Physics 423 Name Key

Newton's Laws: Static Problems

Directions: Show all work, include units and box the final answer.

1. Eddie sits on the floor waiting for a wheel barrel race to begin. Eddie has a mass of 70 kg.
   a. What is his weight?

   $F_g = m(9.8 m/s^2)$ $F_g = (70kg)(9.8 m/s^2) = \boxed{686N}$

   b. How much force must the floor push upwards on him?

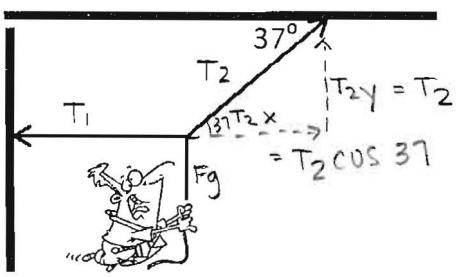
   F_N, F_g $F_{net} = F_N - F_g$ $0 = F_N - F_g$ $0 = F_N - 686N$ $\boxed{F_N = 686N}$

2. While vacuuming, a super mom suspends a 55 kg couch above her head. What force is necessary to hold the couch stationary?

$F_g = m(9.8 m/s^2)$ $F_g = (55kg)(9.8 m/s^2) = 539N$ F_{MOM}, F_g

$F_{net} = F_{MOM} - F_g$
$0 = F_{MOM} - F_g$
$0 = F_{MOM} - 539N$
$\boxed{F_{MOM} = 539N}$

3. Find the tension in each cable supporting the 600 N man.



$T_3 = F_g$
$T_3 = 600N$

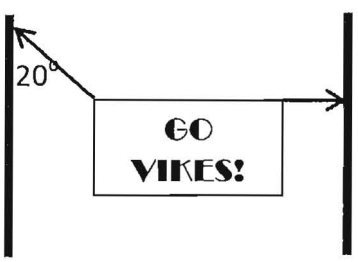
X

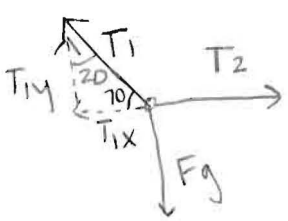
$F_{net} = T_{2x} - T_1$
$0 = T_{2x} - T_1$
$0 = T_2 \cos 37 - T_1$
$T_1 = T_2 \cos 37$
$T_1 = 997N \cos 37$
$\boxed{T_1 = 796N}$

Y

$F_{net} = T_{2y} - F_g$
$0 = T_{2y} - F_g$
$0 = T_2 \sin 37 - 600N$
$T_2 \sin 37 = 600N$
$\boxed{T_2 = 997N}$

4. Danielle hangs a sign that has a mass of 0.5 kg as shown to below. Find the tension in both ropes.





X

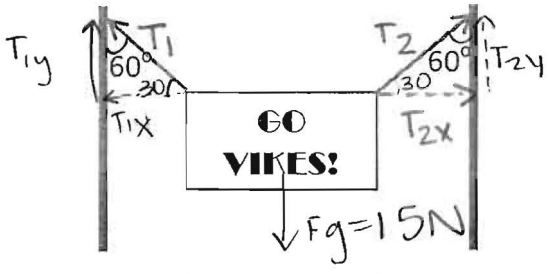
$F_{net} = T_2 - T_{1x}$
$0 = T_2 - T_{1x}$
$0 = T_2 - T_1 \cos 70$
$T_2 = T_1 \cos 70$
$T_2 = (5.214) \cos 70$
$\boxed{T_2 = 1.7835N}$

Y

$F_{net} = T_{1y} - F_g$
$0 = T_{1y} - F_g$
$0 = T \sin 70 - 49N$
$4.9N = T_1 \sin 70$
$\boxed{T_1 = 5.214N}$

$F_g = m(9.8 m/s^2)$
$F_g = (.5kg)(9.8 m/s^2)$
$F_g = 4.9N$

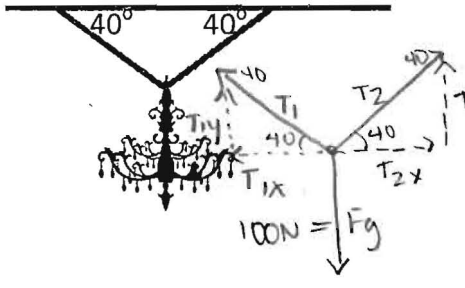
5. A homecoming sign weighs 15 N. It is supported by two strings as shown below.
   a. Find the tension in each string.
   b. As the angle with the wall decreases equally on each side, what happens to the force that each wire exerts? Why?



X
$F_{net} = T_{2x} - T_{1x}$
$0 = T_{2x} - T_{1x}$
$0 = T_2\cos30 - T_1\cos30$
$T_2\cos30 = T_1\cos30$
$T_2 = T_1$

Y
$F_{net} = T_{2y} + T_{1y} - F_g$
$0 = T_2\sin30 + T_1\sin30 - 15N$
$15N = T_2\sin30 + T_1\sin30$
$15N = T_2\sin30 + T_2\sin30$
$T_2 = 15N$
$T_1 = 15N$

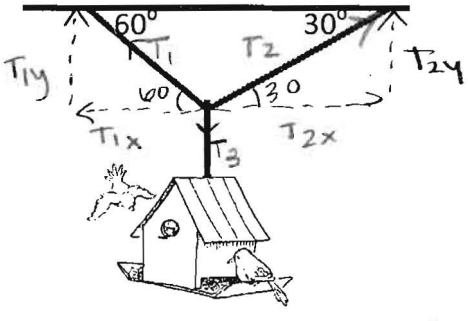
6. Find the tension in the two wires that support the 100 N light fixture.



X
$F_{net} = T_{2x} - T_{1x}$
$0 = T_{2x} - T_{1x}$
$0 = T_2\cos40 - T_1\cos40$
$T_2\cos40 = T_1\cos40$
$T_2 = T_1$

Y
$F_{net} = T_{2y} + T_{1y} - F_g$
$0 = T_2\sin40 + T_1\sin40 - 100N$
$100N = T_1\sin40 + T_1\sin40$
$T_1 = \frac{100}{2(\sin40)}$
$T_1 = 77.8N$ $T_2 = 77.8N$

7. A 15 kg bird feeder is supported by three cables as shown in the figure below. Find the tension in each cable.



$T_3 = F_g$
$T_3 = 147N$

$F_g = m(9.8m/s^2)$
$F_g = (15kg)(9.8m/s^2)$
$F_g = 147N$

X
$F_{net} = T_{2x} - T_{1x}$
$0 = T_{2x} - T_{1x}$
$0 = T_2\cos30 - T_1\cos60$
$T_2\cos30 = T_1\cos60$
$T_2 = T_1\frac{\cos60}{\cos30}$
$T_2 = .5774T_1$

Y
$F_{net} = T_{2y} + T_{1y} - T_3$
$F_{net} = T_2\sin30 + T_1\sin60 - 147N$
$0 = (.5774T_1)\sin30 + T_1\sin60 - 147N$
$147N = .28868T_1 + .866025T_1$
$T_1 = 127.31N$

$T_2 = .5774(T_1)$
$T_2 = .5774(127.31N)$
$T_2 = 73.5N$

8. The homecoming committee chairperson is upset! He thinks that the disco ball shown below was hung sloppily and wants the "sag" removed from the cables which are supporting the light. Is this a reasonable request? Present your argument using your knowledge of physics.

NOPE! Mr. Getch is crazy! The y components (which create the sag) are necessary because they are countering the weight!