CHM 111
Chapter 14 study guide / learning objectives

Chapter 14 reintroduces acid-base chemistry, only this time covering the chemistry as an example of chemical equilibrium. You will learn about the equilibrium of weak acids and bases, about the self-ionization of water, and about pH. You will also learn that there is more than one definition of the terms acid and base.

At the end of this chapter, you should be able to:

[Definitions / Terminology]
- Define an **acid** and a **base** using the **Arrhenius** definition. (This will be discussed in lecture class.)
- Define an **acid** and a **base** using the **Bronsted-Lowr**y definition.
- Define **conjugate acid-base pair**, **conjugate acid**, and **conjugate base.**
- Define **pH** and **pOH.**
- Define and give examples of **weak acids** and **weak bases**.
- Define and write expressions for **acid ionization constants** and **base ionization constants**.
- Define the **common-ion effect.** (This will be discussed in lecture class.)
- Define a **buffer** and give examples of **buffer solutions**.
- Define a **titration** and its **end point**.

[Working with acid-base definitions]
- Give example chemical reactions that illustrate each of the acid-base definitions: Arrhenius and Bronsted-Lowry.
- Label Arrhenius and Bronsted-Lowry acids/bases in a given chemical reaction.
- Explain the differences between the Arrhenius and Bronsted-Lowry definitions.
- Given the chemical formulas of an acid and a base, write the product of their reaction with each other or with water.

[Strength of acids and bases]
- Give examples of common strong acids and strong bases.
- Describe the relationship between acid strength and the strength of the bond holding the acidic proton (hydrogen ion) to the acid.

[Water's self-ionization]
- Write the equilibrium reaction and equilibrium constant expression for the self-ionization of water.
- Use the equilibrium constant for the self-ionization of water to calculate concentration of hydrogen/hydronium ion and hydroxide ion in solutions.
- Explain how the addition of an acid or base affects the water equilibrium.

[The pH scale, and how to find the pH of a strong acid or base solution]
- Convert from $[H^+]$ (or $[H_3O^+]$) to pH.
- Convert from pH to $[H^+]$ (or $[H_3O^+]$).
- Given the pH of a solution, tell whether it is acidic, basic, or neutral.
- Calculate the pH of a strong acid solution of a given concentration. Or, given the pH, calculate the concentration of the strong acid solution.
- Calculate the pH of a strong base solution of a given concentration. Or, given the pH, calculate the concentration of the strong base solution.

[Weak acids and bases]
- Write the reactions for the dissociation of a weak acid or base in water.
- Find values for the equilibrium constant of a weak acid or base in literature or from the pK_a or pK_b.
- Calculate the pH of a weak acid or base solution OR find the concentration of the weak acid or base given the pH.
- Calculate the degree of ionization of an acid/base given the concentraiton and pH.
- Describe the difference between a weak acid/base and a strong acid/base.

[Salt solutions]
- Determine whether a given ion would be considered an acid, a base, or neither.
- Recognize the conjugates of common acids and bases (e.g. acetate ion / acetic acid, ammonium ion / ammonia, ...)
- Determine, based on the formula of the salt, whether a salt solution would be acidic, basic, or neutral.
- Write the acid/base equilibrium and equilibrium expression associated with a given salt.
- Find the K_a or K_b of an ion given the K_a or K_b of its conjugate.
- Calculate the pH of a salt solution.

[The common-ion effect]
- Recognize solutions that show the common-ion effect.
- Write equilibrium reactions and expressions for solutions that show the common-ion effect.
- Calculate the pH of a solution that contains both a weak acid/base and its conjugate.

[Buffers]
- Describe the important properties of buffer solutions.
- Demonstrate the properties of buffers by calculation.
- Given pK_as of several buffer systems, determine which buffer system to choose given a desired pH.
- Use the Henderson-Hasselbalch equation to calculate the pH of a buffer solution.

[Titration]
- Calculate the pH at the equivalence point for an acid/base titration.

[Practice exercises from the OpenStax text]

- 3, 5, 7, 9, 19, 21, 25, 35, 47, 49, 57, 69, 87, 91, 97, 101, 103