Physics 371 Homework #1 Due: Friday, February 5, 2016

1. Sketch the probability distribution of velocity along one direction for a gas of nitrogen molecules, and calculate the root-mean-square (rms) value of the velocity of the molecules for
(a) room temperature (T=300K)
(b) near the liquid state (T=77K)

The distributions should have a particular shape and a particular variance (width). Draw the plots on the same graph so their scale is obvious.

2. Consider N = 7 noninteracting distinguishable particles with a total energy of $E = 6$. Each individual particle can take on integer energies 0, 1, … Write down all the possible configurations of occupation numbers $\boldsymbol{n} = n_1, n_2, \ldots$ and the number of ways $W(\boldsymbol{n})$ the particles can have each configuration. Recall that n_i counts how many particles have an energy E_i. Work out the probability of a particular particle having an energy E_i, and sketch the resulting plot of probability (vertical axis) versus energy (horizontal axis).

3. Make an estimate for the average kinetic energy of the "free" electrons in a metal, assuming they obey Maxwell-Boltzmann statistics. Assume the system is at temperate T. How does this compare with the actual result and why is it different? (Hint: electrons do not obey Maxwell-Boltman statistics because they are identical Fermions)