Chem 163-03 Spring 2018

Unit 1

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

Mar-27 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 relative reaction rates are written and their relation to reaction coefficients.
4. To know examples of experimental methods used to measure rates.
5. To write rate expressions, using signs and inverse coefficients for reactants and products.
6. To understand how a rate law relates rates to concentrations and what a rate constant is.
7. To understand reaction order and how it is determined.

Assignments:

Read §14.1 – 14.2 (skim 14.3). (Prepared Problems start 3/29)

Recommended exercises (throughout course): From assigned sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

Mar-28 Laboratory

Rate of Reaction, Part 1 (pp. 20 – 24 of lab manual file; report due 4/3).

Prelaboratory assignment (p. 24) due at start of lab.

Please read and comply with the clothing requirements specified on p. 4.

Mar-29 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.

Assignments:

Read §14.3

Prepared Problems: due at start of class for peer-group review and discussion. For full credit, work must be shown and explanations made: Chapter-end problems: 14.2, 26, 32c, 38b, 14.41 (Note that the reaction is 2 ClO $\rightarrow$ Cl_2O_2; graphical method recommended).

Apr-3 Outcomes

1. To interpret rate constants from the influences of frequency factors, activation energies and temperature.
2. To describe the meaning of the transition state and contrast it to an activated complex.
3. To quantify these relationships through the Arrhenius equation algebraically and graphically.
4. To use and interpret mechanisms in describing chemical reaction processes.
5. To use the terms elementary step, molecularity, and rate-limiting step in describing mechanisms.
6. To obtain the molecularity of an elementary reaction and the overall order from a mechanism.

7. To understand the dynamics of reversible elementary reactions, and use algebra to remove intermediates from mechanisms involving reversible steps.
8. To understand what an activated complex is, and how transition state theory explains rates using potential energy diagrams.
9. To be able to relate activation energies and reaction enthalpies from potential energy diagrams.
10. To understand that kinetic data and thermodynamic data may predict different reaction outcomes.

Assignments:
Read §14.4, 14.5
Prepared Problems: Chapter-end problems, Chapter 14 #50, 53a, b, 64, 67 (also, use a graphical method to determine the order with respect to each reactant)
Lab report due at start of class, pages 22 – 23 of lab manual file.

Apr-4 Laboratory

Rate of Reaction, Part 2 (pp. 25 – 31 of lab manual file; report due 4/10).
Prelaboratory assignment (p. 31) due at start of lab.

Apr-5 Outcomes

1. To describe qualitatively the role of catalysts and to recognize catalysts within mechanisms.
2. To show the effect of a catalyst in a reaction's potential energy diagram.
3. To describe the mechanisms of action of heterogeneous catalysts and enzyme catalysis.
4. To use principles of rates and mechanisms in the description of equilibrium.
5. To interpret concentration – time and free energy graphs in describing the approach to equilibrium.
6. 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.
7. To interpret values of K to determine whether reactants or products are "favored" and how these are communicated in graphs.
8. To know that the true definition of the equilibrium constant uses activities, not concentrations.
9. 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.
10. To solve for unknown equilibrium concentrations when other equilibrium concentrations are known.
11. To use partial pressures in equilibrium constants.
12. To understand how units enter into equilibrium constants and how Kc and Kp are related.

Assignments:
Read §14.6, 15.1 – 15.3
Prepared Problems: Chapter-end problems, Chapter 14, #89, 100, 101, 105, 107.
Graded Homework, due at start of class: Chapter 14, #32a, 40 (first three intervals), 54a+b together, 66, 78, 90, 101, 104, 108 (explain)

Apr-10 Outcomes

1. To know that adding reactions causes equilibrium constants to be multiplied, and reversing the way a reaction is written inverts equilibrium constants.
2. To understand the reaction quotient (Q) and how it relates to K.
3. To use Q to predict how a non-equilibrium mixture will change to attain equilibrium.
4. To relate the standard free energy change to the equilibrium constant.
5. To find equilibrium constants from tables of thermodynamic data, and data from constants.
6. To distinguish and describe homogeneous and heterogeneous equilibria, and how heterogeneous

substances are handled in equilibrium constant expressions.
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, volume, and temperature.

Assignments:
Read §15.4 – 15.7 and §18.7
Prepared Problems: Chapter-end problems, Chapter 14, #115; Chapter 15, #4, 15, 21, 25, also in #25, if in a different experiment at the same temperature the $[N_2]$ was found to be 6.6×10^{-3} M and $[O_2]$ was still 5.8×10^{-3} M, what should the [NO] be? Also Chapter 18 #63.

Apr-11 Laboratory

An Introduction to Equilibrium (pp. 32 – 41 of lab manual file; report due 4/17).
Prelaboratory assignment (p. 41 - 42) due at start of lab. Read ahead and allow time for this Prelab.

Apr-12 Outcomes

1. 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).
2. 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.
3. To be able to calculate equilibrium concentrations from any set of starting conditions.
4. Start Unit 2 content (Chapter 16): 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 calculate pH from $[H^+]$ and the reverse.

Assignments:
Read §15.8, Unit 2 Content: §16.1 – 16.2 through p. 787.
Prepared Problems: Chapter-end problems, Chapter 15, #41, 47, 53, 61, 73, 75; Chapter 16 (read ahead), chapter end #16a,b, 17, 32 (give pH only), Chapter 18, #64

Apr-17 Outcomes

Group Sheet 2
Success on an **hour exam**! Content from all the above learning outcomes for Chapters 14 and 15, and pertinent content from lab.

Assignments:
Graded Homework, due at start of class: Chapter 15, #22, 26, 42, 54 (explain), 62, 74, 82, 94 (note: given equilibrium M of NO_2); Practice Exercise top of p. 768 (answer in book is wrong).

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.