CH6 Exercises:

1. (6.5) A 75 kg painter climbs a ladder that is 2.75 m long and leans against a vertical call. The ladder makes a 30o angle with the wall. (a) How much work does gravity do on the painter? (b) Does the answer to part (a) depend on whether the painter climbs at constant speed or accelerates up the ladder?

2. (6.15) On a farm, you are pushing on a stubborn pig with a constant horizontal force with magnitude 30 N and direction 37o counterclockwise from the + x axis. How much work does this force do during a displacement of the pig that is (a) **s** = (5 m)**i**; (b) s = -(6 m)**j**; (c) s = -(2 m)**i** + (4 m)**j**?

3. (6.19) 50,000 years ago, a meteor crashed into the earth near present day Flagstaff, Arizona. Measurements from 2005 estimate that this meteor had a mass of 1.4·108 kg (15,000 tons) and hit the ground at a speed of 12 km/s. (a) How much kinetic energy did this meteor deliver to the ground? (b) How does this energy compare to a 1 megaton (= $4.184 \cdot 10^{15}$ J) nuclear bomb?

4. (6.21) Use the work-energy theorem to solve each of these problems, neglecting air resistance. (a) A branch falls from the top of a 95 m tall redwood tree, starting from rest. How fast is it moving when it reaches the ground? (b) A volcano ejects a boulder directly upward 525 m into the air. How fast was the boulder moving just as it left the volcano?

5. (6.23) You are a member of an Alpine Rescue team. You must project a box of supplies up an incline of constant slope angle α so that it reaches a stranded skier who is a vertical distance h above the bottom of the incline. The incline is slippery, but there is some friction present, with kinetic coefficient μ_k. Use the work-energy theorem to calculate the minimum speed you must give the box at the bottom of the incline so that it will reach the skier. Express your answer in terms of g, h, μ_k, and α.

6. (6.39) A 6 kg box moving 3 m/s on a horizontal, frictionless surface runs into a light spring force of constant k = 75 N/cm. Use the work-energy theorem to find the maximum compression of the spring.

7. (6.45) At a waterpark, sleds with riders are sent alone a slippery, horizontal surface by the release of a large compressed spring. The spring, with k = 40 N/cm and negligible mass, rests on the frictionless horizontal surface. One end is in contact with a stationary wall. A sled and rider with total mass 70 kg are pushed against the other end, compressing the spring 0.375 m. The sled is then released with zero initial velocity. What is the sled's speed when the spring (a) returns to its uncompressed length and (b) is still compressed 0.2 m?

8. (6.49) CALC A force in the +x direction with magnitude F(x) = 18 N – (0.53 N/m)x is applied to a 6 kg box that is sitting on the horizontal frictionless surface of a frozen lake. F(x) is the only horizontal force on the box. If the box is initially at rest at x = 0, what is its speed after it has traveled 14 m?

9. (6.51) How many joules of energy does a 100 watt bulb use per hour? How fast would a 70 kg person have to run to have that amount of kinetic energy?

10. (6.57) Your job is to lift 30 kg crates a vertical distance of 0.9 m from the ground onto a bed of a truck. How many crates would you have to load in 1 minute (a) for the average power output you use to lift the crates to equal 0.50 hp (recall 1 hp = 736 J/s); (b) for an average power output of 100 W?

11. (6.59) A ski tow operates on a 15^{o} slope of length 300 m. The rope moves at 12 km/h and provides power for 50 riders at one time, with an average mass per rider of 70 kg. Estimate the power required to operate the tow.

12. (6.65) A horizontally moving 20 N block is connected to a hanging 12 N block by a light string over a massless, frictionless pulley. They move 75 cm. Find the total work done one (a) if there is no friction between the table and the 20 N block. (b) if $\mu_s = 0.5$ and $\mu_k = 0.375$ between the table and the 20N block.

13. You are asked to design spring bumpers for the walls of a parking garage. A freely rolling 1200 kg car moving at 0.65 m/s is to compress the spring no more than 0.09 m before stopping. What should be the force constant of the spring? (Assume it has negligible mass)

14. (6.85) A pump is required to lift 800 kg of water per minute from a well 14 m deep and eject it with a speed of 18 m/s. (a) How much work is done per minute in lifting the water? (b) How much work is done giving the water the kinetic energy it has when ejected? (c) what must be the power output of the pump?