

## Chapter 12 – Electrochemistry

Only Sections 1 through 13 (unfortunately, no 14 or 15). Also I said to skip section 10 in class – DO realize however that the calculations in section 10 ARE very relevant when using the Nernst equation.

Know the difference in voltaic vs electrolytic cells

Know how to write half-reactions for both oxidations and reductions.

Know how to combine 2 half-reactions to give an overall cell reaction. (electron balance?)

Know how to draw a picture of both a voltaic and an electrolytic cell if given the shorthand notation.

anode | anodic solution || cathodic solution | cathode

where the "|" are phase changes and "||" is a salt bridge.

What is a salt bridge and what is it used for?

Which electrode is the anode? the cathode?

What's the sign convention used for the cathode and anode?

What's the significance of the SHE?

What's an inert electrode? Used for what? Pt in the SHE, graphite in a dry cell

Know what standard conditions are and how it is symbolized (same as always).

How to use the Nernst Equation to get cell potentials at non standard conditions.

$$E = E^0 - \frac{RT}{nF} \ln Q$$

$$E = E^0 - \frac{0.0257}{n} \ln Q$$

$$E = E^0 - \frac{0.05916}{n} \log Q$$

How to convert between  $\Delta G$ ,  $E$ , and  $K$ .

$$\Delta G^0 = -nFE^0$$

$$\Delta G^0 = -RT \ln K$$

$$nFE^0 = RT \ln K$$

Calculations, how to get:

- Number of grams of metal for a given electrolytic deposition.  $\frac{I \cdot t}{F \cdot n} = \text{mol of rxn}$
- Number of liters of gas formed during an electrolysis.
- $E^0$  for any half-reaction (look up in table).
- $E^0$  for any overall cell reaction.  $E_{\text{cell}}^0 = E_{\text{red}}^0 + E_{\text{ox}}^0$  or  $E_{\text{cell}}^0 = E_{\text{R}}^0 - E_{\text{L}}^0$
- $E$  for any half-reaction (non std conditions, use Nernst) " $n$ " here is the # of  $e^-$  in the 1/2 rxn
- $E$  for any overall cell reaction. ( $E_{\text{cell}}$  for non standard conditions, use Nernst) " $n$ " here is the # of total  $e^-$  cancelled out in the whole rxn.
- How to calculate  $K$  (or  $K_{\text{sp}}$ ) for a reaction using electrochemical data.  
The key is to find the 2 half-reactions that add up to equal the overall  $K_{\text{sp}}$  reaction.  
Remember, all  $K_{\text{sp}}$  reactions are just dissociations:  $\text{MX(s)} \rightarrow \text{M}^+ + \text{X}^-$

## Chapter 13 – Chemical Kinetics

Refer to equation sheet that is available on our web site for formulas.

- Know how to express (show) the rate of a reaction in terms of ANY of the reactants or products. This also means being able to calculate one rate from another.
- What FOUR factors affect reaction rates?
- Know how to obtain the rate law and value of  $k$  by the method of initial rates. (those tables of data)
- Know how reaction order relates to concentration for 0, 1st, and 2nd order reactions.
- Know how to calculate for different variables in the integrated rate law equations
  - Know how to calculate the **concentration** of a reactant (or product) at a particular time ( $t$ ).
  - Know how to calculate the value of the **rate constant** ( $k$ ) using the proper integrated rate equation.
  - Know how to calculate the **time** ( $t$ ) required to reach a particular final concentration.
  - Know how to calculate the **half-life** (what is it?) for a particular reactant.
  - Can you calculate the concentration of a PRODUCT after a given amount of time? You should be able to.
- What should you **PLOT** to get a straight line for 0, 1<sup>st</sup>, and 2<sup>nd</sup> order kinetics?
- Know the criteria for an **effective collision**. (see collision theory)
- Know how to interpret and write a plausible **Reaction Mechanism** for a chemical reaction. What are **elementary steps**? What is the **molecularity** of a reaction (uni- or bimolecular?). What is a pre-equilibrium condition when looking at a multistep mechanism? Know how that factors into coming up with the right rate law from the mechanism. What is the rate-determining step and how does that affect your version of the rate law.
- How do you get the kinetic version of an equilibrium constant? (section 13.10)
- Arrhenius Equation: Know relationship (equation) between  $k_1$ ,  $T_1$ ,  $k_2$ ,  $T_2$ , and  $E_a$  :  
do know this version  $k = Ae^{-E_a / RT}$  although we use this version the most...  

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$
 be able to calculate any 1 of the 5 variables in this equation.
- Know **transition state theory** (activated complex) and how it relates to a **potential energy diagram**.
- Be able to interpret information from a potential energy diagram: values for  $\Delta H$ , ( or  $\Delta U$ ) and  $E_{a,f}$  and  $E_{a,r}$ , this is called a “reaction profile” in your book. See page 510 – especially Figure 13.25.
- How do catalysts affect reactions? How is this represented on a potential energy diagram?
- Know how a catalyst works. How does it affect a potential energy diagram? What is the difference in a homogeneous and a heterogeneous catalyst? Do a catalyst affect thermodynamic state functions? What are catalysts in living systems called?