MT 202 Metallurgical Thermodynamics

Fall 2006

Home Assignment 4

1. McQuarrie 1.22
   Derive $\Omega(E)$ for the first few energy levels for a free particle confined to a cube of length L.

2. McQuarrie 1.23
   For a single particle in a box of dimension L, compute the number $\Omega(\epsilon)$ of states with an energy between ϵ and $\epsilon\delta\epsilon$. [Use a procedure similar to that used in class for a system with N particles]. Estimate this number when the particle's energy is $\epsilon = 1.5kT$.

3. Reif: 2.4
   Consider an isolated system consiting of a large number N of very weakly interacting particles with a magnetic moment μ which can point either parallel or antiparallel to an applied field H. The energy E of the system is then $E = -(n_1 - n_2)\mu H$, where n_1 (n_2) is the number of particles aligned parallel (antiparallel) to H.

   (a) What is the lowest energy state? What is its energy?

   (b) Derive the number of states $\Omega(E)$ for the first few energy levels.

   (c) Derive a general expression $\Omega(E)$ of states that have an energy between E and $E + \delta E$, where E is far above the ground state. [Note: δE is far larger than μH, but far smaller than E!]