**Chem 401 Study Guide**

**Unit 4**  
**Chapters 18 & 19**

**Chapter 18: Redox & Electrochemistry**

Be able to:

- Identify reactant oxidized and reduced in a reaction.
- Identify oxidizing and reducing agents in a reaction.
- Identify strongest oxidizing agent and reducing agent in an activity series.
- Identify substance most easily oxidized or reduced in an activity series.
- Identify whether a pair of reactants will result in a spontaneous reaction based an activity series or table of $E^\circ$ values.
- Create an activity series based on a set of experimental observations.
- Balance redox reactions in acidic or basic solution using the method of half-reactions.
- Identify all parts of an electrochemical cell including the anode, cathode, electrolytes, salt bridge, direction of electron flow, direction of flow of ions, oxidation $\frac{1}{2}$ cell and reduction $\frac{1}{2}$ cell.
- Go back and forward between cell shorthand notation, cell diagrams, and cell half-reactions.
- Describe the differences between voltaic (a.k.a. galvanic) and electrolytic cells.
- Identify what reaction is the reference $\frac{1}{2}$ reaction that all others are measured in comparison to.
- Determine the overall cell voltage at standard conditions.
- Determine the overall cell voltage at non-standard conditions (using Nernst Equation)
  \[ E = E^\circ - \frac{(RT/nF)\ln Q}{Q} \]
- Convert between the standard overall cell potential $E^\circ$ and the equilibrium constant $K$ for the reaction.
  \[ E^\circ = \frac{(RT/nF)\ln K}{Q} \]
- Convert between the standard overall cell potential $E$ and the Gibbs Free Energy $\Delta G$ for the reaction.
  \[ \Delta G^\circ = -nFE^\circ \] or \[ \Delta G = -nFE \]
- Identify the for the major types of batteries (dry cell, lead-storage, alkaline, and Ni-Cad) what are the primary components, advantages, disadvantages, and ability to be recharged (or not).
- Identify which of two reactions are most likely to happen at each electrode during electrolysis of an aqueous solution.
- Identify what overvoltage means.
- Understand the difference between active and passive (a.k.a. inert) electrodes and when they should be used.
- Calculate the mass of metal plated out during electrolysis of a solution for a given time at a given current. Alternately to calculate the time or current required to plate out a given amount of metal.
- Describe the process of galvanization, why it is done, and the mechanism by which it acts as a protectant.

**Chapter 19: Nuclear chemistry**

Be able to:

- Write chemical symbols for nuclides (isotopes).
- Identify three main causes for an unstable nucleus.
- Identify mechanisms to relieve each of these three causes.
- Identify how these relate to the “band of stability”
- Recognize on the periodic table where
  - all isotopes of a given element are now unstable
  - all isotopes of a given element are man-made
  - the most stable isotope exists and how nuclei react with respect to this isotope during nuclear bombardment reactions.
- For alpha, beta, and gamma radiation be able to
  - identify the thing lost
  - how the lost part is represented
  - the penetrating power of what is lost
  - the ionizing power (damage potential) of what is lost
  - the speed of what is lost
  - when a nucleus would typically exhibit this type of radioactivity
- For positron emission and electron capture
  - identify the thing lost or gained
  - how the lost part is represented
  - when a nucleus would typically exhibit this type of radioactivity
- Work with the intensity vs distance relationship for
  \[ I_2 = \frac{d_2^2}{d_1^2} \]
- Apply first order kinetics to radioactive decay in order to
  - determine the amount remaining after a given amount of time,
  - determine the amount present at some given amount of time in the past
  - determine the amount of time required to reduce the radioactivity to a specified level.
- Understand an apply mass/energy relationships to
  - calculate the mass defect for an atom or nucleus
  - calculate the binding energy of a nucleus in J or MeV per atom, mol, or nucleon.
- Recognize chain reactions and balance a single step in a chain reaction.
- Recognize the differences in Fission vs Fusion and how they relate to nuclear weapons and nuclear reactors.