Name: _____ Phys 12

3.4 Static Equilibrium

For any object to stay at rest, it must not experience forces that:

- Cause it to move (left, right, up, down, etc) -> translational equilibrium
- Cause it to spin around -> rotational equilibrium
- Cause it to oscillate like a spring -> vibrational equilibrium

In this unit, we will learn about translational equilibrium and rotational equilibrium. **Today we will focus on translational equilibrium.**

For translation equilibrium:

$$\sum \boldsymbol{F_x} = \mathbf{0}$$

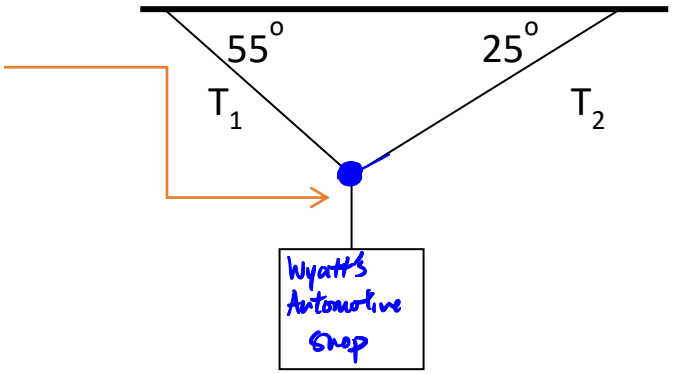
$$\sum \boldsymbol{F_y} = \mathbf{0}$$

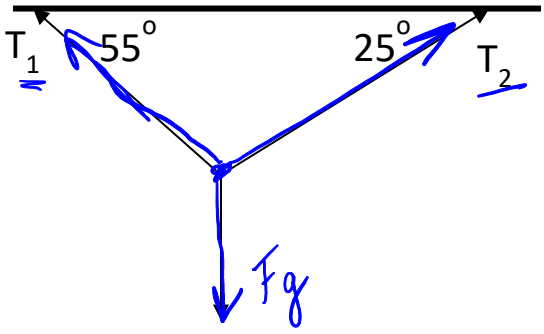
This means that all the forces along the horizontal and vertical axis sum up to 0. With no net force acting on an object, the object will be in constant motion. If the object is moving at constant velocity, this is called **dynamic equilibrium**. If the object is at rest, this is called **static equilibrium**.

Let's go over an example:

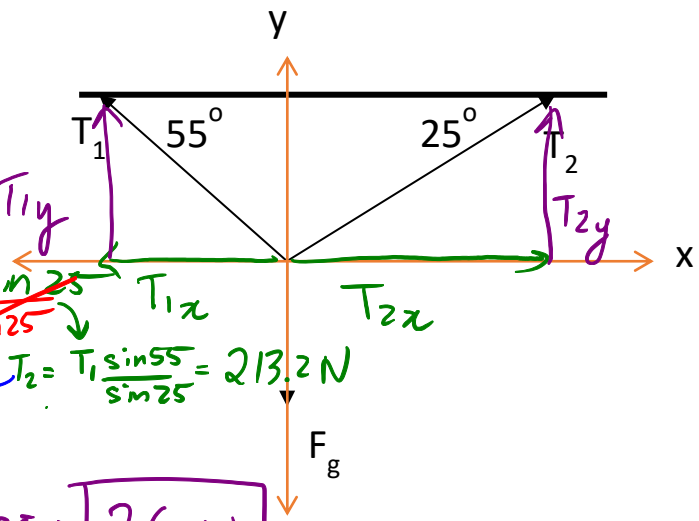
A sign is suspended using ropes as shown in the diagram. If T_1 is 110 N, what is the weight of the sign?

1) Choose a point in the system that is in equilibrium
2) Draw a FBD (free body diagram) for that point.





3) Determine your x and y coordinates.
4) Break your forces into x and y components.
5) Write your F_{net} equations for the x and y axis using $\sum \boldsymbol{F_x} = \mathbf{0}$ and $\sum \boldsymbol{F_y} = \mathbf{0}$.
6) Solve for the weight, F_g.



$T_1 = 110N$

x: $T_{1x} = T_{2x} \Rightarrow T_1 \sin 55 = T_2 \sin 25$

$T_2 = \frac{T_1 \sin 55}{\sin 25} = 213.2\,N$

y: forces pointing up = forces pointing down

$T_{1y} + T_{2y} = F_g$

$T_1 \cos 55 + T_2 \cos 25 = F_g$

$= 110 \cos 55 + 213.2 \ldots \cos 25 = \boxed{260N}$

HW: Worksheet 3.4 ALL