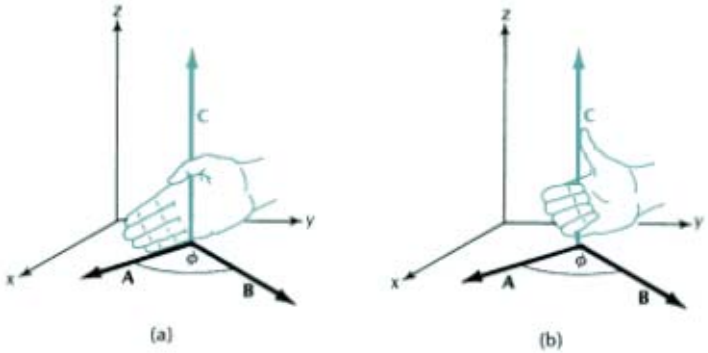
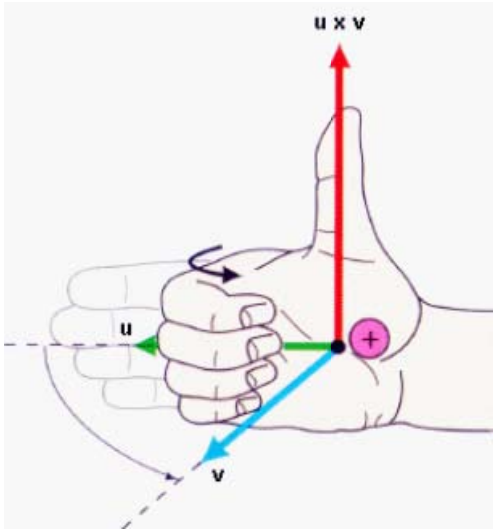
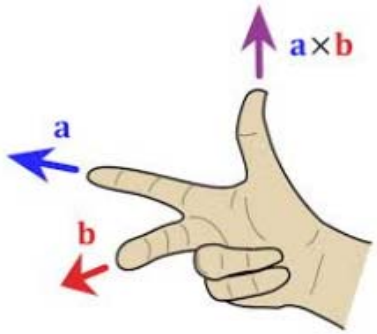
Physics 113 - November 14, 2013

Posted a RHR / cross product applet
also a "precession of a Top" applet





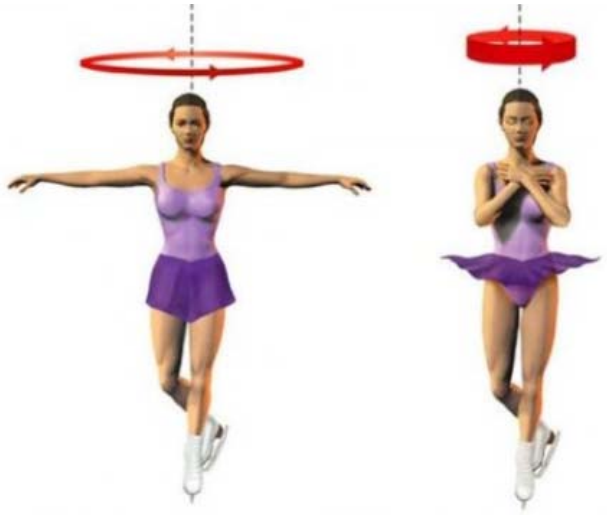


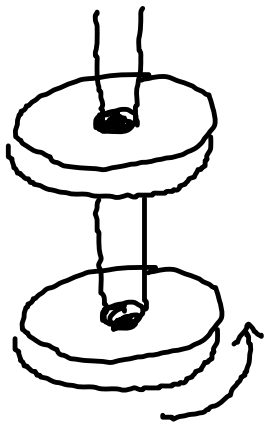
$$\vec{L} = \vec{r} \times \vec{F}$$

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

$$\vec{L} = \frac{d\vec{L}}{dt} = I\,\frac{d\vec{\omega}}{dt}$$

Angular Momentum is conserved
(isolated system)
(vector!)





M, R, ω

$I_{disk} = \frac{1}{2}MR^2$

Top disk Not rotation
Identical
Falls and "Sticks" to bottom
Disk without slipping
What is the final ω?

Conservation of Energy

for single Disk

inelastic collision

$\frac{1}{2}I\omega^2 = \cancel{\frac{1}{2}\left(\frac{1}{2}MR^2\right)\omega^2} = \frac{1}{2}\left(\frac{1}{2}MR^2\right)\omega'^2$

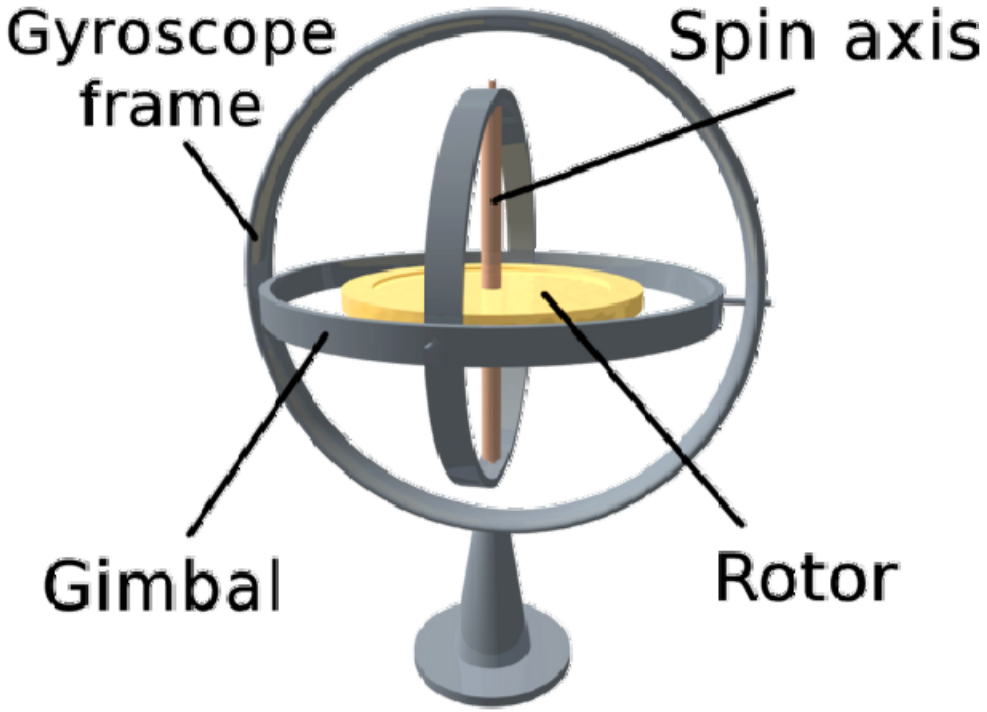
"ω'"

Use Cons. of angular Momentum

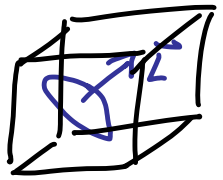
$$\vec{L}_{start} = \vec{L}_{end}$$

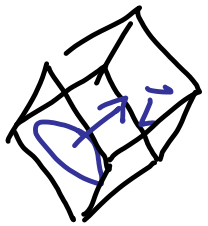
$$I\omega = I'\omega'$$

$$\frac{1}{2}MR^2\omega = \frac{(2)}{2}MR^2\omega' \qquad \frac{\omega'}{\omega} = \frac{1}{2}$$



The gyroscope



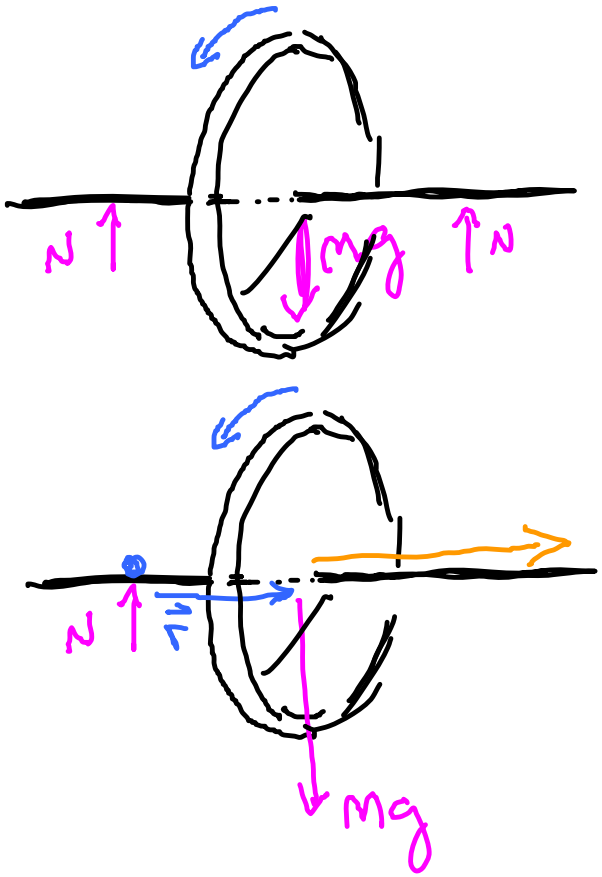


Free spinning wheel from external torques ... orientation is fixed due to Ang. Mom. conservation

very impt. development for navigation

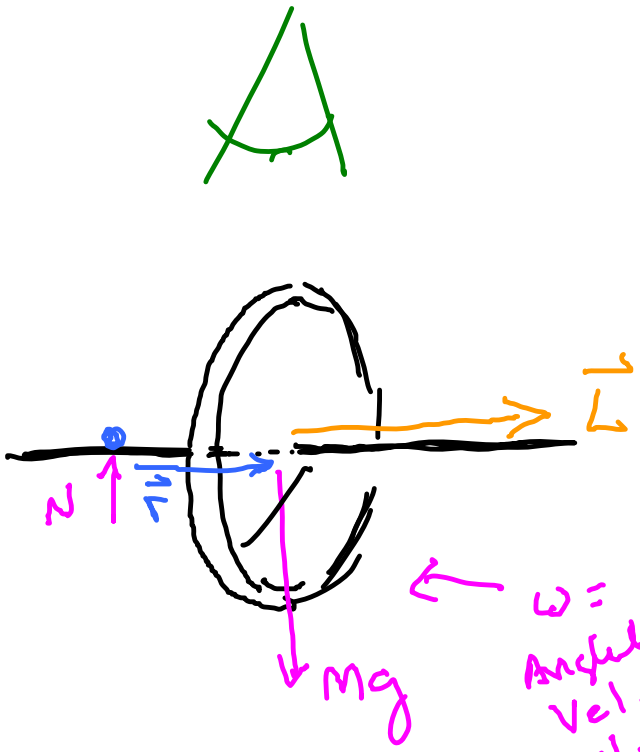
$$\vec{L} = I\vec{\omega}$$

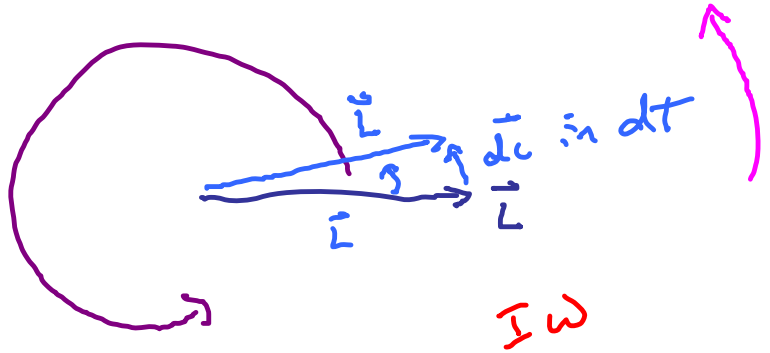
$$\vec{\tau} = \frac{d\vec{L}}{dt}$$



$2N = mg$

$N = mg$





$$\tau = \frac{dL}{dt}$$

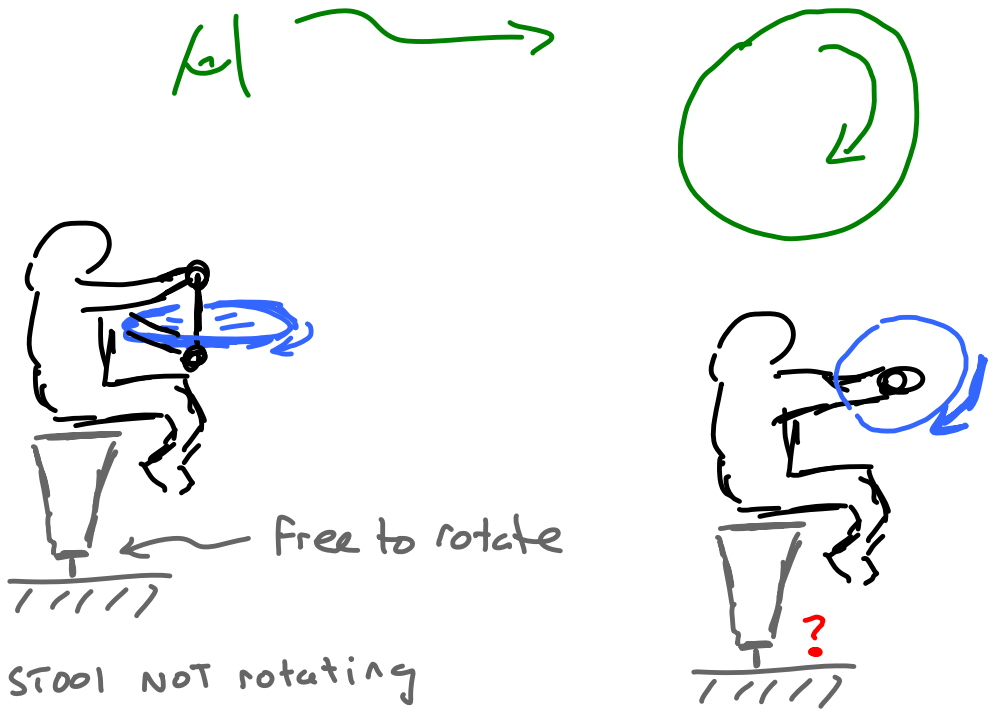
$$Mgr = \tau = \frac{dL}{dt} = |\vec{L}|\frac{d\phi}{dt}$$

$I\omega$

Ω Precession velocity

$$mgr = I\omega\Omega$$

$$\Omega = \frac{mgr}{I\omega}$$



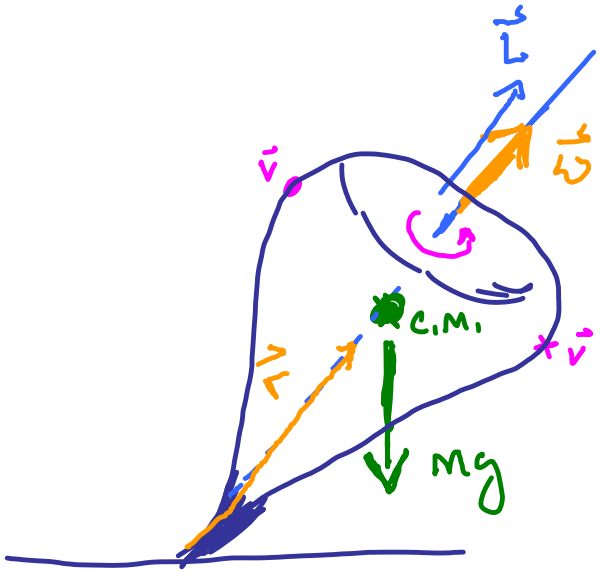
How does stool rotate as viewed from above?

A) clockwise

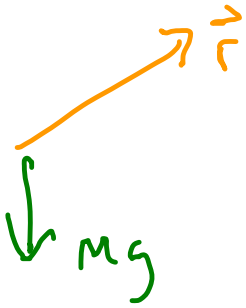
B) counter-clockwise

C) No rotation

Spinning Top



"into board"



what direction is $\vec{\omega}$

what direction is $\vec{L}$

what direction is $\vec{L}$

What direction will the top precess?