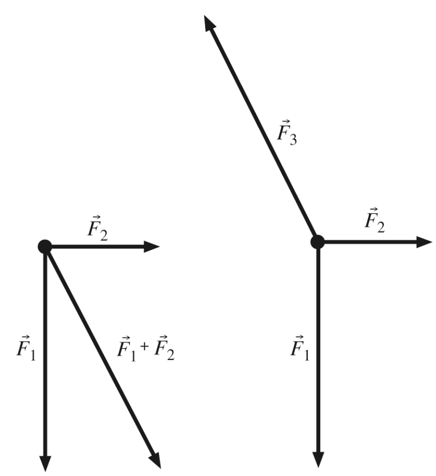
Solutions to HW8, Chapters 5 & 6

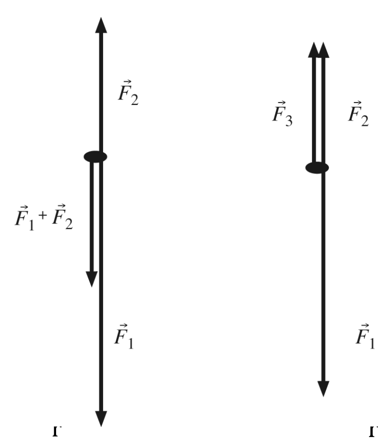
NOTE! The problems in masteringphysics.com had their numbers altered slightly for each individual student. The solutions below use the same numbers as those used in the book for that problem!

5.17. Visualize:



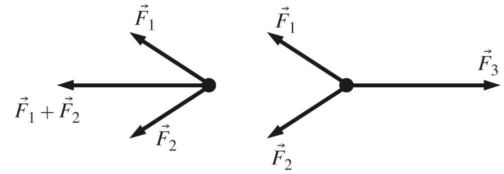
Solve: The object will be in equilibrium if $\vec{F}_3$ has the same magnitude as $\vec{F}_1 + \vec{F}_2$ but is in the opposite direction so that the sum of all the three forces is zero.

5.18. Visualize:



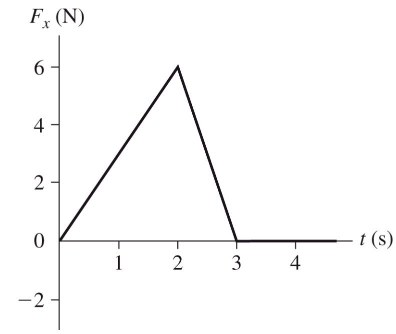
Solve: The object will be in equilibrium if $\vec{F}_3$ has the same magnitude as $\vec{F}_1 + \vec{F}_2$ but is in the opposite direction so that the sum of all three forces is zero.

5.19. Visualize:



Solve: The object will be in equilibrium if $\vec{F}_3$ has the same magnitude as $\vec{F}_1 + \vec{F}_2$ but is in the opposite direction so that the sum of all the three forces is zero.

5.29. Visualize:



Solve: According to Newton's second law $F = ma$, the force at any time is found simply by multiplying the value of the acceleration by the mass of the object. Thus, for example, the point at (2 s, 3 m/s^2) become (2 s, 2 m/s^2 × 2.0 kg) = (2 s, 6 N).

6.8. Solve: Applying Newton's second law to the diagram,

$$a_x = \frac{(F_{\text{net}})_x}{m} = \frac{2.0\text{ N} - 4.0\text{ N}}{2.0\text{ kg}} = -1.0\text{ m/s}^2 \quad a_y = \frac{(F_{\text{net}})_y}{m} = \frac{3.0\text{ N} - 3.0\text{ N}}{2.0\text{ kg}} = 0\text{ m/s}^2$$

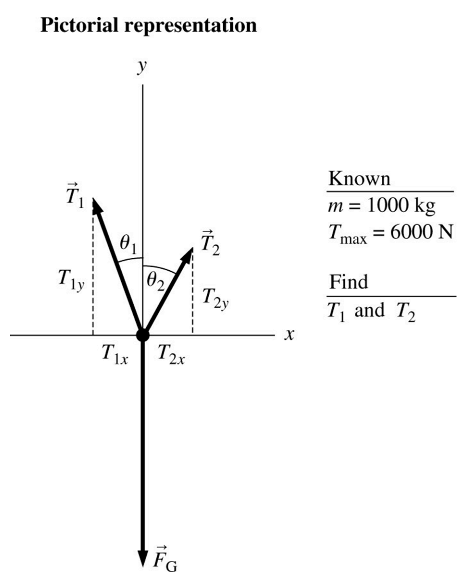
6.9. Solve: Three of the vectors lie along the axes of the tilted coordinate system. Notice that the angle between the 3 N force and the –y-axis is the same 20° by which the coordinates are tilted. Applying Newton's second law,

$$a_x = \frac{(F_{\text{net}})_x}{m} = \frac{5.0\text{ N} - 1.0\text{ N} - (3.0\sin 20°)\text{ N}}{2.0\text{ kg}} = 1.49\text{ m/s}^2 \approx 1.5\text{ m/s}^2$$

$$a_y = \frac{(F_{\text{net}})_y}{m} = \frac{2.82\text{ N} - (3.0\cos 20°)\text{ N}}{2.0\text{ kg}} = 0\text{ m/s}^2$$

6.39. Model: You can model the beam as a particle in static equilibrium.

Visualize:



Solve: Using Newton's first law, the equilibrium equations in vector and component form are:

$$\vec{F}_{\text{net}} = \vec{T}_1 + \vec{T}_2 + \vec{F}_G = \vec{0}\text{ N}$$

$$(F_{\text{net}})_x = T_{1x} + T_{2x} + F_{Gx} = 0\text{ N}$$

$$(F_{\text{net}})_y = T_{1y} + T_{2y} + F_{Gy} = 0\text{ N}$$

Using the free-body diagram yields:

$$-T_1 \sin\theta_1 + T_2 \sin\theta_2 = 0 \text{ N} \qquad T_1 \cos\theta_1 + T_2 \cos\theta_2 - F_G = 0 \text{ N}$$

The mathematical model is reduced to a simple algebraic system of two equations with two unknowns, T_1 and T_2. Substituting $\theta_1 = 20°$, $\theta_2 = 30°$, and $F_G = mg = 9800$ N, the simultaneous equations become

$$-T_1 \sin 20° + T_2 \sin 30° = 0 \text{ N} \qquad T_1 \cos 20° + T_2 \cos 30° = 9800 \text{ N}$$

You can solve this system of equations by simple substitution. The result is $T_1 = 6397 \text{ N} \approx 6400 \text{ N}$ and $T_2 = 4376 \text{ N} \approx 4380 \text{ N}$.

Assess: The above approach and result seem reasonable. Intuition indicates there is more tension in the left rope than in the right rope.