ORGANIC CHEMISTRY
CHEM 241

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Course goals and objectives: This is an introductory course to organic chemistry. Particular attention will be given to the correlation of molecular properties with the physical properties of materials. Detailed mechanisms of several reactions will be covered. This course will provide the needed background for the more advanced Organic Chemistry courses CHEM 242 and CHEM 243.

Resources: Textbook: Wade (first 8 or 9 chapters)

Grading:

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<td>2 1-hour exams</td>
<td>2 x 100</td>
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<tr>
<td>final</td>
<td>200</td>
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<td>total</td>
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Course Information: An FAQ for the class is maintained on WebCT and is updated periodically. E-mail the instructor if your question is not addressed in the FAQ.

Make-up test policy: Tests, quizzes and exam will be available on WebCT. Location and times of testing will be specified in class. Quizzes will be available for each chapter but will not count towards the final grade. Make-up tests will be available on WebCT but will consist of additional questions without additional time. If the make-up option is requested for a test, the grade on the make-up will be used, even if lower than the original test.

Course Format: Each lecture will consist of an overview of approximately one Chapter or one Problem Set. In this package you will find a summary of the important points you will be responsible to know for the exam. You are expected to carefully read the chapters and do the problems BEFORE coming to class to gain maximum benefit from the lecture.

Online Option: A fully online option is available. Simply e-mail the instructor that you would like to take the class fully online and, instead of physically attending class, access the lectures on WebCT going through http://one.drexel.edu. Students attending the class fully online are encouraged to contact the instructor by e-mail to ask questions that will be answered at the start of the following class or to schedule phone or physical appointments to go over any material that requires further explanation.

Attendance Policy: No attendance will be taken.

Grading Policy: A: 90-100%  B: 80-89%  C: 65-79%  D: 50-64%  F: 0-50% (borderline grades are left to the discretion of the professor)
LEWIS DOT APPROACH TO MOLECULAR STRUCTURE

Predicts geometry, polarity, basicity, etc.

ONE COVALENT BOND = 2 SHARED ELECTRONS

1) Count total number of electrons available (by the row in the periodic table, e.g. C=4, N=5, O=6, F=7, Ne=8)

2) Find out how many electrons are needed:
   - 8 for each C, N, O, F and related elements
   - 2 for H

3) \[ \frac{(2)-(1)}{2} = \text{number of bonds in the molecule} \]

4) After placing bonds, complete octets

5) Count electrons around atoms and place charges

6) Make sure total charge, total number of electrons and octets work out
CHAPTER 1
Electronic Configuration

Pauli Exclusion Principle:
- Only 2 electrons per orbital (opposite spin)
- Electrons like to be unpaired if possible

Types of bonds: covalent and ionic

Valence Periodic Table

Solving Lewis Structures

Resonance Hybrids and curved arrow formalism

Lewis, skeletal and condensed structural formulas

Molecular and empirical formulas

Acids and Bases
   Lowry-Bronsted Acid: PROTONS (H+)
   Lewis Base: Lone pair of electrons

Problems
(Edition 4): 22, 24, 27, 36a-c
(Edition 5): 23, 25, 28, 37a-c

CHAPTER 2

Atomic and Molecular Orbitals: the geometry of electron probability distribution
   s, p, sp, sp², sp³

Hybrid orbitals
   sp = 2 groups of electrons = linear
   sp² = 3 groups of electrons = trigonal planar (120°)
   sp³ = 4 groups of electrons = tetrahedral (109°)

Pi and Sigma bonds-the ethylene example

Rigidity of Double Bonds

Isomerism- structural isomers and stereoisomers (geometrical isomers)

Bond polarity and dipole moment
Molecule Polarity: sum of dipole moments

Intermolecular Forces
  Dipole-Dipole interaction (e.g. CH\textsubscript{3}COCH\textsubscript{3} acetone)
  Hydrogen bonding (e.g. HF, H\textsubscript{2}O) NEED F,O or N and H
  van der Waals forces (e.g. He, CH\textsubscript{4})

Structure and physical properties
  Melting point (higher for stronger intermolecular forces)
  Boiling point (higher for stronger intermolecular forces)
  Solubility (like dissolves like)

Alkanes, Alkenes, Alkynes, Alcohols, Ethers, Aldehydes and Ketones, Carboxylic Acids
Acid Chlorides, Esters, Amides, Amines

Problems:
(Edition 4)27,32,33,34,35,36,38,40,42
(Edition 5)29,34,35,36,37,38,40,42,44

CHAPTER 3

Hydrocarbons: aliphatic (-anes), aromatic
Let’s count to 10: methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, decane

Nomenclature: isopropyl, isobutyl, n-butyl, sec-butyl, t-butyl,

Primary, Secondary, Tertiary, Quaternary centers

Reactions of Alkanes
  1) combustion
  2) cracking
  3) halogenation

Conformations of ethane, propane, butane
Newman projections
Steric Hindrance

Cycloalkanes
Cis-trans isomerism of cycloalkanes
Chair and boat configurations of cyclohexane
Axial and Equatorial positions
Problems:
(Edition 4) 33,34,42,44
(Edition 5) 33,34,42,44

CHAPTER 4
Free radical chain reaction: halogenation of alkanes
Bromination of methane
Bond Dissociation Energy
Homolysis and Heterolysis
Transition State (Predicting the geometry using the Hammond Postulate)
Rate-limiting step

Bromination of propane
Chlorination of propane (loss of selectivity)
Free-radical stabilities

Carbocations/Carbanions

Problems
(Edition 4) 37,39,40,43,47
(Edition 5) 39,41,42,45,49

CHAPTER 5
Chirality
R and S configurations
Optical activity: detrorotatory and levorotatory
Specific rotation
Racemic mixture
Fisher Projection
Diastereomers and Enantiomers
Reactions involving chiral centers

Problems
(Edition 4) 27,28,31
(Edition 5) 26,27,30
CHAPTER 6
Alkyl halides
Nomenclature
Preparation
   1) Free-radical halogenation
   2) Hydrohalogenation of alkenes
   3) From alcohols
   4) From other alkyl halides
Reactions
   1) elimination
   2) nucleophilic substitution
SN1 and SN2 reactions
Solvent effects on nucleophilicity
Walden inversion
Rearrangements in SN1 reactions (hydride and methyl shifts of carbocations)
E-1 and E-2 Reactions
Satyzeff Rule

Problems
(Edition 4) 51,52,54,61,64,70,72
(Edition 5) 43,44,46,53,56,60,62

CHAPTER 7
Alkenes
Unsaturation
Nomenclature
Z and E, cis and trans
8 Carbon Rule

Preparation
   1) Dehydrohalogenation
   2) Dehalogenation
   3) Dehydration of alcohols
   4) Catalytic cracking of alkanes
   5) Wittig synthesis

Problems
(Edition 4) 20,22,25,27,31
(Edition 5) 31,33,36,38,42
CHAPTER 8

Reactions of Alkenes
Electrophilic addition
Markovnikov’s rule
Anti-Markovnikov addition
Hydration of Alkenes
Anti-Markovnikov hydration by hydroboration
Catalytic hydrogenation
Simmons-Smith reaction
Halogenation
Hydrohalogenation
Epoxidation
Permanganate hydroxylation (cold, dilute)
Permanganate (warm, concentrated)
Ozonolysis
O$_4$O
Carbenes

Problems
(Edition 4) 44(except o), 45(a-f),46,64
(Edition 5) 47(except o),,48(a-f),49,67

CHAPTER 9

Nomenclature of alkynes
Acidity of alkynes
Preparation
   From vicinal dihalides
   From acetylides

Reactions
   Hydrogenation
   Partial hydrogenation (Lindlar’s catalyst)
   Halogenation
   Markovnikov addition of HBr
   Hydration to ketones
   Permanganate (cold, dilute)
   Permanganate (warm, concentrated)

Problems
(Edition 4) 27,33(a-j),36,37
(Edition 5) 27,33(a-j),36,37