Torque

$\tau = r_\perp F$

or $\tau = rF\sin\theta$

The force could cause two types of rotation:

CCW rotation => + torque (torque vector points out of the board)

CW rotation => - torque (torque vector points into the board)

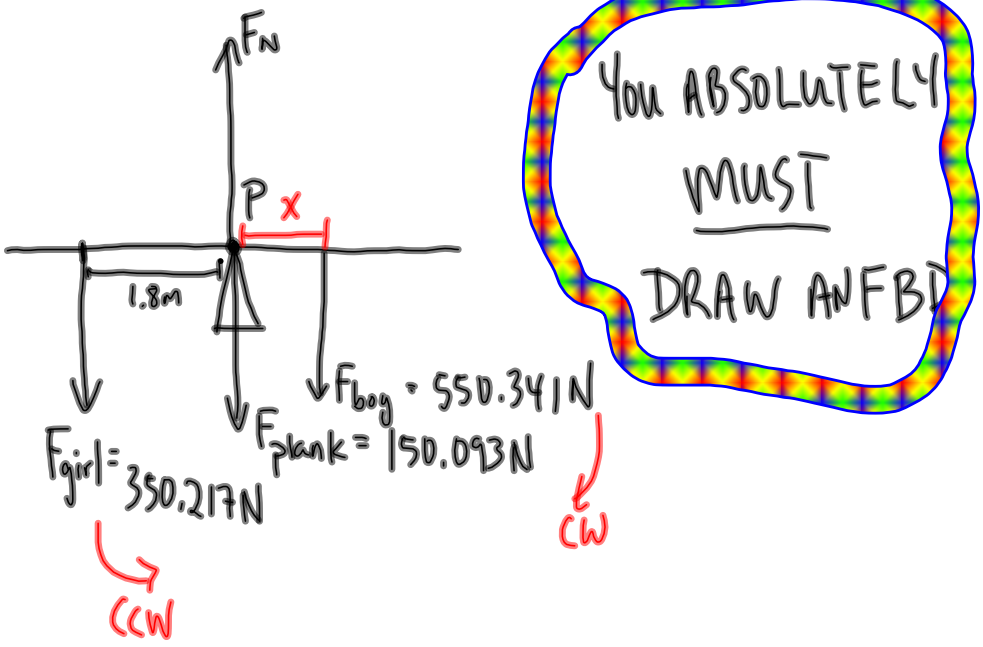
Static Equilibrium in Large Objects

Two conditions must be met:

① $\vec{F}_{net} = 0$

② $\vec{\tau}_{net} = 0 \Rightarrow \sum \tau_{CCW} = \sum \tau_{CW}$

FOP (p216)



YOU ABSOLUTELY MUST DRAW AN FBD

$$\Sigma\tau_{CCW} = \Sigma\tau_{CW}$$

$\tau = r_\perp F$

$$\tau_{girl} = \tau_{boy}$$

$$(1.8m)(350.217N) = x(550.341)$$

$$x \doteq 1.1\,m$$

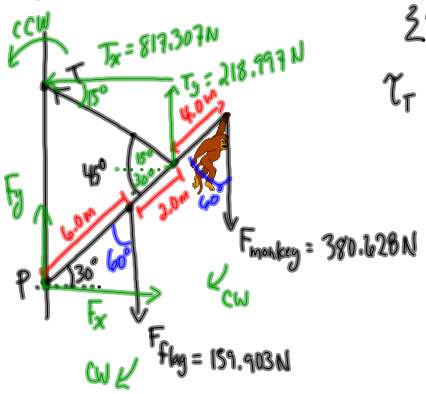
To find the upward force at the pivot:

$$F_N = F_{girl} + F_{plank} + F_{boy}$$

$$F_N = 350.217N + 150.093N + 550.341N$$

$$F_N \doteq 1051\,N$$

FOP (p218)



$\Sigma\tau_{ccw} = \Sigma\tau_{cw}$

$\tau_T = \tau_{flagpole} + \tau_{monkey}$

$\tau = rF\sin\theta$

$\tau_T = \tau_{flagpole} + \tau_{monkey}$

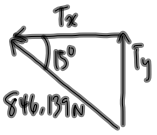
$(8.0m)(T)(\sin 45°) = (6.0m)(159.903N)\sin 60°$

$+(12.0m)(380.628N)\sin 60°$

$(8.0m)(T)\sin 45° = 830.880N\cdot m + 3955.602N\cdot m$

$(8.0m)(T)\sin 45° = 4786.482N\cdot m$

$T \doteq 8.5\times10^2 N$ (846.139 N)



$T_x = (846.139N)\cos 15°$

$T_x = 817.307N$

$T_y = (846.139N)\sin 15°$

$T_y = 218.997N$

Horizontally:

$F_x = T_x$

$F_x \doteq 8.2\times10^2 N$

Vertically:

$F_{flag} + F_{monkey} = T_y + F_y$

$159.903N + 380.628N = 218.997N + F_y$

$F_y = 321.534N$

$F_y \doteq 3.2\times10^2 N$

TO DO:

FOP: PP (2-7)