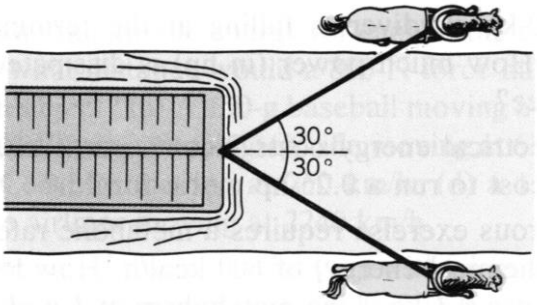
Homework #9

1) A spring gun with k = 90.0 N/m is compressed by 5 cm. What is the exit speed of a 2.10-g projectile?

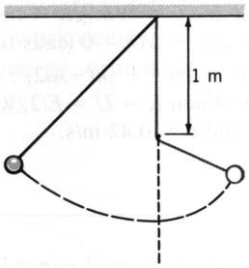
2) (a) The United States, with a population of 2.2×10^{8} people, consumes 5×10^{19} J per year. What is the per capita consumption in watts? (b) The sun's radiation provides the earth with 1000 W/m^2. Assuming solar energy can be converted to electrical energy with a 20% efficiency, how much area is needed to serve the energy needs of each U.S. citizen?

3) A 0.595-kg object is released from a height of 3.60 m and lands on the ground. Find: (a) the work done by gravity; (b) the change in kinetic energy of the ball; (c) the speed just before it lands using energy methods. Ignore air resistance.

4) Two horses pull a barge along a canal at a steady 5.00 km/h, as shown in the figure. The tension in each rope is 420 N and each is at 30^0 to the direction of motion. What is the horsepower provided by the horses?



5) A pendulum bob of mass 0.710 kg is suspended by a string of length 1.50 m. The bob is released from rest when the string is at 30° to the vertical. The swing is interrupted by a peg 1.00 m vertically below the support as shown below. What is the maximum angle to the vertical made by the string after it hits the peg?



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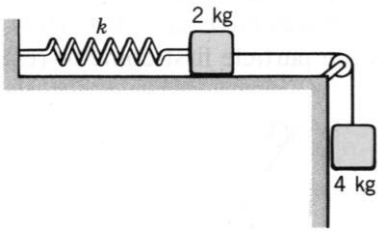
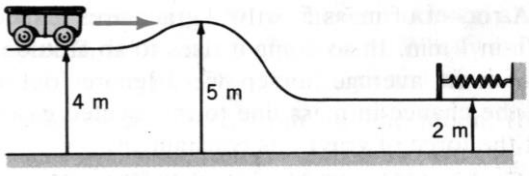
6) A 2.00-kg block slides on a frictionless horizontal surface and is connected on one side to a spring with a spring constant of 45.0 N/m) as shown the figure. The other side is connected to a 4.00-kg block that hangs vertically. The system starts from rest with the spring unextended. (a) What is the maximum extension of the spring? (b) What is the speed of the 4.00-kg block when the extension is 50 cm?



7) A cart with a mass of 3.20 kg, an initial speed of 5.15 m/s and an initial height of 4.00 m is moving towards a hill of height 5.00 m, as shown in the figure. On the other side of the hill is a spring with a spring constant of 125 N/m and a height of 2.00 m. (a) Does the trolley reach the spring? (b) If so, what is the maximum compression? Ignore frictional losses and the rotational energy of the wheels.



8) A projectile is fired at 27.0 m/s in a direction 65º above the horizonal from a rooftop of height 40.0 m. Use energy considerations to find: (a) the speed with which it lands on the ground; (b) the height at which its speed is 15.0 m/s.