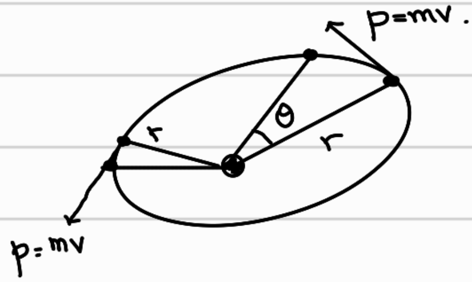
CH 5 Circular Motion Pt. 2.

Angular Momentum. (Moment of momentum).

→ Due to Spin motion or Orbital motion of an object.

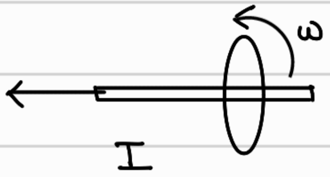
For A Particle.

$$\vec{L} = \vec{r} \times \vec{p} = mvr\sin\theta .$$



For a ridgid body.

$$L = I \times \omega .$$



Law of Conservation of Angular Momentum.

→ Total Angular Momentum of a isolated particle remains invariant.

$$L_1 = L_2 \,,\ \sum_i \vec{L} = \text{Const.} \quad \text{iff} \ \sum_i \tau_{ext} = 0 .$$

$$L = I\omega .$$

$$I_1\omega_1 = I_2\omega_2$$

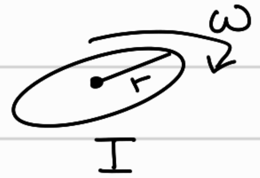
Applications.

$L = r \times p$

- With arms closed wheel speeds up.
- Open arms will slow down the wheels

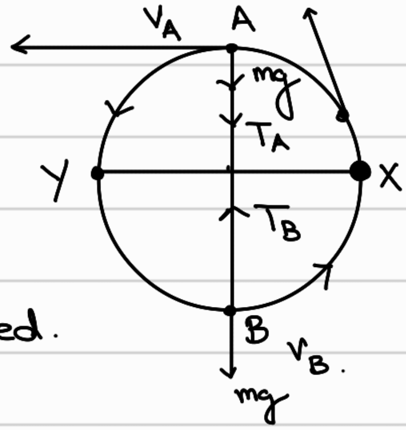
Rotational Kinetic Energy

$$K.E = \frac{1}{2} I \omega^2$$



$$V = r\omega$$

Motion in a vertical Circle



$$T_A + mg = \frac{mV_A^2}{r}$$

If $T_A = 0$

$$\Rightarrow V_A = \sqrt{gr} = V_c \quad \text{Critical speed.}$$

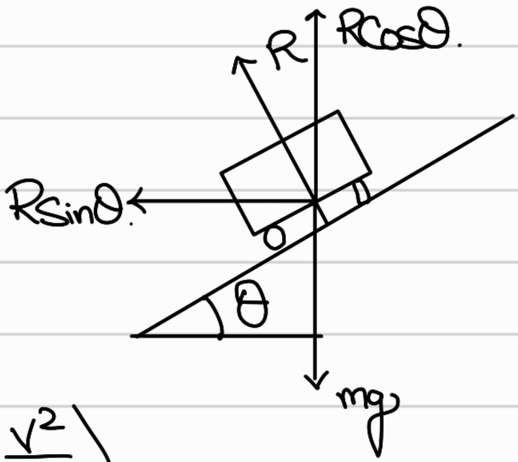
$V_A < V_c$ body falls down.

At point B:

$$T_B - mg = \frac{mv_B^2}{r} \Rightarrow V_B = \sqrt{5gr}$$

$$V_x = V_y = \sqrt{3gr}$$

BANKING OF CURVED TRACKS



$$R\sin\theta = \frac{mv^2}{r}$$

$$R\cos\theta = mg$$

$$\tan\theta = \frac{v^2}{rg} \Rightarrow \theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$$

Max speed possible w/o skid: $\mu = \tan\theta$

$$V_{max} = \sqrt{\mu r g} = \sqrt{\frac{rdg}{2h}}$$