Solved Problems on Energy

(1) You are moving into an apartment and take the elevator to the 6th floor. Suppose your weight is 685 N and that of your belongings is 915 N. (a) Determine the work done by the elevator in lifting you and your belongings up to the 6th floor (15.2 m) at a constant velocity. (b) How much work does the elevator do on you alone (without belongings) on the downward trip, which is also made at a constant velocity?

Solution:

(a) We will use $W = (F\cos\theta)s$ to determine the work W. The force (magnitude = F) doing the work is the force exerted on you by the elevator floor. This force is the normal force and has a magnitude F_N, so $F = F_N$. To determine the normal force, we will use the fact that the elevator is moving at a constant velocity and apply Newton's second law with the acceleration set to zero. Since the force exerted by the elevator and the displacement (magnitude = s) are in the same direction on the upward part of the trip, the angle between them is $\theta = 0°$, with the result that the work done by the force is positive.

The free-body diagram at the right shows the three forces that act on you: **W** is your weight, $\mathbf{W}_b$ is the weight of your belongings, and $\mathbf{F}_N$ is the normal force exerted on you by the floor of the elevator. Since you are moving upward at a constant velocity, your acceleration is zero, you are in equilibrium, and the net force in the y direction must be zero:

