Checklist for Exam 3

Chapter 15 Sections 8 - 15.
- ❑ 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.

Chapter 16 Sections 1 – 6.
- ❑ I know how to write equilibrium expressions for weak acids, weak bases and water as we learned in Chapter 15.

Section 16.1 Neutralization reactions.
- ❑ I know how to write net ionic equilibrium expressions and how to calculate numerical values for K_n for the following. I know that pH neutral ions are not shown in the net ionic equations.
    - ❑ Strong acids reacting with strong bases
    - ❑ Weak acids reacting with strong bases
    - ❑ Strong acids reacting with weak bases
    - ❑ Weak acids reacting with weak bases (here the net ionic is often the same as the overall reaction.)

Sections 16.2 – 16.4 Buffers.
- ❑ I know the two recipes for making a buffer. (We also did this in lab!)
    - ❑ Recipe 1. Mix a weak acid with its conjugate weak base. They do not react, only mix.
    - ❑ Recipe 2. React a weak acid with a limiting reagent amount of strong base.
    - ❑ Recipe 3. React a weak base with a limiting reagent amount of strong acid.
- ❑ I know how to determine the pH of any buffer given the concentrations or the moles of acid and base. I will use the Henderson-Hasselbalch *buffer* equation expressed in terms of concentrations (Recipe 1 only) OR moles (Recipe 1 or 2, 3) of weak base and weak acid.
- ❑ I know how to use the Henderson-Hasselbalch Buffer Equation to determine what the pH becomes when small amounts of strong acid or strong base are added to a buffer. I know to do this, I must work in moles.
- ❑ I know how to determine the buffer capacity towards strong acid or strong base.
- ❑ I know how to calculate the ratio of weak base to weak acid in order to prepare a buffer of desired pH.

Sections 16.5 and 16.6 Titration of a strong acid with a strong base.
- ❑ I can "read" a titration graph and determine if is the titration of sa + sb or wa + sb.
- ❑ Regarding sa + sb, I can calculate the pH anywhere along the way using a ***mole*** ICE table (nICE table) and the reaction: $H_3O^+ + OH^- \rightarrow 2\ H_2O$. To calculate the pH, I must first determine the concentration of excess H_3O^+ or OH^- and to do that, I must use M=n/V and that V is the total volume.
- ❑ I know that at the equivalence point, $n_{acid} = n_{base}$, and the pH = 7.
- ❑ I know that I can use n = MV anytime I want (for example, $n_{acid} = M_{acid} \times V_{acid}$, $n_{base} = M_{base} \times V_{base}$), but only at the equivalence point is the following expression true: $n_{acid} = M_{acid} \times V_{acid} = n_{base} = M_{base} \times V_{base}$

Sections 16.7 Titration of a weak acid with a strong base.

❑ I can "read" a titration graph and determine the pK_a which is equal to the pH half-way to the equivalence point (when $n_{HA} = n_{A^-}$).

❑ Regarding wa + sb (OH⁻), I can calculate the pH anywhere along the way. There are 4 regions, each with a separate calculation:

  ❑ Region I. Before any OH⁻ has been added: The pH of the weak acid is determined as you did in Chapter 15, using a MICE table and the 400 Rule.

  ❑ Region II. The buffer region (between V = 0 mL and the equivalence point): This is a Recipe 2(a) buffer calculation (Reaction a weak acid with a limiting reagent amount of strong base). Use the mole version of the Henderson-Hasselbalch and use the buffer wheel! Note that the initial number of moles of weak base = 0.

  ❑ Region III. Equivalence point: Here you have completely converted all of your weak acid into weak base, so you need to do a Chapter 15 weak base K_b calculation. At the equivalence point, n_{A^-} (now present) = n_{HA} (originally present) = $M_{HA} \times V_{HA}$ = n_{OH^-} (added, but now all gone) = $M_{OH^-} \times V_{OH^-}$. Use a MICE table, and total volume.

  ❑ Region IV. After the equivalence point, there is excess OH⁻. Simply determine the moles of excess hydroxide, divide by the total volume in liters and you have [OH⁻] using a nice table. Then I can determine pOH and pH.

❑ I know that at the equivalence point, $n_{acid} = n_{base}$, and the pH > 7.

❑ I know that I can use n = MV anytime I want (for example, $n_{HA} = M_{HA} \times V_{HA}$, $n_{OH^-} = M_{OH^-} \times V_{OH^-}$), but only at the equivalence point is the following expression true: n_{HA} (originally present) = $M_{HA} \times V_{HA}$ = n_{OH^-} (added, but now all gone) = $M_{OH^-} \times V_{OH^-}$

Sections 16.8 Titration of a weak base with a strong acid.

❑ I can "read" a titration graph and determine the pK_a which is equal to the pH half-way to the equivalence point (when $n_{HA} = n_{A^-}$).

❑ Regarding wb + sa (H_3O^+), I can calculate the pH anywhere along the way. There are 4 regions, each with a separate calculation:

  ❑ Region I. Before any H_3O^+ has been added: The pH of the weak base is determined as you did in Chapter 15, using K_b and a MICE table.

  ❑ Region II. The buffer region (between V = 0 mL and the equivalence point): This is a Recipe 2-b buffer calculation (Reaction a weak base with a limiting reagent amount of strong acid). Use the mole version of the Henderson-Hasselbalch and use the buffer wheel! Note that the initial number of moles of weak acid = 0.

  ❑ Region III. Equivalence point: Here you have completely converted all of your weak base into weak acid, so you need to do a Chapter 15 weak acid K_a calculation. At the equivalence point, n_{HA} (now present) = n_{A^-} (originally present) = $M_{A^-} \times V_{A^-}$ = $n_{H_3O^+}$ = $M_{H_3O^+} \times V_{H_3O^+}$ (added, but now all gone). Use a MICE table, and total volume.

  ❑ Region IV. After the equivalence point, there is excess H_3O^+. Simply determine the moles of excess hydroxide using a nice table, divide by the total volume in liters and you have [H_3O^+]. Then you can determine pH.

❑ I know that at the equivalence point, $n_{acid} = n_{base}$, and the pH < 7.

Section 16.9. Titration of polyprotic acids with strong base.

❑ I know what the titration curve looks like for a polyprotic acid with OH⁻.

❑ I can "read" the titration curve in order to determine all of the K_a values.

❑ I know when I can use $M_{H_3O^+} \times V_{H_3O^+} = M_{OH^-} V_{OH^-}$ and how the first equivalence point is related to the second/third.

❑ I know what buffer systems exist along the titration curve (what the wa and wb base are that constitute a buffer).

❑ I can list all of the major acid and base species present at various points along the titration curve.

❑ I can pick a reasonable indictor (given K_a values for the indicator and the color changes they undergo) for each equivalence point