Checklist for Exam 2 (2019)

Chapter 13. Kinetics, Sections 9 - 13

- ❑ I know what exactly it means when one, two or three (!) things appear as reactants in a mechanism's step.

- ❑ I know how to inspect a reaction mechanism and determine the overall reaction. I can also identify catalysts and intermediates, if any are present.

- ❑ I know how to write a rate law for the slow step in any mechanism. I know that for mechanisms in which the second step is slow, I must substitute out any intermediates that show up in the rate law (because we can't measure their concentrations in lab, so we would have difficulty "proving" the rate law.) To do this, I know how to use an equilibrium expression from the fast step(s).

- ❑ I know how to sketch a reaction profile that diagrams the mechanism. If ΔH is also provided, I can include that in my drawing. I can label the reactants, intermediates, transition states, the various E_{act} (one for each step), and the overall ΔH.

- ❑ I understand the role of temperature in the changing the rate constant (and thereby the rate) for all reactions.

- ❑ I know how to read Boltzmann distributions (population vs. energy) graphs and I know how they change as the temperature changes. I know what it means to sketch E_{act} on these graphs.

Chapter 14. Equilibria

- ❑ I know how to sketch graphs that show the kinetics region becoming the equilibrium region (time vs. concentration.) I know how to include the reaction stoichiometry in these graphs (one A becoming two B, etc.)

- ❑ Given a graph such as the one described above, I can write the chemical equilibrium and determine the equilibrium constant.

- ❑ I can write a K_c and K_p expression for any equilibrium. I know the equation $K_p = K_c(RT)^{\Delta n_g}$ that allows me to interconvert the two.

- ❑ I know how to rearrange K_c or K_p when I write the equilibrium "backwards" or divide/multiply the coefficients, etc.

- ❑ I know how to set up an ICE table, a device used by many of the problems in this and the next chapter. I know I usually work in mol/L unless I can justify that working in moles is acceptable ($\Delta n_g = 0$).

- ❑ I know how to write a Q_c or Q_p expression and how to use it.

- ❑ I can "read" a K_c (K_p) expression and convert it into a chemical equilibrium, complete with long/short arrows. I can describe whether the equilibrium consists of mostly reactants or products given extremely large or small equilibrium constants.

- ❑ Given initial concentrations and an equilibrium constant, I can calculate the equilibrium concentrations for all components.

- ❑ Given initial concentrations and an equilibrium concentration of at least one component, I can calculate the equilibrium constant.

- ❑ I can use Le Châtelier's principle to predict how various stresses affect reestablishing of equilibrium. These stresses are: 1. adding/removing a component, 2. changing the volume, 3. changing the temperature.

- ❑ I can sketch graphs of time vs concentration that include Le Châtelier stresses and how the concentrations of the components adjust to reestablish equilibrium.

- ❑ I understand the relationship between kinetics and equilibrium and specifically that $K_c = k_{fwd}/k_{rev}$ (as per the shoebox water demo.)

- ❑ I understand what a catalyst does and doesn't do to the kinetics and equilibrium regions.

Chapter 15. Acids & Bases

- ❑ I know how to identify a Brønsted-Lowry acid and base. I can identify conjugate acids and bases in a chemical equilibrium and I can write them.
- ❑
- ❑ I know what the hydronium ion is.
- ❑ I can write chemical equilibrium expressions for (a) a strong acid in water, (b) a weak acid in water, (c) a strong base in water and (d) a weak base in water. These expressions include appropriate arrows ($\xrightarrow{100\%}$ or $\xleftarrow{\hspace{1em}}$).
- ❑ I know the equilibrium expression for water and can write it. I know the value for its equilibrium constant, K_w.
- ❑ I know the equations for interconverting pH, $[H_3O^+]$, pOH, and $[OH^-]$.
- ❑ I can calculate the pH of a strong acid, given $[H_3O^+]$.
- ❑ I can calculate the pH of a strong base, given $[OH^-]$.
- ❑ I can calculate the $[H_3O^+]$ (and $[OH^-]$) of a strong acid, given pH.
- ❑ I can calculate the $[OH^-]$ (and $[H_3O^+]$) of a strong base, given pH (or pOH).
- ❑ I can do MICE table calculations for strong acids, weak acids, strong bases, and weak bases. For example, given the initial concentration of an acid and its K_a value, I can determine the concentration of all species as well as the pH, etc. Another example, given the initial concentration of a weak base, and the pH at equilibrium, I can determine a value for K_b for the equilibrium. Third example: I can calculate the pH of any strong acid or base given the initial concentration.
- ❑ I can create a table of weak acids and their conjugate weak bases and I can use these pairs to determine K_a or K_b given one or the other using $K_w = K_a^{wa} \times K_b^{cwb}$.
- ❑ I know how to convert K_a and pK_a^{wa} and K_b and pK_b^{wb} and that $pK_a^{wa} + pK_b^{cwb} = 14$.
- ❑ I can calculate percent dissociation once I have completed my MICE table.
- ❑ I am comfortable with writing equilibrium expressions for weak acids, strong acids and calculating the pH of any solution (given the concentration) of a weak acid or weak base. I can calculate the pH for solutions of strong acids and strong bases, given the concentration.
- ❑ I can look at the formula of a salt and determine if it is acidic, basic, or neutral. I also know when I need more information. In most cases, I can solve for pH given an initial concentration.
- ❑ I know how to recognize a Lewis acid from its Lewis dot structure. I know how to identify a Lewis base, either by its Lewis structure or because iit is a metal cation. I can sketch the product of the reaction of a Lewis acid and base.