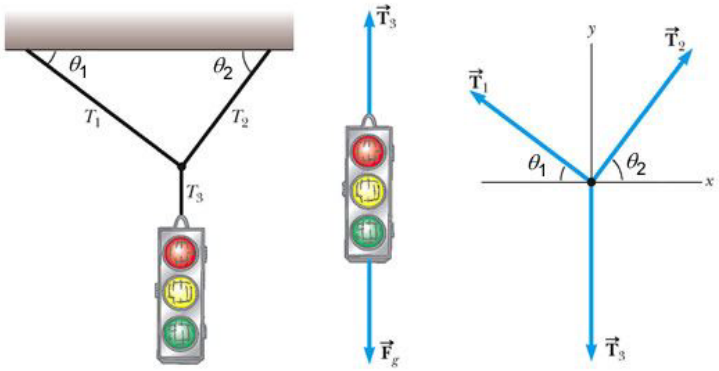
Name & ID

University of Alabama
Department of Physics and Astronomy

PH 105 / LeClair Summer 2012

PH 105 Quiz 4: Newton's Laws

A traffic light weighing 123 N hangs from a cable tied to two other cables fastened to a support, as in the figure below. The upper cables make angles of $\theta_1 = 40°$ and $\theta_2 = 50°$ with the horizontal.



1. What is the magnitude of $\vec{\mathbf{T}}_3$? Hint: draw the free body diagram for the traffic light and cable 3 alone.
   - ☐ 154 N
   - • 123 N
   - ☐ 60 N
   - ☐ 79 N

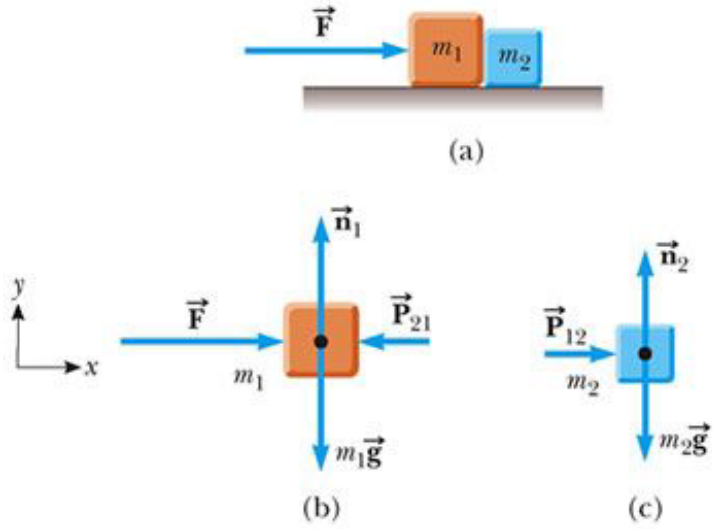
   The cable T_3 has to support the traffic light's entire weight.

2. Which is the sum of the forces in the **x direction** at the point where all three cables meet?
   - ☐ $T_1 \cos 50° - T_2 \cos 40°$
   - ☐ $T_2 \sin 50° - T_1 \sin 40°$
   - • $T_2 \cos 50° - T_1 \cos 40°$
   - ☐ $T_1 \sin 40° + T_2 \sin 50°$

3. Which is the sum of the forces in the **y direction** at the point where all three cables meet?
   - ☐ $T_1 \cos 50° - T_2 \cos 40° - 123\text{N}$
   - ☐ $T_2 \sin 50° - T_1 \sin 40° - 123\text{N}$
   - ☐ $T_2 \cos 50° - T_1 \cos 40° + 123\text{N}$
   - • $T_1 \sin 40° + T_2 \sin 50° - 123\text{N}$

Name & ID

Two blocks of masses m_1 and m_2 ($m_1 > m_2$) are placed in contact on a horizontal, frictionless surface, as shown in the figure below. A constant horizontal force of $\vec{F} = 115\text{N}$ is applied to m_1 as shown.



4. If $m_1 = 15\text{kg}$ and $m_2 = 10\text{kg}$, find the magnitude of the acceleration of the system of two blocks.

- ☐ 113m/s^2
- • 4.6m/s^2
- ☐ 9.2m/s^2
- ☐ 1.5m/s^2

The blocks move together, so this is equivalent to a single mass $m_1 + m_2$ moving under the influence of F. The acceleration is thus $a = F/(m_1 + m_2) \approx 4.6\,\text{m/s}^2$.

5. Newton's third law dictates that $P_{12} = P_{21}$. What is the magnitude of P_{12}?

- ☐ 69N
- ☐ 113N
- ☐ 92N
- • 46N

The only horizontal force acting on block 2 is P_{12}, and this force must then be equal to mass times acceleration for block 2: $\sum F_x = P_{12} = m_2 a$. Given the acceleration from the previous part, this reduces to $P_{12} = \frac{m_1}{m_1+m_2} F \approx 46\,\text{N}$.