What you should now know about the 2nd and 3rd Laws …Boland

- The concepts of spontaneous and reversible change
- Concept of entropy and the requirement that total entropy of the universe (system + surroundings) increases during any spontaneous change (2nd law)
- Qualitative understanding of the Boltzmann ($S=k \ln W$) and Clausius ($\Delta S = q/T$) expressions for entropy and entropy change
- Realize that the increase in entropy and NOT the reduction in energy is the reason why things happen (e.g. evaporation: energy <u>increases</u> due to broken bonds in liquid ($\Delta H > 0$) but entropy increase is even bigger)
- Qualitative estimate of entropy change during reactions and quantitative evaluation of ΔS^o for a reaction given standard values
- Given the entropy of the solid and the enthalpy of sublimation calculate the entropy of the vapor (and all other phase change problems of this type)
- The 3rd law of thermodynamics… what is it, and how is it consistent with the definition of entropy
- The Gibbs free energy G and the criterion for spontaneous and reversible change – how is this consistent with increase in the increase in entropy of the universe
- Understand that $\Delta S_{univ} = -\Delta G / T$ and that you can calculate this if you have to (and you do!).
- $\Delta G=\Delta H-T\Delta S$ where does it come from? Since H and S refer to the system, how does this expression include changes that occur in the surroundings (as required by 2nd Law)
- Why can strong bond formation during a chemical reaction be consistent with the 2nd Law since bond formation increases the local order (i.e. decreases entropy of system)
- How is the spontaneous formation of ordered structures, e,g., crystals, consistent with the 2nd Law
- What does the superscript zero refer to, e.g. ΔS^o
- Calculation of the standard free energy change ΔG^o for a reaction
- Effect of temperature on ΔG^o and predicting the temperature where a reaction changes from being non-spontaneous to spontaneous and vice-versa
- The relationship between ΔG and ΔG^o and K and Q

- How ΔG changes during the course of a reaction, but ΔG^o is a constant
- The reaction quotient Q; how it determines the value of ΔG during a reaction, and controls the direction of reaction
- The significance of the magnitude of the equilibrium constant K and how it relates to ΔG^o
- Calculation involving the equilibrium constant K at some temperature given ΔG^o or ΔH^o and ΔS^o

Homework Problems: Kotz Treichel and Weaver Chapter 19

1, 3, 5, 11, 13, 17, 19, 23, 25, 29, 33, 35, 37, 41, 43, 49, 51, 55, 61, 67,