Physics 595 CL
Homework 2- Chapter 3

1) Filling in the steps

The number of microstates for the distribution D which obeys Maxwell-Boltzmann Statistics is:

$$\Omega_D^{MB} = [N!/(N_1!N_2!\ldots N_i!\ldots)]\, g_1^{N_1} g_2^{N_2} \ldots g_i^{N_i} \ldots$$

where N_i is the occupation number for the state i and g_i is its degeneracy.

Stirling's approximation for N large is:

$$\ln(N)! \sim N \ln N - N$$

a) Show that

$$\ln \Omega_D^{MB} = N \ln N + \sum_i N_i \ln\left(\frac{g_i}{N_i}\right)$$

b) Repeat the steps in class and show that maximizing $\ln \Omega_D^{MB}$ leads to the identification of the probability for a particle to be in state i:

$$P = \frac{N_i}{N} = \frac{g_i e^{-\beta \epsilon_i}}{Z}$$

where the partition function is $Z = \sum_i g_i e^{-\beta \epsilon_i}$

c) With the total energy $E = \sum_i N_i \epsilon_i$. Show that the entropy is

$$S = k \ln \Omega = k(N \ln Z + \beta E)$$

2)Andrews 3.1

3)Andrews 3.2

4)Andrews 3.4

5)Andrews 3.5

6)Andrews 3.6