

## General Chemistry II Chapter-by-Chapter detailed learning objectives

### Thermodynamics

1. Define the system, surroundings and the universe designations and their interactions work and energy interactions.
2. Apply the second law of thermodynamics to physical and chemical processes to find their spontaneity.
3. Define the definition of the Third law of thermodynamics.
4. Relate to the Boltzman equation and calculation of entropy based on microstates.
5. Relate to entropy based on enthalpy change of a system and its temperature (at constant pressure)
6. Connect the Second law to the Free energy determination for the system.
7. Predict entropy changes for chemical equations and physical processes.
8. Combine reactions and find the Free energy, entropy and enthalpy changes for the overall reaction in a manner similar to Hess's law.
9. Apply the summation (products – reactants) equation to find the standard state Free energy, entropy and enthalpy change for a reaction.
10. Apply the non-standard state free energy equation to chemical equations at any state of concentration, pressure and temperature.
11. Analyze (graphically) the non-standard state free energy during the course of a reaction and define the spontaneous, non-spontaneous and equilibrium points on the graph. Relate the ideas to the non-standard state Free energy equation.
12. Analyze the effect of the magnitude of  $K_{eq}$  on the standard state Free energy change and its conceptual significance.
13. Analyze the impact if temperature on  $K_{eq}$ .
14. Calculate Gibbs Free energy (Free energy) for aqueous equilibria problems (ex. Solubility, acid-base, complex ion)
15. Relate the meaning of free energy and its relationship to the maximum work involved in a physical or chemical process.
16. Distinguish between the reversible and irreversible work.