# Homework #6 for CCB 425/525, Spring 2022

due Tues., Nov 15 in class

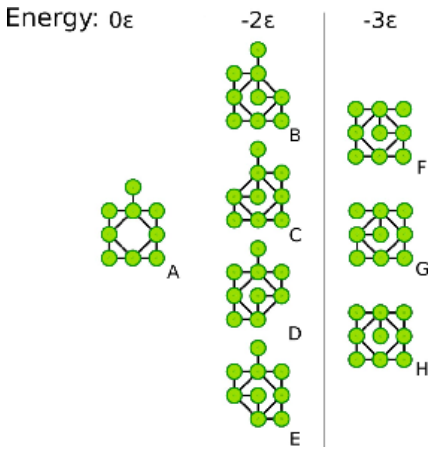
**Instructions:** Unlike other homework assignments, please complete this *on your own*, without consulting anyone else.

1. Suppose that, at constant pressure and over some temperature range, the molar free energy $G_m(T)$ can be fit to a polynomial $G_m(T) = a + bT + cT^3$ where *a, b,* and *c* are constants.
   a) What are $H_m(T)$ and $S_m(T)$ under these conditions? Write your result in terms of the constants $a$, $b$ and $c$.
   b) Show explicitly that these results satsify the Gibbs-Helmholtz equation:

$$\left(\frac{\partial(G/T)}{\partial T}\right)_p = -\frac{H(T)}{T^2}$$

   (that is: evaluate both sides of the above equation in terms of the constants $a$, $b$ and $c$, and show that they are equal)

2. A polymer has 8 different conformations, some of which have different energies:




   a) Write down the partition function of the system in terms of $\varepsilon$ and T; ignore translational and rotational degrees of freedom.
   b) Obtain a numerical value for Q if $\varepsilon = 2.0$ kcal/mol and T=310K.
   c) What are the numerical values for $F$, $H$, and $S$ at 310K? In each case, write an algebraic expression in terms of $\varepsilon$ and $T$, and then compute a numerical value with the constants given in part (b).

3. In a reaction where A can be converted to B (and vice versa), let the equilibrium constant K be 25 at T=300K.
   a) What is the numerical value of $\Delta\mu^o$ at 300K?
   b) If $\Delta h^o$ is 15 kcal/mol, what is the numerical value of K at 305K?
   c) What is the numerical value of $\Delta s^o$ at 300K?