Homework #3

due: Thursday, 10/29/09

1. Calculate the probability of observing an energy that differs by 10^{-6} from the average energy of 1 mole of an ideal gas (hint: use the Gaussian distribution for P(E) derived in class).

2. Derive the principal thermodynamic connection formulas of the grand canonical ensemble starting from.

$$pV = kTln\Xi$$

and

$$d(pV) = SdT + Nd\mu + pdV$$

3. Show that the partition function appropriate to an isothermal-isobaric ensemble is

$$\Delta(\mathrm{N, p, T}) = \sum_E \sum_V \Omega(N, V, E) e^{-\beta E}\, e^{-\beta pV}$$

Derive the thermodynamic connection formulas for this ensemble.

4. One can derive the characteristic function for the grand canonical ensemble (see the first equation in problem 2) using fluctuation theory as we did for the canonical ensemble in class. The grand canonical partition function is given by

$$\Xi\,(V, T, \mu) = \sum_N Q(N, V, T)\, e^{\beta \mu N}$$

where Q(N,V,T) is the canonical partition function