Unit: Energy

I. Work
   A. What is Work
   B. Force and Distance: Parallel Components

II. Kinetic Energy, and Potential Energy
   A. Storing Energy
   B. Work Kinetic Energy Theorem

III. Conservation of Energy
   A. Defining Systems
   B. Conservation of Total Energy
A non-bouncy object is dropped from the top of a 100m building. If the object comes to rest upon hitting the ground, does this defy conservation of energy? Explain.
A 0.5 kg toy sinks into the lake. If the buoyant and viscous forces of the water on the toy do a total of 10J of work, what is the speed of the toy 3m below the surface?
You just took a ride on the roller coaster below and wonder how fast you were going at the end of the ride. By counting the steps into and out of the ride, you determine that you started 30m up and ended 5m up. How fast were you going at the end?
A cart is to be released from the left side of the roller coaster shown below. If the cart is to make it all the way around the loop (which has a radius of 20m) without falling, what is the minimum height of the starting point?

a) 20 m  
b) 30 m  
c) 40 m  
d) > 40 m  
e) There is no minimum height.
A ball moves on a spring at a 30° angle below the horizontal. The equilibrium length of the spring is 1.5m. If the ball is released from rest at a total spring length of 1m, give an expression for the kinetic energy when the spring is at its equilibrium length.
A ball moves on a spring at a 30° angle below the horizontal. If the ball is released from rest at 1m above the equilibrium, how much will the spring stretch beyond its equilibrium length (give an expression in terms of k and m)?
A 2kg ball on a 3m pendulum is released from rest at a 45° above the lowest point. If the spring constant is 3600N/m, how far will the spring compress? (Ignore the small rise in the ball at the end.)
For the following situation, give an expression for conservation of energy in terms of $U_i$, $U_f$, $K_i$, $K_f$, $f_k$, and $d$. 

$v_i = 5\text{m/s}$

$y_f = 0.5\text{m}$
For the following situation, if it were twice the mass, the block would travel
a) higher.
b) lower.
c) The same height.
In order to find the speed of the cart at the top of the second bump, give an expression for conservation of energy:

a) in terms of $U_i$, $U_f$, $K_i$, $K_f$, $f_k$, and $d$.

b) in terms of $m$, $d$, $f_k$ and the given numbers.
What would happen to the final speed if the bridge shown were built between the two hills (the bridge produces the same friction as the ground)?

a) it would be greater than without the bridge.

b) it would be less than without the bridge.

c) it would be the same as without the bridge.
The cart on the roller coaster below barely makes it around the loop without falling off the track. Give an expression for conservation of energy:

a) in terms of $U_i$, $U_f$, $K_i$, $K_f$, $f_k$, and $d$.

b) in terms of $m$, $d$, $f_k$ and the given numbers.
A ball moves on a spring at a $30^\circ$ angle below the horizontal. The equilibrium length of the spring is 1.5m. The ball is released from rest at a total spring length of 1m. Give an expression for conservation of energy:
a) in terms of $U_i$, $U_f$, $K_i$, $K_f$, $f_k$, and $d$.
b) in terms of $m$, $f_k$ and the given numbers.
To find the final compression of the spring, give an expression for conservation of energy:

a) in terms of $U_i, U_f, K_i, K_f, f_k, d,$ and $k$.

b) in terms of $m, d, k, f_k$ and the given numbers.
A ball is fired from a 2m long spring cannon at a 30° angle above the horizontal. The equilibrium length of the spring is 1m and it is originally compressed to one quarter its length. The cannon produces a constant friction force. To determine the maximum height of the ball, give an expression for conservation of energy:

a) in terms of $U_i$, $U_f$, $K_i$, $K_f$, $f_k$, and $d$.

b) in terms of $m$, $f_k$ and the given numbers.