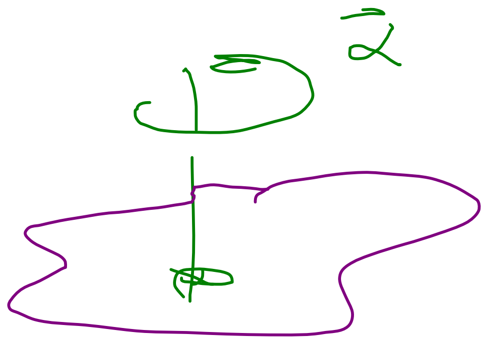
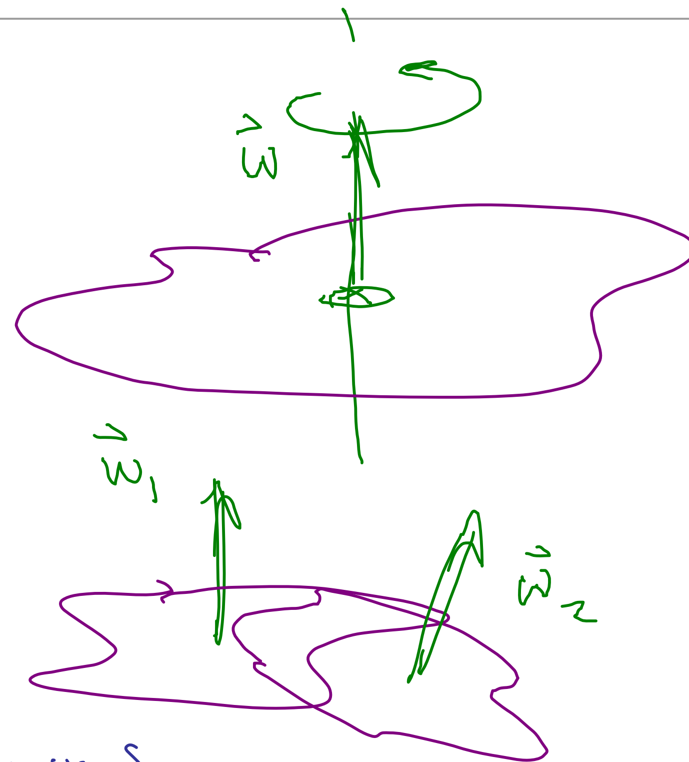
Phys 2110-4 4/8/13

Note Title 4/8/2013

Rotations





Right-handed sense

$$\Delta\vec\omega = \vec\omega_2 - \vec\omega_1$$

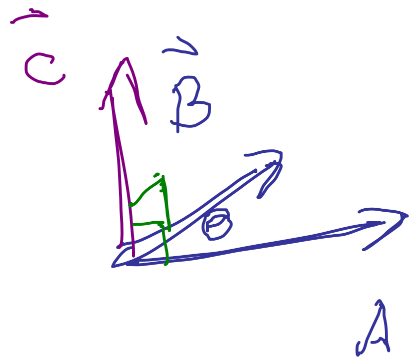
$$\vec\alpha = \frac{\Delta\vec\omega}{\Delta t}$$ vector.

Correct def'ns in terms of vectors

Need vector operation called cross-product.

$\vec{A} \cdot \vec{B}$, dot product $\Rightarrow$ scalar.

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



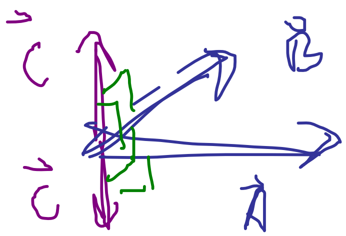
What is vector

θ is angle between $\vec{A}$ & $\vec{B}$.

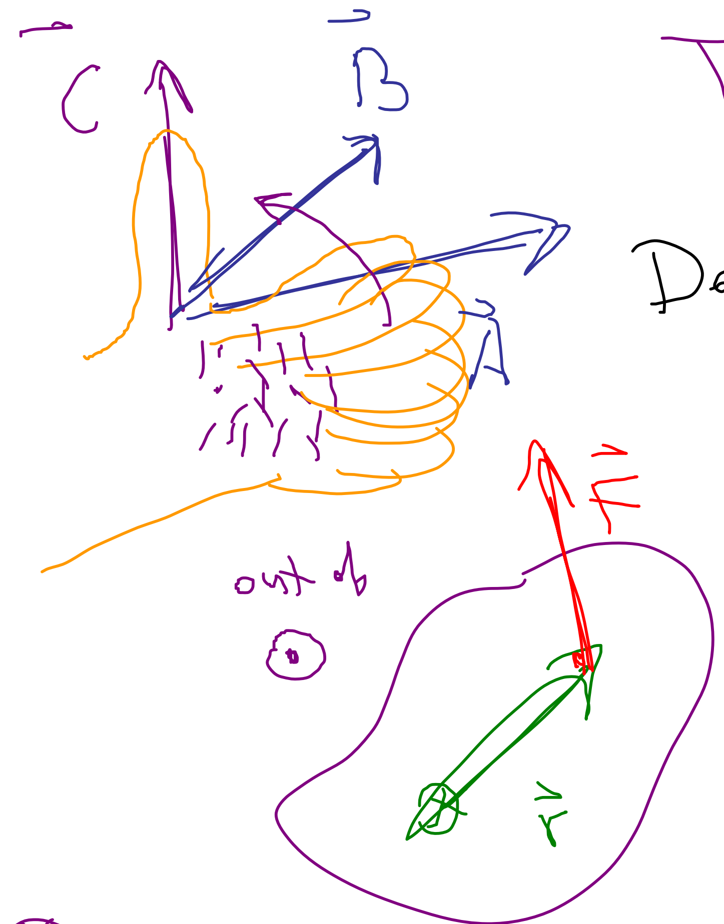
Magnitude of C is

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

$\vec{C}$ is perp. to both $\vec{A}$ & $\vec{B}$



Dir. of $\vec{C}$ is det'd by right-hand rule.



Thumb goes in dir of $\vec{C}$

Def of torque really involves cross product

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

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

$+ \quad - \quad -$

mnemonic

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

$\oplus \quad \ominus$

$$\tau = I\alpha \qquad \alpha = a/R$$

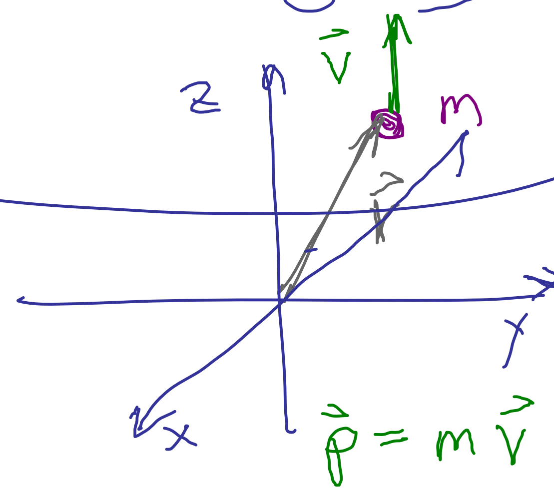
$\tau = I\alpha$ $K = \frac{1}{2} I \omega^2$ $L = I\omega$ angular momentum

$F = ma$ $K = \frac{1}{2} m v^2$ $p_x = m v_x$

$L = I\omega$ units $kg\, m^2 \frac{1}{s} = \frac{kg\, m^2}{s}$ "action"

angular momentum $= J \cdot s$

(Really a vector, $\vec{L} = I \vec{\omega}$

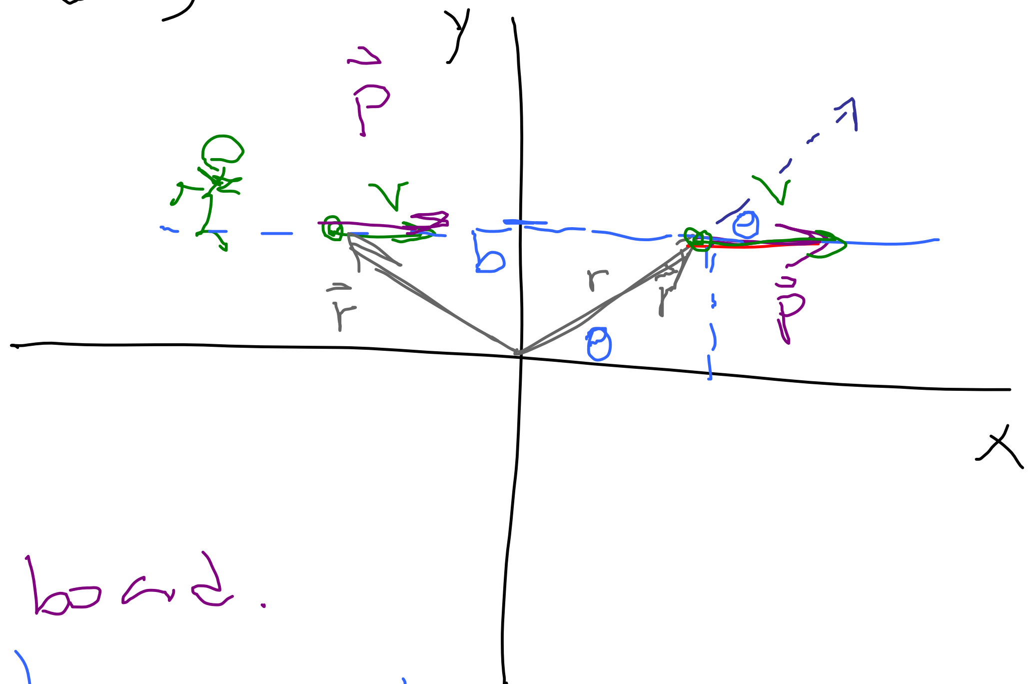


Real def of angular mom.

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

Before disc. objects, axes)

In this pic, find $\vec{L}$ for little man.

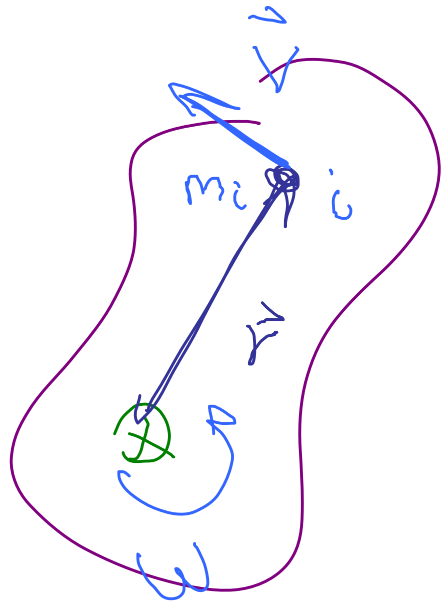


What is $\vec{r} \times \vec{p}$?

Vector points into board.

$$|\vec{L}| = \underline{r}\,\underset{mv}{p}\,\left|\underline{\sin\theta}\right| = mvb$$

Now move on to rotating rigid body.



$$L = (m_i v_i) r_i$$

$$= (m_i r_i \omega) r_i$$

$$= (m_i r_i^2) \omega$$