Conservation of Energy Problems

1. A 1,500 kg car travels at a speed of 15 m/s. It is driving on a bridge that is 50m above the bottom of a canyon.
   a. What is its kinetic energy?

   b. What is its gravitational potential energy? What reference point did you use?

2. A large chunk of ice falls from a cliff. You want to know how fast it is travelling when it reaches the bottom of the cliff.
   a. Define the system you will be analyzing.

   b. You know that $K_i + U_i = K_f + U_f$. What will you use as your "initial" point (to determine K_i and U_i), and what will you use as your "final" point (to determine K_f and U_f) ?

   c. If the cliff is 500m tall, how fast will the ice be falling when it hits the ground?

3. You are coasting in the car from problem 1 (not pushing the gas pedal) at a speed of 15 m/s. You come up to a hill and coast up the hill. Ignoring friction, how high will you be able to coast up the hill?

4. A 5.0-kilogram stone falls off a cliff from a height of 20 meters. Ignoring air resistance, what will be the stone's kinetic energy the instant it strikes the ground?

5. Mrs. Jenkins is pumping up a 2 kg-water bottle rocket. To fill it with air, she exerts a force of 50N on the pump shaft, which is 25 cm long. Mrs. Jenkins pumps it 30 times.

   a. Assuming 100% efficiency, how much stored energy does the rocket have?

b. If all of this stored energy is converted to kinetic energy, what is the maximum possible speed of the rocket?

c. If it flies vertically, how high will the rocket go?

6. Two cars are driving towards an intersection. Red car (mass 1,000kg) is travelling at 20m/s and blue car (mass 1,500kg) is travelling at 10m/s when the two cars crash into each other.

   a. What is the total kinetic energy of the cars just prior to crashing?

   b. What is the total kinetic energy of the two cars (now stuck together) just after they crash?

   c. What force slows them down? How much work does this force need to do to slow them completely down? What is the name of the law that tells us this?

7. In the 1950s, an experimental train that has a mass of 2.50×10^4 kg was powered up a hill by a jet engine that produced a thrust of 5.00×10^5 N for a total distance of 500 m. The incline of the hill was 15º.

   a. Draw a detailed picture of this problem. →

   b. Find the work done on the train by the engine.

   c. How much gravitational potential energy did the train gain going up the hill?

   d. What is the final kinetic energy of the train? What is its speed at this time?