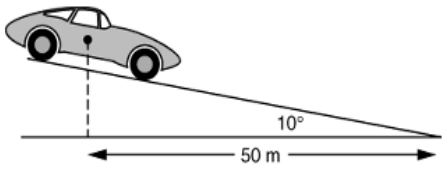
Physics 200B
Lab 8 homework

Name: _____

Assume all quantities are 3 significant figures unless otherwise explicitly specified.

1. A car of mass 1000 kg is at the top of a 10º hill as shown. The car begins at rest.



a. What is its gravitational potential energy relative to the bottom of the hill?

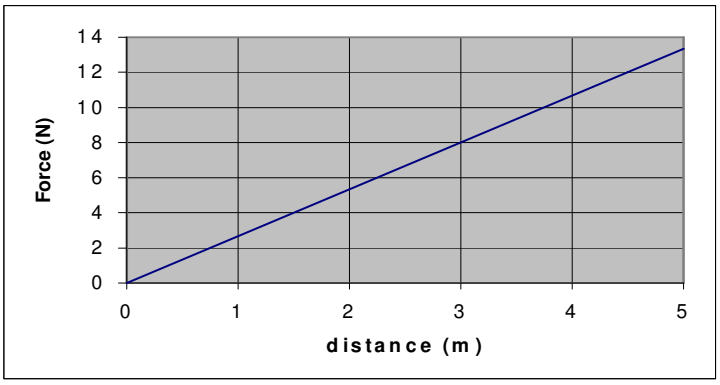
b. If the car rolls down the hill (with the engine off) with negligible friction and air resistance, what will its kinetic energy be when it reaches the bottom? Explain briefly.

c. What will its speed be when it reaches the bottom?

d. The car now rolls up a (still frictionless) hill with a steeper slope. How high (vertical distance) above the bottom of the hill does it get before coming to a (momentary) stop? Explain briefly but carefully why you don't need to know how steep the slope is to answer the question.

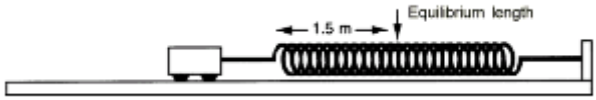
e. Suppose that the amount of work done on the car by the frictional and air resistance forces as the car rolls down the original hill is -40,000 J. What then is the speed of the car when it reaches the bottom of the hill?

2. The graph below is of the force exerted on a spring as a function of the distance the spring is stretched from its unstretched length. Show calculations for each part below.



a. What is the spring constant of this spring?

b. What is the elastic potential energy if the spring is stretched 1.5 m from its unstretched length?



c. A low-friction cart of mass 5.0 kg is attached to the spring as shown above, the spring is stretched 1.5 m from its unstretched (equilibrium) length, and then the cart is released. What is the kinetic energy of the cart just as the spring passes through its unstretched length? What is the velocity of the cart at this position? (The cart moves on a flat horizontal surface.)

d. Assume the cart continues to oscillate back and forth around the unstretched position. Sketch a graph of its kinetic energy vs. time for at least one full cycle of the oscillation. Using a different color or type of line, sketch the potential energy of the spring on the same graph. Mark on your graph the time(s) when the spring is at its unstretched position.

3. A spring-loaded dart gun shoots a dart straight up into the air to a maximum height of 24 m. The dart is retrieved and shot straight up again, but this time the spring is compressed only half as far before firing. How high does the dart go this time? (Ignore air resistance.)

4. A skier has a speed v at the bottom of a hill, and glides a distance of d up the hill before stopping. For the skier to glide a distance of 2d up the hill before stopping, how fast would she have to be going at the bottom of the hill? (Ignore friction and assume the slope of the hill doesn't change.)