

## Physics 317

### Homework #4 – *Due in class, Wed Oct 5*

1. Baierlein p 112, #2
2. An atom moves in a cubical box with sidelength 1 meter at temp 1200K. Assume the ideal gas law holds and compute  $\langle n_x \rangle$  for
  - a. A mercury atom
  - b. A zinc atom
3. Consider  $N$  distinguishable particles. Then the multiplicity of the macrostate with  $N_k$  particles in  $g_k$  quantum states with energies  $\varepsilon_k$  is given by

$$\Omega = N! \frac{g_1^{N_1} g_2^{N_2} g_3^{N_3} \dots g_m^{N_m}}{N_1! N_2! N_3! \dots N_m!}$$

where  $g_k \gg N_k$ .

- a. Calculate  $\ln \Omega$  using Stirling's approximation
- b. Find the maximum of  $\ln \Omega$  subject to the constraints

$$N = \sum_{k=1}^m N_k \quad \text{and} \quad U = \sum_{k=1}^m \varepsilon_k N_k$$

where  $N$  and  $U$  are constants.