

| Topic | Comments | |
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| Covalent Bonding and Shapes of Molecules | | |
| 1.1 Electronic Structure of Atoms | Concepts and principles and definitions you should know from General Chemistry | |
| 1.2 Lewis Model of Bonding | | |
| How To Draw Lewis Structures From Condensed Structural Formulas | | |
| The Octet Rule | | |
| 1.3 Functional Groups | | Know the ones presented in lectures |
| 1.4 Bond Angles and Shapes of Molecules | | Know the organic examples: alkanes; alkenes; alkynes |
| 1.5 Polar and Nonpolar Molecules | | Be able to classify both bonds & molecules as polar or nonpolar |
| 1.6 Quantum or Wave Mechanics | | Wave function; orbitals & shapes of orbitals (definitions) |
| 1.7 The Molecular Orbital and Valence Bond Theories of Covalent Bonding | | Hybridization-know all 3 types for C & the geometry & bond angles for each |
| 1.8 Resonance | | Know how to interconvert structures by moving pairs of e- and charges and double bonds |
| How To Draw Curved Arrows and Push Electrons | VSEPR & Resonance | |
| 1.9 Molecular Orbitals for Delocalized Systems | In Alkanes, Alkenes & Alkynes | |
| 1.10 Bond Lengths & Bond Strengths | | |
| 2 Alkanes and Cycloalkanes | | |
| 2.1 The Structure of Alkanes | C_nH_{2n+2} and sp^3 hybridization | |
| 2.2 Constitutional Isomerism in Alkanes | definition and how to draw them | |
| 2.3 Nomenclature of Alkanes & The IUPAC System | Basic IUPAC system | |
| 2.4 Cycloalkanes | C_nH_{2n} | |
| 2.5 Conformations of Alkanes and Cycloalkanes | Butane conformers; chair, boat, twist-boat | |
| 2.6 Cis, Trans Isomerism in Cycloalkanes | definition and how to draw them | |
| How To Convert Planar Cyclohexanes to Chair Cyclohexanes | from 2D to 3D chairs | |
| 3 Stereoisomerism and Chirality | | |
| 3.1 Chirality—The Handedness of Molecules | the concept & recognize chiral carbons | |
| 3.2 Stereoisomerism | Definition and how to recognize it | |
| How To Draw Chiral Molecules | enantiomers | |
| 3.3 Naming Chiral Centers—The R,S System | know rules of priority | |
| How To Assign R or S Configuration to a Chiral Center | | |
| 3.4 Acyclic Molecules with Two or More Chiral Centers | diastereomers; how to recognize them | |
| 3.5 Cyclic Molecules with Two or More Chiral centers | use in cycloalkane systems | |
| 3.6 Tying the terminology together | | |
| 3.7 Optical Activity—How Chirality Is Detected | know concept & definitions | |
| Cutoff for Exam 1 Material | | |
| 4 Acids and Bases | | |
| 4.1 Arrhenius Acids and Bases | definition and use in context | |
| 4.2 Brønsted-Lowry Acids and Bases | definition and use in context | |
| 4.3 Acid Dissociation Constants, pKa; Relative Strengths | know trends | |

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| 4.4 The Position of Equilibrium in Acid-Base Reactions | know how to determine |
| 4.5 Thermochemistry & Mechanisms of Acid-Base | Rxn coordinate diagrams; "pushing electrons" |
| 4.6 Molecular Structure and Acidity | trends in size; delocalization effects |
| 4.7 Lewis Acids and Bases | definition |
| 5 Alkenes: Bonding, Nomenclature, & Properties | |
| 5.1 Structure of Alkenes | hybridization; geometry; π bonding |
| How To Calculate the Index of Hydrogen Deficiency | know format & how to apply it (CHO formulas only) |
| 5.2 Nomenclature of Alkenes | IUPAC rules; common names |
| 5.3 Physical Properties of Alkenes | Nonpolar hydrocarbons; BP trends |
| 6 Reactions of Alkenes | |
| 6.1 Reactions of Alkenes—An Overview | π bond as a Lewis base; acts as the nucleophile |
| 6.2 Organic Reactions Involving Reactive Intermediates | protocols & rules for writing mechanisms |
| 6.3 Electrophilic Additions | H_2O ; X_2/H_2O ; X_2/CH_2Cl_2 mechanism for all |
| 6.4 Hydroboration-Oxidation | BH_3 ; H_2O_2 ; OH and $Hg(OAc)_2$; H_2SO_4 - partial mechanism |
| 6.5 Oxidation | OsO_4 ; glycols; O_3 (also see epoxidation 11.8(for final xm)) |
| 6.6 Reductions | Stereochemistry; rank order of alkene stabilities |
| Cutoff for Exam 2 Material | |
| 7 Alkynes | |
| 7.1 Structure of Alkynes | Bond angle is 180° |
| 7.3 Physical Properties of Alkynes | Nonpolar hydrocarbons; BP trends |
| 7.4 Acidity of 1-Alkynes | Terminal alkyne H pKa~25 |
| 7.5 Preparation of Alkynes | Dehydrohalogenation (twice)- mechanism |
| Alkyne anions as nucleophiles & bases | Know C-C bond rxn; use of $R-C\equiv C Na$ as a base- mechanism |
| 7.6 Electrophilic Addition to Alkynes | halogenations; addn of HX |
| 7.7 Hydration of Alkynes to Aldehydes and Ketones | $(sia)_2BH$; H_2O_2 ; OH and $HgSO_4$; H_2SO_4 |
| | keto-enol tautomerism & how it is used |
| 7.8 Reduction of Alkynes | Complete & partial; stereochemistry |
| 7.9 Organic Synthesis | Know how to do simple two step synthesis-how to use the reactions in sequence. |
| 8 Haloalkanes, Halogenation, and Radical | |
| 8.1 Structure | Haloalkanes Classification as 1° 2° 3° |
| 8.2 Nomenclature | Basic IUPAC |
| 8.3 Physical Properties of Haloalkanes | Solubility trends; BP trends |
| 8.4 Preparation of Haloalkanes by Halogenation of alkanes | Free radical substitution reaction |
| 8.5 Mechanism of Halogenation of Alkanes | Initiation; chain reaction; termination |
| 8.6 Allylic Halogenation- Mechanism | role of NBS; stability of the allylic radical |
| 8.8 Radical Addition of HBr to Alkenes | Difference of radical vs ionic addn of HBr- Mechanism |

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| 9 Nucleophilic Substitution and β-Elimination | |
| 9.1 Nucleophilic Substitution in Haloalkanes | Definition |
| 9.2 Mechanisms of Nucleophilic Aliphatic Substitution | Solvent properties-polar; nonpolar; protic; aprotic |
| 9.3 Experimental Evidence for SN1 and SN2 Mechanisms | energy diagrams for both; arrow pushing for both |
| | Kinetics; stereochemistry; structure of RX |
| 9.4 Analysis of Several Nucleophilic Sub Rxns | Conditions for SN1 vs SN2 |
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| Cutoff for Exam 3 Material | |
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| 9.5 β -Elimination | Definition |
| 9.6 Mechanisms of β -Elimination | know both E1 and E2; stereochemistry |
| 9.7 Experimental Evidence for E1 and E2 Mechanisms | Zaitsev's rule and exceptions to it |
| 9.8 Substitution Versus Elimination | Conditions favoring S vs E reactions |
| 9.9 Analysis of several E vs. Sub Rxns | |
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| 10 Alcohols | |
| 10.1 Structure and Nomenclature of Alcohols | IUPAC rules; common names |
| 10.2 Physical Properties of Alcohols | Solubility trends; BP trends |
| 10.3 Acidity and Basicity of Alcohols | Bronsted-Lowry acidity; Lewis acidity of OH |
| 10.4 Reaction of Alcohols with Active Metals | to form alkoxides |
| 10.5 Conversion of Alcohols to Haloalkanes | reactions with HX (mechanisms); PBr ₃ SOCl ₂ products |
| 10.6 Acid-Catalyzed Dehydration of Alcohols | to form alkenes; rearrangements; mechanisms |
| 10.8 Oxidation of Alcohols | H ₂ CrO ₄ ; PCC |
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| 11 Ethers, Sulfides, and Epoxides | |
| 11.1 Structure of Ethers | geometry of C-O-C; bond angle |
| 11.4 Preparation of Ethers | Williamson Ether Synthesis; addn of ROH to alkenes |
| 11.8 Synthesis of Epoxides | Oxidation of C=C; RCOOOH use |
| 11.9 Reactions of Epoxides | Nucleophilic ring opening Rxns; regio- & stereochemistry |
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| | NO NMR ON FINAL EXAM |
| END OF COURSE MATERIAL: COMPREHENSIVE FINAL EXAM | |
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