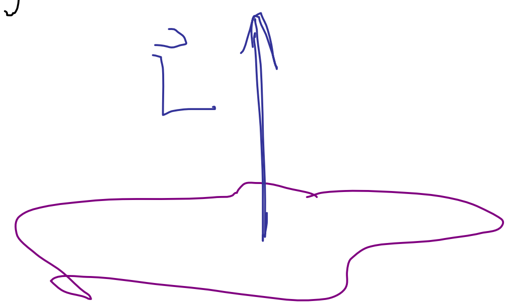
$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$-$ $+$

(Determinant)

So far, nothing corresp. to $p_x = m v_x$

$L = I\omega$ Angular momentum



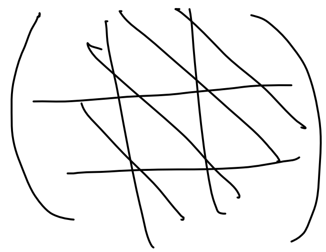
Really a vector

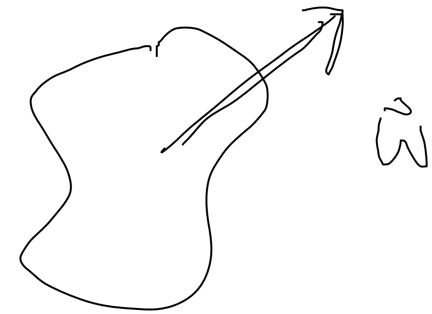
Units?

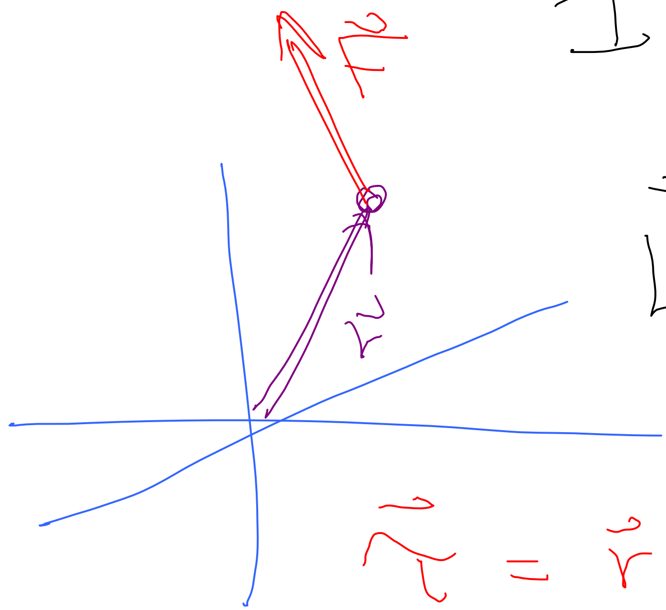
$kg\, m^2$ $1/sec$

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

$$L = I\omega$$

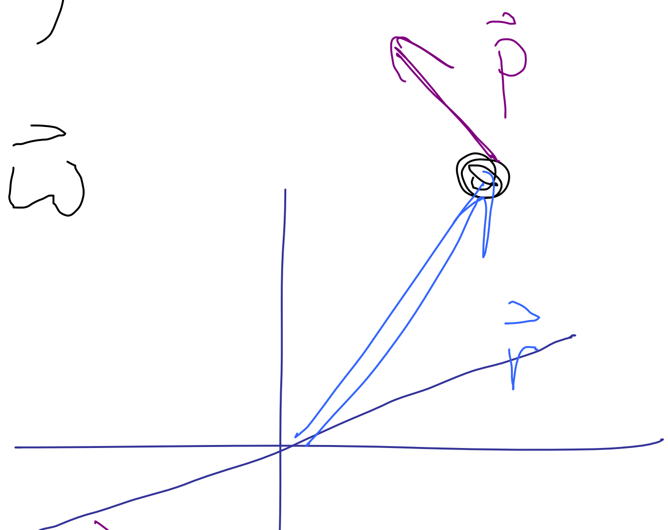
$I =$ 



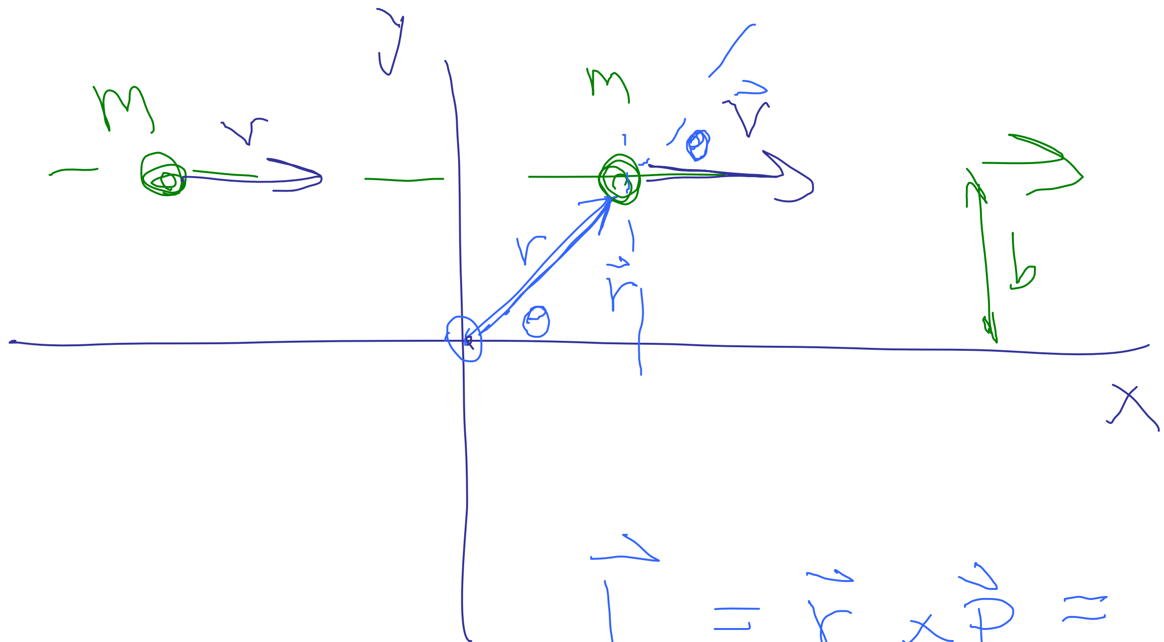


$$\vec{L} = \underset{\approx}{I}\,\vec{\omega}$$

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



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



Ang mom of this mass.

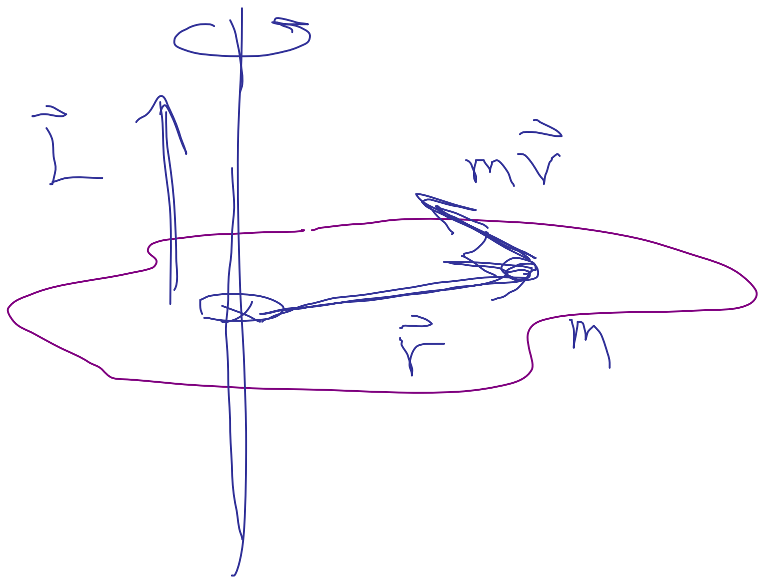
$$\vec{L} = \vec{r} \times \vec{p} = r\,(mv)\sin\theta\,(-\hat{k})$$

into page

$$|L| = r m v \sin\theta \qquad r\sin\theta = b$$

$$= mvb$$

keep this in mind for later...



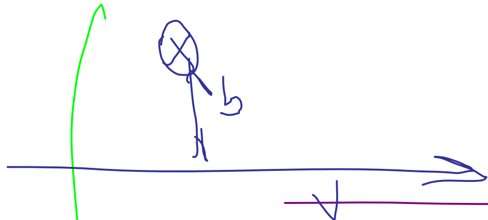
mass point

$\vec{r} \times \vec{p}$ is up.

$$\vec{L} = \vec{r} \times \vec{p}$$
$$= r(mv)\hat{k}$$
$$= rm(r\omega)\hat{k}$$
$$= mr^2\omega\hat{k}$$

$$\vec{L}_{total} = \sum_i m_i r_i^2 \omega \hat{k}$$
$$= \left[\sum_i m_i r_i^2\right]\omega\hat{k} = I\omega\hat{k}$$

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



$L = \pm mvb$

$$\vec{F} = \frac{d\vec{p}}{dt} \qquad \boxed{\vec{\tau} = \frac{d\vec{L}}{dt}}$$

$$\tau = \frac{dL}{dt} = I\frac{d\omega}{dt} = I\alpha$$

$\vec{L}$, Huh! What is it good for.

$\vec{p}$ Huh! What is it good for? ___

Isolated system (no net ext <u>force</u>)

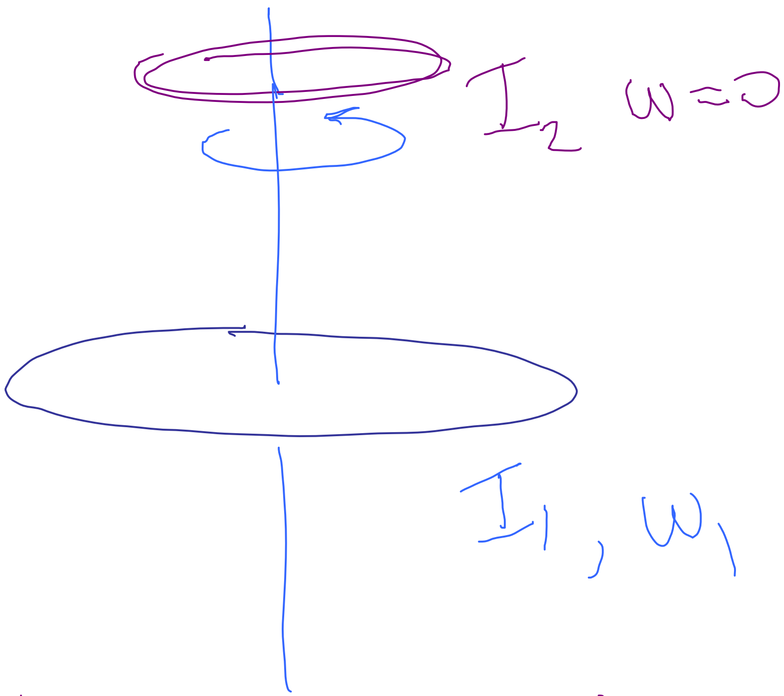
$\vec{P}$ is constant

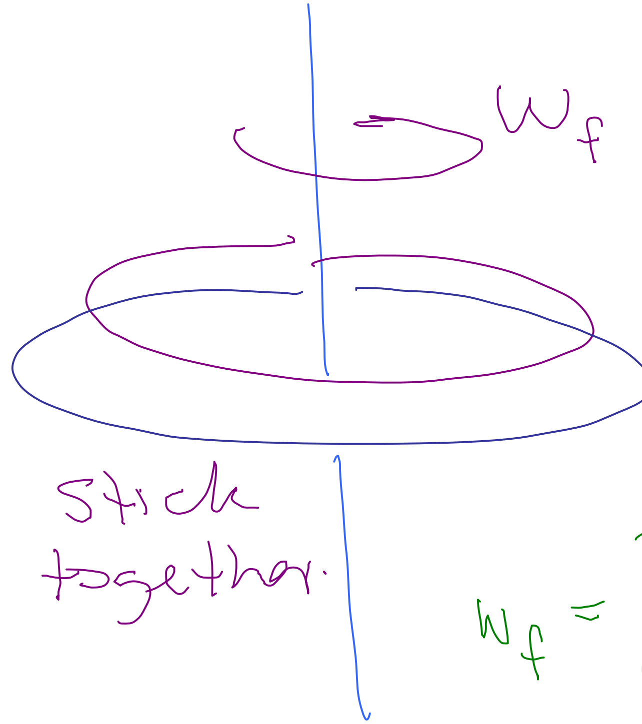
See 11.4 p. 178

Isolated system (no net external torque)

$\vec{L}_{Total}$ is constant.

Rotational collisions



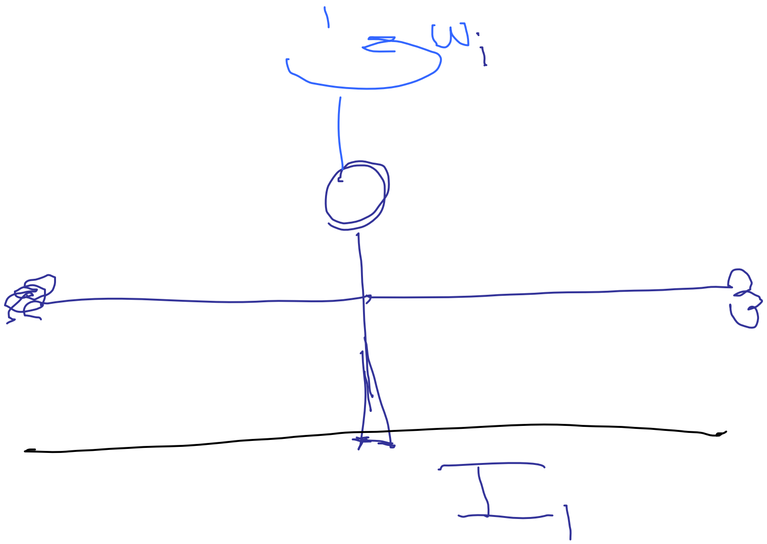


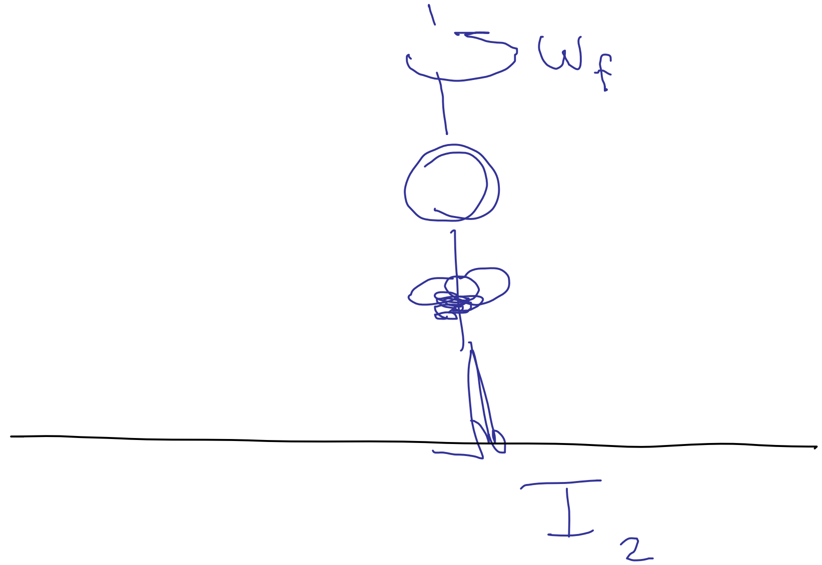
stick together.

$$\omega_f = \frac{I_1 \omega_1}{(I_1 + I_2)}$$

L is conserved

$$L_{init} = I_1 \omega_1 = L_f = (I_1 + I_2)\, \omega_f$$





I changes

$$I_1 \omega_i = I_2 \omega_f$$

$$\omega_f = \frac{I_1}{I_2}\,\omega_i$$

Energy not conserved.

Gain in energy.