

Chapter 12

This chapter will be covered in two sections. One part will be included on the first exam and the second part will be on Exam 2. The sections with the asterisks (**) are the ones we will stress and hold you mainly responsible for; but you should read the whole chapter and there may be SmartWork problems from some of those sections without asterisks.

****Section 12.1** You should know that **Organic Chemistry** encompasses the study of all carbon compounds, classified on the basis of **functional groups** (subunits of structure that confer upon molecules specific and typical chemical and physical properties). Organic compounds are also differentiated based on size. **Polymers** or macro molecules have molar masses from several thousand to over 1,000,000 g/mol.

****Section 12.2** You should know that the carbon atoms in **alkanes** (or **saturated hydrocarbons**) bear the maximum number of hydrogen atoms that is possible and contain carbon-carbon single bonds. A **homologous series** of alkanes is generated by sequential addition of $-\text{CH}_2-$ units (**methylene groups**) into the chain terminated by a $-\text{CH}_3-$ (**methyl group**). **Straight-chain alkanes** may have **structural isomers**, hydrocarbons with the same formula but having different arrangements of C-C bonds (**branched-chain hydrocarbons**, and physical properties. **Alkenes** and **alkynes** are **unsaturated hydrocarbons**, because their respective double and triple bonds can be **hydrogenated** to incorporate more hydrogen into their molecular structures.

Section 12.3 You should know that **crude oil** is composed primarily of hydrocarbons that can be separated by **fractional distillation** into gasoline and other useful products. The vapor pressure of a pure substance as a function of temperature is determined by the **Clausius-Clapeyron equation**. The vapor pressure of a solution of volatile compounds follows **Raoult's Law**.

****Section 12.4** You should know that alkenes are found as structural isomers as well as **geometric isomers: E** or **trans isomers** and **Z** or **cis isomers** depending on the arrangement of the groups around the double bond. Alkenes can also be polymerized to **homopolymers** used in construction, in fabrics, as wrapping and packaging material, and in medical devices.

****Section 12.5** You should know that aromatic hydrocarbons are characterized by planar rings in which sp^2 -hybridized carbon atoms are joined by a combination of σ and π bonds. The π bond electrons are delocalized over all the carbon atoms in the ring. Compounds with two or more aromatic rings belong to a class of compounds called polycyclic aromatic hydrocarbons. The unusual stability of aromatic systems is due to the fact that resonance changes their chemical reactivity compared to alkenes.

****Section 12.6** You should know that the **alcohol** ($\text{R}-\text{OH}$) and **ether** ($\text{R}-\text{O}-\text{R}$), functional groups (where R is an alkyl (carbon containing) group or an aromatic ring) represent two ways of incorporating the **heteroatom** oxygen into organic compounds.

****Section 12.7** You should know that organic compounds may also contain carbon-oxygen double bonds in a subunit called the carbonyl group. The carbonyl group is found in **aldehydes** (RCHO), **ketones** (RCOR'), **carboxylic acids** (RCOOH), **esters** (RCOOR') and **amides**

(RCONH_2) where R represents an alkyl or aromatic group. The chemical reactivity of aldehydes and ketones centers on the $\text{C}=\text{O}$ bond. In carboxylic acids, the COOH group imparts acidic properties to the molecules. Carboxylic acids react with alcohols to form esters and with ammonia or amines to form amides in **condensation reactions**. Condensation reactions are used to prepare polymeric esters (polyesters) and amides (polyamides) from difunctional compounds for use in fabrics under the familiar name of Dacron and nylon.

Section 12.8 You should know that hydrocarbons are produced from biomass through the action of **methanogenic bacteria** on a variety of substrates including CO_2 and H_2 , alcohols, carboxylic acids, and **amines**. Amines are organic compounds with appreciable basicity and the general formula RNH_2 , R_2NH or R_3N , where R is any organic subgroup.