Conservation of Mechanical Energy Problems

Potentially useful equations:

$E_g = mgh$	$E_k = \frac{1}{2}mv^2$	$E_{T(before)} = E_{T(after)}$	$E_T = E_g + E_k$

****be sure to state the $E_g = 0$ reference point and make a diagram where possible.**

1. A 30 kg rock is pushed off a cliff that is 95.0 m high. Assume it starts from rest.
   a) Calculate the kinetic and gravitational potential energy of the rock at the top of the cliff. Also, calculate the total energy of the system.
   b) Calculate the kinetic and gravitational potential energy of the rock when it is 40 m above the ground.
   c) Calculate the kinetic and gravitational potential energy when the rock hits the ground.
   d) Calculate the speed the rock hits the ground at.

2. A ball of mass 240 g is moving through the air at 18 m/s and has a gravitational potential energy of 70 J.
   a) Calculate the total energy of the system.
   b) Calculate the speed of the ball once it has fallen to height of 3 m above the ground.
   c) Calculate the speed that the ball hits the ground.

3. A 2 kg ball is launched from the ground with an initial speed of 24 m/s.
   a) Calculate the speed of the ball when it is 8 m above the ground.
   b) Calculate the maximum height that the ball will reach.

4. A 5 kg object is thrown into the air from the ground with a kinetic energy of 2000 J.
   a) Calculate how fast it is moving at the point where the gravitational potential energy is 500 J.
   b) Calculate the height it has reached at this point?

5. A 1000 kg car is moving at 4 m/s at the top of a hill. How high is the hill if it is moving with a speed of 45 m/s at the bottom of the hill? (assume the cart simply coasts down the hill and does not use its engine).

6. A rollercoaster cart is coasting towards a large hill. The cart rolls up the hill to a maximum height of 35 m before it stops and starts rolling back down. What was the initial speed of the cart in km/h?