Survey of Organic Chemistry
Chemistry 326 Lecture Section
Fall 2017
Dr. Badger

Contents:

The Instructor (contents)

- Name: Dr. Robert Badger (colleagues or fellow basketball players call me Bob; students usually call me Dr. Badger or Dr. B)
- Office: B143
- Phone: 715-346-3700
- email: rbadger@uwsp.edu

Philosophy (contents)

Chemistry 326 is the second semester a two semester organic chemistry course designed to introduce you to the properties, applications and importance of organic substances. In lecture we shall discuss - demonstrate - elucidate - illuminate material from chapters 12-30 of Smith. This necessarily means we will move at a fairly rapid pace and in some cases will not be able to discuss in sufficient detail material that may be of interest or confusing to you. I urge you to ask questions in lecture, stop by my office, or stop me in the street, if necessary, to obtain satisfactory solutions to problems you may have. I can not guarantee to have all the answers, but I will try to find them, if possible.

Format:

The course consists of three hours of lecture per week, three hours of lab per week and, at least, eight hours per week outside of class; some of the outside hours will be spent in on line and electronic notebook activities.

Audience:

Sophomores and Juniors majoring in chemistry, biochemistry or pre-professional preparation in pharmacy, medicine and other health professions. You must have achieved at least a C- or better in Chemistry 325.

Goals:

- To understand how microscopic molecular and electronic structure correlate with macroscopic physical properties and chemical reactivity.
- To understand how electron movement during chemical reactions cause atoms to move and change their bonding character.
- To understand how laboratory observations, measurements and experiments have led to the fundamental chemical concepts that describe the molecular structure and reactions of organic molecules.

Required and Supplementary Materials

REQUIRED:

Course Text: Smith, J. G., "Organic Chemistry," 3rd Edition, McGraw/Hill, 2011. Available at text rental. Chemistry majors ought to purchase this text or an equivalent one.

A black or blue ultra fine point Sharpie to be used in the lab for labeling glassware and samples.

Recommended:

- Molecular models (**strongly recommended**) can be purchased from the bookstore or over the internet. They range in price from about $10 to $40 or more. I particularly like the Indigo Instruments MolyMod kit. It is flexible and contains enough pieces to meet your current and future chemistry course needs. Another option would be to visit A113, our computer lab, and experiment with GausView a molecular modeling program. A somewhat less expensive possibility would be to purchase some gumdrops and toothpicks. In any event, make sure you have access to some models before the first exam.
- Laboratory Text: Anne B. Padias *Making the Connections: A How-To Guide for Organic Chemistry Lab Techniques*, 2nd ed.; Hayden/McNeil, Plymouth, MI, 2011. For purchase in the bookstore.
- I expect you to be able to solve all of the problems presented in the book paying especial attention the ones I have indicated in the study guide for each chapter. A student study guide and solutions manual for these problems is available for purchase in the bookstore, in the LRC reserve room and on the internet. I will be happy to discuss any of these problems in class or my office, but will not post answers since the solution manual is available.
  Janice Gorzynski Smith and Erin Smith Berk, *Student Study Guide/Solutions Manual to accompany "Organic Chemistry", 3rd Edition*, McGraw/Hill, 2011.

Lecture:

Attendance records will be maintained and extended absences will be reported to the Dean of Students. Attendance, in itself, will have no direct effect on your grade, but your performance on exams, and problem sets will undoubtedly suffer.

Lab:

Laboratory attendance is mandatory, since you will not be able to perform experimental work anywhere else.

Absences:

The student is responsible for all missed material.

Grading (contents)

Generally, final grades will be based on total points and will be assigned on the following curve:

grade	Percent points possible	Course Exercise	Course point allocations
A	93	Three Hour exams	300 pts.
A-	90-93	Twelve Problem Sets	120 pts.
B+	87-90	Laboratory	155 pts
B	83-87	Final exam	150 pts.
B-	80-83	Total	755 pts.
C+	77-80		
C	73-77	Lab points breakdown	
C-	70-73	Electronic Lab Notebook	75 pts.
D+	67-70	Post Labs and samples	40 pts.
D	60-70	Prelabs (four)	40 pts.
F	60		

I reserve the right to alter this curve depending on the overall performance of the class. I will under no circumstances raise this curve.

Exams (contents)

Exams are closed book and will be given during the Friday class hour indicated on the attached schedule(last page). Questions will be taken mainly from the lecture and assigned text. It has become my policy to include one or more problems from each chapter on exams. Thus, by diligently working the problems, you are assured of being able to successfully answer at least two or three questions correctly on exams. The more problems you solve the better your exam results will be. I have made sample exams available via the Chemistry 326 home page. These samples will give you an idea of the depth and type of questions I will ask.

Typically the exams will consist of five types of questions: 1) multiple choice similar to the problem sets; 2) short, fill in the blank questions, typically nomenclature questions; 3) three or four short reaction or structure drawing questions; 4) two of three longer essay questions, typically explain in some detail the mechanism of a reaction or formation of a particular product, for which partial credit will be given; and 5) define, describe and possibly explain questions.

Materials you may bring: pencils, pens, erasers, calculators and one side of one 3 x 5 inch index card containing any information you feel may help you on the exam.

Materials I will provide: the exam, a periodic chart, and scratch paper.

Please note the excerpt from UWSP 14 below. I am concerned about academic misconduct. It is my policy that anyone guilty of academic misconduct will receive an F

for the course grade. I intend to initiate some or all of the following measures to protect your intellectual property:

- **Assigned exam seats** On exam day I may project a list of assigned seats and you will be required to sit in your assigned seat or, if and as space allows, a seat that is completely isolated from others.
- **Unique exam** I may create two or more different exams on different colored paper. You must have a different colored exam than your neighbor to the left and right.
- **Video tape** I may video tape the exam to assist in preventing academic misconduct.
- **Your assistance** During the exam please take every precaution to protect your intellectual property - the answers you have placed on your exam. Keep your eyes on your paper or the periodic chart at the front of the class.

UWSP 14.03 ACADEMIC MISCONDUCT SUBJECT TO DISCIPLINARY ACTION. (contents)

Academic misconduct is an act in which a student:

1. Seeks to claim credit for the work or efforts of another without authorization or citation;
2. Uses unauthorized materials or fabricated data in any academic exercise;
3. Forges or falsifies academic documents or records;
4. Intentionally impedes or damages the academic work of others;
5. Engages in conduct aimed at making false representation of a student's academic performance; or
6. Assists other students in any of these acts.
7. Examples of academic misconduct include, but are not limited to:

- cheating on an examination
- collaborating with others in work to be presented, contrary to the stated rules of the course
- submitting a paper or assignment as one's own work when a part or all of the paper or assignment is the work of another
- submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas
- stealing examinations or course materials
- submitting, if contrary to the rules of a course, work previously presented in another course
- tampering with the laboratory experiment or computer program of another student
- knowingly and intentionally assisting another student in any of the above, including assistance in an arrangement whereby any work, classroom performance, examination or other activity is submitted or performed by a person other than the student under whose name the work is submitted or performed.

Homework (contents)

The most efficient way to learn new material is to practice applying it. To this end, I will give 12 multiple choice problem sets (one for each chapter) worth 10 points each which

will be submitted via the internet. While you are encouraged to discuss these problems with the instructor and classmates you must ultimately provide your own answers.

Lab (contents)

The lab grade is broken down into four parts:

Electronic Lab Notebook(70 pts.)

Grading:

The guiding principle in writing up an experiment is to record all the details which would enable another person to understand what was done and to repeat the entire experiment exactly without prior knowledge. An important first step to this process is a table of physical data, such as chemical names, chemical formulas, reported melting point where boiling point, expected mass/moles that will be used or produced. This page should also include balanced chemical reactions produced using ChemDraw or other structure drawing program. Thus, in addition to a written account of the work done, including notes on any special apparatus used, details of all volumes, weights, temperatures, times, chromatographic procedures (for instance TLC were GLC) and conditions and results, etc., must all be recorded. The writing up of all laboratory work must be done at the time of the work, in your electronic lab notebook; a loosely notebook is not suitable. It is important that numerical results such as yields, melting points and boiling points, etc., are entered directly into the notebook and not on scratch paper. The latter are liable to be lost and your use encourages untidy practical habits. Spectral data, such as proton and carbon NMR spectra and infrared spectra should be annotated and pasted directly into a graphics pane of a notebook page. Digital data files can be attached directly to that page to make it easier to retrieve and examine the spectra. Pictures of experimental apparatus and other analyses can also be placed in the notebook. (paraphrased from Kanare, H. M. **Writing the Laboratory Notebook;**, American Chemical Society: 1985 and Furniss et al, **Vogel's Textbook of Practical Organic Chemistry,** 5th ed., Wiley, 1989, p. 32.)

Five points for each lab period, are allocated for keeping the notebook up to date which means you must create and post at least one notebook entry each day describing what you have done. I will periodically scan through your notebook and comment on what you have posted. The 'guiding principle' stated above will be the rubric used to evaluate your records. Basically you will start each lab period with five points. If you post pages and do a good job recording your work, you will receive the five points.

Laboratory Maintenance(1 point for each day I have to clean up)

I will inspect all workstations at end of each lab period to see that your benchtop, sink, and common equipment are in good working order. White solids and unidentifiable liquids on your benchtop will result in loss of points. Paper towels, broken glass and other water insoluble solids found in the sink may result in loss of points for all students in the lab. Improperly or unlocked equipment drawers will result in loss of points. Everyone will lose one maintenance point every time I am required to clean up the balances or chemical hoods. Please speak with me if you are unsure how to clean up a

particular spill.

Prelabs (four)(40 pts.)

The multiple choice prelabs will consist of 10 or more questions that you will be able to answer by reading the lab procedure, the recommended pages in Padias and material in your lecture text that pertain to reactions being performed. There will undoubtably be some questions you can not answer without help from me. Please do not hesitate to ask and I will point you in the correct direction to answer the questions. This multiple choice component will be worth 5 points. The remaining 5 points will be allocated to a materials and reactions page that must be posted in your electronic notebook before the project begins. You may use laboratory time to answer these questions and prepare the materials page.

Samples and sample characterization(60 pts)

You will be submitting four samples for evaluation. Five points are allocated for submission of the physical sample itself and the remaining 10 are allocated to the presentation and analysis of physical data (mp, bp, mass, percent yield) and spectral data (ir, proton and carbon nmr) in your notebook. Missing data will cost you points. You must get all data into your notebook as soon as possible after making the measurements.

Schedules (contents)

Chemistry 326 - Tentative Lecture Schedule – Fall 2017

Exams will be held on the Exam days during the lecture hour.					
Problems sets will be due on problem days by midnight.					
Reading assignments in Smith.					
September					
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Reading Assign.**
4	5	6	7	8	Chap 13
11	12	13	***14 Prob 1***	15	Chap 12
18	19	20	***21 Prob 2***	22	Chap 16
25	26	27	***28 Prob 3***	29	Chap 17
October					
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Reading Assign.**
2	***3 Prob 4***	4	5	6 Exam 1	Chap 18
9	10	11	***12 Prob 5***	13	Chap 20
16	17	18	***19 Prob 6***	20	Chap 21
23	24	25	***26 Prob 7***	27	Chap 19
30	***31 Prob 8***				Chap 22
November					
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Reading Assign.**
		1	2	3 Exam 2	Chap 22
6	7	8	***9 Prob 9***	10	Chap 23
13	14	15	***16 Prob 10***	17	Chap 23
20	21	22	23	24	Chap 24
27	28	29	***30 Prob 11***		Chap 25
December					
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Reading Assign.**
				1 Prob 11	Chap 25
4	***5 Prob 12***	6	7	8 Exam 3	Chap 27
12	13	14	15	16 Chem 329 10:15-12:15	Chap 15
18	19	20 Chem 326 08:00-10:00	21	22	

Chemistry 326 - Tentative Lab Schedule - Fall

Multiple choice prelabs must be submitted by midnight on the specified due date. Materials page and reactions are due in your notebook 24 hours before your lab section is scheduled to begin a given project. Post labs are due the midnight on the date specified. The readings below refer to relevant web pages.

Week	Starting Date	Experiment	Reading Assignment pp
1	September 6-11	Check-in	Check-in
	September 12	***Benzoin Prelab is due***	
2	September 14-18	Reduction of Benzoin	
3	September 20-25	Reduction of Benzoin	
4	Sept. 26-Oct. 2	Reduction of Benzoin	
	October 3	***Acetylferrocene Prelab is due***	
5	October 4-9	Preparation of Acetylferrocene	
	October 13	***Benzoin Postlab is due***	
6	October 11-16	Preparation of Acetylferrocene	
7	October 18-23	Preparation of Acetylferrocene	
	October 24	***Triphenylmethanol Prelab is due***	
8	October 25-30	Preparation of Triphenylmethanol	
	November 4	***Acetylferrocene Postlab is due***	
9	November 1-6	Preparation of Triphenylmethanol	
10	November 8-13	Preparation of Triphenylmethanol	
	November 14	***Esterification Prelab is due***	
11	November 15-20	Fischer Esterification	
	December 1	***Triphenylmethanol Postlab is due***	
12	November 27-29	Fischer Esterification	
13	December 4-6	Fischer Esterification	
14	December 11-13	Check-out	
	December 15	***Esterification Postlab is due***	

Learning Goals (contents)

Chapter 13 Mass Spectrometry and Infrared Spectroscopy

1. Be able to use mass spectra to determine molecular weight.
2. Be able to deduce the presence of Br, Cl, and N from analysis of the molecular ion region.
3. Be able to use fragmentation patterns to assist in the confirmation of a proposed structure.
4. Be able to integrate IR, NMR and MS data to determine structure.
5. Be able to integrate IR and NMR to determine structure.
6. Given the structure of a molecule, be able to predict important features of its IR, NMR and MS spectra.
7. Be able to identify functional groups (alkane, alkene, alkyne, aromatic, alcohols, amines, aldehydes, ketones, carboxylic acids, carboxylic esters, and amides) present in a molecule from characteristic band frequency, intensity and shape.
8. Be able to predict stretching frequencies and band shapes for a given structure.
9. Be able to identify conjugated systems from their IR frequencies.

Spectroscopy Tutorials

Suggested problems: Pages 489-493

25, 27, 28, 30, 33, 35, 37, 38, 39, 40, 42

Last update:

Chapter 12 Oxidation and Reduction

1. Be able to identify whether the organic reactant in a reaction has undergone oxidation or reduction.
2. Be able to identify the common reduction reactions of carbon-carbon multiple bonds.
3. Be able to determine the stereoselectivity of the common reduction reactions of carbon-carbon multiple bonds.
4. Be able to use the common reduction reactions of carbon-carbon multiple bonds in synthetic processes.
5. Be able to identify the common reduction reactions of alkyl halides and expoxides with lithium aluminum hydride.
6. Be to identify the common oxidation reactions of alkenes, alkynes and alcohols.

Suggested problems: Pages 457-462

32, 33, 34, 35, 39, 40, 43, 44, 45, 46, 49, 50, 53, 63, 64, 65, 66

Last update:

Chapter 16 Conjugation, Resonance and Dienes

1. Be able to draw simple pi molecular orbitals for isolated dienes and conjugated dienes.
2. Be able to draw resonance structures for allyl and conjugated systems.
3. Be able to evaluate the relative stability of resonance structures.
4. Be able to draw mechanisms that explain 1,2 and 1,4 electrophilic additions to conjugated dienes.
5. Be able to draw the products and stereochemistry of Diels-Alder reactions of dienes.
6. Be able to discuss and identify the products of kinetic control.
7. Be able to discuss and identify the products of thermodynamic control.

Suggested problems: pages 601-606

31, 32, 33, 34, 35, 36, 38, 39, 42, 44, 45, 46, 48, 50, 51, 52, 54, 56, 58, 61, 66

Last update:

Chapter 17 Benzene and Aromatic Compounds

1. Be able provide common names for aromatic molecules.
2. Be able to draw the Kekule structures for benzene.
3. Be able to predict/explain proton and carbon nmr chemical shifts for aromatic systems.
4. Be able to draw the bonding molecular orbitals for benzene and cyclobutadiene.
5. Be able to identify non-aromatic, anti-aromatic and aromatic systems.
6. Be able state the principle requirments for aromatic systems.
7. Be able to identify heterocyclic aromatic systems and specify the electon pairs that are part of the aromatic system (furan and pyrole).
8. Be able to identify charged aromatic systems such as the cylopentadienyl anion and the tropilium cation.

Suggested problems: pages 633-640

End of chapter: 26, 28, 29, 30, 32, 33, 34, 35, 36, 37, 41, 42, 44, 47, 51, 54, 58, 60, 64

Last update:

Chapter 18 Electrophilic Aromatic Substitution

1. Be able to predict products of the reaction of benzene, mono and di substituted benzenes with:
    1. $Br_2/AlBr_3$
    2. H_2SO_4/SO_3
    3. HNO_3/H_2SO_4
    4. $R\text{-}Cl/AlCl_3$

5. R-C=OCl/$AlCl_3$

2. Be able to draw mechanisms for the above reactions including all resonance structures for reactive intermediates.
3. Be able to explain activating/deactivating effects based upon mechanisms of electrophilic aromatic substitution.
4. Be able to explain ortho-para and meta directing effects of substituients.
5. Be able to design syntheses that use the reactions above to prepare compounds.
6. Be able to predict and explain reactions of benzylic positions in aromatic compounds.

Suggested problems: pages 680-687

End of chapter: 35, 36, 37, 38, 39, 40, 42, 44, 46, 47, 51, 5253, 57, 62, 63, 64, 70, 79

Last update:

Chapter 20 Introduction to Carbonyl Compounds

1. Be familiar with the reduction of carbonyl compounds, α, β unsaturated compounds acid chlorides, esters, carboxylic acids, and amides. Review the oxidation of aldehydes with CrO_3, $Na_2Cr_2O_7$, $K_2Cr_2O_7$, $KMnO_4$ and Ag_2O/NH_4OH.
2. Be able to prepare and describe Grignard reagents and their common reactions.
3. Be able to prepare and describe organolithium reagents and their common reactions.
4. Be able to prepare and describe Gilman (organocuprates) reagents and their common reactions.
5. Be able to prepare and describe lithium and sodium acetylides and their common reactions.
6. Be able to use silyl groups to protect alcohols in synthetic schemes.

Suggested problems: pages 765-773

End of chapter: 39, 40, 41, 42, 43, 45, 46, 48, 50, 51, 52, 53, 56, 59, 60, 61, 64, 67, 71, 72, 74, 82

Last update:

Chapter 21 Aldehydes and Ketones - Nucleophilic Addition

1. Be able to name/draw structures of ketones and aldehydes.
2. Be able to interpret NMR, IR and mass spectra of ketones and aldehydes and determine their structures from spectral data.
3. Be able to predict reaction products of ketones and aldehydes with:
    - Grignard reagents
    - organolithium reagents
    - Wittig Reagents (phosphorus ylides)

- hydrogen cyanide
- ammonia and amines
- water
- alcohols and glycols
- hydrogen/catalyst
- sodium borohydride
- lithium aluminum hydride

Assume that aqueous acid workup will be used as appropriate for some of these reactions.

4. Draw mechanisms for the above reactions.

Suggested problems: pages 815-824

End of chapter: 42, 43, 45, 47, 48, 49, 50, 52, 53, 55, 57, 60, 61, 63, 66, 71, 73, 75, 76, 79, 85, 86, 93

Last update:

Chapter 19 Carboxylic Acids

1. Be able to provide IUPAC and common names for carboxylic acids containing up to 10 carbon atoms.
2. Be able to provide IUPAC and common names for dicarboxylic acids containing up to 6 carbon atoms.
3. Be able to prepare carboxylic acids from primary alcohols and alkyl substituted benzene rings.
4. Be able to predict and explain the relative acidity of carboxylic acids, phenols, and alcohols.
5. Be able to predict reaction products with sodium bicarbonate, sodium hydroxide and strong mineral acids.
6. Be able to recognize an α-amino acid.
7. Be able to define the isoelectric point for amino acids and be aware that the pI is usually the average of the $pK_a$of the carboxylic acid and the ammonium ion.

Suggested problems: pages 714-720

End of chapter: 30, 31, 33, 34, 35, 36, 37, 38, 39, 41, 43, 56, 57, 66, 68

Last update:

Chapter 22 Carboxylic Acid Derivatives

1. Be able to provide common and IUPAC names for simple acid derivatives discussed in the chapter.
2. Be able to explain the differences in physical properties of acids and acid derivatives.
3. Be able to interconvert acid derivatives via acyl substitution.

4. Be able to draw mechanisms for interconversion of acid derivatives.
5. Be able to predict products of acid derivatives when reacted with:
    1. H_2O acidic or basic conditions
    2. LAH
    3. Grignard reagents
    4. Organolithium reagents
    5. Alcohols
    6. Amines
6. Be able to draw mechanisms for the acid catalyzed or base promoted hydrolysis of acid derivatives.
7. Be able to draw mechanisms for the reaction of acid chlorides and acid anhydrides with alcohols and amines.
8. Be able to synthesize acid derivatives from carboxylic acids.

Suggested problems: pages 870-879

End of chapter: 41, 42, 43, 45, 46, 47, 48, 50, 52, 54, 55, 57, 58, 61, 64, 68, 69, 71, 72, 76, 82, 85, 89

Last update:

Chapter 23 Substitution Reactions of Carbonyl Compounds at the α Carbon

1. Be able to draw mechanisms for acid and base catalyzed keto-enol tautaumerizations.
2. Be able to predict products and draw mechanisms for base promoted halogenation of ketones.
3. Be able to describe the conditions that effect kinetic or thermodynamic formation of α enolate anions.
4. Be able to predict the products and draw the mechanism of α alkylation reactions.
5. Be able to predict the products and draw the mechanisms of malonic ester synthesis.
6. Be able to predict the product and draw the mechanism of the acetoacetic ester synthesis.
7. Be able to use theses α carbonyl reactions to synthesize compounds.

Suggested problems: pages 908-915

End of chapter: 30, 31, 32, 33, 34, 36, 39, 41, 43, 46, 47, 49, 52, 53, 54, 56, 60, 61, 64, 65, 71, 72

Last update:

Chapter 24 Carbonyl Condensation Reactions

1. Be able to predict the products and draw the mechanisms of base promoted aldol and crossed aldol condensations.
2. Be able to predict the products and draw the mechanisms of Claisen, crossed Claisen and Dieckmann condensations.
3. Be able to predict the product and draw the mechanism of Michael addition reactions.
4. Be able to use the aldol condensation, Claisen condensation, Michael addition, Robinson annelation, acetoactic ester and malonic ester reactions to synthesize compounds.

Suggested problems: pages 941-948

End of chapter: 27, 28, 30, 31, 32, 35, 37, 38, 41, 42, 44, 45, 46, 47, 50, 52, 54, 55, 59, 60, 61, 63, 69

Last update:

Chapter 25 Amines

1. Be able to name simple amines.
2. Be able to explain/predict the relative boiling points of amines.
3. Be able to explain/predict the relative basicities of amines.
4. Be able to draw the products formed when amines react with strong acids.
5. Be able to prepare amines via substitution and reduction reactions.
6. Be able to predict the products when amines reaction with aldehydes, ketones, acid chlorides and acid anhydrides.
7. Be able to predict the products formed when amines (primary, secondary and tertiary aliphatic and aromatic) react with nitrous acid.
8. Be able to exploit the synthetic utility of primary aromatic amines in synthetic processes.
9. Be able to explain and predict the products of Hoffman elimination.

Suggested problems: pages 994-1001

End of chapter: 41, 42, 44, 45, 46, 48, 51, 54, 55, 56, 57, 58, 60, 61, 66, 67, 71, 74, 77, 81, 86, 88

Last update:

Chapter 27 Carbohydrates

1. Know the meaning of: carbohydrate, monosaccharide, oligosaccharide, polysaccharide, disaccharide, trisaccharide.
2. Know the meaning of: aldose, ketose, triose, tetrose, pentose, hexose, glyceraldehyde, dihydroxyacetone.
3. Know the meaning of: D- or L-sugar, Fischer projection formula, Haworth formula, epimer.

4. Know the meaning of: (α and β configurations, anomer, furanose and pyranose forms, mutarotation.
5. Know the meaning of: glycosidic bond, reducing and nonreducing sugar, aldaric acid, aldonic acid.
6. Draw the Fischer projection formula for a simple monosaccharide.
7. Tell whether two structures are epimers or anomers.
8. Given the acyclic formula for a monosaccharide, draw its cyclic structure in either the pyranose or furanose form and either (α or β configuration.
9. Given the formula for a monosaccharide, draw the formula for its glycoside with a given alcohol or with a given additional monosaccharide.
10. Draw the cyclic structures (Haworth projection and conformational structure) for (α-D- and β-D-glucose and the corresponding methyl glycosides.

1. Be able to draw the Fischer projection of D-glucose from memory.
2. Be able to draw the Haworth projection or chair conformation(all substituents equatorial) of beta-D-glucose.
3. Given the Fischer projection of a keto or aldohexose, be able to draw the Haworth projection of the alpha or beta epimers of furanose or pyranose rings.
4. Be able to name mono and disaccharides and draw structures from names.
5. Be able to draw the mechanism for base catalyzed epimerization and enediol rearrangement of aldoses.
6. Be able to predict whether a carbohydrate will mutarotate.
7. Be able to predict whether a carbohydrate is a reducing sugar.
8. Be able to draw and identify glycidic linkages.
9. Be aware of the oxidation (with Ag_2O/NH_4OH or HNO_3) and reduction products of the aldohexoses.

Omit sections: 27.10, 27.10A, 27.10B, 27.10C, 27.11

Suggested problems: pages 1068-1073

End of chapter: 39, 40, 43, 46, 47, 48, 50, 59, 63

Last update:

Chapter 15 Radical Reactions

1. Be able to draw initiation, propagation and termination elementary steps for free radical halogenation.
2. Be able to draw Lewis structures and describe the characteristics of free radical reactive intermediates.
3. Be able to utilize bond dissociation energies to evaluate energy changes in the elementary steps of free radical halogenation.
4. Be able to utilize bond dissociation energies to assist in the construction of reaction coordinate diagrams.
5. Be able to explain what is meant by the rate determining step and activation energy.
6. Be able to draw the transition state for the rate determining step in the

halogenation of alkanes.

7. Explain the relative reactivity of primary, secondary and tertiary hydrogens in halogenation reactions.
8. Explain the relative stability of primary, secondary and tertiary alkyl radicals.
9. Be able to explain and draw the stereochemistry of products formed in free radical processes when a new chiral center is formed and when a chiral center is already present in the reactant.
10. Explain the free radical halogenation of allyl and benzyl systems with NBS.
11. Explain the addition of HBr to alkenes in the presence of peroxides.

Suggested problems: pages 565-570

32, 33, 34, 35, 36, 37, 39, 40, 41, 44, 45, 46, 48, 49, 51, 55, 56, 59, 62, 63, 70, 77
