CH2420: ORGANIC CHEMISTRY – Summer 2005

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Text: Fessenden & Fessenden, 6th edition

TENTATIVE SCHEDULE

I. **Spectroscopy**: IR (Origin of Infrared Absorption, Functional Group Bands, Fingerprint Region), \(^1\)H NMR (Origin Nuclear Magnetic Resonance, NMR Spectrum and Terminology, Shielding-Deshielding by \(\sigma\) and \(\pi\) electron Induced Fields, Equivalent versus Nonequivalent Protons, Integration, Spin-Spin Coupling, \(n+1\) Rule and Splitting Patterns, Chemical Exchange, Factors that Complicate Splitting Patterns, High-Field Spectrometers), \(^13\)C NMR (Theory, Chemical Shifts, Off-Resonance Decoupling), Problem Solving with Spectroscopy.

II. **Alkenes and Alkynes**: Acidity of Alkenes versus Alkynes (Alkyne Reactions with NaNH\(_2\) and Organometallics), \(^1\)H NMR Spectroscopy (cis versus trans Coupling Constants and Allylic Coupling), Synthesis with Alkyne Anions, Electrophilic Additions (General Mechanism, Hydrohalogenation and Markovnikov's Rule, Hydration, Oxymercuration, Hydroboration, Halogenation), Free-Radical Addition of HBr, Carbenes (Generation and Addition to Alkenes), Reductions (Catalytic Hydrogenation and Sodium-Liquid Ammonia), Oxidations (sym Dihydroxylation with KMnO\(_4\) and OsO\(_4\), Oxidative Cleavages with Permanganate and Ozone).

III. **Benzene and Electrophilic Aromatic Substitutions**: Nomenclature, IR and NMR Spectroscopy, Aromaticity versus Antiaromaticity (Benzenoid, Nonbenzenoid and Heterocyclic Systems) Electrophilic Aromatic Substitution Mechanism, Monosubstitutions (Halogenations, Nitrations, Sulfonations, Friedel-Crafts Alkylations and Acylations), Disubstitutions (Relative Reactivities and Directing Effects), Trisubstitutions.

IV. **Substituted Benzenes**: Side Chain Reactions of Alkylbenzenes, Phenols, Benzenediols and Benzoquinones (Photography, Dyes, Coenzyme Q and Biological Electron Transfer), Benzenediazonium Salts (Sandmeyer Reactions, Azo Coupling and Azo Dyes), Nucleophilic Aromatic Substitutions (Addition-Elimination versus Benzyne Mechanism), Multistep Aromatic Syntheses.


VI. **Carboxylic Acids and Derivatives**: Nomenclature, Conversion of Carboxylic Acids into Acyl Halides and Anhydrides, Esterification - Ester Hydrolysis, Carboxylic Acid Derivatives (Relative Reactivities, Reactions with Oxygen Nucleophiles, Nitrogen Nucleophiles, Metal Hydrides, Organometallics), \(\alpha\)-Halogenations, Hofmann Rearrangement of Amides, Polyesters, Polyamides, Polyurethanes, Decarboxylation of \(\beta\)-Keto Acids.
VII. **Enolates and Carbanions:** Acidity of Carbonyl Compounds, Alkylations of Enolate Ions (Malonic Ester/Acetoacetic Ester Syntheses, Aldol and Related Condensations), Aldolase Mediated Retro-Aldol of Fructose 1,6-bisphosphate, Acylations of Enolate Ions and Enamines (Claisen and Related Condensations), Michael and Related Conjugate Additions.

VIII. **Nucleophilic Additions to $\alpha,\beta$-Unsaturated Carbonyl Compounds:** Kinetic versus Thermodynamic Control of 1,2- and 1,4-Nucleophilic Additions.

**Quizzes and Exams:**

There will be five 1-hour exams (short-answer type, 100 pts. each). The exams will be in-class exams and are scheduled for **Thursday July 7, Monday, July 18, Wednesday, July 27 Thursday, August 4 and Friday, August 12.** My exams are designed to test your ability to apply what you have learned, not to test your ability to simply regurgitate information. I will also be handing out a number of self-assessment quizzes throughout the semester.

**Grades:**

Your course grade will be determined by the percentage of the 500 possible total points earned. I do not have any set percentage-letter grade equivalencies, but from past experience, I expect the beginning percentages for A, B, C, and D to be the following: A ~ 83%, B ~ 72%, C ~50%, D ~40%.

**Problems:**

Selected in-chapter and end-of-chapter problems are assigned for each of the chapters covered and are listed below. The problems will not be collected or graded. It is to your advantage to work as many of the assigned (and unassigned) problems as possible. Working problems is the best way that I know for you to gauge your understanding of organic chemistry. If you truly understand how to work the assigned problems, you should have little (if any) trouble on the exams.

In addition to the text problems, I will pass out my own problem sets as a form of review of the material covered before each exam. These will also provide examples of the type of questions you should expect to see on my exams.
Assigned Problems


Chapter 10: 10.5-10.7, 10.9c,d, 10.10, 10.12, 10.14, 10.18, 10.19, 10.21b, 10.22a,b, 10.24, 10.25b,d, 10.26, 10.27c,f,h, 10.30, 10.31a-d,f,g, 10.32, 10.33, 10.34, 10.36-10.40a,c,d,f, 10.41-10.47, 10.48a,e,f, 10.49a, 10.50a, 10.51-10.56, essay.

Chapter 11: 11.1, 11.2b, 11.4, 11.6, 11.7b,d, 11.8, 11.9, 11.11a-e,g, 11.13, 11.14, 11.15b,d-f, 11.16c, 11.17, 11.18, 11.20, 11.22c,e-g, 11.25a,c,e, 11.26, 11.27a,b,d, 11.28 - 11.35, 11.36b, 11.37, 11.40, 11.42, essay.

Chapter 12: 12.2, 12.5, 12.6, 12.9, 12.10, 12.12, 12.13 - 12.15, 12.17c-e, 12.18, 12.19a-e, 12.20, 12.21, 12.22a,c-g,i, 12.24, 12.25, 12.27, 12.28c,d,e, 12.29, 12.31, 12.33, essay.


Chapter 14/15: nomenclature (14.1a,c,d,f, 14.2b,c,f-h, 14.16a,b, 14.17a,b,e, 14.18c, 15.3, 15.10, 15.13, 15.24, 15.26c, 15.32, 15.36b,c, 15.38b, 15.39), 14.3, 14.5a,c, 14.6a,b, 14.7b-e, 14.8, 14.9, 14.13, 14.15c, 14.20, 14.21, 14.22, 14.23d,g,h, 14.24, 14.25, 14.26, 14.28, 14.29, 14.30a, 14.31, 14.32a, 14.33a,b,d,e,h, 14.35b-d,g, 14.39, 14.40, 14.41, 14.42a,d,e,h,i, 14.43, 15.1, 15.2, 15.9, 15.11, 15.14, 15.16a,c,d, 15.19b, 15.20, 15.25, 15.28, 15.30(for 15.29a), 15.34, 15.35, 15.40, 15.41 - 15.43, 15.44b-d,i, 15.45a, 15.46, 15.47a, 15.48, 15.51a,d,f, 15.52b,c, 15.53-15.55, essays. 18.8.

Chapter 17: 17.1, 17.2, 17.6, 17.8b,c,e, 17.9, 17.10a, 17.11, 17.13, 17.15, 17.16, 17.17b, 17.18b,c, 17.21a,c,f, 17.22a-c, 17.24a,e,d, 17.25, 17.26b,e, 17.28a,c, 17.30b-e, 17.31, 17.32, 17.33a, 17.34a,d, 17.35d,e,i, 17.36a,c, 17.37a, 17.38a, 17.39, 17.40, 17.42a,c, 17.43, 17.44a,c,d,f,g,k, essay.

Chapter 16: 16.17, 16.23b,d,e, 16.26, 16.36.