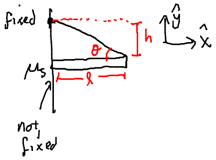
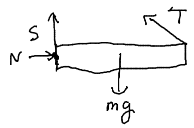
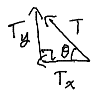
Not yet. Monday.

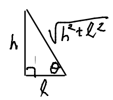
In equilibrium

$\vec{F}_{net} = 0 \qquad \tau_{net} = 0$









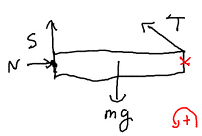
$$\frac{T_y}{T} = \frac{h}{\sqrt{h^2+\ell^2}} \qquad \frac{T_x}{T} = \frac{\ell}{\sqrt{h^2+\ell^2}}$$

horiz forces: $N - T_x = 0$

$$N = \frac{\ell}{\sqrt{h^2+\ell^2}} T$$

vertical: $S + T_y - mg = 0$

$$S + \frac{h}{\sqrt{h^2+\ell^2}} T = mg$$



$\tau_N = 0$ N points at pivot

$\tau_T = 0$ T acts at pivot

$\tau_{mg} = +\left(\frac{1}{2}\ell\right) mg$

$\tau_S = -\ell S$

$\frac{1}{2} mg\ell - S\ell = 0$

$\rightarrow S = \frac{1}{2} mg$

$$S + \frac{h}{\sqrt{h^2+\ell^2}} T = mg$$

$$\frac{1}{2} mg + \frac{h}{\sqrt{h^2+\ell^2}} T = mg$$

$$\frac{h}{\sqrt{h^2+\ell^2}} T = \frac{1}{2} mg$$

$$T = \frac{\sqrt{h^2+\ell^2}}{h} \frac{1}{2} mg$$

$$N = \frac{\ell}{\sqrt{h^2+\ell^2}} T$$

$$N = \frac{\ell}{\cancel{\sqrt{h^2+\ell^2}}} \frac{\cancel{\sqrt{h^2+\ell^2}}}{h} \frac{1}{2} mg$$

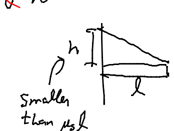
$$N = \frac{1}{2} mg \frac{\ell}{h}$$

For this not to slip

$$S \leq \mu_s N$$

$$1\,\cancel{\tfrac{1}{2} mg} \leq \mu_s \cancel{\tfrac{1}{2} mg} \frac{\ell}{h}$$

$$h \leq \mu_s \ell$$



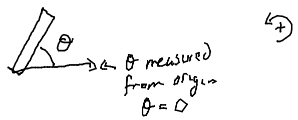
What if $\tau_{net} \neq 0$?

$F_{net} \neq 0 \rightarrow$ acceleration

$\tau_{net} \neq 0 \rightarrow$ angular acceleration

Analogs between linear & angular kinematics

Position $x \rightarrow$ Angle θ



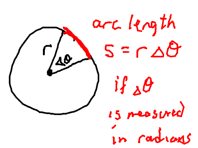
Displacement $\Delta x \rightarrow$ Angular Displacement $\Delta\theta = \theta_f - \theta_i$

Units for angles

degrees (360° to turn around once)

revolutions 1 rev

radians 2π rad = 1 rev = 360°



e.g.
if $\Delta\theta = 2\pi$ rad
then $s = r\Delta\theta$
$= 2\pi r$
= circumference

$\Delta\theta = \pi$ rad

velocity $v = \frac{\Delta x}{\Delta t} \rightarrow$ angular velocity $\omega = \frac{\Delta\theta}{\Delta t}$

lower-case omega not W

$$\frac{\text{revs}}{\text{s}} \times \frac{2\pi\,\text{rad}}{\text{rev}} = \frac{\text{rad}}{\text{s}}$$

$$f \times 2\pi = \omega$$

"frequency of rotation"
= "how often object spins around per second"

$$\frac{\text{revs}}{\text{s}} = 1/s = \text{Hz}$$

Hertz

$T = \frac{1}{f}$: period of rotation
"number of seconds per revolution"