

Chemistry 211

NAME & NUMBER OF COURSE

STUDENT EVALUATION PROCEDURE:

This will be conducted under a flexible system guided by the following:

Laboratory (reports and techniques)	25%
Mid-term examinations (2)	40%
Class participation and instructor's assessment	5%
Final examination	30%

COURSE CONTENT: All references are to McMurry (McM)

Introduction and Review: McM. ch. 1, ch. 2 (omit 2.9)

A general review of some fundamental concepts. Bonding in organic compounds (sp^3 , sp^2 , sp hybrid orbitals, delocalized orbitals). Bond polarity, molecular polarity, intermolecular forces (dipole-dipole, H-bonding, van der Waals solubility. Acidity and basicity.

Alkanes and Cycloalkanes: McM. ch. 3, 4, 5.3, 10.3, 10.4

Alkanes: homologous series, nomenclature, structural isomerism. Conformations, torsional strain, steric strain, conformational analysis. Reactions of alkanes: combustion, free radical chlorination and bromination: reactivity and selectivity, free radical stability.

Cycloalkanes: nomenclature, stability of cycloalkanes, C_3 - C_6 : Baeyer ring strain theory, H data, orbital aspects, factors affecting stability. Conformations, particularly of cyclohexane and substituted cyclohexane, axial/equatorial positions, stereoisomerism, diaxial interactions, conformational analysis.

Alkenes: McM. 5.1, 5.4, 5.5, ch. 6 (not 6.2)

- Structure and Synthesis: nomenclature, structures, isomers and their relative stabilities. Synthesis by elimination reactions: (i) dehydrohalogenation with related stereochemistry; (ii) dehydration with carbocation rearrangements. Synthesis by partial hydrogenation.
- Reactions: Electrophilic addition and oxidation reactions (H_2 , X_2 , HX , H_2O , ROH , B_2H_6 , $KMnO_4$, O_3 , epoxidation). Reaction mechanisms for hydrogenation, halogenation--Markovnikov and free radical, hydration, halohydrin, hydroboration, oxidation, epoxidation with stereochemical implications. Applications of reactions to multi-step syntheses.

Alkynes: McM. ch. 8

Nomenclature, structures, and isomerism. Preparation by elimination. Reactions: electrophilic addition, oxidation as for alkenes; and substitution using terminal alkynes: S_N2 vs. $E2$ aspects. Acidity of terminal alkynes. Use of alkynes with alkenes in multi-step syntheses.

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COURSE CONTENT: (contd.)

Stereoisomerism: McM. ch. 9, 27.5 (resolution of amino acids)

Structural and stereoisomerism - a review. Chirality, enantiomerism, optical activity (including allenes), racemic modification, configuration (R, S nomenclature). Compounds with two chiral centres, meso, threo, erythro forms. Three dimensional and Fischer structures. Stereochemistry of syn/anti addition to alkenes. Reactions of chiral molecules, retention, inversion, racemization of configuration. Relating configurations and resolution.

Alkyl Halides and Substitution/Elimination: McM. ch. 10 (10.1-10.2, 10.7-10.10), ch. 11 (Sub. & Elim.)

Nomenclature, preparations. Nucleophilic substitution reactions (S_N1 , S_N2), mechanisms, influence of R, Nu, L, solvent and temperature; stereochemical aspects; solvolysis. Elimination reactions (E1, E2), mechanisms, influence of R, Nu, L, solvent and temperature; stereochemical aspects; Zaitsev and Hofmann products. Substitution v. Elimination summary.

Alcohols: McM 10.8 (Grignards) and ch. 17 (except 17.12)

Nomenclature and physical properties. Preparation: S_N2 attack, hydration, hydroboration, oxymercuration-demercuration, reduction of carbonyls, Grignard synthesis, diol formation. Reactions: contrast of C-O and O-H bond strengths, dehydration, PX_3 , tosylate, oxidation. Synthesis problems (Grignards). Use of alcohols in multi-step syntheses.

Ethers: McM 18.1-18.7

Nomenclature and structures. Preparation: substitution by alkoxy ions, Williamson synthesis, alkoxymercuration. Reactions - cleavage by acid, use as solvents.

LABORATORY EXPERIMENTS

To be selected from:

1. Distillation and the Purity of Liquids (Refractive Index)
2. The Purity of Solids: Melting Point and Mixed Melting Point
3. Purification of Solids by Crystallization
4. Extraction
5. Qualitative Organic Analysis: Sodium Fusion and Functional Group Tests
6. Nucleophilic Substitution: Effect of Leaving Group on Adamantyl Halide Solvolysis
7. Synthesis of an Alkene (Cyclohexene, by Dehydration of Cyclohexanol)
8. Synthesis of an Alkyl Halide (1-Bromobutane from n-Butanol)
9. Gas Chromatography: Analysis of a Mixture of Alkenes
10. Synthesis of an Alcohol (Triphenyl Methanol, via Grignard Reagent)