

III. FUNCTIONAL GROUPS

Although hydrocarbons are the most basic organic compounds, many other compounds form when other atoms replace one or more hydrogen atoms in a hydrocarbon. These atoms or groups of atoms are called **functional groups**. They give the compounds distinctive chemical and physical properties.

Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
halide (halocarbon)	—F (fluoro-) —Cl (chloro-) —Br (bromo-) —I (iodo-)	$R\text{—}X$ (X represents any halogen)	$\text{CH}_3\text{CHClCH}_3$ 2-chloropropane
alcohol	—OH	$R\text{—OH}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ 1-propanol
ether	—O—	$R\text{—O—}R'$	$\text{CH}_3\text{OCH}_2\text{CH}_3$ methyl ethyl ether
aldehyde	$\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ R\text{—C—H} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C—H} \end{array}$ propanal
ketone	$\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ R\text{—C—}R' \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CCH}_2\text{CH}_2\text{CH}_3 \end{array}$ 2-pentanone
organic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ R\text{—C—OH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C—OH} \end{array}$ propanoic acid
ester	$\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—O—} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ R\text{—C—O—}R' \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{COCH}_3 \end{array}$ methyl propanoate
amine	$\begin{array}{c} \\ \text{—N—} \end{array}$	$\begin{array}{c} R' \\ \\ R\text{—N—}R'' \end{array}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ 1-propanamine
amide	$\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—NH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ R\text{—C—NH} \end{array}$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3\text{CH}_2\text{C—NH}_2 \end{array}$ propanamide

R represents a bonded atom or group of atoms.

1. HALIDES - _____

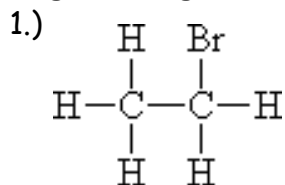
- Compound is called a _____

Examples of Halocarbons:

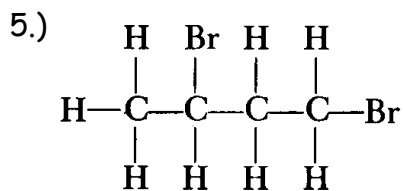
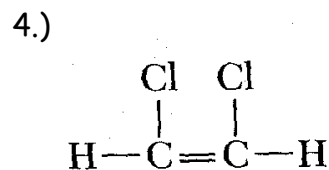
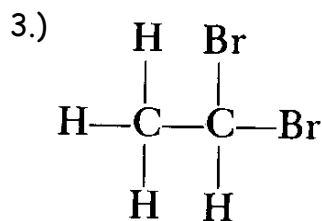


(X represents
any halogen)

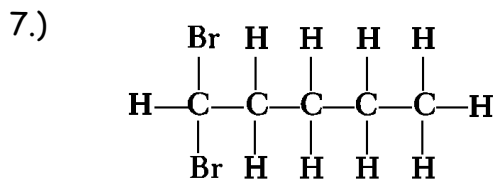
Naming/Drawing a Halocarbon



2.) **1,1-dichlorobutane**



6.) **1-chloro-2-fluoropentane**



8.) **1,3-difluoro-2-iodohexane**

2. ALCOHOLS - _____

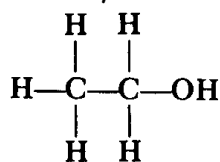
- The -OH groups is called the _____ group in organic chemistry
- Although the -OH group resembles the hydroxide ion of bases, it DOES NOT form an ion in water

Examples of Alcohols

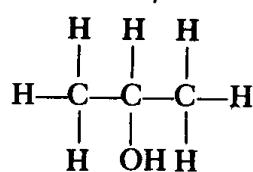


Classifications of Alcohols

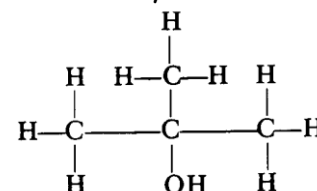
- Primary Alcohol



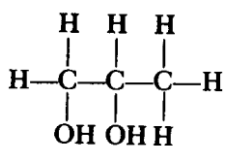
- Secondary Alcohol



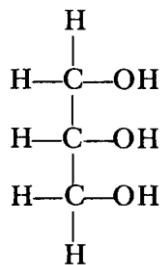
- Tertiary Alcohol



- Dihydroxy Alcohols

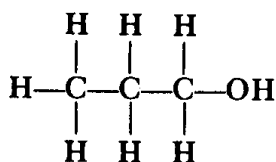


- Trihydroxy Alcohols



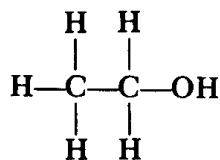
Naming/Drawing an Alcohol

1.)



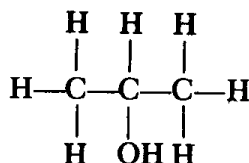
2.) 2-propanol

3.)



4.) 3,3-hexandiol

5.)

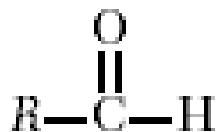


6.) 2,4-heptanol

3. ALDEHYDES - _____

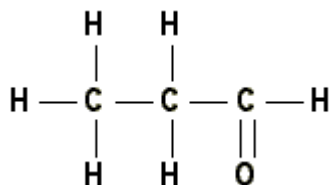
- the bond is called a _____ group
- *this group is found on the END CARBON of a chain

Examples of Aldehydes



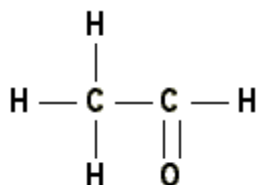
Naming & Drawing Aldehydes

1.)



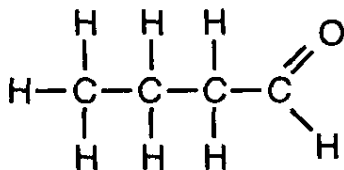
2.) **hexanal**

3.)



4.) **pentanal**

5.)



6.) **nonanal**

7.) **methanal**

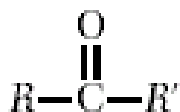
8.) **octanal**

4. KETONES - _____

* The bond is called a _____ group

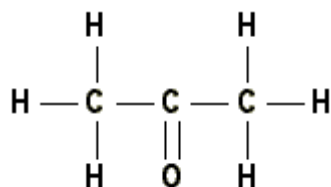
*this group is found on the INTERIOR CARBON of a chain

Examples of Ketones



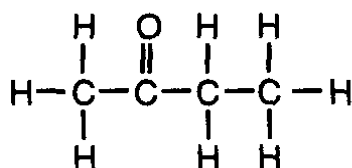
Naming & Drawing Ketones

1.)



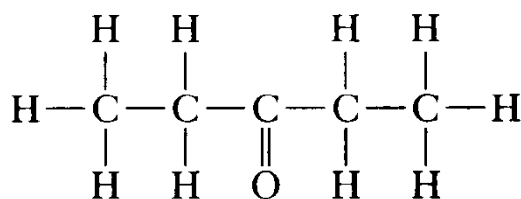
2.) **4-octanone**

3.)



4.) **2-pentanone**

5.)



6.) **3-heptanone**

7.) **2-nonanone**

5. ETHERS - _____

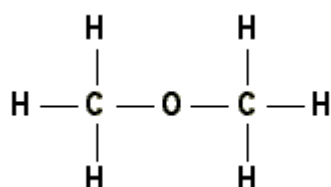
* General formula is written _____ to show the oxygen bridge between the two carbon chains

Examples of Ethers



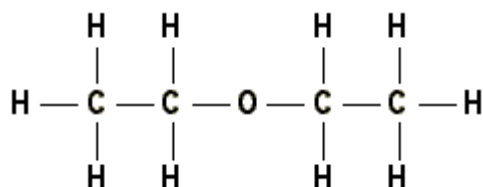
Naming & Drawing Ethers

1.)



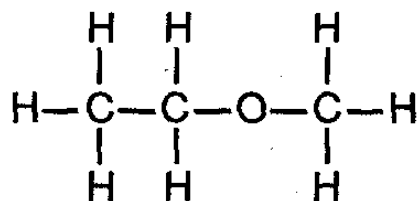
2.) **methyl propyl ether**

3.)



4.) **propyl ethyl ether**

5.)

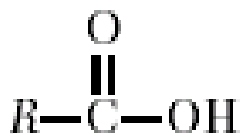


6.) **methyl ethyl ether**

7.) **ethyl butyl ether**

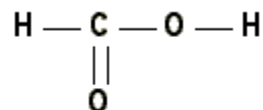
6. ORGANIC ACID

Examples of Organic Acids



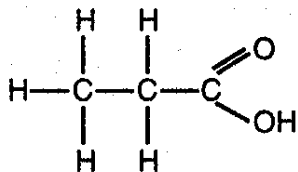
Naming & Drawing Organic Acids

1.)



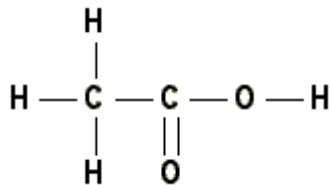
2.) **pentanoic acid**

3.)



4.) **butanoic acid**

5.)



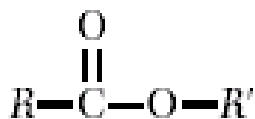
6.) **hexanoic acid**

7.) **octanoic acid**

7. ESTERS _____

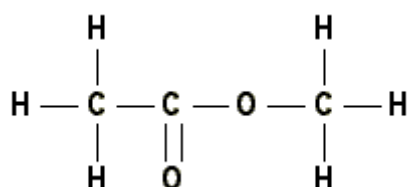
- General formula is written _____ to show the oxygen bridge between the two carbon chains
- Esters are commonly formed from a reaction between a carboxylic acid and an alcohol

Examples of Esters



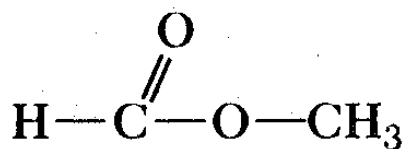
Naming & Drawing Esters

1.)



2.) **ethyl ethanoate**

3.)



4.) **ethyl propanoate**

8. AMINES - _____

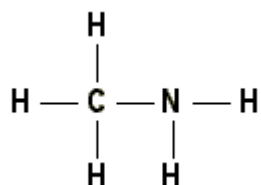
- A derivative of ammonia:

Examples of Amines



Naming & Drawing Amines

1.)



2.) **1-butanamine**

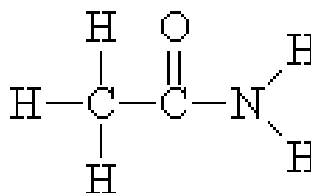
3.) 2-propanamine

4.) 3-pentanamine

9. AMIDES - _____

- amines react with carboxylic acids to form amides

A. Examples of Amides

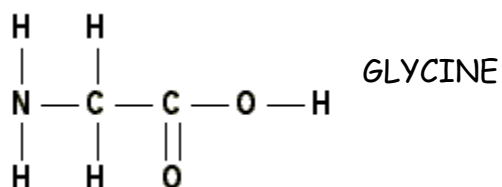


10. AMINO ACIDS _____

- like all organic acids, amino acids contain the group but also contain an amine group

* The amine group () is attached to the carbon atom that is adjacent to the acid group

B. Examples of Amino Acids



IV. ISOMERS

Definition: _____

Example: C_4H_{10} - Butane

Example: C_5H_{12} - Pentane

Structural isomers can also involve the position of a functional group and the position of a double or triple bond.

A. Position of a functional group: molecular formula = C_3H_7OH

B. Position of a double bond: molecular formula = C_4H_8

C. Position of a triple bond: molecular formula = C_4H_6