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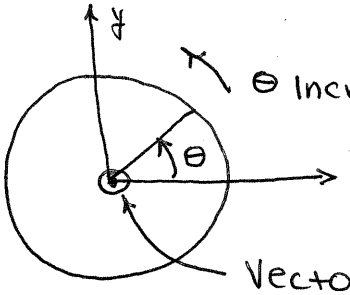
Angular Variables as Vectors

LINEAR	ANGULAR
$\vec{x}$	$\vec{\theta}$
$\vec{v}$	$\vec{\omega}$
$\vec{a}$	$\vec{\alpha}$
$\vec{F}$	$\vec{\tau}$

$\vec{\theta}$



$\odot$ ≡ Arrow Pointing Out of Page

$\times$ ≡ Arrow Pointing Into Page

Wrap Fingers of Right Hand in the direction of θ.

Thumb Points Direction of $\vec{\theta}$. CCW => Out of Page

=> $+\theta \Rightarrow \odot$ CW => Into Page => $-\theta \Rightarrow \times$

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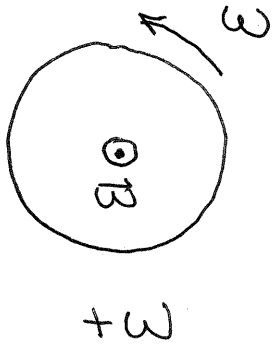
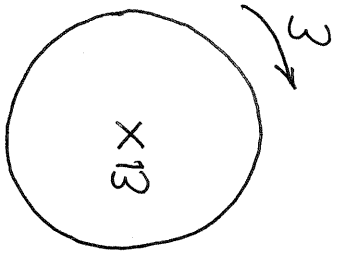
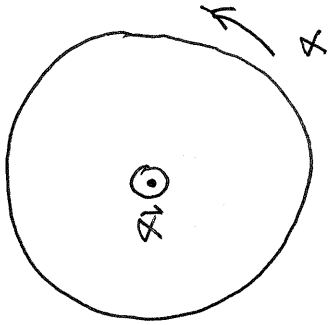
The SAME Right HAnd convention applies to $\vec{\omega}$ and $\vec{\alpha}$



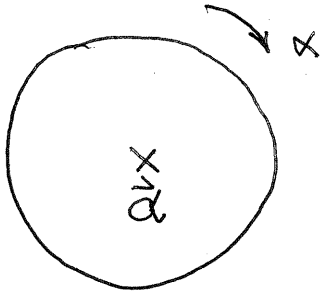
$+\omega$



$-\omega$



$+\alpha$

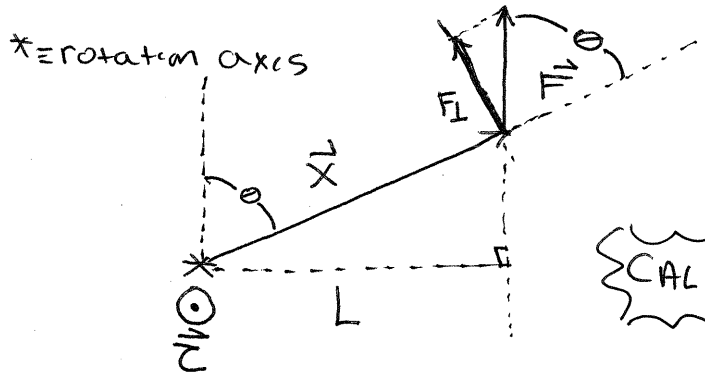


$-\alpha$

TORQUE

TORQUES PLAY the same ROLL in Angular MOTION That FORCES PLAY IN LINEAR MOTION =>

NEWTON'S second LAW => $\vec{\tau} = I\vec{\alpha}$



$|\vec{x}| \equiv x$

$L \equiv$ Lever Arm

CALCULATING TORQUE

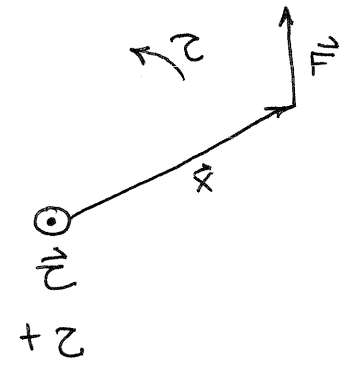
$$|\vec{\tau}| = |\vec{x}|F_\perp = x F \sin\theta = \perp \text{component of } F \text{ times distance } x$$

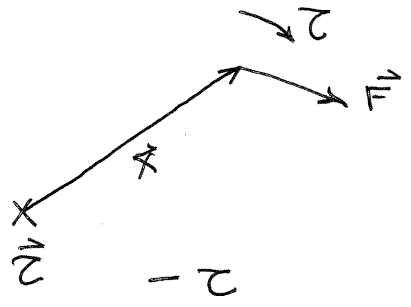
– OR –

$$|\vec{\tau}| = |\vec{F}| \cdot L = |\vec{F}|\underbrace{|\vec{x}|\sin\theta}_{L \equiv \text{Lever Arm}} = x F \sin\theta$$

$= |\vec{F}|$ time $\perp$ distance to Axis $\equiv$ Lever Arm

direction of $\vec{\tau}$ FROM RHR =>





TORQUES PROVIDE ANOTHER CONDITION FOR STATIC EQUALIBRIUM:

$$\sum F_x = 0$$

$$\sum F_y = 0$$

$$\sum \tau_i \text{ ABOUT AXIS CHOSEN} \equiv 0$$