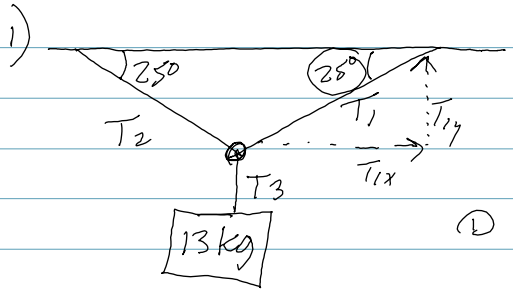
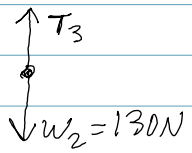
Unit 4 - Equilibrium Problems

1)



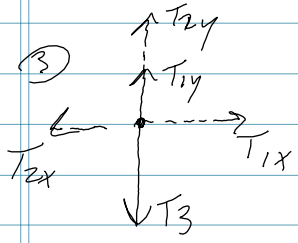
What is the tension in each string?

① 

② $\Sigma F_y = 0 = T_3 + W_2$

$0 = T_3 - 130$

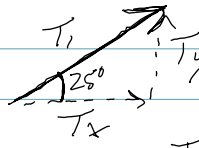
$\boxed{T_3 = 130\,N}$ ✱

③ 

④ $\Sigma F_y = 0 = T_{1y} + T_{2y} + T_3$

$0 = 2T_y - 130$

$T_y = 65N$

⑤ 

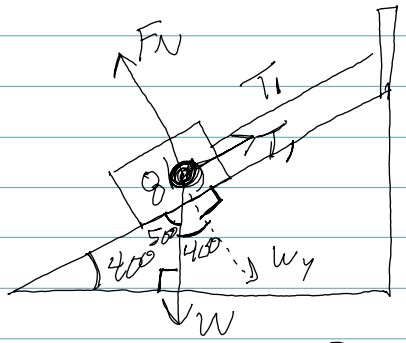
~~$T_1 \cos 25$~~

$\sin 25° = \frac{T_{1y}}{T_1} = \frac{65}{T_1}$

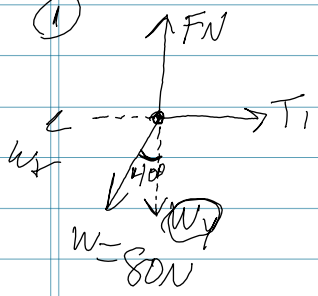
$T_1 = \frac{65}{\sin 25°} = \boxed{153.80N}$

$\boxed{T_2 = 153.80N}$

2)



Draw a free body force diagram & label each force with its value.

① 

② $\cos 40° = \frac{W_y}{W} = \frac{W_y}{80}$

$W_y = 61.28\,N$

$\sin 40° = \frac{W_x}{W} = \frac{W_x}{80}$

$W_x = 51.42N$

③ $\Sigma F_y = 0 = F_N + W_y$

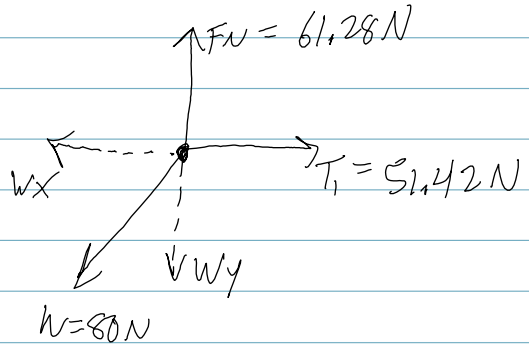
$0 = F_N - 61.28$

$\boxed{F_N = 61.28N}$

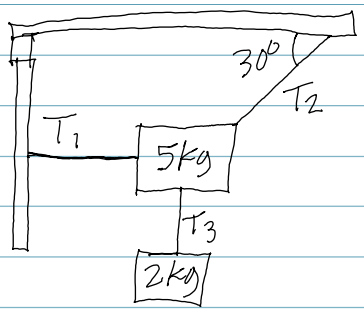
④ $\Sigma F_x = 0 = W_x + T$

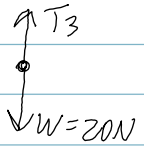
$0 = -51.42 + T$

$\boxed{T = 51.42\,N}$



3) Find the tension in each string.

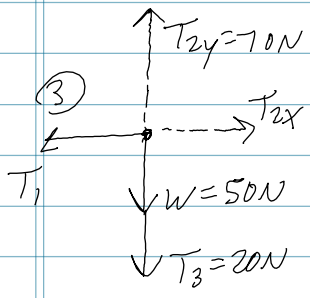


① 

② $\Sigma F_y = 0 = T_3 + W$

$0 = T_3 - 20$

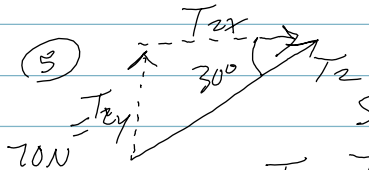
$\boxed{T_3 = 20N}$

③ 

④ $\Sigma F_y = 0 = T_3 + W + T_{2y}$

$0 = -20 - 50 + T_{2y}$

$T_{2y} = 70N$

⑤ 

$\sin 30° = \frac{70}{T_2}$

$T_2 = \frac{70}{\sin 30°} = 140N$

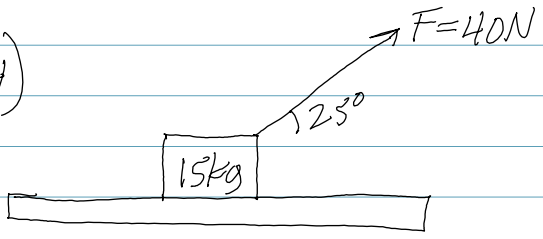
⑥ $\tan 30° = \frac{70}{T_{2x}}$

$T_{2x} = \frac{70}{\tan 30°} = 121.24N$

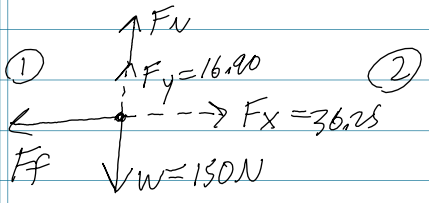
⑦ $\Sigma F_x = 0 = T_1 + T_{2x}$

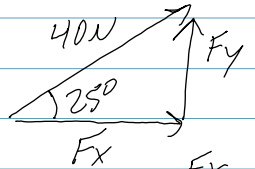
$0 = T_1 + 121.24$

$\boxed{T_1 = -121.24N}$

4) 

If the box is moving to the right at a constant speed, what is the normal force & frictional force acting on the box?

① 

② 

$\sin 25° = \frac{F_y}{40}$

$F_y = 16.90N$

$\cos 25° = \frac{F_x}{40}$

$F_x = 36.25N$

③ $\Sigma F_x = 0 = F_x + F_f$

$0 = 36.25 + F_f$

$\boxed{F_f = -36.25N}$

④ $\Sigma F_y = 0 = F_N + F_y + W$

$0 = F_N + 16.9 - 150$

$\boxed{F_N = 133.10N}$