Discussion 7

Name and section: _____

1. Derive an expression for S as was done in class for U.

2. Consider a system in two parts A and B separated by a permeable barrier that contains one type of molecule.

   (a) What equalities will be satisfied at equilibrium?

   (b) Derive expressions for the tendencies of matter and energy to exchange. That is, under what conditions will molecules move from A to B?

3. With N ideal gas molecules at p_1, V_0, T_1, reversibly heat the system at constant volume.
   (a) How much work is done on the system in this *isochoric* process?

   (b) If the final system is at p_2, V_0, T_2, find an expression for how much heat was added in terms of C_V, T_1, T_2 and C_V, N, V_0, p_1, p_2. Use the equation:

$$\Delta U = C_V(T_2 - T_1). \tag{1}$$

   (c) Find an expression for the entropy change ΔS in this process.

4. Consider a two level system on a lattice of size N with energies ϵ_1 and ϵ_2.
   (a) What is the general partition function for one site?

   (b) What is the general partition function for all sites? Give an expression for distinguishable and indistinguishable sites.

   (c) What is the partition function for one site with Boltzmann weighted probabilities?

   (d) What is the partition function for all sites with Boltzmann weighted probabilities?

5. Consider a constant-pressure process: With N molecules of an ideal gas in a cylinder with a movable piston at $p_0 = p_{\text{ext}}, V_1, T_1$, transfer and amount of heat q to increase the gas volume and temperature to V_2, T_2.

   (a) What is the work done in this *isobaric* process?

   (b) Using the ideal gas law and eq. (1), find expressions for ΔU, the change in internal energy.

   (c) Find an expression for q, the heat applied to the system.

   (d) Find an expression for the entropy change ΔS in this process.