6th Assignment, due Wednesday **November 18th** (class, no later than NOON) - distributed November 6th

1.) Explain in your own words: (6 points)
a) the microscopic picture of “raising temperature” of a volume of gas
b) the difference between convection, conduction and radiation
c) what we mean when we talk about an ideal gas
d) Suppose you are cooking spaghetti for dinner, and the instructions say “boil the pasta in water for 10 min. To cook spaghetti in an open pot with the least amount of energy, should you turn up the burner to its fullest so the water vigorously boils, or should you turn down the burner so the water barely boils. Explain your answer.

2.) An extreme skier, starting from rest, coasts down a mountain that makes an angle of 25.0° with the horizontal. The coefficient of kinetic friction between her skis and the snow is 0.200. She coasts for a distance of 10.4 m before coming to the edge of a cliff. Without slowing down, she skis off the cliff and lands downhill at a point whose vertical distance is 3.50 m below the edge. How fast is she going just before she lands? (4 points)

3.) The heat Q that must be supplied or removed to change the temperature of a substance of mass m by an amount ΔT is defined as $Q = cm\Delta T$, where c is the specific heat capacity of the substance. The specific heat capacity of the human body is 3500 J/(kgC). In half an hour, a 65-kg jogger can generate 8.0×10^5 J of heat. This heat is removed from the jogger’s body by a variety of means, including the body’s own temperature-regulating mechanisms. If the heat were not removed, how much would the body temperature increase? (3 points)

4.) Air is primarily a mixture of nitrogen N_2 (molecular mass = 28.0 u) and oxygen O_2 (molecular mass = 32.0 u). Assume that each behaves as an ideal gas and determine the rms speeds of the nitrogen and oxygen molecules when the temperature of the air is 293 K. (Determine the average kinetic energy first, then the particle mass of nitrogen and oxygen, before you finally calculate v_{rms}.) (3 points)

5.) A clown at a birthday party has brought along a helium cylinder, with which he intends to fill balloons. When full, each balloon contains 0.034 m^3 of helium at an absolute pressure of 1.2 x 10^5 Pa. The cylinder contains helium at an absolute pressure of 1.6 x 10^7 Pa and has a volume of 0.0031 m^3. The temperature in the tank and in the balloons is the same and remains constant. What is the maximum number of people who will get a balloon? (3 points)

6.) Occasionally, huge icebergs are found floating on the ocean's currents. Suppose one such iceberg is 120 km long, 35 km wide, and 230 m thick.
(a) How much heat would be required to melt this iceberg (assumed to be 0 °C, density of ice is 917 kg/m^3, assume "box-form") into liquid water at 0 °C?
(b) The annual energy consumption by the United States in 1994 was 9.3 x 10^{19} J. If this energy were delivered to the iceberg every year, how many years would it take before the ice melted? (4 points)

7.) The filament of a light bulb has a temperature of 3.0 x 10^3 °C and radiates sixty watts of power. The emissivity of the filament is 0.36. Find the surface area of the filament. (2 points)