

## **Complete Course Coverage for Chemistry 110, “General, Organic, & Biochemistry”, Bettleheim, Brown, Campbell & Farrell, 8th Edition.**

Chapter 10: The student should know the number of bonds that C, N, O & Cl form in their various organic compounds, and the number of unshared pairs of electrons on N, O & Cl. Know the functional groups formed by C, N & O. Be able to classify carbon and hydrogen atoms as primary, secondary or tertiary (or higher for C), alcohols as primary, secondary or tertiary; be able to classify amines as primary, secondary or tertiary and as aliphatic or aromatic. Know the structure of the carbonyl and carboxyl group.

Chapter 11: The student should be able to draw expanded and condensed structural formulas for alkanes and cycloalkanes, be able to recognize constitutional isomer pairs versus identical compounds drawn differently or as different conformations. Recognize geometric (cis-trans) isomers in alkane rings. Know the names of the first ten alkanes, the names and structures of substituent groups formed from the first four alkanes, how to name alkanes and cycloalkanes using the IUPAC nomenclature system. How to draw structural formulas from IUPAC names.

Chapter 12: Know how to: name alkenes and cycloalkenes using the IUPAC nomenclature system; recognize Geometric (cis-trans) Isomers in both alkenes, cycloalkenes and polyenes; use Markovnikov's Rule in addition reactions to the carbon-carbon double bond and when to apply it to chemical systems, know the mechanistic reason Markovnikov's rule works, i.e. the stability of Carbocations and why acidic catalysis is commonly needed to catalyze addition reactions. Be able to recognize primary, secondary and tertiary carbocations. Know how carbocations can be intermediates in alkene polymerization. Be able to identify alkene monomers given the repeating unit of a polymer.

Chapter 13: Be able to name benzene derivatives and special derivatives. Be able to describe how aromatic unsaturation differs from that of alkenes; what is meant by resonance. What are PAHs? Know the basic reaction chemistry of benzenes, i.e. aromatic substitution reactions. Know how phenols differ from alcohols, and what their properties are.

Chapter 14: Be able to: recognize alcohols, thiols, thioethers and disulfides; differentiate primary, secondary and tertiary alcohols; name alcohols, diols, triols using common and IUPAC nomenclature; know the physical properties of alcohols versus alkanes and how they *hydrogen bond* and why alcohol volatility is much lower than alkanes and water solubility is much higher. Be able to predict the chemical products of dehydration of alcohols, oxidation (dehydrogenation) of primary and secondary alcohols, condensation reactions of alcohols and phenols to produce ethers. Explain the physical properties of ethers, why they are as volatile as alkanes of similar MW and are as soluble in water as alcohols of similar MW. Know the role of hydrogen bonding in the properties of alcohols and ethers.

Chapter 15: Be able to recognize or describe one of the various categories of isomers. Know the basic characteristics of enantiomers and diastereomers, be able to draw enantiomer pairs, be able to prioritize and designate R/S enantiomers for any given stereocenter, be able to describe the basics of polarimetry (measuring optical rotation, no calculations). Know what is meant by the superimposition of two molecules. Be able to determine the numbers of enantiomers & diastereomers in molecules with multiple stereocenters.

Chapter 16: Know the acid base chemistry of amines, the various categories of amines, relative basicity of various types, physical properties of the various amine types relative to alkanes and alcohols and how to name the various types of amines. Be able to show mathematically whether an amine is mostly in the amine or ammonium form in physiologic fluids.

Chapter 17: Be able to recognize and name aldehydes and ketones. Know the basic reactions characteristic of, or used to detect these functional groups, and how they react with polar molecules in addition reactions. Be able to recognize and form hemiacetals, and to recognize, form and hydrolyse acetals. Be aware of Tautomerism in carbonyl compounds, be able to draw keto and enol isomers given the other.

Chapter 18: Be able to recognize carboxylic acids and anions. Be able to name carboxylic acids and their salts. Be able to describe the properties of carboxylic acids, their salts. Know the effect on water solubility of a carboxylic acid when converted to its anion. Be able to write the characteristic reactions of carboxylic acids. .

Chapter 19: Be able to recognize carboxylic anhydrides, esters and amides. Be able to name carboxylic esters, anhydrides and amides. Be able to describe the properties of carboxylic esters and amides. Be able to write the reaction of a carboxylic anhydride and an alcohol or phenol or an amine. Be able to write the hydrolysis products of saponification of esters or acid catalyzed hydrolysis with excess water. Be able to write the hydrolysis products of carboxylic amides with strong acid or strong base. Be able to write the structure of phosphoric acid, diphosphoric acid and triphosphoric acid and show that the di- and tri- are anhydrides.. Be able to write the structures of simple monoesters of mono-, di- and triphosphoric acid. Know the basic condensation reactions leading to step-growth or condensation polymers forming polyamides, polyesters.

Chapter 20: Be able to identify a aldose/ketose sugar and name by the number of carbons. Be able to recognize D/L sugars, identify an enantiomer, determine the number of tetrahedral stereocenters and the number of enantiomer/diastereomers possible for a given sugar group. Be able to Identify D-glucose, D-galactose, D-fructose, D-ribose. Know the three aminosugars. Be able to interpret Fischer Projections and explain what they mean. Be able to convert a Fischer projection of a pentose or hexose into a Haworth projection (The best way to do these is to start at the penultimate TS and count back: F-right = H-down and F-left = H-up) and for aldohexoses a chair conformation structure. Know the meaning of anomeric centers, alpha and beta anomers, mutarotation, alditols, aldonic acids, uronic acids, glycosides, (non)reducing sugars, alpha and beta glycosidic bonds, acetals, disaccharides, structure of starch, cellulose and glycogen.

Chapter 21: Defn of Lipids, classes of lipids, structural features of triacylglycerols, phosphatic acid and phosphatides, steroids. How fatty acid salts and phospholipids organize in water. The nature of lipid bilayers and micelles. Hydrolysis products of triacylglycerols and phospholipids.

Chapter 22: Proteins, Students should know the structures of glycine, alanine, phenylalanine, serine, aspartic acid, lysine, and cysteine. Be able to classify aminoacids as polar, non-polar, acidic, basic in side chain properties, and which are hydrophilic and hydrophobic. Be able to recognize an alpha-amino acid, a tetrahedral stereocenter, peptide bond, peptide residue, N-terminus, C-terminus. Students should know which is the natural amino acid family, what is meant by isoelectric point, the consequences of isoelectric point in proteins, native proteins, denaturation, denatured proteins, zwitterion (dipolar) nature of amino acids and proteins, the hydrophobic/hydrophilic nature of sidegroups and their consequences in protein structure, primary, secondary, tertiary and quaternary structure of proteins and what forces stabilize them and/or cause them to occur, alpha-helix and beta-pleated sheet forms of proteins, disulfide bonds, ionic bonds (salt bridges). Students should know the functions and main classes of proteins, what glycoproteins are, what O- and N-glycosidic bonds refer to. Students should be able to make, find or dissolve peptide bonds, recognize peptide residues in protein structures, estimate where the pI of an amino acid will be based on side group character.

Chapter 23: Enzymes, Students should know the nature of enzymes (proteins) and what is needed for their functioning (cofactors & coenzymes), why enzymes function best over only very narrow pH and temperature ranges. How enzymes are named and be able to identify that function from the name. Know how enzymes are formally named. Know the general mechanism of enzyme function, why specificity is so great, what induced fit and allosterism mean; how allosterism can lead to the activation or inactivation of enzymes of substrates. How to distinguish between competitive and noncompetitive enzyme inhibition. How allosterism can lead to a feedback mechanism of control