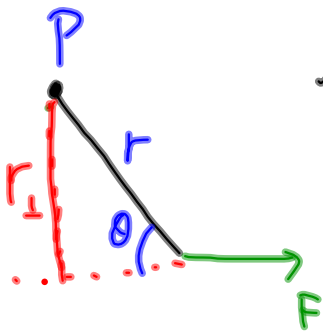


Torque

Twisting action that results from forces that do not act through a common point (centre of mass)



$$\tau = r_{\perp} F$$

$$\tau = r F \sin \theta$$

θ is the angle between the object and the force (or line of action of force)

What about Static Equilibrium?

$$\textcircled{1} \quad \vec{F}_{\text{net}} = 0 \Rightarrow \vec{F}_{x\text{net}} = 0, \vec{F}_{y\text{net}} = 0$$

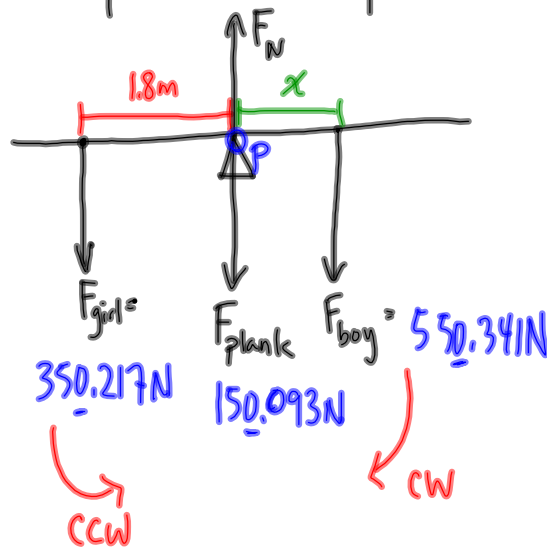
$$\textcircled{2} \quad \vec{\tau}_{\text{net}} = 0 \Rightarrow \sum \tau_{\text{ccw}} = \sum \tau_{\text{cw}}$$

Example

Two children sit on a teeter-totter made of a uniform 15.3 kg plank that rests on a frictionless pivot at its centre. A 35.7 kg girl sits at the left end, 1.8 m from the pivot point. A 56.1 kg boy moves back + forth at the right end until the teeter-totter balances horizontally

a) where does he finally sit?

b) What is the upward force at the pivot on the plank?



$$\tau = r_{\perp} F$$

$$\sum \tau_{\text{CCW}} = \sum \tau_{\text{CW}}$$

$$\tau = r F \sin \theta$$

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

$$(1.8 \text{ m})(350.217 \text{ N}) = x (550.341 \text{ N})$$

$$\boxed{x = 1.1 \text{ m}}$$

b)

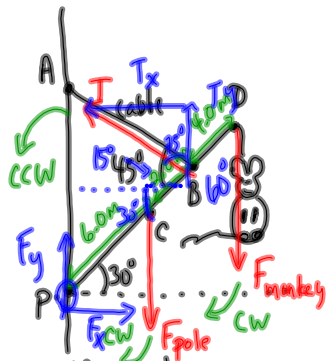
$$F_N = F_{\text{girl}} + F_{\text{plank}} + F_{\text{boy}}$$

$$F_N = 350.217 \text{ N} + 150.093 \text{ N} + 550.341 \text{ N}$$

$$F_N = 1050.651 \text{ N}$$

$$\boxed{F_N = 1051 \text{ N}}$$

Example



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

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

$$(8.0m)T(\sin 45^\circ) = (12.0m)(380.628N)\sin 60^\circ$$

$$m(\text{flagpole}) = 16.3 \text{ kg } (159.903 \text{ N})$$

$$m(\text{monkey}) = 38.8 \text{ kg } (380.628 \text{ N})$$

$$T = ?$$

$$F \text{ at } P = ?$$

$$+ (6.0m)(159.903 \text{ N})\sin 60^\circ$$

$$(8.0m)T(\sin 45^\circ) = 3955.60 \text{ N}\cdot\text{m} + 830.88 \text{ N}\cdot\text{m}$$

$$(8.0m)T(\sin 45^\circ) = 4786.48 \text{ N}\cdot\text{m}$$

$$T = 846.14 \text{ N}$$

$$T = 8.5 \times 10^2 \text{ N}$$

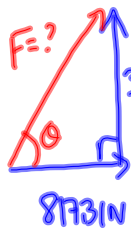
Now: $\vec{F}_{net} = 0$

$$T_x = 846.14 \text{ N}(\sin 75^\circ) = 817.31 \text{ N}$$

$$T_y = 846.14 \text{ N}(\cos 75^\circ) = 219.00 \text{ N}$$

At P: $F_x = T_x = 817.31 \text{ N}$

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



$$F_y = F_{pole} + F_{monkey} - T_y$$

$$F_y = 159.903 \text{ N} + 380.628 - 219.00 \text{ N}$$

$$F_y = 321.53 \text{ N}$$

Finish.....

TO DO: FOP(86-3) 2,3+4