Discussion Section #7 – March 21, 2014
(Chapter 8)

1. **A thermodyamic cycle for mutations in protein folding**
Suppose you can measure the stability of a wild-type protein, $\Delta G_1 = G_{folded} - G_{unfolded}$, the free energy difference between folded and unfolded states. A mutant of that protein has a single amino acid replacement. Design a thermodynamic cycle that will help you find the free energy difference $\Delta G_2 = G_{unfolded,mutant} - G_{unfolded,wildtype}$, the effect of the mutation on the unfolded state.

2. **Free energy of an ideal gas**
(a) For an ideal gas, calculate F(V), the free energy versus volume, at constant temperature. Hint: Start from the differential form of F(T,V,N)

(b) Compute G(V). Note that V is not a natural variable of G=G(T,P,N)

3. **Heat capacity of an ideal gas.**
(a) The energy of an ideal gas does not depend on volume, $\left(\frac{\partial U}{\partial V}\right)_T = 0$. Use this fact to prove that the heat capacity $C_V = \left(\frac{\partial U}{\partial T}\right)_V$ for an ideal gas is independent of volume.

(b) Show that the heat capacity $C_p = \left(\frac{\partial H}{\partial T}\right)_P$ for an ideal gas is also independent of volume.

3. Computing entropies.

Assume the following where needed: (1) T=300K (2) C_v=(5/2)Nk for a diatomic molecule.

(a) One mole of O_2 gas fills a room of 500m^3. What is the entropy change ΔS for squeezing the gas into 1cm^3 in the corner of the room?

(b) One mole of O_2 gas is in a room of 500m^3. What is the entropy change ΔS for heating the room from T=270K to 330K?

(c) The free energy of a conformational motion of a loop in a protein is ΔG=2 kcal·mol^{-1}. The enthalpy change is ΔH=0.5 kcal·mol^{-1}. Compute ΔS.