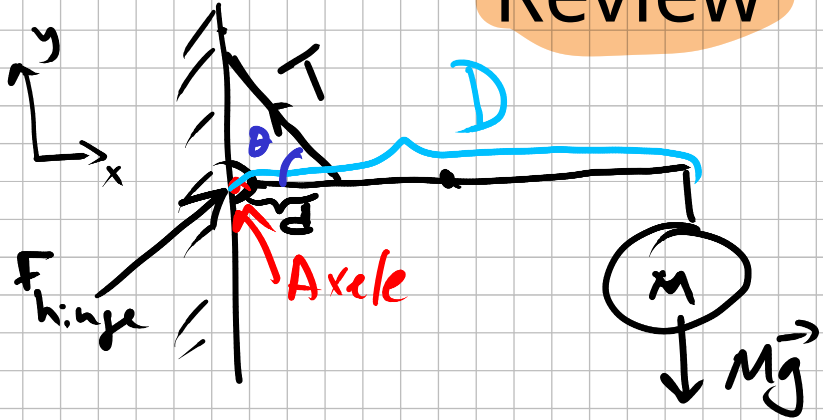
Review

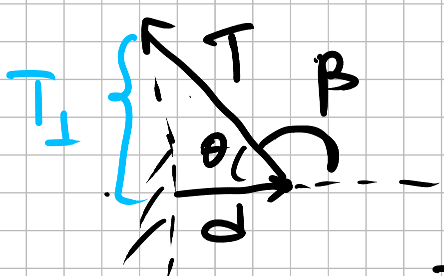


Forces acting on the rod:

$$\vec{F}_{net} = \vec{0} = \vec{T} + M\vec{g} + \vec{F}_H$$

$$\vec{\tau}_{net} = \vec{0}$$

$$= \vec{\tau}_T + \vec{\tau}_g + \vec{\tau}_H = 0$$



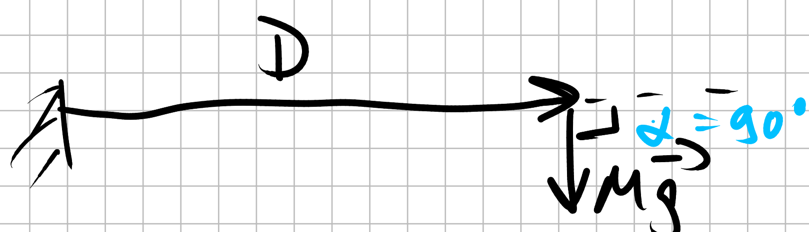
$$\tau_T = \vec{d} \times \vec{T} = d \cdot T_\perp$$

with respect to A : $\vec{\tau}_{net} \Rightarrow$

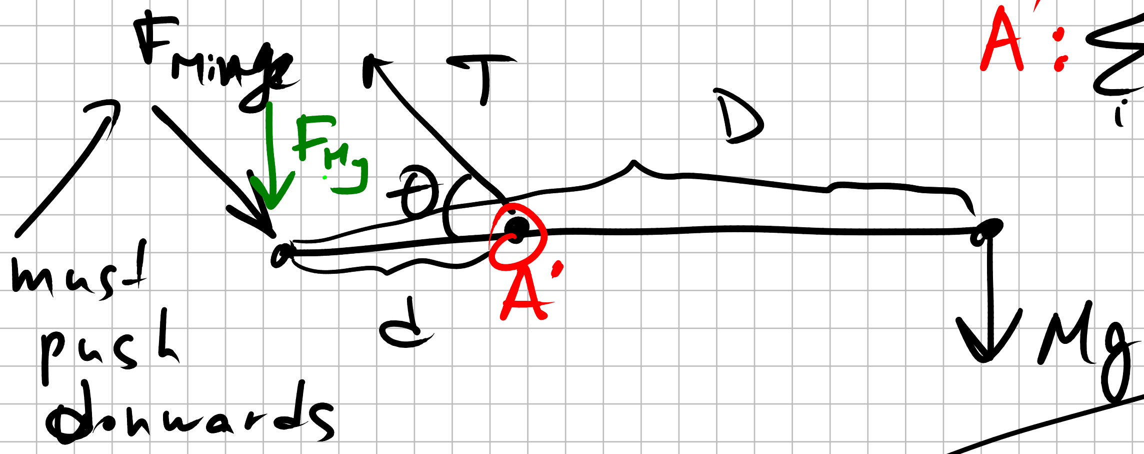
cw : $\tau_{net} = -d \cdot T \sin \overbrace{\beta}^{180^\circ - \theta} + D \cdot Mg \cdot \sin 90^\circ + 0 \cdot F_H$

$$= -dT \cdot \sin(180^\circ - \theta) + D \cdot Mg$$

$$= -d \cdot T \sin(\theta) + D \cdot Mg$$



$$\Rightarrow \boxed{T = \frac{D}{d \cdot \sin\theta} Mg}$$



$$A': \sum_i \vec{\tau}_i = 0 \Rightarrow d \cdot F_{H_y} - (D-d)Mg$$

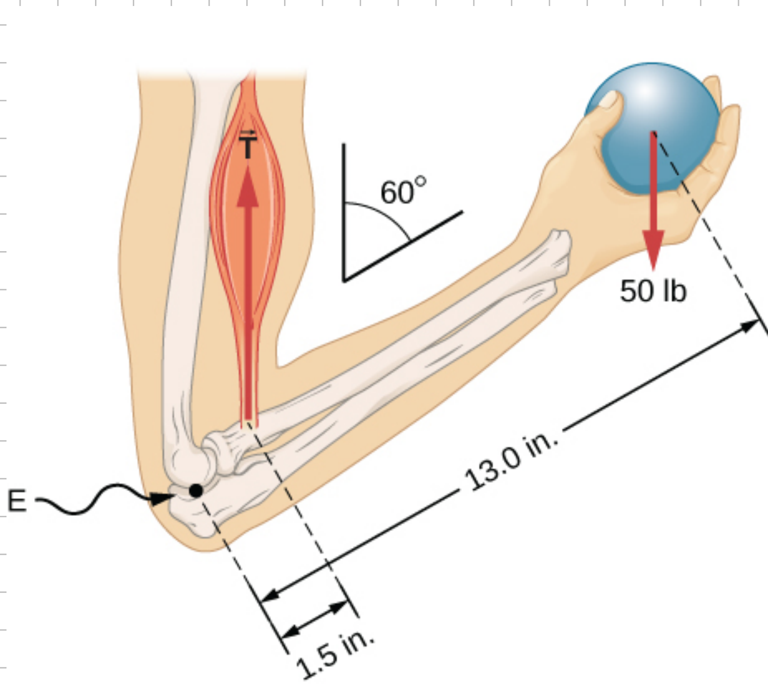
$$\sum \vec{F}_i = 0$$

$$x: \quad F_{H_x} + T_x = 0$$

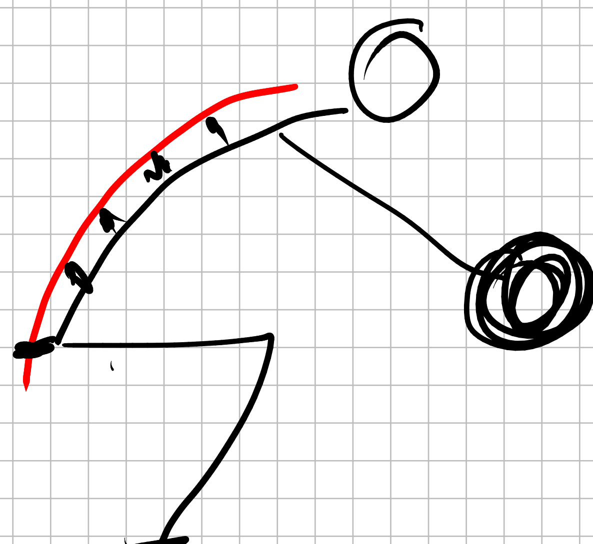
$$y: \quad F_{H_y} + T_y + Mg_y = 0$$

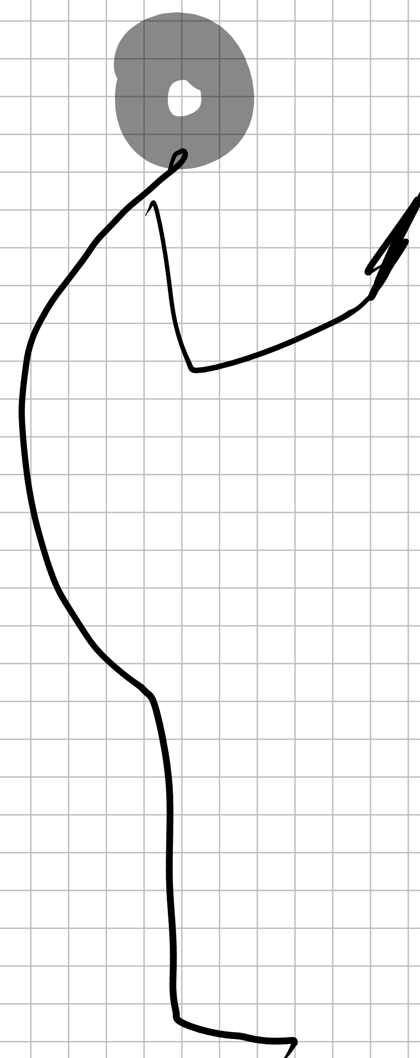
$$F_{H_y} = \frac{D-d}{d} \cdot Mg$$

$$\Rightarrow F_{H_x} = T\cos\theta$$



T
60°
50 lb
13.0 in.
1.5 in.
E

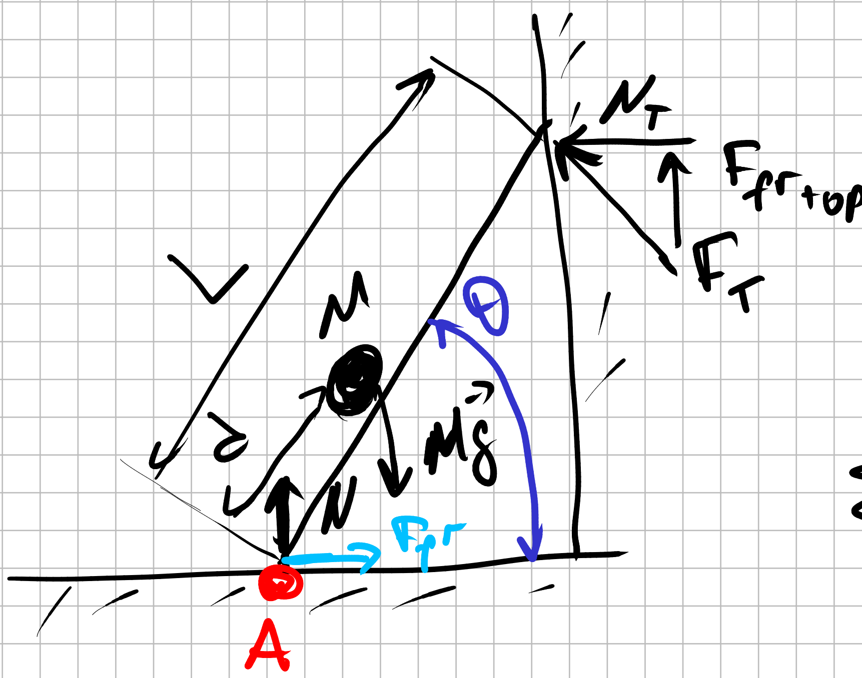




Climbing lader

$$\sum_i \vec{F}_i = 0$$

$$\sum_i \vec{\tau}_i = 0$$

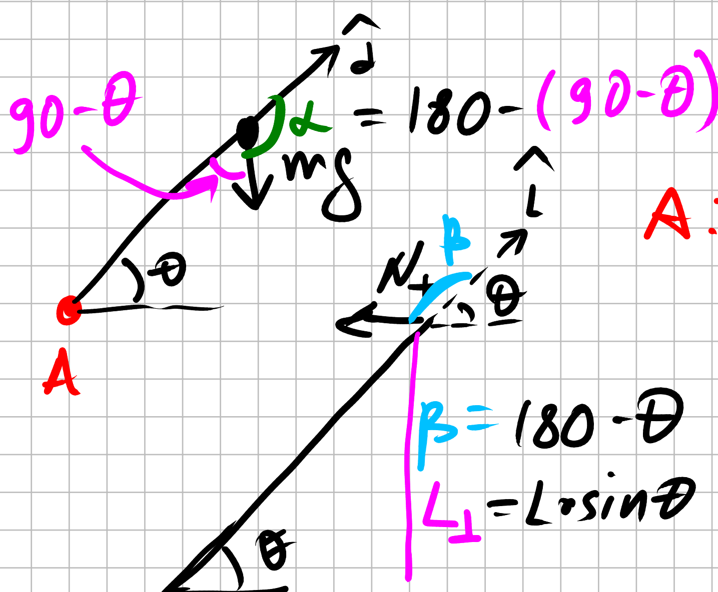


$= 0$ ↑ Forcing it

$$\sum_i \vec{F}_i = \vec{N} + m\vec{g} + \vec{F}_{fr} + \vec{N}_T = \vec{0}$$

x: $\sum F_x = 0 + 0 + F_{fr} - N_T$

y: $\sum F_y \quad 0 = N - mg$



A: $\sum \vec{\tau}_i = \vec{0} = \vec{\tau}_N + \vec{\tau}_g + \vec{\tau}_{fr} + \vec{\tau}_{N_T}$

$= 0 + d\cdot Mg\cdot\sin\alpha\cdot\hat{cw} + 0$

$+ L\cdot N_T\sin\beta\cdot\hat{ccw}$

$= d\cdot Mg\,\hat{cw}\cdot\sin\alpha - L N_T\cdot\sin\beta\cdot\hat{cw}$

$\hat{cw}$:

$d\cdot Mg\sin(180-90+\theta)$

$- L N_T \sin(180-\theta) = 0$

$$d \cdot Mg \cdot \underbrace{\sin(90+\theta)}_{\cos\theta} - L N_T \sin\theta = 0$$

$$d\, Mg \cos\theta - L N_T \sin\theta = 0$$

$$N_T = \frac{d\, Mg}{L} \frac{\cos\theta}{\sin\theta}$$

$$F_{fr} - ? \xrightarrow{\Sigma F_x} F_{fr} - N_T = 0$$

$$F_{fr} = \frac{d\, Mg}{L} \frac{\cos\theta}{\sin\theta} \leq N \cdot \mu = \mu Mg$$

$$\frac{1}{\mu} \frac{d}{L} \leq \frac{\sin\theta}{\cos\theta}$$

$$\tan\theta \geq \frac{1}{\mu} \frac{d}{L}$$