

Equilibrium Review

Monday, March 31, 2014
1:50 PM

7 M.C. $\left\{ \begin{array}{l} \text{concepts} \\ \text{calc.} \end{array} \right.$

4 written - hanging mass
- beam (level)
- ladder, flag pole

3 conditions for Equilibrium

$$\sum \tau = 0 \quad \text{Rotational E.}$$

$$\left. \begin{array}{l} \sum F_x = 0 \\ \sum F_y = 0 \end{array} \right\} \text{Translation E.}$$

Steps to solve

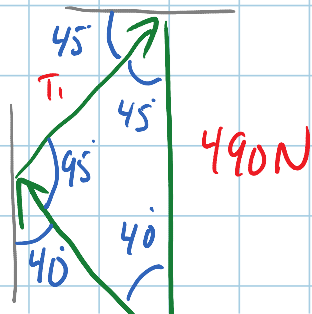
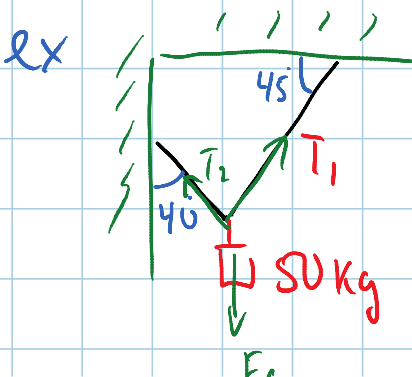
1) F.B.D. (C_g , F_N , F_g , T , etc)

2) Pivot Point - eliminate a force
- natural pivot

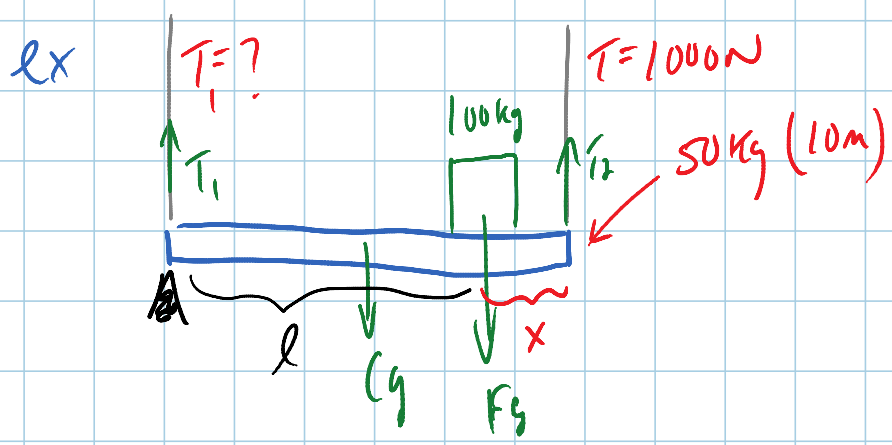
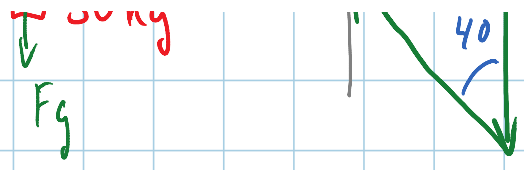
3) F_{\perp} to the beam

4) $\sum \tau = 0$ (solve for unknown force or distance)

5) $\sum F_x = 0$, $\sum F_y = 0$



$$\frac{T_1}{\sin 40} = \frac{490 \text{ N}}{\sin 45}$$



$T_1 = ?$

$$\sum \tau = 0 \quad CW \tau = CCW \tau$$

$$C_g(5m) + F_g(l) = T_2(10m)$$

$$(490)(5) + (980)l = 1000(10)$$

$$2450 + 980l = 10000$$

$$l = 7.7m$$

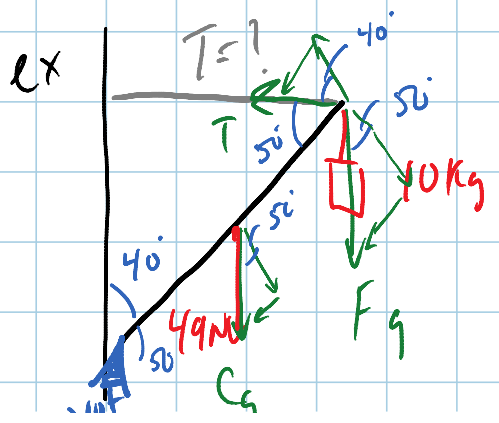
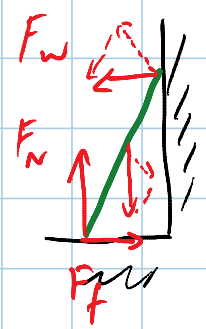
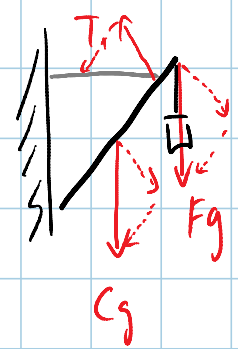
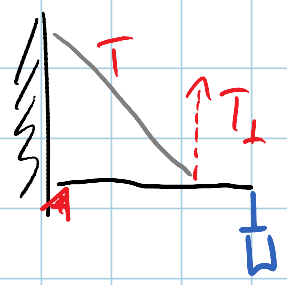
$$x = 2.3m$$

$$\sum F_y = 0 \quad F_{up} = F_{down}$$

$$T_1 + T_2 = C_g + F_g$$

$$T_1 = 470N$$

Angled



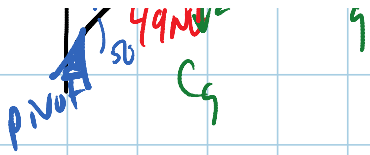
$$F_{g\perp} = F_g \cos 50^\circ$$

$$= 63N$$

$$C_{g\perp} = C_g \cos 50^\circ$$

$$= 31.5N$$

$$\sum \tau = 0 \quad CW \tau = CCW \tau$$

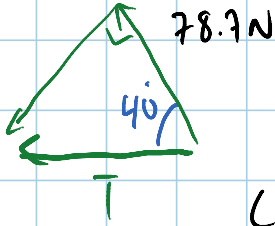


$$\sum \tau = 0 \quad \text{CW} \tau = \text{CCW} \tau$$

$$C_g \left(\frac{l}{2} \right) + F_g(l) = T_{\perp}(l)$$

$$31.5 \left(\frac{l}{2} \right) + 63(l) = T_{\perp}(l)$$

$$T_{\perp} = 78.7 \text{ N}$$



$$\cos 40^\circ = \frac{78.7}{T}, \quad T = \frac{78.7}{\cos 40^\circ} = 103 \text{ N}$$