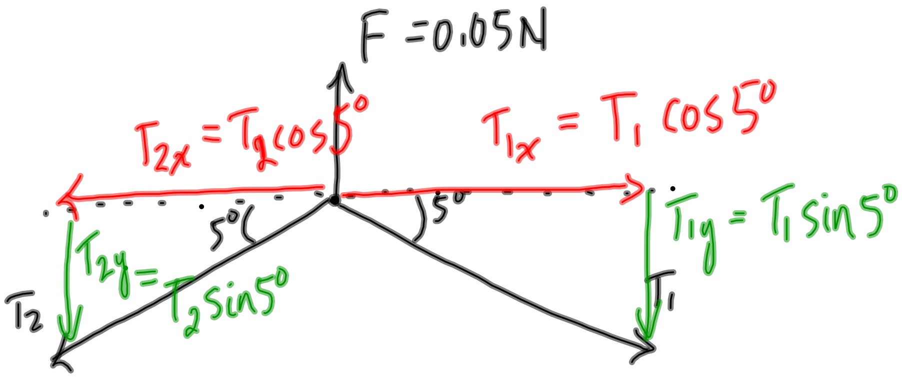
FoP (§6-1)

3.



Horizontally: $T_{1x} = T_{2x}$

$T_1 \cos 5^\circ = T_2 \cos 5^\circ$

$T_1 = T_2$

Vertically: $T_{1y} + T_{2y} = 0.05N$

$T_1 \sin 5^\circ + T_2 \sin 5^\circ = 0.05N$

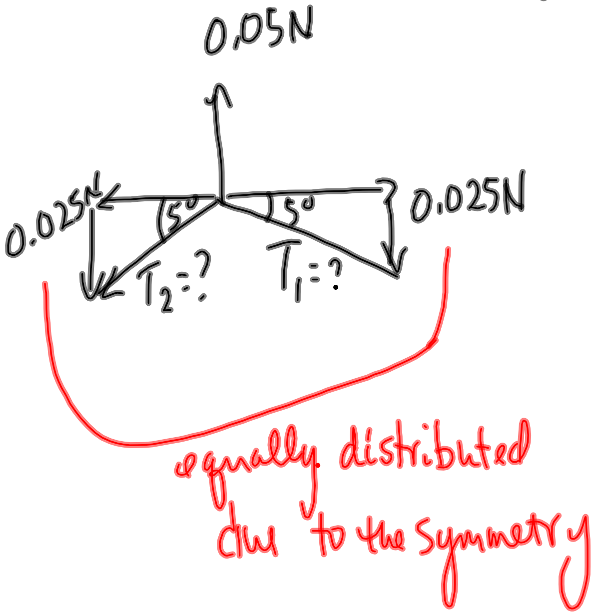
$T_2 \sin 5^\circ + T_2 \sin 5^\circ = 0.05N$

$2T_2 \sin 5^\circ = 0.05N$

$T_2 = \frac{0.05N}{2(\sin 5^\circ)}$

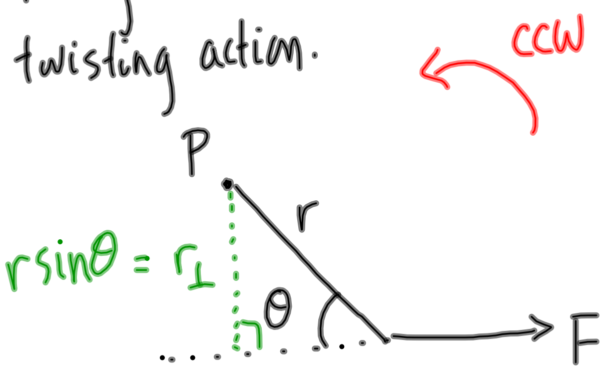
$T_2 = 0.3N$

$T_1 = 0.3N$



Torque & Static Equilibrium

When dealing with "larger" objects, all the forces may not act through a common point and as a result there will be a twisting action.



A force, F acts on an object at a distance, r from a pivot point, P. A twisting or turning action occurs causing the object to rotate in a clockwise (−) or counterclockwise (+) direction.

$$\tau = r_\perp F$$

$$\tau = rF\sin\theta$$

Where τ is torque (N·m)

r is the distance from the pivot (m)

F is the force acting on the object (N)

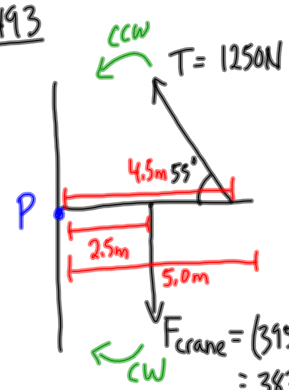
θ the angle between the force and the object.

This twisting action is referred to as torque. Torque is a vector that is perpendicular to the plane that r and F lie in.

+ torque → out of the board

− torque → into the board

MP|493



$F_{crane} = (395\,kg)(9.81\,m/s^2)$
$= 3874.95\,N$

a) $\tau_{Tension} = ?$

b) $\tau_{crane} = ?$

a) $\tau_{Tension} = rF\sin\theta$

$\tau_{Tension} = (4.5\,m)(1250\,N)\sin 55°$

$\tau_{Tension} \doteq 4.6 \times 10^3\ N\cdot m$

Since the rotation is CCW, the torque is $+4.6\times10^3\ N\cdot m$ (out of board)

$\tau_{crane} = r_\perp F$

$\tau_{crane} = (2.5\,m)(3874.95\,N)$

$\tau_{crane} \doteq 9.7 \times 10^3\ N\cdot m$

Since the force causes CW rotation, the torque is $-9.7\times10^3\ N\cdot m$ (into the board)

Since the torque from the CCW rotation is not balanced with the torque from the CW rotation, the crane is not in static equilibrium. Since the torque from the CW rotation is greater, the crane would be rotating in that direction.

Conditions for Static Equilibrium:

1. $\vec{F}_{net} = 0$
2. $\vec{\tau}_{net} = 0 \quad (\Sigma\tau_{ccw} = \Sigma\tau_{cw})$

TO DO: - PP|1 (FOP|§6-3)
- PP|495 (30 - consider the base of the ladder as the pivot)