Beverly Hills High School -- AP Physics C -- Test #5 -- 100 points

Need I say, be neat and complete? Didn't think so...calculators okay, partial credit and all...fifteen points each.

1) A father racing his son has 2/5 the kinetic energy of the son, who has 2/5 the mass of the father. The father speeds up by 1.25 m/s and then has the same kinetic energy as the son. What are the original speeds of the (a) father and (b) the son?

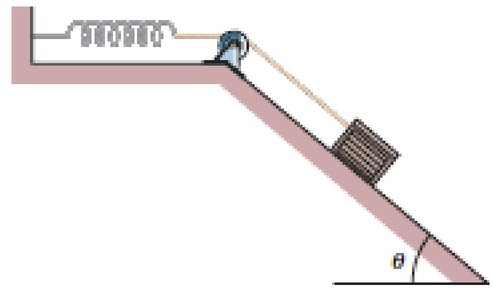
2) A 7.5 g marble is fired vertically upward using a spring gun. The spring must be compressed 12.0 cm if the marble is to just reach a target 25 m above the marble's position on the compressed spring. (a) What is the change ΔU_g in the gravitational potential energy of the marble–Earth system during the 25 m ascent? (b) What is the change ΔU_s in the elastic potential energy of the spring during its launch of the marble? (c) What is the spring constant of the spring?

3) A 57.5 kg skier is skiing down a 10.0° mountain slope covered in hard-packed snow. When she is 925 m above the base, her speed is 12.0 m/s. Given that no energy is lost due to friction or air resistance (hardly realistic), calculate her speed:

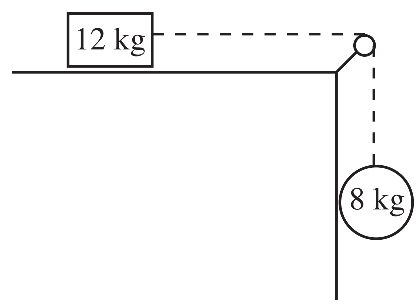
   a) when she is 600 m above the base
   b) when she is 100 m above the base

4) A 2.5 kg breadbox on a frictionless incline of angle $\theta = 35°$ is connected, by a cord that runs over a pulley, to a light spring of spring constant $k = 140$ N/m, as shown below right. The box is released from rest when the spring is unstretched. Assume that the pulley is massless and frictionless.

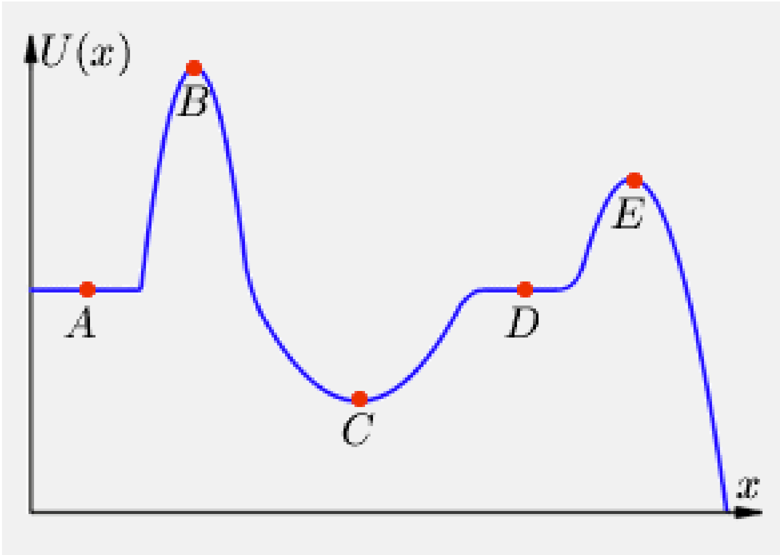
(a) What is the speed of the box when it has moved 10 cm down the incline? (b) How far down the incline from its point of release does the box slide before momentarily stopping, and what are the (c) magnitude and (d) direction (up or down the incline) of the box's acceleration at the instant the box momentarily stops?



5) Recall the problem example where a rectangular block was being pulled off the table by a massless rope over a pulley by a round mass? In this example, mass A = 12 kg and mass B = 8 kg. This time, the coefficient of kinetic friction is only 0.3. Also, in this problem, someone is pushing mass A to the right with a force of 2 N. Using the work-energy theorem as shown in class, determine the speed of the 8 kg ball after it has traveled 1.20 m.



Consider the potential energy diagram at the right and answer these questions. Three points.



6) Which point(s) is/are point(s) of unstable equilibrium?

7) Which point(s) is/are point(s) of stable equilibrium?

8) Which point(s) is/are point(s) of neutral equilibrium?

9) Approximately 5.5×10^6 kg of water drops 50 m over Niagara Falls every second. (a) Calculate the amount of potential energy lost every second by the falling water. (b) Calculate the power output of an electric generating plant that could convert all of the water's potential energy. (c) If the utility company sold this energy at an industrial rate of 1 cent/kWh, what would be their yearly income from this source?