Chemistry 163-03 **Spring '17**

TENTATIVE Unit I

3/28 Outcomes:

1. To understand how reaction rates are defined and what is meant by an instantaneous rate.
2. To know the factors that control reaction rates.
3. To know how rate expressions are written and their relation to reaction coefficients.
4. To know examples of experimental methods used to measure rates.
5. To understand how a rate law relates rates to concentrations and what a rate constant is.
6. To understand reaction order and how it is determined.
7. To understand how a chemical reaction takes place at the molecular level.
8. To understand how collision theory explains rates from collision frequency, collision energy, and collision orientation, and what an activation energy is.

Reading Assignments: Ch. 15, §15.1, 2
Recommended: Chapter 15, in-chapter problems and odd-numbered end-of chapter problems.
Prepared Problems: start next class; see expectations in Syllabus

3/29 Laboratory: Rate of Reaction, Part 1 (Report due 4/4.)
All experiments are located in individual files on Canvas. Before lab, download and print the experiment, and complete the Prelab (p. 24, which is the last page of this document). Also read the introductory material in the document "Chem 163 Lab Manual Intro_Appendices." Print only p. 6, sign, and bring p. 6 to lab.

3/30 Outcomes:

1. To understand how an "integrated" rate law gives concentrations vs. time.
2. To work with equations and graphs of concentration vs. time rate laws, specifically, to be able to get concentrations, times, and order of reaction from concentration/time data.
3. To be able to work with "half-lives" of first-order reactions.
4. To know how a "pseudo-order" simplifies experimental methods.
5. To use initial rate data to obtain rate constants and orders.
6. To review graphical analysis of concentration vs. time data to obtain rate constants and orders.
7. To review and memorize tests of order for zero, first, and second order reactions.

Reading Assignments: Ch. 15, §15.3, 4, 5
Prepared Problems: Ch. 15 chapter-end #7a, b, 9, 13, 19, 21

4/4 Outcomes:

1. To use and interpret mechanisms in describing chemical reaction processes.
2. To use the terms elementary step, molecularity, and rate-limiting step in describing mechanisms.
3. To obtain the molecularity of an elementary reaction and the overall order from a mechanism.
4. To understand the dynamics of reversible elementary reactions, and use algebra to remove intermediates from mechanisms involving reversible steps.
5. To understand what an activated complex is, and how transition state theory explains rates using potential energy diagrams.
6. To be able to relate activation energies and reaction enthalpies from potential energy diagrams.
7. To understand that kinetic data and thermodynamic data may predict different reaction outcomes.
8. To interpret rate constants from the influences of frequency factors, activation energies and temperature.
9. To describe qualitatively the role of catalysts and to recognize catalysts within mechanisms.
10. To show the effect of a catalyst in a reaction's potential energy diagram.
11. To describe the mechanisms of action of heterogeneous catalysts and enzyme catalysis.

Reading Assignments: §15.6, 7
Prepared Problems: Ch 15 #25a, b, 27, 29a,b, 41a, b, 43, 57, 61
Rate of Reaction, Part 1 Lab Report due at start of class.

4/5 Laboratory: Rate of Reaction, Part 2 (Report due 4/11.)

4/6 Outcomes:

1. To use principles of rates and mechanisms in the description of equilibrium.
2. To interpret concentration – time and free energy graphs in describing the approach to equilibrium.
3. To understand the definition of an equilibrium constant and how it follows from the definition of equilibrium in terms of rates; to write equilibrium constants from rate expressions and concentrations.
4. To know that the true definition of the equilibrium constant uses activities, not concentrations.

5. To interpret values of K to determine whether reactants or products are "favored" and how these are communicated in graphs.
6. To distinguish and describe homogeneous and heterogeneous equilibria, and how heterogeneous substances are handled in equilibrium constant expressions.
7. To know that adding reactions causes equilibrium constants to be multiplied, and reversing the way a reaction is written inverts equilibrium constants.
8. To solve for unknown equilibrium concentrations when other equilibrium concentrations are known.
9. To use partial pressures in equilibrium constants.
10. To understand how units enter into equilibrium constants and how K and Kp are related.

Reading Assignments: §16.1, 2, 3, 4.
Prepared Problems Ch. 15 #73, 75, 83, 85, 91

4/11 Outcomes:

1. To understand the reaction quotient (Q) and how it relates to K.
2. To use Q to predict how a non-equilibrium mixture will change to attain equilibrium.
3. To be able to set up algebraic relationships among reactants and products, symbolizing initial, change, and equilibrium quantities, based on reaction coefficients and initial conditions.
4. To use algebraic relationships and equilibrium constants to solve for equilibrium concentrations, and to apply square root methods, the quadratic formula, and the method of intersections (with a TI calculator).
5. To know what simplifying assumptions are reasonable and useful to solve problems, and to use the method of successive approximations (not in text) to solve problems.
6. To be able to calculate equilibrium concentrations from any set of starting conditions.
7. To understand LeChatelier's Principle and how it follows from rates determining equilibrium as well as from the definition of Q.
8. To be able to apply LeChatelier's Principle to changes of concentration, pressure, and temperature.

Reading Assignments: §16.5, 16.6
Prepared Problems Ch. 16 #15, 17, 21, 25, 29, 35
Rate of Reaction Part 2 Lab Report due at start of class.

4/12 Laboratory: Introduction to Equilibrium (Due 4/18.)

4/13 Outcomes:

1. To understand when and how a catalyst affects an equilibrium reaction.
2. To relate the standard free energy change to the equilibrium constant.
3. To find equilibrium constants from tables of thermodynamic data, and data from constants.
4. To know definitions of acids and bases by Arrhenius, Bronsted-Lowry, and Lewis theories.
5. To identify acids and bases in reactions.
6. To identify conjugate acids and bases in equilibrium reactions.
7. To know how strong and weak acids are defined based on degree of dissociation, and how that relates to equilibrium vs. non-equilibrium reactions.
8. To know the definition of, and to write the acid dissociation constant expression from reactions.
9. To apply equilibrium principles to dissociation constants in order to evaluate the strength of acids in terms of how "product favored" the equilibrium is.
10. To describe, qualtitatively, why acid strengths differ based on bonding principles.

Reading Assignments: §16.7; 17.1, 17.2
Prepared Problems: Ch. 16 #43, 45, 49, 53, 69, 71
Graded Homework due Ch. 15 #30a, b, 58, 62 (sketch graph and show fit); Ch. 16 #22, 46, 56

4/18 Outcomes:

Prepared Problems: Ch. 16 #77, 83, 91; Ch 17 #1,3,5b,11,15
Lab report due at start of class.
Group Sheet 1
Success on an hour exam covering the above outcomes and pertinent topics from lab.

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: Start Unit 2