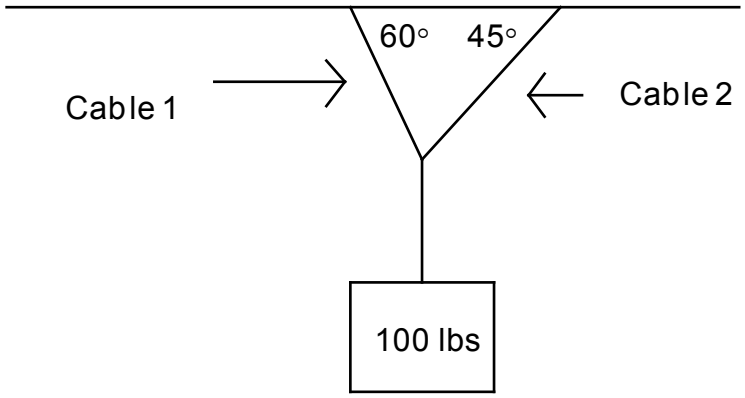
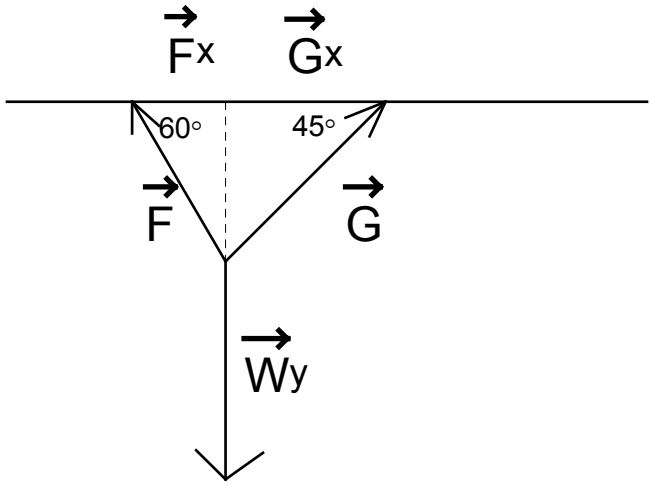
Foothill College Math 48C - Final Exam Mitchell Schoenbrun

11. [10] In the diagram below a motionless weight is held from the ceiling by two cables. The weight is 100 lbs. What is the force (weight) pulling on each cable.




Solution: Label the force of the weight pulling down $\vec{W}_y$ and the force of the two cables $\vec{F}$ and $\vec{G}$.




Then the *x* components of $\vec{F}$ and $\vec{G}$ must balance so that the weight does not move left and right. This gives us the equation:

$F_x = G_x$ where $F = \left\|\vec{F}\right\|, G = \left\|\vec{G}\right\|$ and $F_x = F\cos\left(60^\circ\right)$ and $G_x = G\cos\left(45^\circ\right)$.

Substituting we get the first of two equations in the two unknowns *F* and *G*.

$$F\cos\left(60^\circ\right) = G\cos\left(45^\circ\right)$$

or

(1) $$\frac{1}{2}F = \frac{1}{\sqrt{2}}G$$

Also the *y* components of *F* and *G* must be opposite to the weight *W*=100lbs.

The components are $F_y = F\sin\left(60^\circ\right)$ and $G_y = G\sin\left(45^\circ\right)$

so we have $F_y + G_y = W = 100$ or $F\sin\left(60^\circ\right) + G\sin\left(45^\circ\right) = 100$ or

(2) $$\frac{\sqrt{3}}{2}F + \frac{1}{\sqrt{2}}G = 100$$

This gives us two equations (1) and (2) in two unknowns which we solve using the algebra technique of substitution.

We can substitute (1) into (2) and get

$\frac{\sqrt{3}}{2}F + \frac{1}{2}F = 100$ which gives an exact value for *F* of

$$F = \frac{100}{\frac{\sqrt{3}}{2} + \frac{1}{2}} = \frac{200}{\sqrt{3}+1}$$

We can substitute this back into (1) giving a value of *G* of

$$G = \frac{100\sqrt{2}}{1+\sqrt{3}}$$

Providing approximate answers for *F* and *G* from your calculator would be fine too.