(9/20)

## Static Equilibrium

Conditions that must be met.

$\Sigma F_x = 0 \Rightarrow$ Right = Left

$\Sigma F_y = 0 \Rightarrow$ up = down

$\Sigma \gamma = 0 \Rightarrow$ cw = ccw
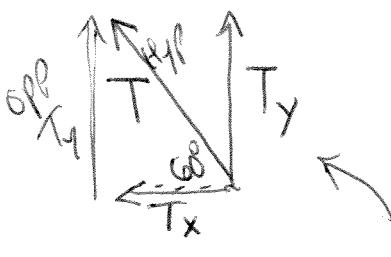
$$\boxed{\text{Torque} \quad \gamma = rF_\perp = rF\sin\theta}$$

θ = Angle between Force & lever

$T = ?$ ccw

T_y

60°

ℓ

m

cw

$$\gamma = rF_\perp = \boxed{\ell mg}$$

ccw

$$\gamma = \frac{\ell}{2} T_y$$

$$\boxed{\gamma = \frac{\ell}{2} T\sin 60}$$

T T_y 60° T_x opp T_y
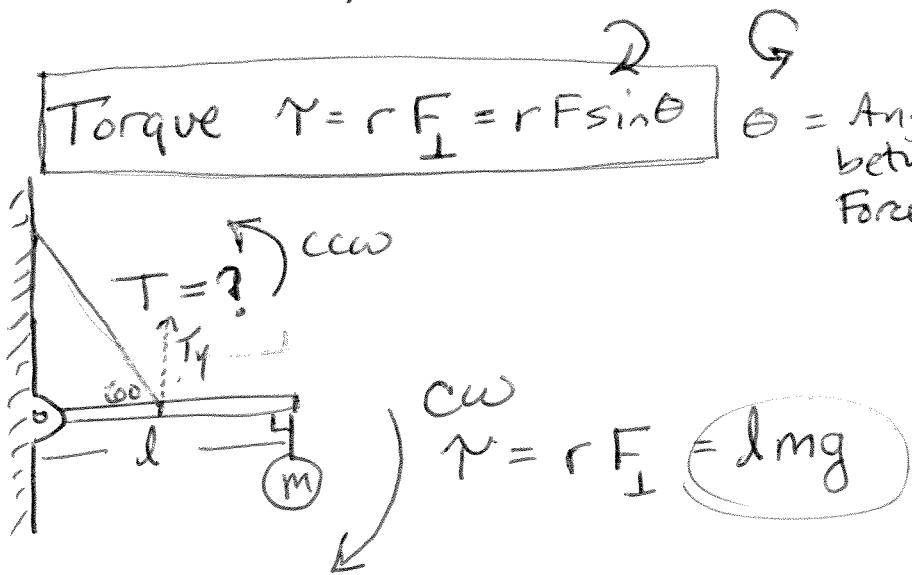
Torque is balanced

$$\Sigma \gamma = 0$$

$$cw - ccw = 0$$

$$\ell mg - \frac{\ell}{2} T\sin 60 = 0$$

$$\frac{\ell mg}{\ell} = \frac{\frac{\ell}{2} T\sin 60}{\ell}$$

$$2mg = \frac{T\sin 60}{2}$$

$$\frac{2mg}{\sin 60} = \frac{T\sin 60}{\sin 60}$$

$$\boxed{T = \frac{2mg}{\sin 60}}$$

15N
No torque

CCW
5N

W = 20N

CW
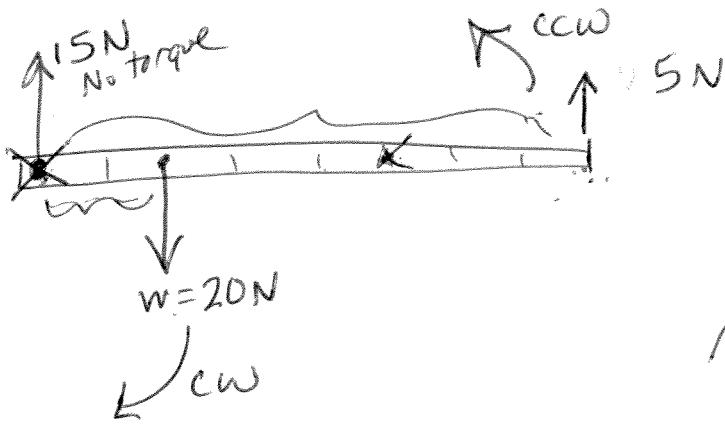
up = Down.

$$\tau = rF_{\perp}$$

unit is (N·m)

Not a Joule!

$$\Sigma \tau = 0$$

$$cw - ccw = 0$$

$$(2 \, units) \, 20N - (8 \, units) \, 5N = 0$$

$$40 \, N \cdot units - 40 \, N \cdot units = 0$$

No torque
T_1

50kg CCW

T_2

−1m−

2m

3m

CW

PPP

Find tension in both cords.

$$\Sigma F_y = 0$$

up − down = 0

$$T_1 + T_2 - 500N = 0$$
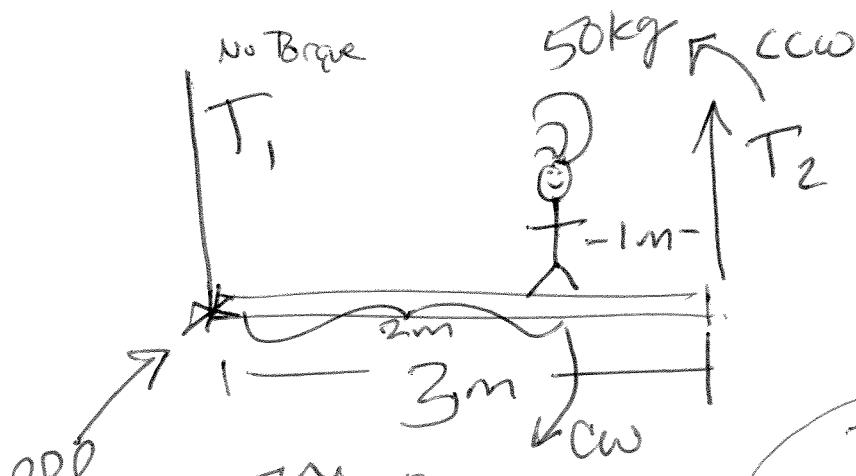
$$T_1 + 333 - 500 = 0$$

$$\underline{T_1 = 167N}$$

$$\Sigma \tau = 0$$

$$cw - ccw = 0$$

$$(2) \, 500 - 3T_2 = 0$$

$$1000 = 3T_2$$

$$T_2 = 333 \, N$$

Bar has a
mass of 5kg.

center

30°

8kg

$\Sigma \Upsilon = 0$

$CW - CCW = 0$

CCW

T

60 | mg
80N

30

60

F_y

PPP F_x

mg
50N $\bigg\downarrow_{CW}$

$\bigg\downarrow_{CW}$

$\ell(80\sin 60) + \ell(50\sin 60) -$
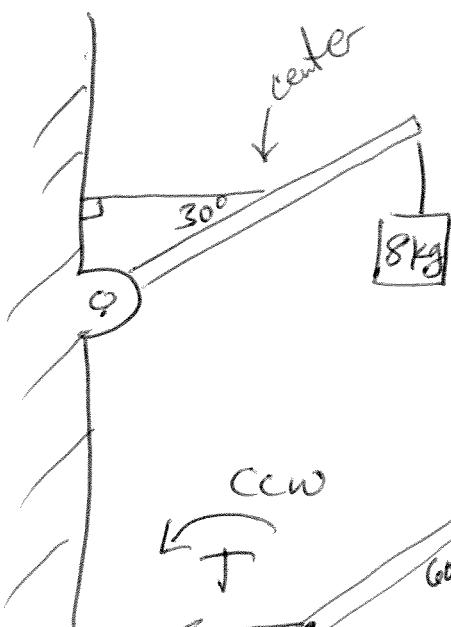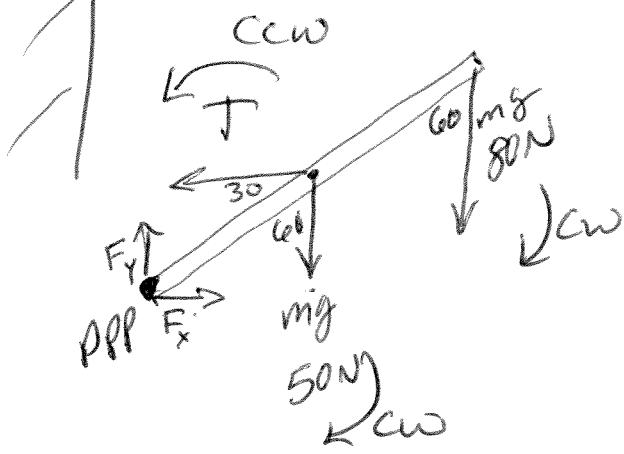
$\to \frac{\ell}{2} T \sin 30 = 0$

$\ell(69.3) + \ell(43.3) - \ell T(.25) = 0$

ℓ cancels

$112.6 - 0.25T = 0$

$\underline{\underline{T = 450N}}$

side note:
For the hinge $F_x = 450N$, too and
$F_y = 130N$ = total weight.