Ph202H/212H
W09 Homework – due Monday January 26, 2009

1. In an experiment, the speeds of a group of 22 particles are distributed as follows:
1.0 m/s – 2 particles
2.0 m/s – 4 particles
3.0 m/s – 6 particles
4.0 m/s – 8 particles
5.0 m/s – 2 particles
Find the average speed and the rms speed for this group of particles.

2. A sample of a diatomic gas contains 1.43×10^{24} molecules. It experiences a temperature increase of 65.2 K. (a) Find the increase in the internal energy if only translational and rotational motions are possible. (b) Find the increase in the internal energy of the gas if translational, rotational, and vibrational motions are allowed. (c) How much of the energy calculated in (a) and (b) is translational kinetic energy?

Answer: (a) 3.22×10^{3} J

3. A container holds 6.02×10^{23} nitrogen molecules at a temperature of 280 K. Find the probability that a molecule has speed between 643.1 m/s and 655.8 m/s.

Ans: 0.0177 = 1.77%

4. A metal rod is in contact with two thermal reservoirs (large bodies whose temperature stays constant as heat energy enters or leaves). One end of the rod is in contact with a thermal reservoir at a temperature of 130°C and the other end is in contact with a reservoir at 24°C. During a certain time interval, 1200 J of heat are conducted through the rod from the high-temperature reservoir to the low-temperature reservoir. The rod is well insulated so that no other energy transfers occur. Calculate the entropy change of each reservoir, the rod, and the universe.

Ans: $\Delta S_{universe} = 1.06$ J/K

5. A container holds 1021 g of water and 1021 g of ice at 0°C. Later on it is found to hold 1780 g of water and 262 g of ice with its temperature still at 0°C. Find the entropy change of this system. (Hint: You will need to find out how much energy it takes to convert a gram of ice at 0°C to a gram of water at 0°C.)

Ans.: 926 J/K