Ph202H/212H
W09 Homework – due January 22, 2009

1. For 6 tosses of a fair coin, enumerate all possible outcomes in terms of heads and tails and show that the relative number of heads and tails agrees with the binomial formula.

2. Suppose we have 6 units of energy to distribute among 5 identical atoms represented as one-dimensional oscillators. (a) Identify the 10 different macrostates. (For example, in one macrostate all 6 units go to the same atom. In another, one atom gets 5 units and another gets 1 unit.) (b) Find the number of different microstates in each macrostate. (For example, the first macrostate has 5 microststes, because there are 5 different ways to choose the atom that gets the 6 units of energy. In the second macrostate, there are 5 ways to choose the atom that gets 5 units and then 4 ways to choose the next atom that gets the 1 unit, for a total of 20 (= 5×4) microstates.) You should get a total of 210 microstates for the 10 macrostates. Don't forget that you have to correct for the double-counting that occurs when you give 2 or more identical atoms the same amount of energy. For example, if you want to divide the 6 units of energy so that two atoms each get 3 units, there are again 5 ways to choose the first atom and 4 ways to choose the second atom, but only 10 (=5×4/2) microstates because choosing atom #1 first and atom #4 second gives exactly the same microstate as choosing atom #4 first and atom #1 second, because the atoms are identical.

3. (a) How many of the 210 microstates have an atom with 3 units of energy? (b) If we had a large number of these systems, what would be the probability to find an atom with 3 units of energy?

Ans: (a) 90 (b) 100/(5×210) = 9.5%