

Unit II

4/19 Laboratory: pH and Buffers Part I (due 4/25.)

Due to the exam period on 4/18, lab prep material will be posted on Canvas: Files > Laboratory

4/20 Outcomes (several introduced in pH and Buffers – I lab on 4/19):

1. To understand the self-ionization of water, that it always occurs in any aqueous solution, and that it has a specific equilibrium constant called K_w , the ion product of water.
2. To understand the definitions of pH and pOH, and review operations of common logarithms.
3. To convert among $[H^+]$, $[OH^-]$, pH, and pOH with ease.
4. To relate qualitative acidic or basic qualities of solutions based on their pH.
5. To rank weak acids by ionization constants and pK values.
6. To use the definition of pH to determine the pH of strong acid solutions.
7. To use K_w to judge when dilute strong acids do not lower pH significantly.
8. To use K_a and equilibrium skills to determine the pH of weak acid solutions.
9. To use LeChatelier's principle to judge when and how a "common ion" suppresses a dissociation.
10. To use critical thinking to evaluate and apply simplifying assumptions in solving weak acid dissociation problems.
11. To use either exact (i.e. + algebra) or approximate methods to determine pH in strong acid – weak acid mixtures.
12. To know the definition of a buffer, what it contains, and the techniques used to form buffers.
13. To calculate pH values of buffer solutions from K_a expressions, using assumptions that values do not change significantly upon mixing components. To recognize that the same is possible for base – conjugate acid buffers (later).
14. To use guidelines and critical thinking to select components of a buffer, and once selected, to use algebraic techniques to calculate exact quantities.
15. To use a logarithmic form of the K_a expression to simplify buffer calculations.
16. To describe the functioning of a buffer system by referring to the titration curve of its weak acid or weak base component.
17. To determine the buffer capacity (in moles) of a buffer system by referring to its titration curve.
18. To use an approximate guideline for the buffer capacity (± 1 pH unit change) of a buffer system.
19. To calculate pH changes in buffer systems from the addition of strong acid or strong base.

Reading Assignments: Ch. 17, §17.3, 4; Ch 18, §18.1

Bring the "Post-Laboratory Exercise" (p. 48) to class; complete the two blanks before the Part A table, and the first three columns of the table before class. (No Prepared Problems.)

4/25 Outcomes:

1. To use the definition of pH to determine the pH of strong base solutions.
2. To know that K_b is defined as a base hydrolysis reaction, and not a simple dissociation.
3. To use the definition of K_b , equilibrium skills, and assumptions to determine the pH of weak base solutions.
4. To know the relationships among K_a , K_b , K_w , p K_a , p K_b , and p K_w .
5. To know examples of typical polyprotic acids and recognize that second (and third) dissociations get successively weaker.
6. To know the meaning of nomenclature of polyprotic acid salts and write the conjugate bases from salt formulas.
7. To know when assumptions can be used to simplify polyprotic acid problems.
8. To describe the features of the shape of titration curves, in particular, starting, halfway, and equivalence points.
9. To use the x-axis (mL) of a pH titration graph to determine moles of acid or base added, and determine moles at the equivalence point.
10. To describe qualitatively and quantitatively the amounts of acid and conjugate base at various points of a titration curve.
11. To know that strong acid – strong base titrations go to completion and use mole calculations to evaluate pH changes.
12. To view and know the qualitative differences between strong acid and weak acid titration curves.
13. To use mole calculations and equilibrium skills to evaluate pH changes in weak acid – strong base titrations.
14. To apply all of the above skills to weak base – strong acid titrations.

Reading Assignments: Ch. §17.5, 6; Ch 18, §18.2

Prepared Problems: Ch. 17 chapter-end #3, 5b, 27, 37, 39; Ch. 18, #5
pH and Buffers – Part 1 Report due.

4/26 Laboratory: pH and Buffers Part II (report due WEDNESDAY 5/3)

A careful read of pp. 51 – 53 will be needed for the Prelab, p. 57.

4/27 Outcomes:

1. To know that a salt is a compound or composition that can be produced by the neutralization of an acid and a base.
2. To recognize spectator ions, acids, and bases from the components of salts and evaluate the acid-base properties of salts.
3. To predict pH values qualitatively for salt solutions based on the acids and bases that could have produced them.
4. To calculate pH for pure salt solutions for monoprotic acid and base conjugates, and for the first salt of a polyprotic acid.
5. To relate salt solution pH values to titration curves; to review and apply salt solution skills to obtain the pH at the equivalence point of titrations, and guide indicator selection.
6. To recognize the special case of zwitterions (specifically amino acids) and qualitatively predict pH.
7. To describe how pH changes affect the charge on amino acids.
8. To recognize acid and base anhydrides through their reactions with water.
Reading Assignments: §17.7, 8; review §18.1, 2
Prepared Problems: Ch 17 #51, 55, 59 (ignore K_{a3} !); Ch 18 #33 (refer to pp. 792-795, noting that strong acid-strong base reactions go to completion.)

5/2 No Classes

5/3 Laboratory: Polyprotic Acids (Prelab, p. 66; Report due 5/9)
pH and Buffers Part II Lab Report due at start of lab

5/4 Outcomes:

1. To understand how the definition of the solubility product constant is the same as an equilibrium for dissolving a salt.
2. To understand the relationship of "solubility" and the solubility product constant, and how to obtain one from the other.
3. To use solubility product constants in conjunction with common ion solutions.
4. To use the reaction quotient ("Q") to predict whether precipitation should occur, and to calculate actual equilibrium concentrations in precipitation reactions.
5. To apply the terms ligand, -dentate, chelate, and formation constant to complex ions.
6. To view the formation constant of a complex ion as the opposite of a dissociation constant.
7. To understand how complex ion equilibria affects species in solution and solubilities.
Reading Assignments: §18.3, 4 (not pp. 813 – 815)
Prepared Problems: Ch 17 #65, 67, 73, 75; Ch. 18 #3, 7, 9, 13, 25
Graded Homework due Ch. 17 #28, 40, 74 ; Ch. 18 #6, 12, 36 (assume volumes add exactly).

5/9 Outcomes:

Polyprotic Acids Lab report and lab notebooks due
Prepared Problems: Ch. 18 #47, 49, 53, 55
Group Sheet 2
Success on an hour exam covering the above outcomes plus content from §17.1 and 17.2.

Please note!**5/10 Laboratory: Experimental Cell Potentials (Unit 3 content).**

We will begin in **CC1-302** for about 45 minutes and then move to 330. Bring the Prelab assignment and safety goggles; lab notebooks will be returned to you.