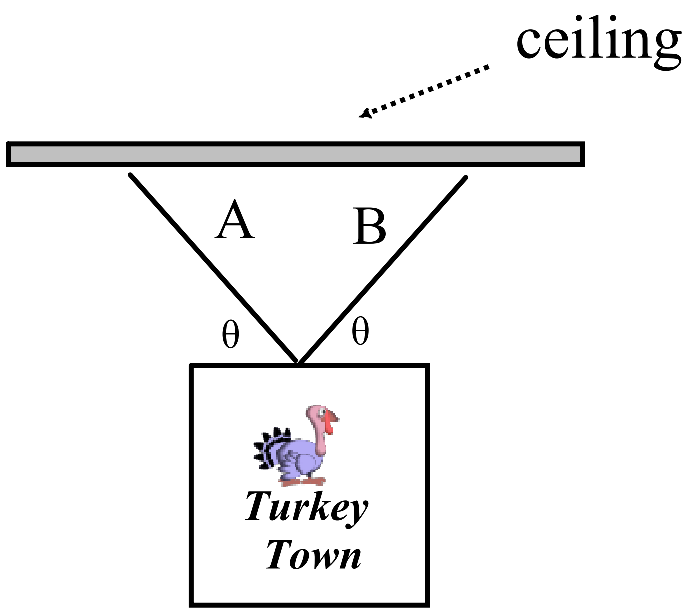
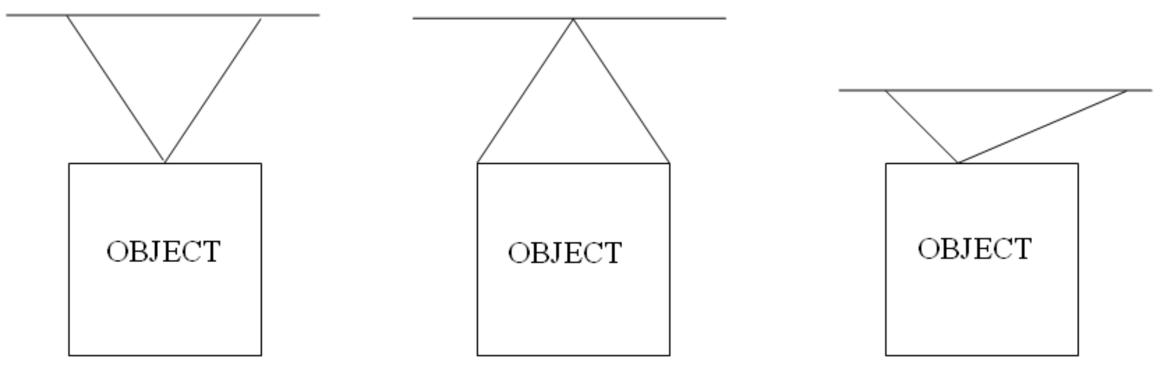
Type II - Signs/Pictures/Hanging Objects

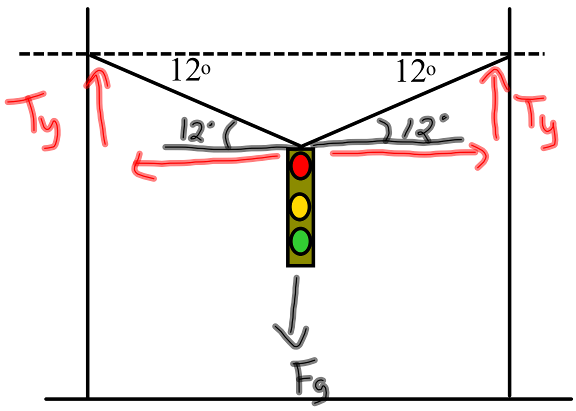
If an object is hung by a rope (wire, chain, etc.), we can resolve the force of tension along the rope.



An object can be hung in a variety of ways.



Example



A traffic light hangs in the center of the road from cables as shown in the figure. (a) If the mass of the traffic light is 65 kg, what is the magnitude of the force that each cable exerts on the light to prevent it from falling? (b) What is the tension in each cable?

(a) The y-component of the tension in each cable must add together to support the light's weight; the light is in static equilibrium. Since the angles are the same the tension in each cable and their components are the same.

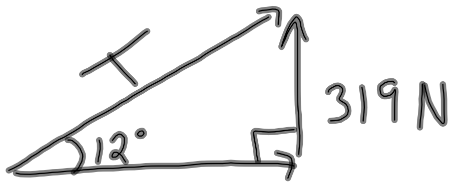
$$F_{net_y} = T_y + T_y + F_g$$

$$0 = 2T_y - (65)(9.81)$$

$$637.65 = 2T_y$$

$$\boxed{319\text{ N} = T_y}$$

(b) Use trig to solve for the tension in each cable.



$$\sin 12 = \frac{319}{T}$$

$$T = \frac{319}{\sin 12} = \boxed{1533\text{ N}}$$

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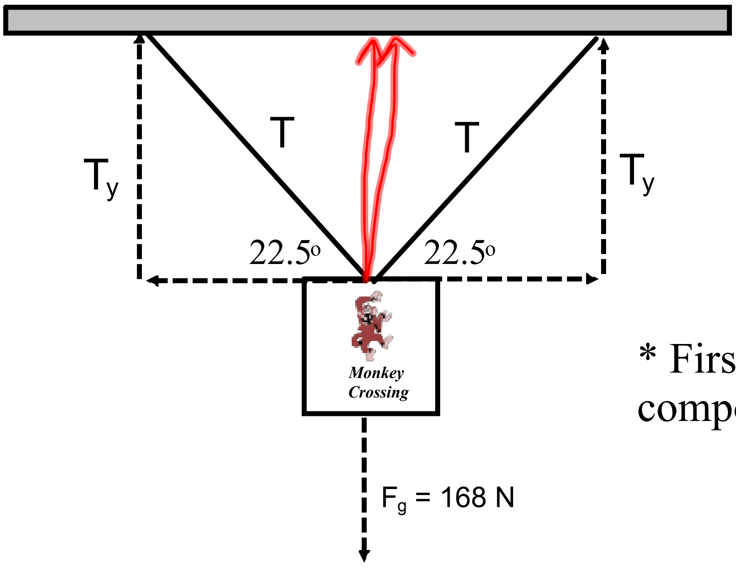


A sign that weighs 168 N is supported by two ropes, A and B, that make 22.5° angles with the horizontal. Determine the tension along the ropes.

* First label the diagram to view the components of each rope's tension.

Determine y-component of tension:

Fnety = 0 N

Fnety = 2Ty + Fg

0 N = 2Ty - 168 N

Ty = 84 N

Determine tension in each rope (remember they are the same if the angles are the same):

$T = (Ty)/(\sin\theta^\circ)$

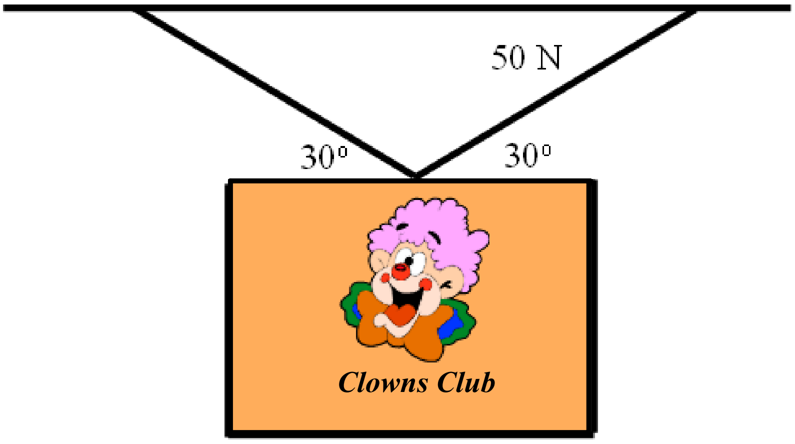
$T = 84\ N/\sin 22.5^\circ$

T = 220 N

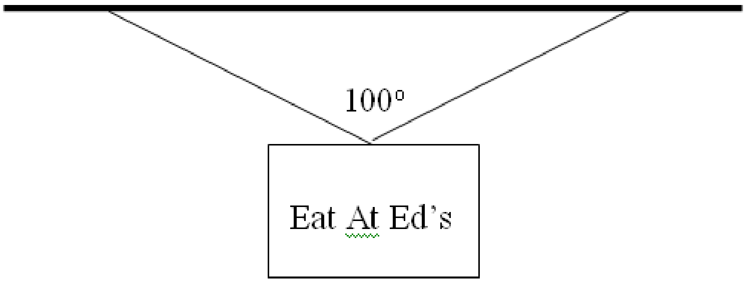
Physics 122/121 Pg 8-10 problem set

Handout - Static Equlibrium -Hanging Signs

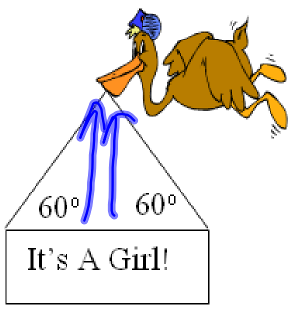
1. Find the magnitude of the weight of the clown's picture. (50 N)



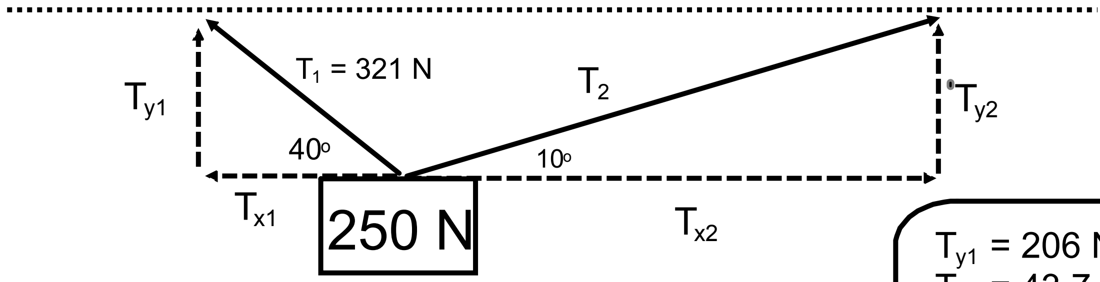
2. If the sign has a mass of 5.00 kg, what is the tension in the cables? (38 N)



3. The infamous stork announces good news. If the sign has a mass of 10 kg, then what is the force of tension in each cable? (57 N)



Determine T_{y1}, T_{y2}, T_2 , T_{x1}, and T_{x2} in the following sketch.



T_{y1} = 206 N
T_{y2} = 43.7 N
T_2 = 251 N
T_{x1} = 247 N (left)
T_{x2} = 247 N (right)

$\sin 40 = \frac{T_{y1}}{321}$

$321 \sin 40 = T_{y1}$

$206 = T_{y1}$

$F_{net,y} = T_{y1} + T_{y2} + F_g$

$0 = 206 + T_{y2} - 250$

$44\text{ N} = T_{y2}$

$\sin 10 = \frac{T_{y2}}{T_2}$

$T_2 = \frac{44}{\sin 10}$

$= 251\text{ N}$

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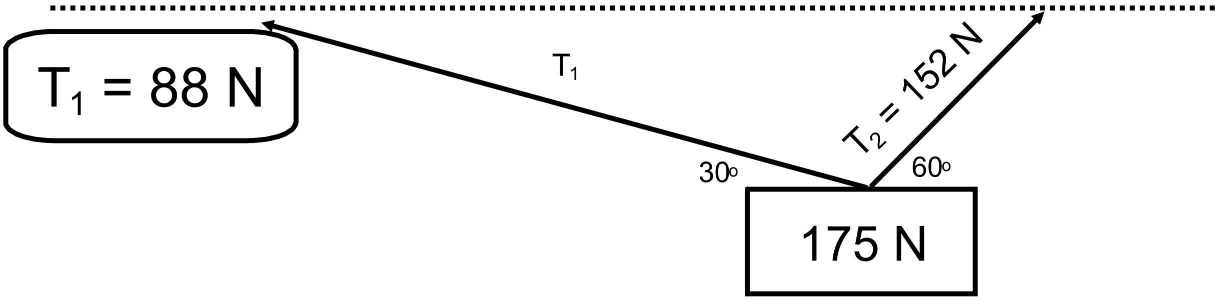
Determine T_1 in the following sketch.



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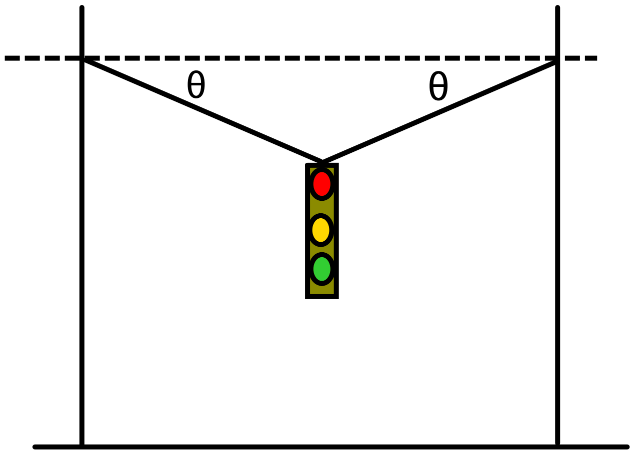
A traffic light is to be hung like in the diagram to the right (both angles are the same). The cable being used will break if their tension reaches 2100 N. What is the smallest angle that can be made if the lights have a mass of 110 kg? (Answer: 15°)



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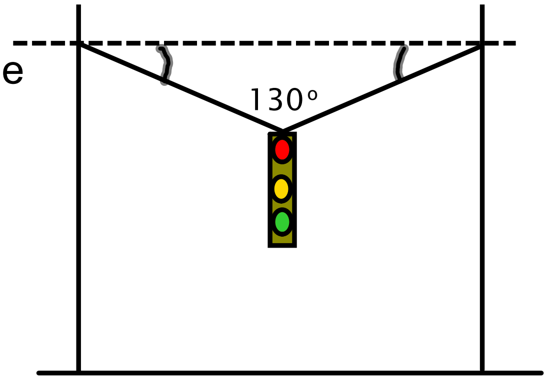
A traffic light is to be hung like in the diagram to the right. The cable being used will break if its tension reaches 1750 N. What is the largest mass that can be hung? (Answer: 151 kg)



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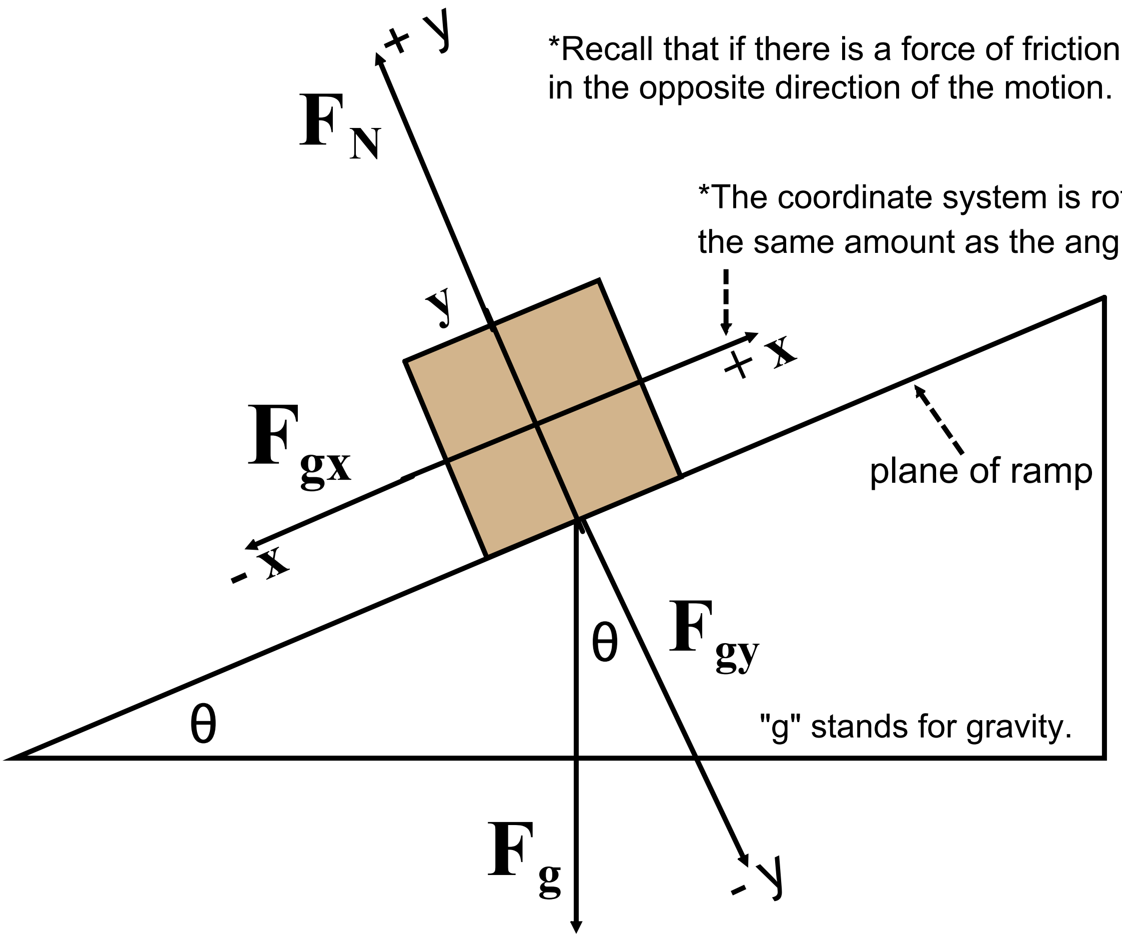
Type III - Inclined Planes, Hills, Ramps

(printed copy for students)

*Recall that if there is a force of friction it acts in the opposite direction of the motion.

*The coordinate system is rotated the same amount as the angle θ.



F_{gy} and F_g are separated by θ because of two similar triangles.

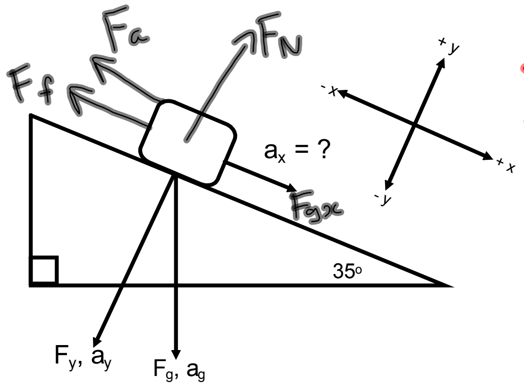
$F_{gx} = F_g \sin\theta$ ⟵ component parallel to the plane.

$F_{gy} = F_g \cos\theta$ ⟵ component perpendicular to the plane.

NOTE! The *sin* and *cos* have switched places. This will only happen when dealing with objects on a ramp.

NOTE FURTHER! Every ***F*** in the above diagram can be replaced with an ***a*** for acceleration.

1. A 55 kg block is sliding down an incline. The coefficient of kinetic friction is 0.13 and the incline makes an angle of 35 ° with the ground. What applied force up the ramp is necessary so the block accelerates with a magnitude of 0.83 m/s² down the ramp ?



Step 1 Find F_{netx}

$F_{netx} = m a_x$

$= (55)(0.83)$

$= 45.7 N$

Step 2 Find F_f

$F_f = \mu F_N$

$= 0.13 F_{gy}$

$= (0.13)(55)(9.81)\cos 35° = 57.5 N$

F_g

Step 3 Find F_{gx}

$F_{gx} = F_g \sin\theta$

$F_{gx} = (55)(9.81)\sin 35 = 309 N$

Step 4 Find F_a

★ $F_{netx} = \sum Forces$

$F_{netx} = F_{gx} + F_f + F_a$

$45.7 = 309 + (-57.5) + F_a$

$-206 N = F_a$