

CHE 1000: INTRODUCTORY CHEMISTRY

2019/2020

Elemental Composition and Classifications of Organic Compounds

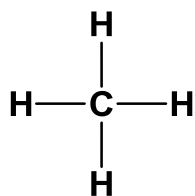
1. Functional Groups

A functional group could be an **atom** or a **group of atoms** within a molecule that is responsible for its characteristic **chemical reactions** and **physical properties**

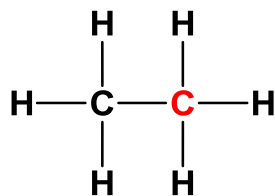
They are various types of functional groups ;

□ Alkanes

- ❖ They are compounds which contains only carbon and hydrogen atoms with an empirical formula of C_nH_{2n+2} and the bond connecting these atoms are all single bonds
- ❖ And their names end with *-ane* and classified as **primary, secondary and tertiary hydrocarbons**

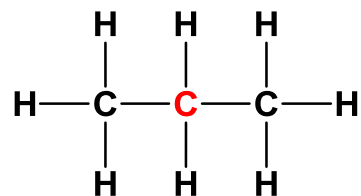


methane



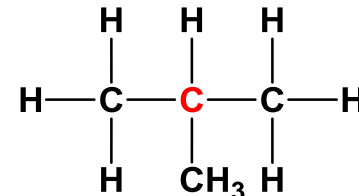
1 carbon directly attached

primary (1°) carbon



2 carbons directly attached

secondary (2°) carbon



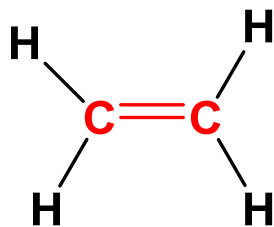
3 carbons directly attached

tertiary (3°) carbon

- ❖ In general alkanes are relatively unreactive so they need attached to them one or more reactive organic molecules called **functional group(s)**
- ❖ Functional groups such **carbon-carbon double** or **triple bonds** or *those that* contains atoms other than carbon or hydrogen in then such as **O, N and Cl atoms etc..**

1. Alkenes

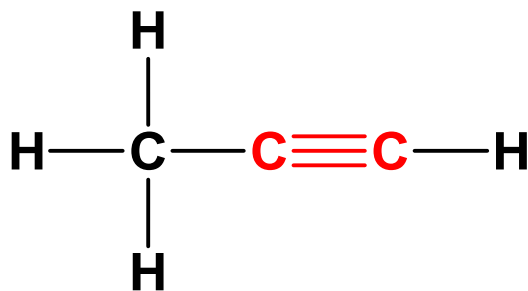
- Alkenes are organic molecules made of the functional group carbon-carbon double bond(s) and are written in the empirical formula of C_nH_{2n}
- They have suffixes ending in *-ene*
- Example;



ethene

2. Alkynes

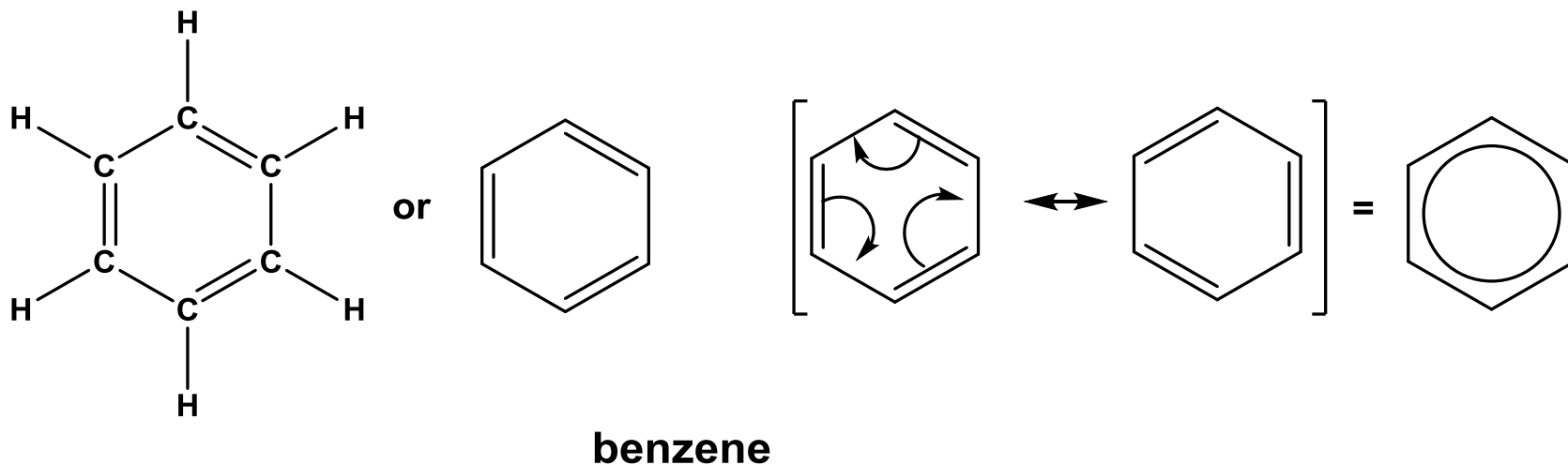
- Alkynes are organic molecules made of the functional group carbon-carbon triple bond (s) and are written in the empirical formula of C_nH_{2n-2}
- They have suffixes ending in *-yne*
- Example;



propyne

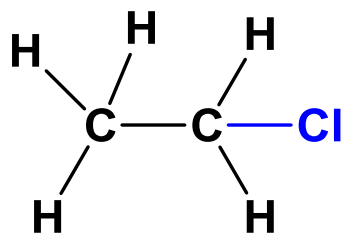
3. Aromatics

- They are ring molecules with the empirical formula C_nH_n and often drawn to look like alkenes, but they behave much differently than alkenes
- They have an alternating pattern of double and single bonds within a ring
- Example;



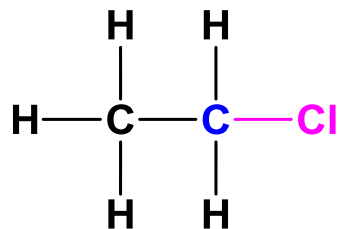
4. Alkyl halides

- Alkyl halides are organic compounds in which a **hydrogen atom** from the **alkane** is replaced by a **halogen (F, Cl, Br and I)**



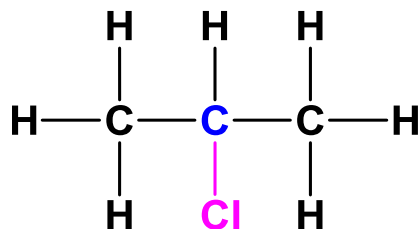
chloroethane

- Alkyl halides just like in alkanes have **primary, secondary and tertiary classification**



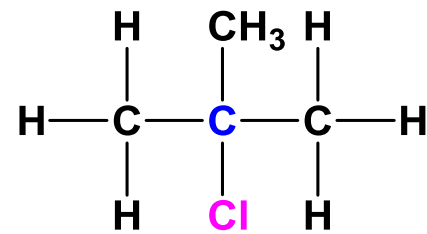
1° carbon

A 1° alkylchloride



2° carbon

A 2° alkylchloride

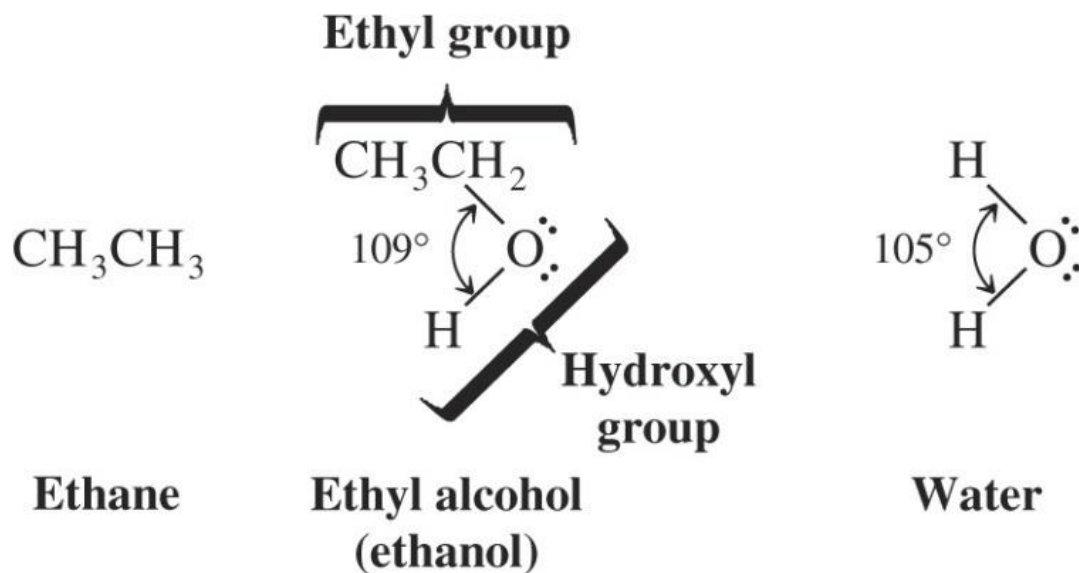


3° carbon

A 3° alkylchloride

5. Alcohols

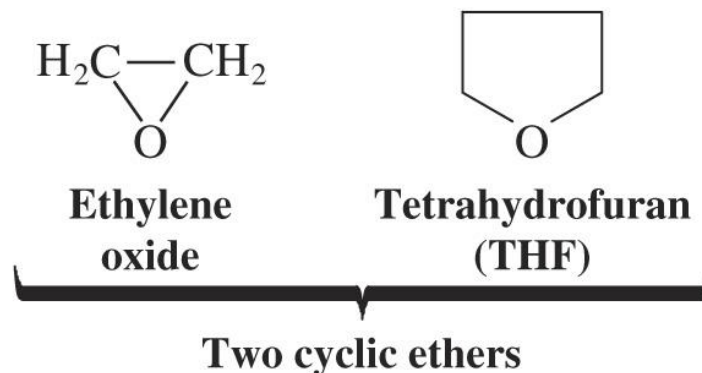
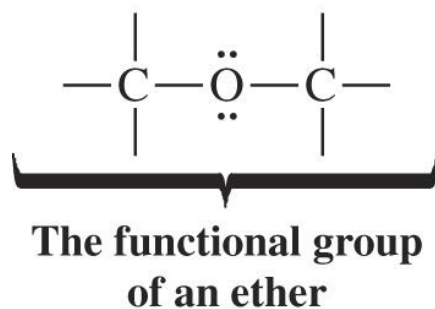
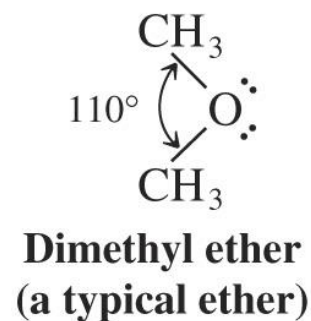
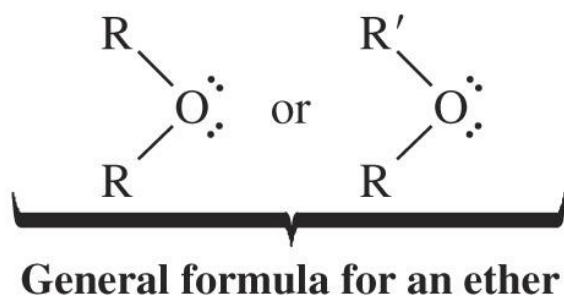
- In alcohols the hydrogen of the alkane is replaced by the hydroxyl (-OH) group
- An alcohol can be viewed as either a hydroxyl derivative of an alkane or an alkyl derivative of water



- Alcohols are also classified according to the carbon the hydroxyl is directly attached to as 1° , 2° and 3° if the carbon is 1° , 2° and 3° , respectively

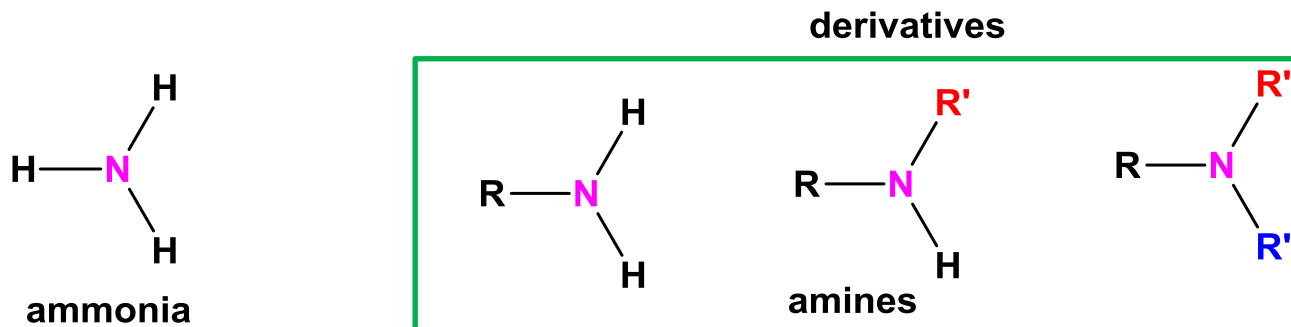
6. Ethers

- Ethers have the general formula R-O-R (symmetrical) or R-O-R' (unsymmetrical) where R' ≠ R
- They can be considered organic derivatives of water in which both hydrogens are replaced by organic groups
- The bond angle at oxygen is close to the tetrahedral angle

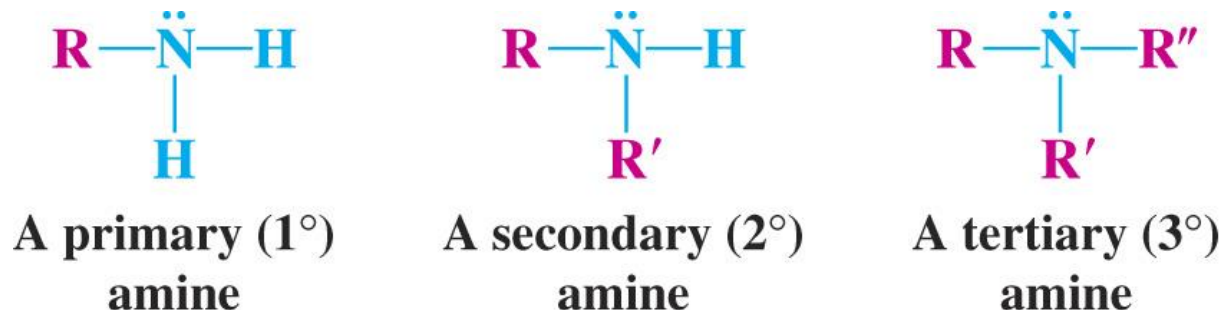


7. Amines

- Amines are organic derivatives of ammonia

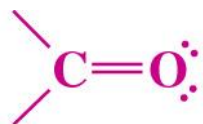


- They are classified according to how many alkyl groups replace the hydrogens of ammonia
- This is a different classification scheme than that used in alkyl halides and alcohols



8. Aldehydes and Ketones

- Both contain the carbonyl group

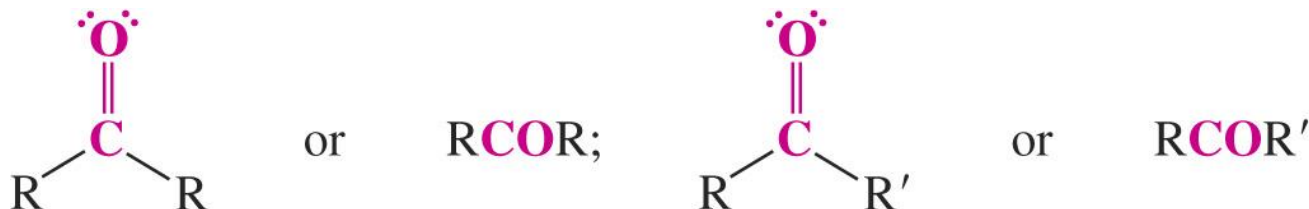


The carbonyl group

- Aldehydes have one carbon (organic group) attached to the carbonyl group and a hydrogen atom



- Ketones have two carbons (organic groups) attached to the carbonyl group



9. Carboxylic Acids, Esters and Amides

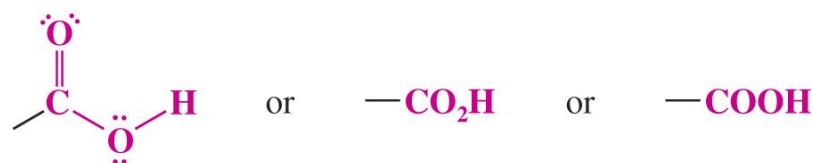
- All these groups contain a carbonyl group bonded to an oxygen or nitrogen

I. Carboxylic Acids

- Contain the carboxyl (carbonyl + hydroxyl) group



A carboxylic acid



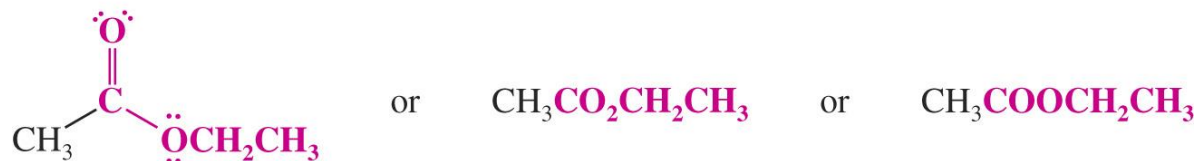
The carboxyl group

II. Esters

- A carbonyl group is bonded to an alkoxyl (OR') group



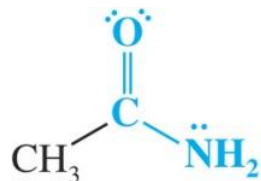
General formula for an ester



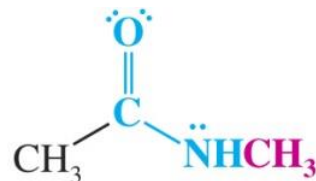
A specific ester called ethyl acetate

III. Amides

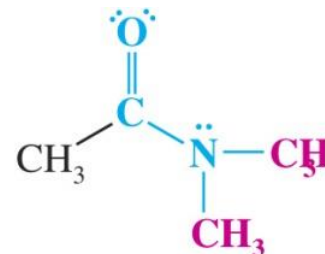
- A carbonyl group is bonded to a nitrogen derived from ammonia or an amine



Acetamide



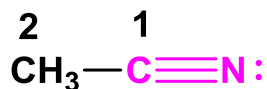
N-Methylacetamide



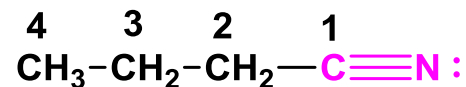
N,N-Dimethylacetamide

iv. Nitriles

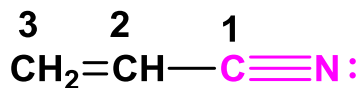
- An alkyl group is attached to a carbon triply bonded to a nitrogen and carbon is part of the chain
- This functional group is called a cyano group when it's a substituent within an organic molecule



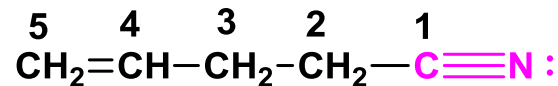
acetonitrile



butyronitrile



acrylonitrile



4-pentenenitrile

Take home problem;

1. Identify, circle and name all the functional groups present in the molecule given below:

