Chem 163-03 Spring 2018

Unit 2

Please note that in the event of school closure, our course content will continue following this Unit Syllabus supplemented by required information from Canvas.

Apr-12 Outcomes (see Unit 1 Syllabus)

Apr-18 Laboratory

pH and Buffers, Part 1 (pp. 42 – 50 of lab manual file; note that due to the Non-Instructional Day on 4/19, the report is due at start of lab on 4/25).

Prelaboratory assignment (p. 50) due at start of lab.

Apr-19 Non-Instructional Day

No classes.

Apr-24 Outcomes

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 Kw, 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 and strong base solutions.
7. To know examples of typical polyprotic acids and recognize that second (and third) dissociations get successively weaker.
8. To apply the principles of polyprotic acid reactions to the problem of ocean acidification.
9. To know when assumptions can be used to simplify polyprotic acid problems.
10. To describe the features of the shape of titration curves, in particular, starting, halfway, and equivalence points.
11. 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.
12. To describe qualitatively and quantitatively the amounts of acid and conjugate base at various points of a titration curve.
13. To know that strong acid – strong base titrations go to completion and use mole calculations to evaluate pH changes.
14. To view and know the qualitative differences between strong acid and weak acid titration curves.
15. To use mole calculations and equilibrium skills to evaluate pH changes in weak acid – strong base titrations.
16. To apply all of the above skills to weak base – strong acid titrations.

Assignments:

Read §16.2, 16.4, 16.9 (sequence selected to serve for lab preparation)

Prepared Problems: Ch. 16, #14, 16c, 18, 26, 38 (strong acid), 44

Apr-25 Laboratory

Titration of a Polyprotic Acid (pp. 51 – 59 of lab manual file; report due 5/1).

Prelaboratory assignment (p. 51) due at start of lab.

Lab report for pH and Buffers – Part 1 (pp. 46 – 47) due at start of lab. Bring p. 48 to class on 4/26.

Apr-26 Outcomes

1. To use data from lab to relate pH to the conjugate base / acid ratio ("r") contained within Ka.
2. To use Kw to judge when dilute strong acids do not lower pH significantly.
3. To quantify the relationships among Kw, pKw, Ka, pKa, Kb, and pKb.
4. To describe the dissociation reactions of weak bases as base hydrolyses, and define Kb.
5. To use Ka and equilibrium skills to determine the pH of weak acid solutions, and Kb to determine the pH of weak base solutions, using critical thinking to evaluate and apply simplifying assumptions in solving weak acid and base dissociation problems.
6. To describe, qualtitatively, why acid strengths differ based on structure and bonding principles.
7. To know that a salt is a compound or composition that can be produced by the neutralization of an acid and a base.
8. To recognize spectator ions, acids, and bases from the components of salts and evaluate the acid-base properties of salts.
9. To predict pH values qualitatively for salt solutions based on the acids and bases that could have produced them.
10. To calculate pH for salt solutions of monoprotic acids' conjugate bases using base hydrolysis.
11. 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.
12. To know the meaning of nomenclature of polyprotic acid salts and write the conjugate bases from salt formulas.
13. To recognize the special case of zwitterions (specifically amino acids) and qualitatively predict pH.
14. To describe how pH changes affect the charge on amino acids.

Assignments:

Read §16.3, 16.5, 16.6

Bring page 48 of the lab manual ("Post-Laboratory Exercise") to class partly filled in per the instructions.

Prepared Problems: Ch. 16 #34, 36c, 64 (also calculate $[SO_3^{2-}]$, 70b, 114 (no calculation), 122

May-1 Outcomes

1. To describe the common ion effect through Ka (alternatively, Kb), "r", and LeChatelier's principle.
2. To reflect on lab experiences with titration curves regarding conditions under which pH is stable and unstable.
3. To know the definition of a buffer, what it contains, and the techniques used to form buffers.
4. To calculate pH values of buffer solutions from Ka 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).
5. To use guidelines and critical thinking to select components of a buffer, and once selected, to use algebraic techniques to calculate exact quantities.
6. To use the lograithmic form of the Ka expression (Henderson-Hasselbalch equation) and apply "r" to simplify buffer calculations.
7. To use these skills to select materials and quantities for the design of buffers.
8. To describe the functioning of a buffer system by referring to the titration curve of its weak acid or weak base component.
9. To determine the buffer capacity (in moles) of a buffer system by referring to its titration curve.
10. To use an approximate guideline for the buffer capacity (± 1 pH unit change) of a buffer system.

Assignments:

Read §16.7, 16.8

Prepared Problems: Practice exercise p. 793 (show work), 58, 60b, 74, 80

Lab report for Titration of a Polyprotic Acid (pp. 55 – 58) due at start of class.

May-2 Laboratory

pH and Buffers, Part 2 (pp. 60 – 66 of lab manual file; report due 5/8).
Prelaboratory assignment (p. 66) due at start of lab.

May-3 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 define Lewis acids and bases, compare to the Bronsted definition, and view how they are applied to non-aqueous reactions and to the binding of electron-pair donors to transition metal ions.
6. To apply the terms ligand, -dentate, chelate, and to complex ions.
7. To know and be able to draw representative coordination complex geometries.
8. To know specific biological examples of coordination complexes and the specific structural changes when hemoglobin binds oxygen.
9. To write, interpret, and use formulas of coordination complexes.
10. To view the formation constant of a complex ion as the opposite of a dissociation constant.
11. To understand how complex ion equilibria affects species in solution and solubilities.

Assignments:
Read §16.10, 17.1 – 17.3
Graded Homework, due at start of class: Chapter 16, #4 (no calculation), 6, 20, 36a, 36a, 36d (assume 400., and 600. mL of each), 54, 85 (show work), 96 (hint: first calculate pKa for pyridinium ion), 116
Prepared Problems: Ch. 16 #88, 94, 100 (first find pKa of the conjugate acid), 110 a, b (first find “r”)

May-8 Outcomes

1. Learn the nomenclature specific to coordination complexes and compounds.
2. Given a name, to be able to write the formula of a coordination complex or compound.
3. To draw and interpret structures of polydentate complexes.
4. To review the relationships among color, wavelength, frequency, and energy levels.
5. To understand that in coordination complexes, d orbitals have different energies, and they are affected by the strength of ligands’ bonding.
6. Given an energy level diagram, to interpret why transition metal coordination complexes are colored, and why colors and magnetic properties vary with ligands.

Assignments:
Read §17.4 and 17.6 – 17.9
Prepared Problems: Chapter 16, #136, 140; Chapter 17, #16, 24, 28
Lab report for pH and Buffers – Part 2 (pp. 64 - 65) due at start of class.

Lab notebooks due at start of class for grading; they will be returned May-9 with time to make your preliminary entries for lab.

May-9 Class and Laboratory

We will begin in class (in CC1-331) for about 45 minutes for the following class material, and then move to 330 for Experimental Cell Potentials (Prelab, p. 75). Worksheet 12 Parts 1&2 should be done ahead of class time, and it is part of your Prelab. Bring Worksheet 12 Parts 1&2, the Prelab assignment and safety goggles; lab notebooks will be returned to you, with time to make your preliminary entries.

Outcomes (Unit 3 Material)

1. To know the terminology of electrochemical cells, including voltaic cell, electrolytic cell, half reaction, oxidation, reduction, anode, cathode.
2. To review the definitions of redox reactions and how to identify them.
3. To interpret and write half reactions for oxidations and reductions including balance of electrons and charge.
4. To use half reactions to identify what gets oxidized, what gets reduced in redox reactions and describe the substances as reducing agents or oxidizing agents.
5. To combine half reactions into balanced overall reactions.
6. To construct wet cells, measure potentials, and identify anode and cathode.
7. To become familiar with cell notation, and how it corresponds to half reactions, and overall reactions.

Assignments:

Read Ch. 19, §19.1, 2 (No Reading Quiz); Lab manual p. 67

Worksheet 12 Parts 1&2: Handed out 5/8, complete and bring to class; graded as part of your Prelab.

Prelaboratory assignment: p. 75 of lab manual and Worksheet 12 Parts 1 & 2.

Laboratory: Experimental Cell Potentials (pp. 67 – 75 of lab manual file; report due 5/15).

May-10 Outcomes

Group Sheet 2

Success on an **hour exam**! Content from all the above learning outcomes for Chapters 16 and 17, and pertinent content from lab (other than 5/9 lab).