PHYS 107 - Week 09 - Wednesday

* Announcements: travel → grad students teaching on Friday and Monday → opportunity to give them feedback

Reading quiz Friday: will post today

* Static equilibrium: $\vec{F}_{net} = 0$ and $\tau_{net} = 0$

↳ three equations (x, y for $\vec{F}_{net} = 0$, one equation from $\tau_{net} = 0$)

↓ solve for unknown forces, angles, etc

Where to pick the pivot? At a point where some of the unknown forces apply → then they will drop out in $\tau_{net} = 0$ equation

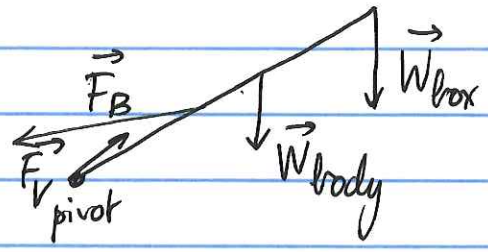
Q Equilibrium 2

* Mechanical advantage: $MA = \frac{F_{out}}{F_{in}}$

if $F_{out} < F_{in} \rightarrow MA > 1$

if $F_{out} > F_{in} \rightarrow MA < 1$

* Lifting with your back



1) Calculate τ_{net} around hip

$$\rightarrow \tau_{net}^{hip} = (0.35\,m)(55\,kg)(9.8\,m/s^2) + (0.50\,m)(30kg)(9.8\,m/s^2) - (0.08\,m)F_B$$

(weight upper body) (weight of box) (back muscle)

$$\hookrightarrow F_B = 4200\,N$$

$\tau = r_\perp F$

$$MA = \frac{W_{body} + W_{box}}{F_B} = 1/5.04 = 0.198 \approx 20\%$$

2) Force on lower vertebrae

$$F_{net,y} = 0 = F_{V,y} - W_{body} - W_{box} - F_B \sin 29°$$

$$\hookrightarrow F_{V,y} = 2890\,N$$

$$F_{net,x} = 0 = F_{V,x} - F_B \cos 29°$$

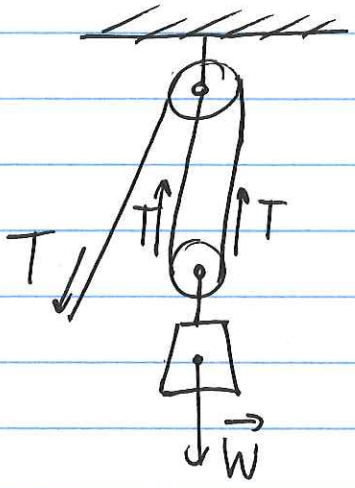
$$\hookrightarrow F_{V,x} = 3670\,N$$

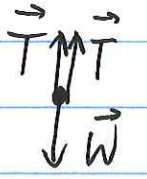
$$\Rightarrow F_V = 4660\,N \text{ at angle of } 38° = \theta$$

Q Equilibrium 5-a, b

* Pulleys and mechanical advantage

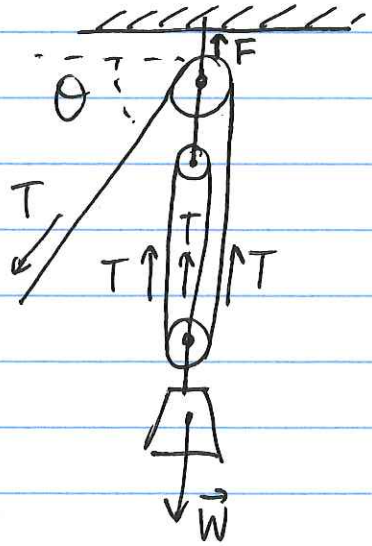
Tension T : always pulls, can change direction of forces

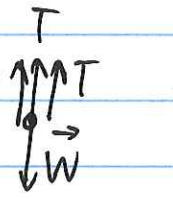


FBD  $\rightarrow 2T - W = 2T - Mg = 0$

$\hookrightarrow T = \frac{W}{2} = \frac{Mg}{2}$

$MA = \frac{F_{out}}{F_{in}} = \frac{W}{T} = 2$

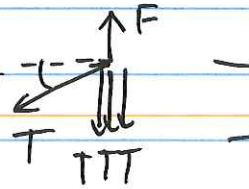


FBD  $\rightarrow 3T - W = 3T - Mg = 0$

$\hookrightarrow T = \frac{W}{3} = \frac{Mg}{3}$

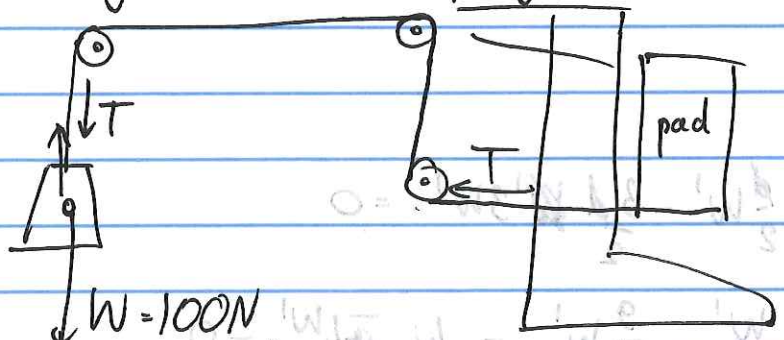
$\rightarrow MA = 3$

What is the force $\vec{F}$ in the hinge? (vertical comp)

FBD :  $\rightarrow -3T - T\sin\theta + F = 0$

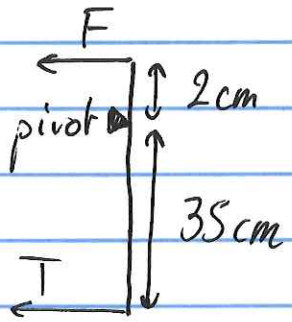
$\rightarrow F = 3T + T\sin\theta$

* Leg stretcher in physical therapy



allows for a constant force (not possible with springs)

knee muscles:



$$\tau_{net} = 0 = -T(0.35\,m) + F(0.02\,m)$$

$$\hookrightarrow F = \frac{35\,cm}{2\,cm} T = 1750\,N$$

* Watching NetFlix at Swem : force on upper vertebrae

$$\tau_{net} = 0 = Wd \sin(90° + \theta) - F_m d \sin(\theta - 33°)$$

$$\vec{F}_{net} = 0 \begin{cases} F_V \sin\theta = W + F_m \sin 33° \\ F_V \cos\theta = F_m \cos 33° \end{cases}$$

$$\hookrightarrow \begin{matrix} F_V = 97\,N \\ \theta = 58.7° \end{matrix} \Bigg\} MA = \frac{F_{out}}{F_{in}} = \frac{W}{F_V} = \frac{1}{2}$$