CHAPTER 15
APPLICATIONS OF AQUEOUS EQUILIBRIA

We will spend five lecture days on this chapter. This chapter builds on Chapter 14.

- Days 1 and 2. Sections 1 – 4: During the first two class meetings we will introduce neutralization reactions, common ion effect, recognizing weak acids and bases, buffers. Regarding buffers, we will discuss the pH stability of buffers, how to make buffers two different ways. Buffers are pH-stable and we will learn how to make buffers of any precise pH value. We will use the Henderson-Hasselbalch equation to compute the pH for any buffer solution and to predict the effect of addition of strong acids or bases on the pH of the buffer.

- Days 2 - 4. Sections 5 – 9: After buffers, the second major topic is acid-base titrations. We will learn how to predict the pH of any point along a titration curve for (a) the titration of a strong acid with a strong base, and(b) the titration of a weak acid with a strong base. We will extend this to cover the titration reaction of strong acid with weak base and the titration of a polyprotic acid. We will learn to identify titration curves by their shape.

- Day 5. Sections 10 – 13: The third major topic in the chapter is solubility of "insoluble" salts. In Chapter 4 we learned the solubility rules and used them to predict whether or not a salt was soluble. As it turns out, the "insoluble" salts all dissolve to some very small extent and we will study these equilibria. We will learn how to calculate exact solubility and to be able to predict if a precipitation reaction occurs.

Hint! This is a chapter about chemical reactions. Sketch beakers to help you think about what is in the beaker after each reaction has taken place.

Section 15.1
- ❑ Write balanced net ionic equations for the four types of neutralization reactions.
- ❑ From the relative strengths of the acid and base in a neutralization reaction, predict whether the pH will be equal to, greater than, or less than 7.00 at the equivalence point.
- ❑ Do Problems 1, 2, 44 – 50, even.

Section 15.2
- ❑ Describe the effect on pH when the conjugate base of a weak acid is added to a solution of the weak acid and the conjugate acid of a weak base is added to a solution of the weak base. Calculate the concentrations of all species present at equilibrium and percent dissociation.
- ❑ Do Problems 3 – 5, 52 – 58, even.

Section 15.3
- ❑ Differentiate between buffer and non-buffer solutions.
- ❑ From a table of weak acids and their K_a values, select the weak acid/conjugate base pair that would make the best buffer at a given pH.
- ❑ Given the initial concentration of weak acid (or weak base) and its conjugate base (or weak acid), determine the equilibrium concentrations of all species and the pH of a buffer solution.
- ❑ Calculate the pH of a buffer after the addition of OH^- or H_3O^+.
- ❑ Do Problems 7 and 8.

Section 15.4
- ❑ Use the Henderson-Hasselbalch equation to calculate the pH of a buffer.
- ❑ Do Problems 9 – 12, 60 – 74, even.

Section 15.5
- ❑ Identify the equivalence point on a titration curve.
- ❑ Given a titration curve, select which indicator(s) could be used to detect the equivalence point.

"Duh."

Section 15.6 ❑ Recognize a strong acid-strong base titration curve.
❑ Calculate pH values for a strong acid–strong base titration before titrant is added, before the equivalence point, at the equivalence point, and after the equivalence point.
❑ Do Problems 13 and 14.

Section 15.7 ❑ Recognize a weak acid–strong base titration curve.

❑ Calculate pH values for a weak acid–strong base titration before titrant is added, before the equivalence point, at the half-equivalence point, at the equivalence point, and after the equivalence point.
❑ Do Problems 16, 17.

Section 15.8 ❑ Recognize a weak base–strong acid titration curve.
❑ Calculate pH values for a weak base-strong acid titration before titrant is added, before the equivalence point, at the half-equivalence point, at the equivalence point, and after the equivalence point.

Section 15.9 ❑ Recognize a polyprotic acid–strong base titration curve.
Calculate pH values for a polyprotic acid–strong base titration before titrant is added, halfway to the first equivalence point, at the first equivalence point, halfway between the first and second equivalence points, and at the second equivalence point.
❑ Do Problems 18, 19, 76 – 86, even.

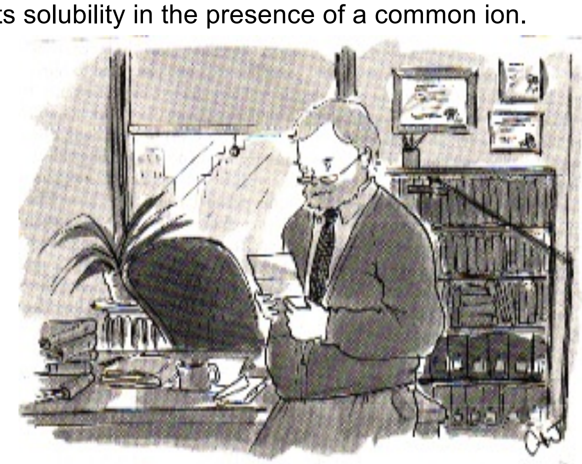
Section 15.10 ❑ Write the solubility product expression for a given ionic compound.
❑ Do Problem 20

Section 15.11 ❑ Given the K_{sp} of an ionic compound, calculate its solubility and vice versa.
❑ Do Problems 21 – 23, 88 – 96, even.

Section 15.12 ❑ Show qualitatively how the addition of a common ion affects solubility.
❑ Given the K_{sp} of an ionic compound, calculate its solubility in the presence of a common ion.
❑ Identify ionic compounds that have an enhanced solubility at low pH. Write chemical equations showing why the solubility increases as $[H_3O^+]$ increases.
❑ Do Problem 25, 98 – 104, even.

Section 15.13 ❑ From K_{sp} values and ion concentrations, determine whether a precipitate will form on mixing solutions of ionic compounds.
❑ Do Problems 29, 30, 112, 114, and 118.

Skip Sections 15.14 and 15.15



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