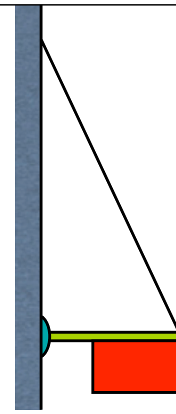
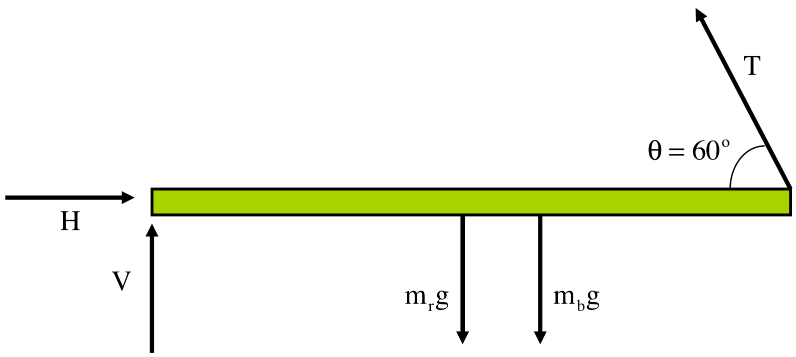
# Problem 8.19:

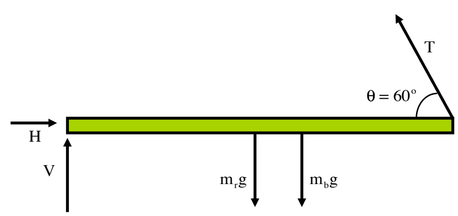
The hinged rod is 6 meters long and weighs 100 newtons. The sign is 4x3 meters and weighs 500 newtons. So what's the tension in the line? The key is to look at the forces/torques acting on the pole.



A f.b.d. is shown to the right.






We could sum up the forces in the "x" and "y" directions, but we'd still have three unknowns and only two equations. In other words, we'd still have to deal with torques. The smart way to do this is to sum the torques about the pin, thereby eliminating the "H" and "V" variables (they produce no torque about the pin as they act AT the pin), and solve that equation for "T." (You should be able to tell which of the three possible torque-calculating approaches I used for each piece.)

$$\cancel{\Gamma}_V^{=0} + \cancel{\Gamma}_H^{=0} + \Gamma_r + \Gamma_b + \Gamma_T = I\cancel{\alpha}^{=0}$$

$$\Rightarrow \quad -(m_r g)\left(\frac{\cancel{L}}{2}\right)\sin 90^\circ - (m_b g)\left(\frac{2\cancel{L}}{3}\right)\sin 90^\circ + T\cancel{L}\sin 120^\circ = 0$$

$$\Rightarrow \quad T = \frac{\frac{m_r g}{2} + \frac{2 m_b g}{3}}{\sin 120^\circ}$$

$$\Rightarrow \quad T = \frac{\frac{(100\text{ N})}{2} + \frac{2(500\text{ N})}{3}}{.866}$$

$$\Rightarrow \quad = 443\text{ N}$$