Chapter 6 Even Problem Solutions

**16.** We note that because of the system of pulleys in place, the block $m_2$ must move precisely twice the distance that block $m_1$ moves in an equal time interval (draw the figure out and try to see why this is). Therefore, we know that: $a_2 = 2a_1$(we define a positive acceleration for block 2 to be in the rightward direction, and a positive acceleration for block 1 to be in the down direction). The force on block 2 is purely tension, while the force on block 1 is both tension and gravitational force. We find then:

$$m_1 a_1 = m_1 g - 2T \tag{1}$$

And:

$$m_2 a_2 = T \tag{2}$$

Plugging in eqution 2 to equation 1, we get:

$$m_1 a_1 = m_1 g - 2m_2 a_2 = m_1 g - 4m_2 a_1 \tag{3}$$

Solving this we get:

$$a_1 = \frac{m_1 g}{m_1 + 4m_2} \tag{4}$$

And:

$$a_2 = \frac{2m_1 g}{m_1 + 4m_2} \tag{5}$$

**20.** It is best to start by drawing a figure, a good free body diagram will make the problem much simpler.

**a.** The gravitational force on the upper climber is: $F_1 = m_1 g \sin(12°) = 75{*}9.8{*}\sin(12°) = 153N$, the gravitational force on the lower climber is: $F_2 = m_2 g \sin(38°) = 63 * 9.8 * \sin(38°) = 380N$. If the rope is taunt, then there is a tension force of the rope on both climbers. The tension force will tend to pull the upper climber down faster, while it will tend to slow the lower climber. The two climbers must have the same acceleration since they are tied together. Therefore:

$$a = \frac{153N + T}{75kg} = \frac{380N - T}{63kg} \tag{6}$$

Solving for the tension, we find:

$$T = 137N \tag{7}$$

Therefore:

$$a = 3.9\frac{m}{s^2} \tag{8}$$

**b.** Once the climbers have come to a complete stop, the Ax must support the gravitational force on both men. Therefore:

$$F = 153N + 380N = 533N \tag{9}$$