NOTES PHYSICS 03-22-10 (PAGE 1)

TODAY HW7 DUE

DISCUSS CH 11

WED. READ 11.7

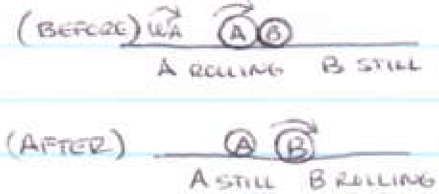
MORE ON CH 11

3/29: HW8 DUE REVIEW

3/31: MT 2 (BRING 1 PAGE OF NOTES) (CH 6-11)

ROLLING SPHERES (MARBLE)

ELASTIC COLLISION (ONE DIMENSIONAL)



ASSUME BOTH MARBLES HAVE MASS m.

ASSUME MARBLES PERFECTLY SPHERICAL (UNIFORM DENSITY)

$K = \frac{1}{2} m v_A^2 + \frac{1}{2} I \omega_A^2$

$I = \frac{2}{5} mR^2$

R = RADIUS OF MARBLES A & B

ASSUME MARBLES HAVE SAME SIZE

$K = \frac{1}{2} m v_A^2 + \frac{1}{2} I \omega_A^2 = \frac{1}{2} m v_A^2 + \frac{1}{2}\left(\frac{2}{5} mR^2\right)\omega_A^2$

MOMENT OF INERTIA $R^2\omega_A^2 = v_A^2$

ROLLING W/O SLIPPING: $v = R\omega \Rightarrow \frac{v}{R} = \omega$

$K = \frac{1}{2} m v_A^2 + \frac{1}{5} m v_A^2 = \frac{7}{10} m v_A^2$

$P = m v_A$

(AFTER) $K^* = \frac{7}{10} m (v_A^*)^2 + \frac{7}{10} m (v_B^*)^2$

$P^* = m v_A^* + m v_B^*$

$v_A^* = 0 \quad v_B^* = v_A$

$\omega_A = 0 \quad \omega_B^* = \omega_A$

$K = K^*$

$\frac{7}{10} m v_A^2 = \frac{7}{10} m (v_A^*)^2 + \frac{7}{10} m (v_B^*)^2$

$v_A^2 = (v_A^*)^2 + (v_B^*)^2$

$v_A^2 = (v_A - v_B^*)^2 + (v_B^*)^2$

$v_A^2 = v_A^2 - 2 v_A v_B^* + (v_B^*)^2 + (v_B^*)^2$

$0 = 0 + v_B^*(-2v_A + v_B^* + v_B^*)$

$0 = 2 v_B^*(v_B^* - v_A)$

$\Leftrightarrow 2v_B^* = 0$ OR $v_B^* - v_A = 0$

NO COLLISION

$\Downarrow$

$v_B^* = v_A \Rightarrow v_A - v_A = v_A^*$

$\Downarrow$

$= \boxed{0}$

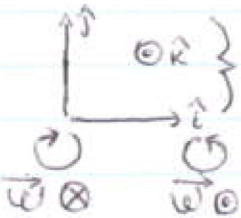
$P = P^*$

$m v_A = m v_A^* + m v_B^*$

$v_A = v_A^* + v_B^*$

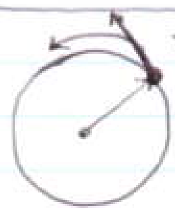
$v_A^* = v_A - v_B^*$

ANGULAR ROTATION ($\odot$ = OUT $\otimes$ = IN)



RIGHT-HANDED COORDINATE SYSTEM

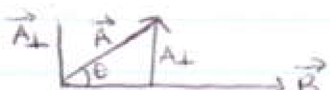
$\hat{i}\times\hat{j}=\hat{k}$ CROSS PRODUCT	$\hat{j}\times\hat{i}=-\hat{k}$ $\otimes$



$\vec{v}$ = VELOCITY OF Pt. ON RIM RELATIVE TO CENTER

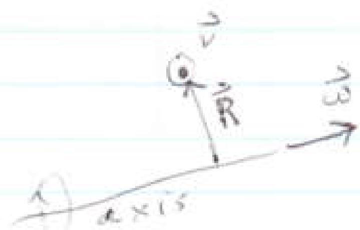
$$\vec{\omega}=\frac{\vec{R}\times\vec{v}}{R^2}$$ ← (THERE ISN'T ALWAYS A RIGHT ANGLE BETWEEN $\vec{R}$ & $\vec{v}$)

$$|\vec{A}\times\vec{B}|=|\vec{A}||\vec{B}|\sin\theta$$
$$\vec{A}\cdot\vec{B}=|\vec{A}||\vec{B}|\cos\theta$$



$$|\vec{A}\times\vec{B}|=\underbrace{|\vec{A}_\perp|}_{|\vec{A}|\sin\theta}|\vec{B}|=|\vec{A}||\vec{B}_\perp|$$

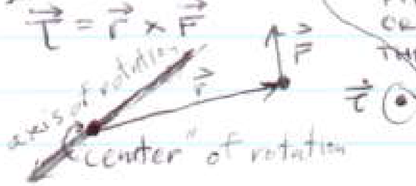
$$|\vec{A}\cdot\vec{B}|=\underbrace{|\vec{A}_{\parallel}|}_{|\vec{A}|\cos\theta}|\vec{B}|=|\vec{A}||\vec{B}_{\parallel}|$$



LINEAR	ANGULAR
$\vec{v}$	$\vec{\omega}=\frac{\vec{R}\times\vec{v}}{R^2}$
$v=\lvert\vec{v}\rvert$	$\omega=\lvert\vec{\omega}\rvert$
$\vec{a}=\frac{d\vec{v}}{dt}$	$\vec{\alpha}=\frac{d\vec{\omega}}{dt}$
$\Sigma\vec{F}_{ext}=m\vec{a}$	$\Sigma\vec{\tau}_{ext}=I\vec{\alpha}$ ← ONLY FOR EITHER FIXED AXIS OF ROTATION OR AN AXIS OF ROTATION THROUGH THE C.M.

↖ Also must axis of symmetry

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



LINEAR

$\vec{p} = m\vec{v}$

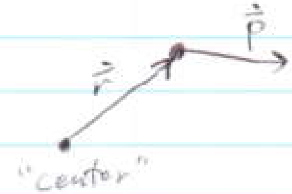
$\vec{P} = \sum_i m_i \vec{v}_i$

$\frac{d\vec{P}}{dt} = \sum \vec{F}_{EXT}$

ANGULAR

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

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

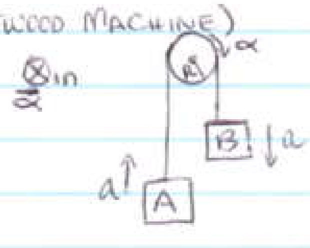


$\vec{L} = I\vec{\omega}$ ← for axis of symmetry

↑ ANGULAR MOMENTUM

$\frac{d\vec{L}}{dt} = \sum \vec{\tau}_{EXT}$ ← for fixed center pt. or for center pt. = CM.

(CH4 ATWOOD MACHINE)



$m_A < m_B$

IGNORE MASS OF PULLEY:

$$a = \frac{m_B - m_A}{m_A + m_B} g$$

WHAT IF THE MASS OF THE PULLEY ISN'T IGNORED?

TORQUES ACTING ON PULLEY!

$\vec{\alpha} = \frac{1}{I} \sum \vec{\tau}_{EXT}$

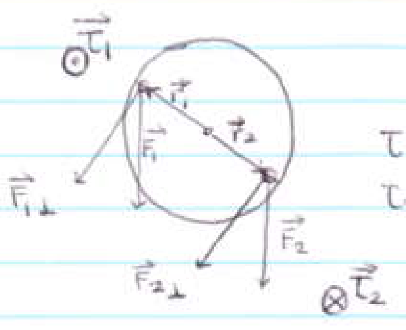
$a = R\alpha = \frac{R}{I} \sum \vec{\tau}_{EXT}$

(SEE PAGE 295)

ASSUME THE ROPE DOESN'T SLIP: $V = R\omega$

LET'S ASSUME WE KNOW I, THE MOMENT OF INERTIA OF THE PULLEY: $\left(I = \sum_i m_i r_i^2\right)$ OR $\left(I = \int r^2 dm\right)$

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



$\tau = F_{1\perp} r_1$

$\tau_2 = F_{2\perp} r_2$

NO TORQUE FROM GRAVITY ON THE PULLEY