The Mother of all Work, Power, Energy, and Momentum Problems

Physics

A box is sliding up a ramp at a velocity of 8.8 m/s. The ramp makes an angle of 27 degrees to the ground and the coefficient of friction between the box and the ramp is 0.32. The box goes up the ramp, slows, stops, and comes back down. It reaches the end of the ramp after it has traveled 2.41 m from its original position. It slides across a horizontal surface (again, with a coefficient of friction of 0.32) for 1.2 m, then strikes a spring with k = 1.81 N/cm. The spring compresses, and then a switch is flipped that causes the spring to decompress by pushing on another box on its other side. The spring uses 4.8 Watts of power to accelerate (at a constant rate) the second box to a velocity of 3.1 m/s in 2.5 seconds. The second box slides along a friction-free surface then collides with another box in a perfectly elastic collision. As a result of the collision, the third box flies off with a velocity of 1.2 m/s at an angle of 13 degrees from the second box's original direction of travel.

a) What are the masses of the boxes?
b) How much did the spring compress?
c) How far above the ground was the first box on the ramp when it turned around?