PHYS 211: Problem Set 4

June 6, 2012

1. A block of mass m is held on a wedge of angle (with horizontal) of θ. The friction coefficient between the block and the wedge is μ. When the block is let go, it slides down. Answer the following questions regarding its motion:

   (a) What is the acceleration of the block (magnitude and direction)?

   (b) What is the speed of the block at the bottom if it starts at a height H. Do it using kinematics.

   (c) What is the work done by friction on the block?

   (d) What is the work done by gravity on the block?

   (e) What is to total change in kinetic energy of the block?

   (f) How are the above three related?

2. Two blocks of mass 5kg and 7kg hang at the ends of massless string slung around a frictionless pulley. Find the acceleration of each block. If their (the blocks) initial heights above the ground were 2m and 1m respectively, find the total initial potential energy. After 2 seconds of acceleration, find the total potential energy, and the total kinetic energy of the blocks. Is energy conserved? Could you have used conservation of energy to solve for the acceleration of the blocks? How?

3. A car traveling at 100mph comes to a rolling halt in 500ft. Where did all the kinetic energy disappear? Can you calculate how much energy was dissipated? Now lets say you were driving down a long hill, and you were holding the brakes throughout to keep your speed constant. What is happening to your kinetic energy? What about potential energy? And so, what about the total energy? Where are you losing energy? How does this energy loss manifest itself?

4. By climbing a flight of stairs that elevates you (you know your mass) by 10m, (about three floors), what is your change in gravitational potential energy? Where did all this energy come from? Now, 1Nm of energy (also called 1 joule) is equal to 0.24 calories, and 1 food calorie, or 1 Calorie (with a capital C) is equal to 1 kilocalorie (with a small c). How many Calories do you burn going up this flight of stairs assuming there were no frictional losses?