CHAPTER ONE
ATOMIC STRUCTUR

Atoms; is the smallest uncharged particle of an element which can inter into chemical combination .

<u>The atomic structure is described by the two statements</u>

A. \ Atoms of all elements are made up of three subatomic units, the electron, the proton and the neutron .

B. \ The atom consist of : [1] the nucleus at the center,
[11] a system of electron in motion outside the nucleus .

The mass of the atom is concentrated in the nucleus ; the volume of the atom is the volume which contains all the moving electrons .

The Neutron : is a particle of mass 1.009 , and diameter of 10^{-13} cm . It has no electrical charge .

The Proton : is a particle of mass 1.008 , and its diameter is 10^{-13} cm , its carries appositive electrical charge equal in magnitude to negative of electron .

The Nucleus : carries a positive charge , the mass of the nucleus near equal to the sum of the masses of the protons and neutrons.

The Electron : is a particle of mass [9.11 x 10^{-23} gm] the electron represent a charge of negative electricity .

ATOMIC STUCTURE AND THE PERIODIC TABL

The chemical properties of an element are determined by the number of electrons in the atoms

Mathematical expression known as "**Orbital**" is used to describe the type of motion of an electron in an atom .

An electron which is described by a particular orbital is said to "Occupy orbital" , a giving orbital corresponds to a definite state of energy of the electron .

When an electron changes from one orbital to another , energy in the form of radiation is either emitted or absorbed .

It is found that the arrangement of possible orbital is similar for all elements . The orbital are grouped in seven shells designated either by the number 1 , 2 , 3 , 4 , 5 , 6 and 7 , or the letter K , L , M , N , O , P and Q .

Electrons in "K" shell posses the least energy and are most stably to the nucleus ; those in the "Q" shell posses the most energy , and are least stably bound to the nucleus .

The orbital in the "k" shell is nearest the nucleus , and those in the "Q" shell is the most remote .

THE ELECTRONIC STRUCTURE IN THE PERIODIC TABLE

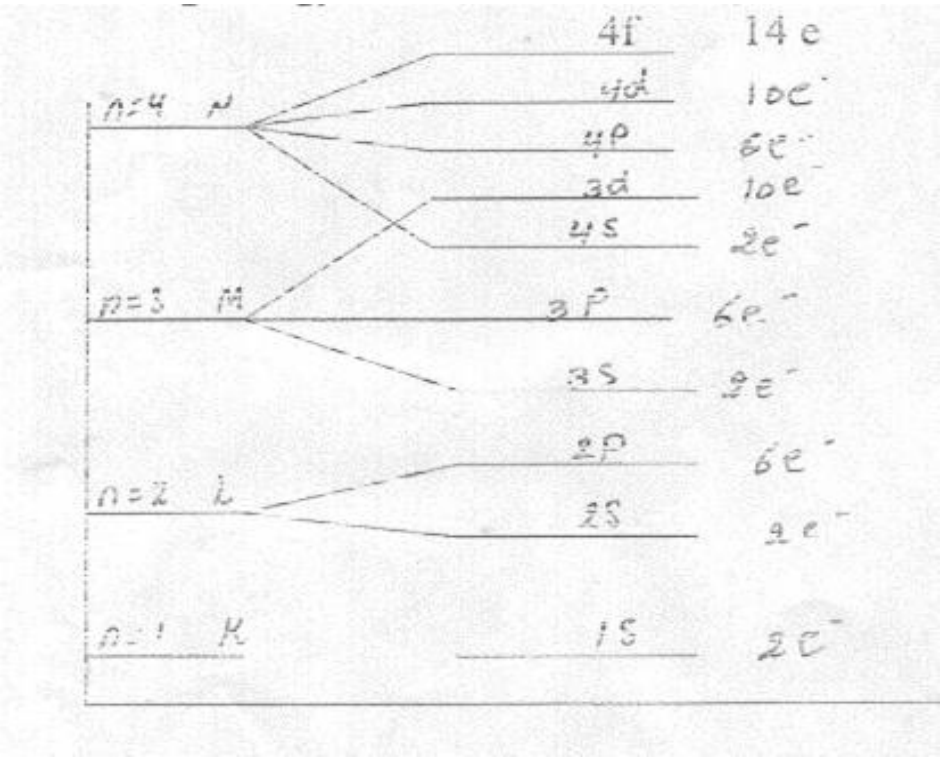
1- The atom of an element immediately following another in the periodic table .

2- The electron in an atom are arranged in shells about the nucleus as the center .

3- The building up of a new shell starts with the first element of each period of the periodic table and is completed at the last element of each period .

Each main shell contain sub shells as known "s , p , d and f " .
Each sub shells contain electron has a definite energy

The electrons in the shells distribution a cording to the increasing energy as shown in this diagram :-



Energy – Level diagram with component sub shells

PERIODIC CLASSIFICATION

Mndeleef and Luther Mayer summarized the result of their work , that the position of the element in the periodic table dependence on their "Atomic Weights" .

It is possible to arrange the element in horizontal rows called "**Period**" in order of increasing atomic number , in such a way that elements with similar electron configuration fall in to the same vertical columns called "**Group**" .

The distribution of elements in periodic table :-

(a) The first period (H $\rightarrow$ He) contain 2 elements in 1S sub shells .

(b) The second period (Li $\rightarrow$ Ne) contain 8 elements in 2S is filled first and then the 2P sub shells .

(c) The third period (Na $\rightarrow$ Ar) contain 8 elements in 3S is filled first and then the 3P sub shells .

(d) The fourth period (K $\rightarrow$ Kr) 4S sub shell is filled then 3d sub shell is filled , contain 18 elements , ten elements (Sc $\rightarrow$ Zn) known as (Transition Element) .

(e) The fifth period (Rb $\rightarrow$ Xe) , contain 18 elements , 5S , 4d and 5P .

(f) The sixth period (Cs $\rightarrow$ Rn) , 6S , 5D , 4f group of 14 elements of 4f , (Ce $\rightarrow$ Lu) called the lanthanides 4d , 6p . Contain 32 elements .

The modern form of the period law is the properties of the elements are in periodic dependence on their "**Atomic Number"** .

" Atomic Properties of the periodic table "

(1) **Atomic number** : It is the number which describes the position of an element in the periodic table

(2) **Ionization energy** : It is the less energy require to remove the electron from neutral gaseous atom .

The first ionization energy of each element has been plotted as a function of atomic number

The value of the first ionization energy tends to rise as we move from a group one to a group seven elements.

(3) **Electron affinity** : It is the energy are leased when an electron is added to a gaseous atom

The experimental determination of electron affinities is difficult . Values have been determined by mass spectrometer . For a few elements and in other cases value have been assigned indirectly .

The electron affinities tend to increase a cross a period as the atomic number increases .

(4) **Electro negativity** : It is the a numerical measure of the electron – attracting power of an atom.

The value of electro negativity decrease down a group and increases across a period .

The most electro negative elements are those in the top right – hand corner of the periodic table and the least electro negativity are those in the bottom left – hand corner .

<u>It is useful to summarized those correlation</u> :

(a) – Elements with **low** electro negativity , ionization energy and electro affinity tend to be **metals** .

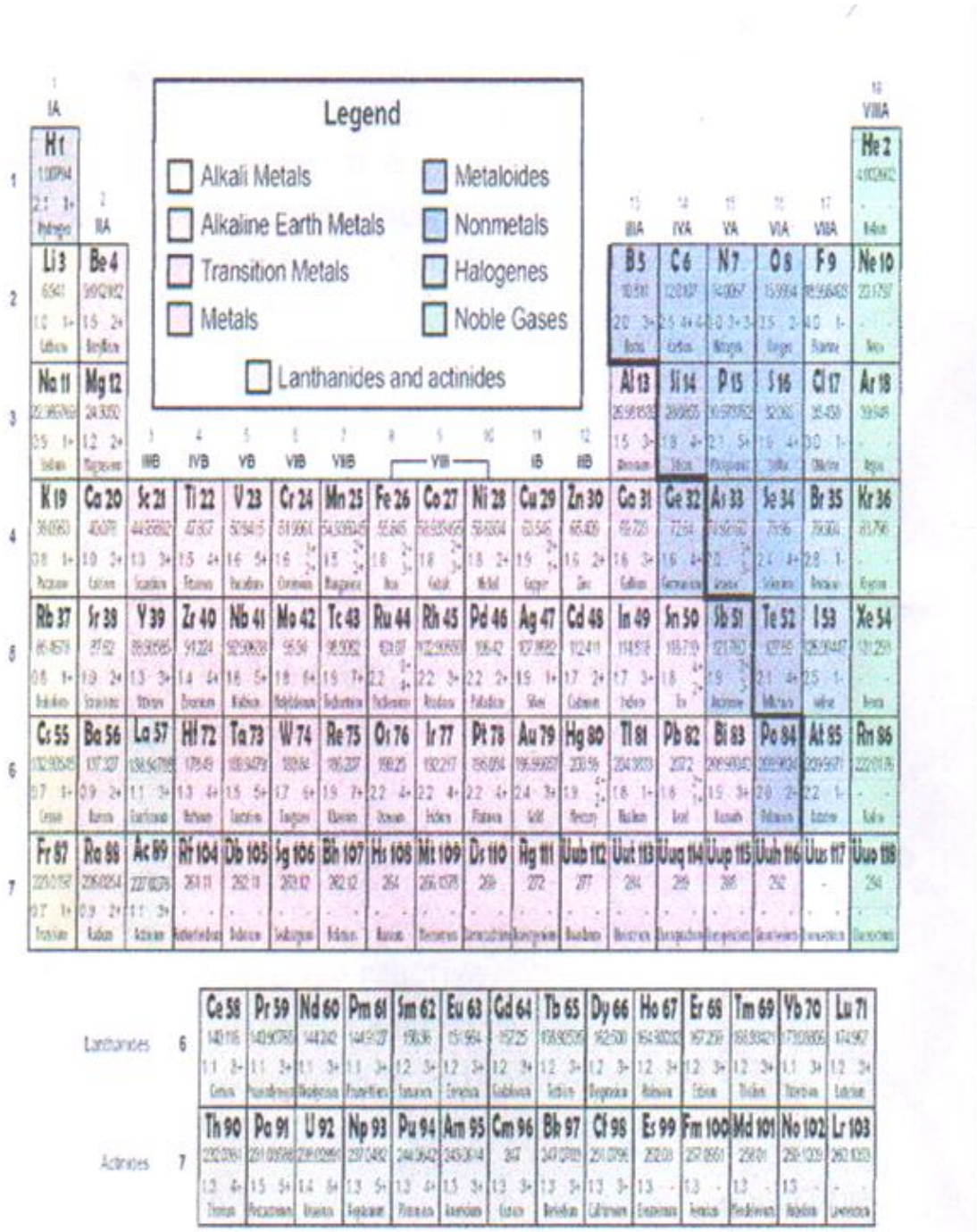
(b) – Elements with **high** electro negativity , ionization energy and electro affinity tend to be **non – metals** .

(c) – In a compound **a high** electro negativity difference between constituent elements tends to result in bonding predominantly **ionic** in character , e.g. **Na-F** .

(d) – In a compound elements have **a low** electro negativity difference with elements have **a high** electro negativity tends to result in bonding predominantly **covalent** in character , e. g. Si – C .

(e) – The elements have **a low** electro negativity tends to result in bonding predominantly **metallic** in character between elements , e.g **Copper – Zink** .

Element classes in the periodic table



Li 3
6.941
1.0 1+
Lithium
Na 11
22.989769
0.9 1+
Sodium
K 19
39.0983
0.8 1+
Potassium
Rb 37
85.4678
0.8 1+
Rubidium
Cs 55
132.90545
0.7 1+
Cesium
Fr 87
223.0197
0.7 1+
Francium

Alkali Metals

- All alkali metals have 1 valence electron
- Alkali metals are NEVER found pure in nature; they are too reactive
- Reactivity of these elements increases down the group

Potassium, K reacts with water and must be stored in kerosene

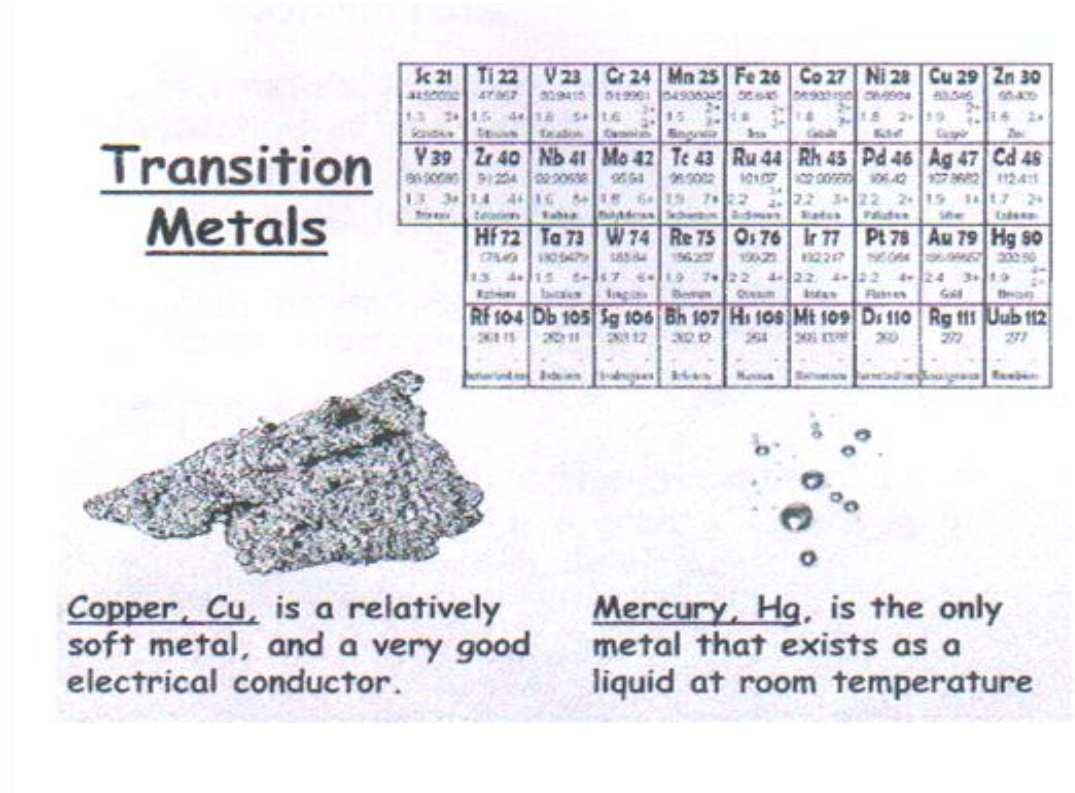
Alkaline Earth Metals

- All alkaline earth metals have 2 valence electrons
- Alkaline earth metals are less reactive than alkali metals
- Alkaline earth metals are not found pure in nature; they are too reactive
- The word "alkaline" means "basic"
  - common bases include salts of the metals
    - $Ca(OH)_2$
    - $Mg(OH)_2$

Be 4
9.012182
1.5 2+
Beryllium
Mg 12
24.3050
1.2 2+
Magnesium
Ca 20
40.078
1.0 2+
Calcium
Sr 38
87.62
1.0 2+
Strontium
Ba 56
137.327
0.9 2+
Barium
Ra 88
226.0254
0.9 2+
Radium

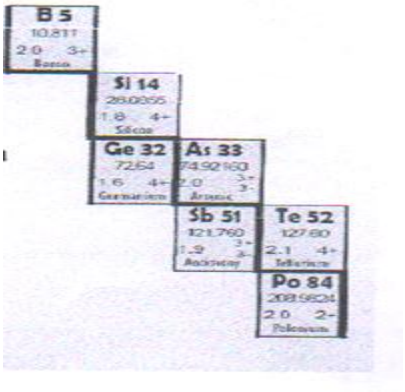
Properties of Metals

- Metals are good conductors of heat and electricity
- Metals are malleable .
- Metals are ductile .
- Metals have high tensile strength .
- Metals have luster .



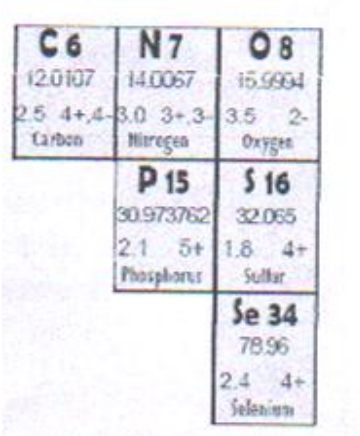
Properties of Metalloids

- They have properties of both metals and nonmetals .
- Metalloids are more brittle than metals , less brittle than most nonmetallic solids .
- Metalloids are semiconductors of electricity .
- Some metalloids possess metallic luster .



Nonmetals

- Nonmetals are poor conductors of heat and electricity .
- Nonmetals tend to be brittle .
- Many nonmetals are gases at room temperature



Carbon , the graphite in “pencil lead” is a great example of a nonmetallic element .

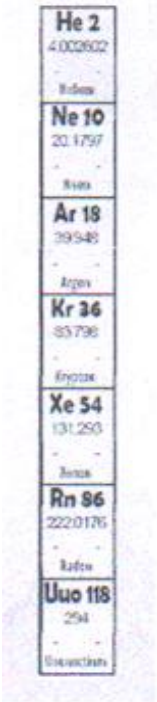
Halogens

- Halogens all have 7 valence electrons
- Halogens are never found pure in nature , they are too reactive .
- Halogens in their pure form are diatomic molecules (F_2 , Cl_2 , Br_2, and I_2)

Chlorine is a yellow – green poisonous gas

Noble Gases

- Noble gases have 8 valence electrons (except helium , which has only 2)
- Nable gases are ONLY found pure in nature – they are chemically unreactive .
- Colorless , odorless and unreactive : they were among the last of the natural elements to be discovered .



CHAPTER 2

CHEMICAL BOND

The attraction between tow atoms within a molecule is called **chemical bond** .

In (1916) two kinds of chemical bonds were described , The covalent bond by G.N.Lewis and Ionic bond by Walther Kossel .

The covalent bond

It results from sharing of electrons between atoms

For example the formation of the hydrogen molecule , when two hydrogen atoms colloid a shared **pair of electrons** result because each hydrogen atom has a single electron in it .

$$H^* + H^* \rightarrow H_2$$

In a similar way we can suggest the formation of

HF , H_2O , NH_3 , CH_4 and CF_4 .

The properties of covalent compounds :

1- Gases , liquids or low melting point .

2- Covalent compounds are usually hardly soluble in water .

3- Most of them are soluble in hydrocarbons solvents or organic compounds .

4- Aqueous solution are usually poor conducting of electricity .

5- Covalent compounds referred as non – polar compounds .

The Ionic bond

It results from completely transfer of electron between two atoms .

For example the formation of the , **LiF , Li** atom has two electrons in its inner shell , and one electron in its outer shell or valance shell . A **(F)** atom has **2e** in its inner shell **7e** in its valance shell ; the gain of **1e** would give **F** a full outer shell of eight . The electrostatic attraction between the oppositely charged ions is called **ionic bond** .

Ions either positive or negative ;
A positive ion is known as **Cat ion .**
A negative ion is known as **An ion .**

In a similar way we can suggest the formation of

NaCl , $CaCl_2$, CaS , Li_2O .

The properties of Ionic compounds :

1- They have high melting point .

2- Ionic compound are usually soluble in water .

3- Most are in soluble in organic solvent .

4- Ionic compound which dissolved in water give conducting electricity solution .

5- Ionic compound referred as polar compound .

The Polarity Bonds

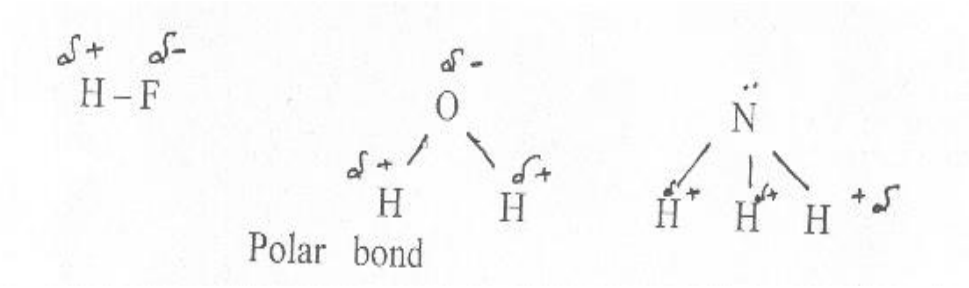
It is a covalent bond , whose shared the electrons of two atoms , but it is defer in electro – negativity between them .

Because electrons may be shard un equally between atoms it is necessary to have some way of describing electric charge distribution in a bond .

For example ; the bond in (H_2) and (Cl_2) are called non polar ; the bond in (HCl) , (H_2O) polar , why ?
In the , non polar bond , the electrons pair is shared equally between two atomic center .
But in the , polar bond , this bond have one end has positive charge and the other has negative charge ; that is mean ; there is a **negative pole** and **positive pole** , such bond is said to be polar bond or to posses **polarity** .

We can indicate polarity using symbol ($\overset{+}{\delta}$) and ($\overset{-}{\delta}$) which indicate partial (+) and (-) charge .

Ex :



The molecules have polar covalent bond differ in their tendency to attract electron , and that is mean differ in electro negativity .
The most electro negativity of elements are those located in the upper right hand corner of the periodic table .

F > O > Cl . N > Br > C , H

Electro negativity for some elements

The polarity of bond can lead to polarity of molecule and thus effect in melting point and solubility .

CHAPTER 3

ACIDS AND BASES

Properties of Acids

- Acids are proton (hydrogen ion , H^+) donors
- Acids have a pH lower than 7
- Acids taste sour
- Acids effect indicators
  - Blue litmus turns red
  - Methyl orange turns red
- Acids react with active metals , producing H_2
- Acids react with carbonates
- Acids neutralize bases

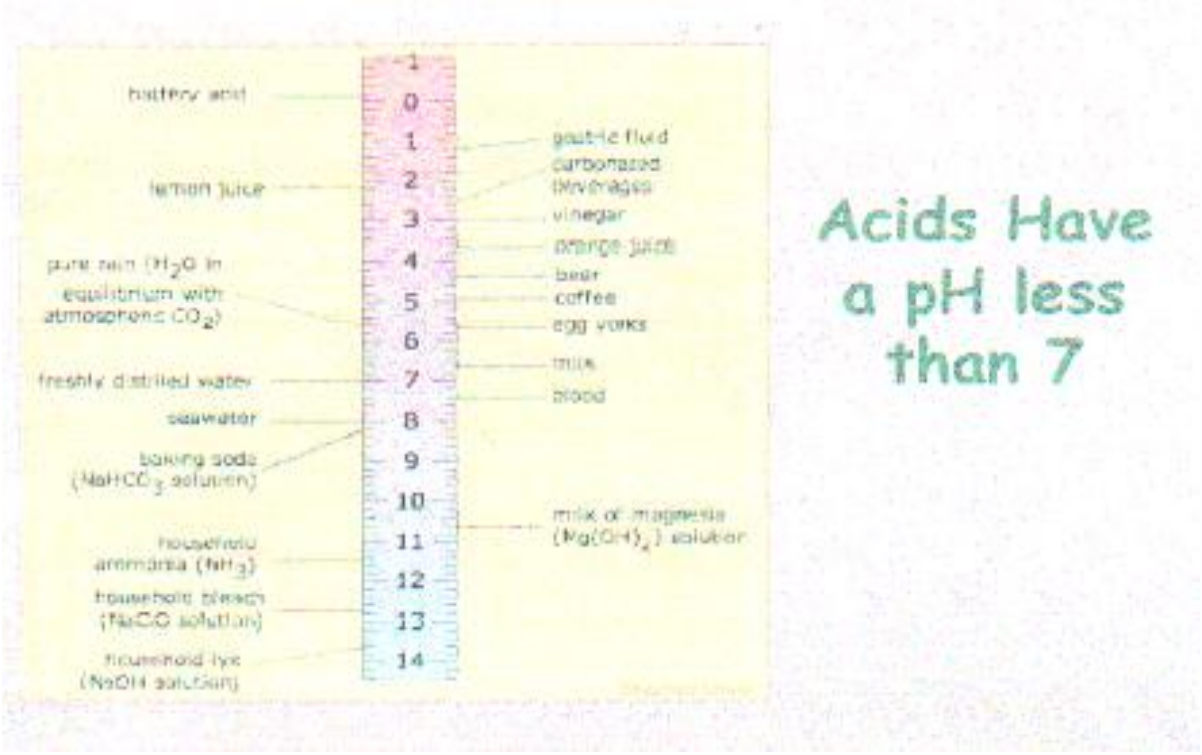
Acids are Proton (H^+ ion) Donors

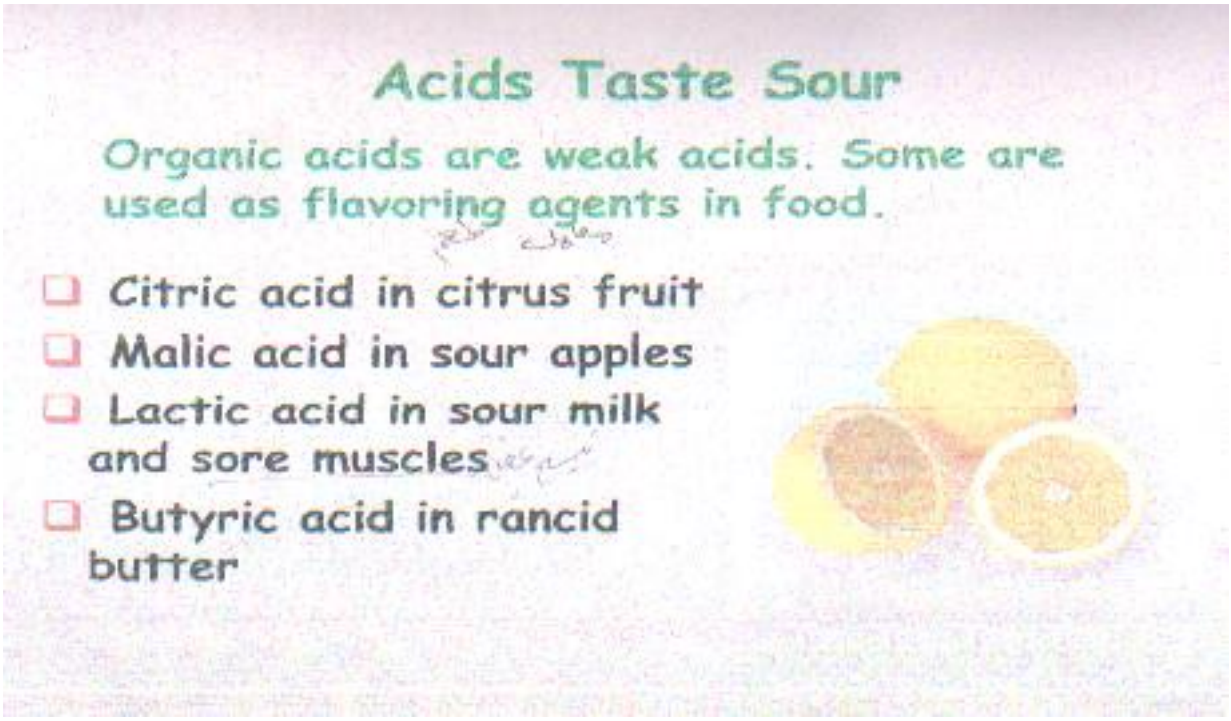
Strong acids are assumed to be 100% ionized in solution (good H^+ donors)

HCl H_2SO_4 HNO_3

Weak acids are usually less than 5% ionized in solution (poor H^+ donors)

H_3PO_4 $HC_2H_3O_2$ Organic acids


battery acid
lemon juice
pure rain (H_2O in equilibrium with atmospheric CO_2)
freshly distilled water
seawater
baking soda ($NaHCO_3$ solution)
household ammonia (NH_3)
household bleach (NaClO solution)
household lye (NaOH solution)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
gastric fluid
carbonated beverages
vinegar
orange juice
beer
coffee
egg yolks
milk
blood
milk of magnesia ($Mg(OH)_2$ solution)
Acids Have a pH less than 7


Acids Taste Sour
Organic acids are weak acids. Some are used as flavoring agents in food.
Citric acid in citrus fruit
Malic acid in sour apples
Lactic acid in sour milk and sore muscles
Butyric acid in rancid butter

Organic Acids

Organic acids all contain the "carboxyl" group, sometimes several of them.

The carboxyl group is a poor proton donor, so ALL organic acids are weak acids.

Acids Effect Indicators

Blue litmus paper turns red in contact with an acid.

Methyl orange turns red with addition of an acid

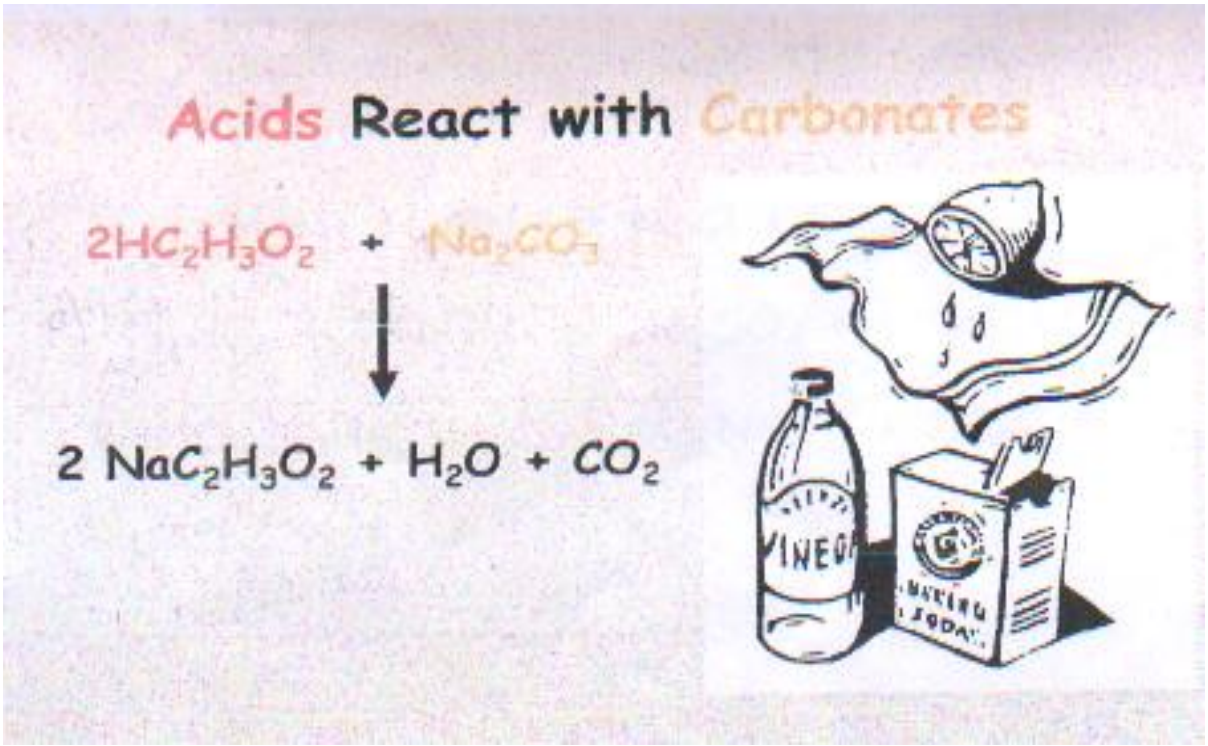
Acids React with Active Metals

Acids react with active metals to form salts and hydrogen gas

$Mg + 2HCl \rightarrow MgCl_2 + H_2(g)$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2(g)$

$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2(g)$



Effects of Acid Rain on Marble
(calcium carbonate)

George Washington:
BEFORE

George Washington:
AFTER

Acids Neutralize Bases

Neutralization reactions ALWAYS produce a salt and water

$$HCl + NaOH \rightarrow NaCl + H_2O$$

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

$$2HNO_3 + Mg(OH)_2 \rightarrow Mg(NO_3)_2 + 2H_2O$$

Properties of Bases

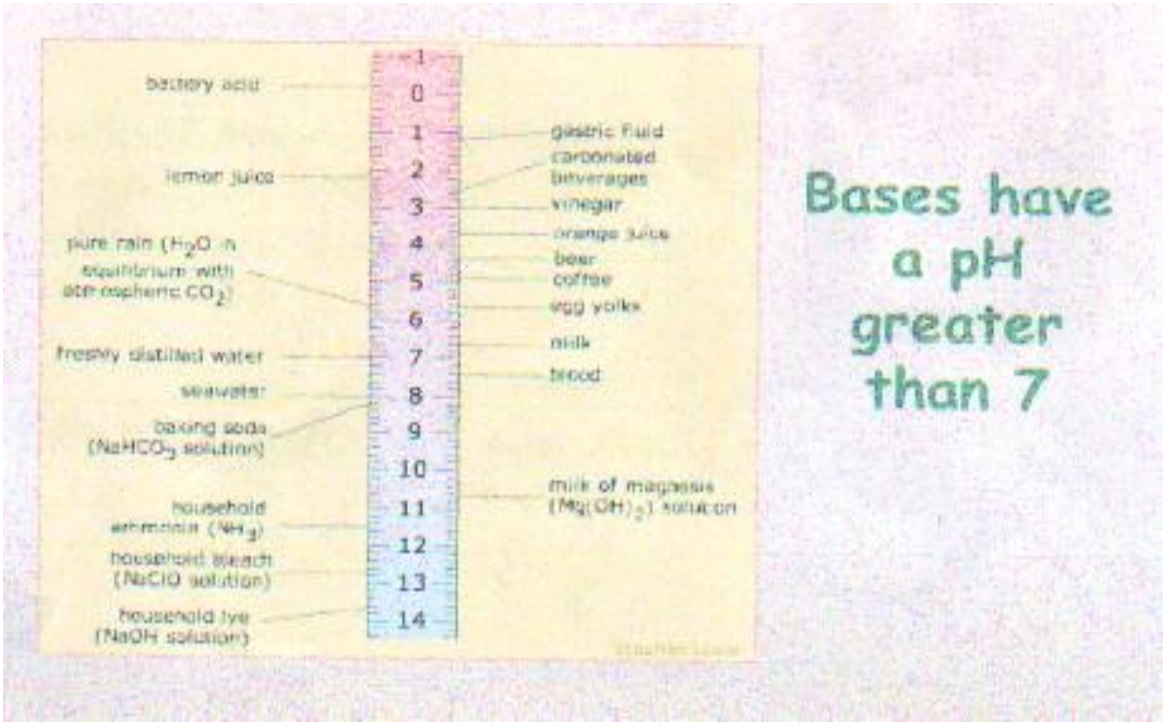
- Bases are proton (hydrogen ion , H^+) acceptors .
- Bases have a pH greater than 7 .
- Bases taste bitter .
- Bases effect indicators
    - Red litmus turns blue .
    - Phenolphthalein turns purple .
- Solution of bases feel slippery .
- Bases neutralize acids .

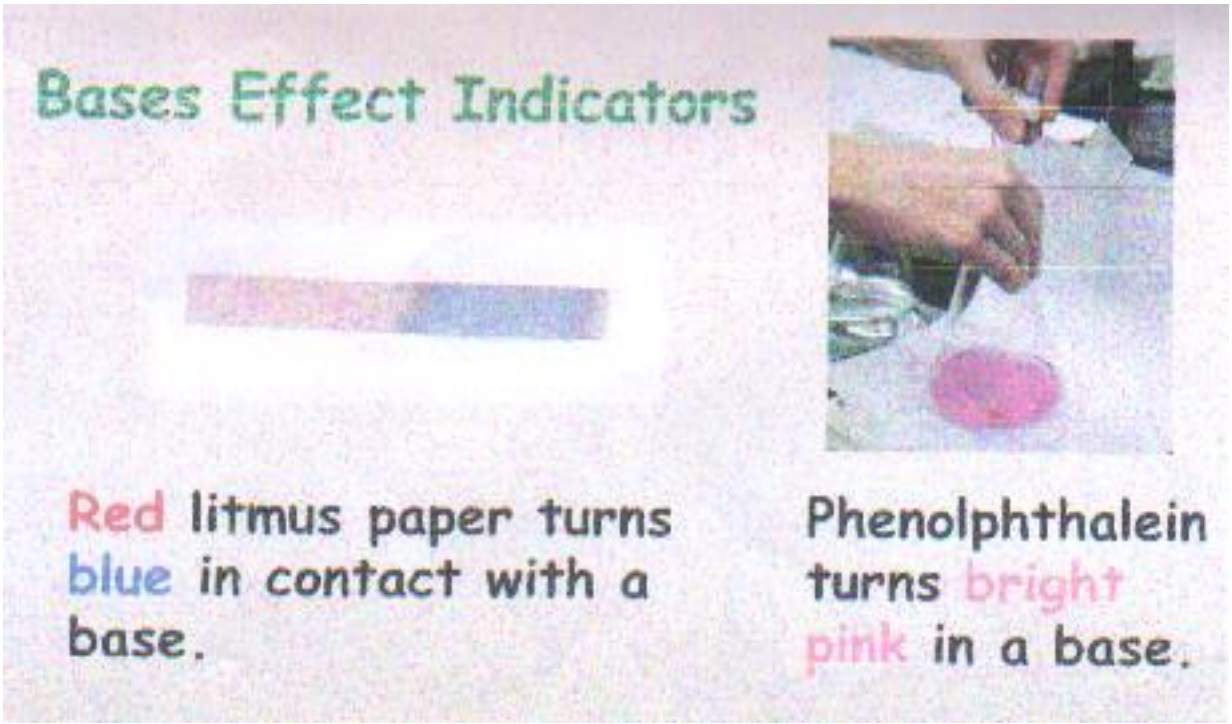
Bases are Proton (H^+ ion) Acceptors

- Sodium hydroxide (lye) . NaOH
- Potassium hydroxide . KOH
- Magnesium hydroxide , $Mg(OH)_2$
- Calcium hydroxide (lime) , $Ca(OH)_2$

OH – (hydroxide) in base combines with H^+ in acids to form water .

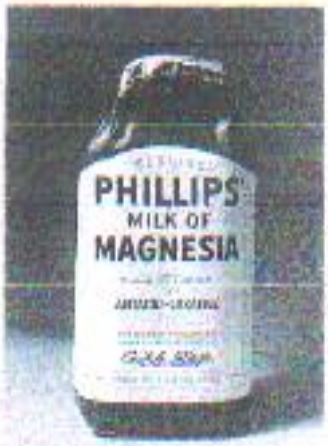
$$H^+ + OH^- \rightarrow H_2O$$


battery acid
lemon juice
pure rain (H_2O in equilibrium with atmospheric CO_2)
freshly distilled water
seawater
baking soda ($NaHCO_3$ solution)
household ammonia (NH_3)
household bleach (NaClO solution)
household lye (NaOH solution)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
gastric fluid
carbonated beverages
vinegar
orange juice
beer
coffee
egg yolks
milk
blood
milk of magnesia ($Mg(OH)_2$) solution
Bases have a pH greater than 7


Bases Effect Indicators
Red litmus paper turns blue in contact with a base.
Phenolphthalein turns bright pink in a base.

Bases Neutralize Acids

Milk of Magnesia contains magnesium hydroxide, $Mg(OH)_2$, which neutralizes stomach acid, HCl.



$$2\ HCl + Mg(OH)_2 \longrightarrow MgCl_2 + 2\ H_2O$$

CHPTER 4

ANALYSIS CHEMISTRY

The analysis chemistry study the determination the chemical structure of compounds or substance ;and in general it is include the :

1- Qualitative Analysis

Study what the elements and compounds constituted of the substance.

2- Quantitative Analysis

It is determining of quantities of compound , or quantities of element include in the chemical component , or percentage weight of component of mixture .

Quantitative analysis include two classes :

A \ Volumetric Analysis : It is include :

1- Titration 2- Gas analysis 3- Instrument analysis

B \ Gravimetric Analysis

Volumetric Methods of Analysis

The analysis of an unknown substance involves determining what constituents are present in that quantities .

When the analysis is made in terms of weight unit , it is called , " **Gravimetric analysis** " ; (when reactants in solution are measured in weight unit) .

And when the analysis is made in terms of volume unit , it is called , " **volumetric analysis** " ; (when reactants in solution are measured in volume unit) .

Any two solution in which the solute react chemically can be analyzed by volumetric methods if :

1- The concentration of one of the solutions is known .

2- There is known a method for following the course of reactions as it occurs in the solution .

The titration of acids and bases is one of the most common ways of making a volumetric analysis .

Titration of Acid and Base

Titration is the process of determining the volume of a standard solution that will react with a known quantity of the sample that is undergoing analysis .

To make accurate measurements of volume , an apparatus called (burette) is used in titration , equivalent quantities of **Acid and Base** have reacted .

There are certain substances called (**indicators**) that are one colure in an **Acid** solution and another colure in **Basic** solution .

In the process of **Acid – Base** titration a known volume either the **Acid** or the **Base** is placed in the flask and a few drops of indicator solution are added .

The solution of **Base or Acid** from a burette then added slowly to the flask and is constantly until the change in colure of the indicator shows that (**end point**) has been reacted .

Then the application law is :

$$N_A \times V_A = N_B \times V_B$$

Where A : Acid B : Base

Methods Expressing Analytical Concentration and Volumetric :

1- Molarity 2- Normality 3- Molality

4- mole fraction 5- percentage weight

MOLARITY

The number of moles of solute contains in one liter of solution .

$$M = \frac{moles\ of\ \ solute}{N\ of\ \ liter\ of\ \ solution}$$

$$= \frac{W\ \ /\ \ M.wt}{V\ \ /\ \ 1000}$$

$$= \frac{W}{M.wt}\ \ x\ \frac{1000}{V}$$

NORMALITY

The number of grams equivalent weight of solute contained in (1) liter of solution .

$$N = \frac{N_2\ .\ of\ \ (gm.eq.wt.)}{N_2\ .\ of\ \ liter\ \ of\ \ solution}$$

$$= \frac{Wt.\ \ /\ \ eq.wt}{V\ \ /\ \ 1000}$$

$$= \frac{Wt}{eq.wt}\ \ x\ \frac{1000}{V}$$

MOLALITY

It is the number of moles of solute dissolve in (**1 K gm**) of solvent .

$$m = \frac{moles\ of\ solute}{K\ gm\ of\ solvent}$$

$$m = \frac{W\ /\ m.wt}{wt.\ /\ 1000}$$

$$m = \frac{W}{m.wt} \bullet \frac{1000}{wt}$$

MOLEFRACTION

The number of moles of solute to the number of moles of all solution (solute and solvent) .

mole fraction = W_1 / (W_1 + W_2)

PERCENTAG WEIGHT

The number of gram of solute in **K . gm** of solution .

$$\% = \frac{W_1}{W_1 + W_2} \ x\ 1000$$

GRAVIMETRIC ANALYSIS

It is the precipitate of substance (final product) in one features . The final measurements involves the determination of weight .

For example :

To determined **Ca** it precipitate in form **Oxalate** , then burn the product and weight in **CaO** features .

To determined **Al** it precipitate in form **Al $(OH)_3$** , then burn the product and weight in **$Al_2 O_3$.**

In the same way **Ba** as **Ba SO_4** .

Ag in form **AgCl** .

Weight Factor

It is the atomic weight of metals contain in the atomic weight of compound .

$$Weight\ \ Factor\ \ =\ \ \frac{Atomic\ \ weight\ \ of\ \ metal}{Atomic\ \ weight\ \ of\ \ compound}$$

Find wt. F for magnesium iodide (**Mg I_2**) , in (**AgI**) .

Wt . F = wt of MgI m. wt of AgI

And to determined the percentage weight of the ion in any sample as :-

% = a / w × wt.F × 100

Examples for Volumetric and Gravimetric Analysis

Q1 : In a titration , (46.3 ml) of (0.47 N) H_2SO_4 neutralized (35.4 ml) of unknown solution of (NaOH) . calculate the Normality of (NaOH) solution : and how many gram of (NaOH) can be used to make that solution .

Q2 : Calculate the Molarity of a solution that contains (100 gm) of (NaCl) dissolved in water to make (1500 ml) of solution .

Q3 : How many moles of solute are there in (500 ml) of (0.25 M) NaOH solution .

Q4 : Calculate the Molality of a solution that contains (100 gm) of NaCl dissolved in (1500 gm) of water .

Q5 : A solution was prepared by adding sufficient water to (100 gm) of NaOH to make a solution of (0.5 L) , calculate the Normality of the solution .

Q6 : How many gram equivalent weights are there in (500 gm) of (H_3PO_4) .

Q7 : A solution contain (500 gm) of KOH in (`1700 ml) water , what is Normality and Molarity , and how many milliliters of (0.5 N) of HCl react with (50 ml) of KOH .

Q8 : Find the weight factor for MgI_2 in AgI .

Q9 : When analyzed a sample weighted (1.5 gm) contain chloride ion (Cl) , the sample added to the solution silver nitrite ($AgNO_3$) to make AgCl which weighted (0.921 gm) .

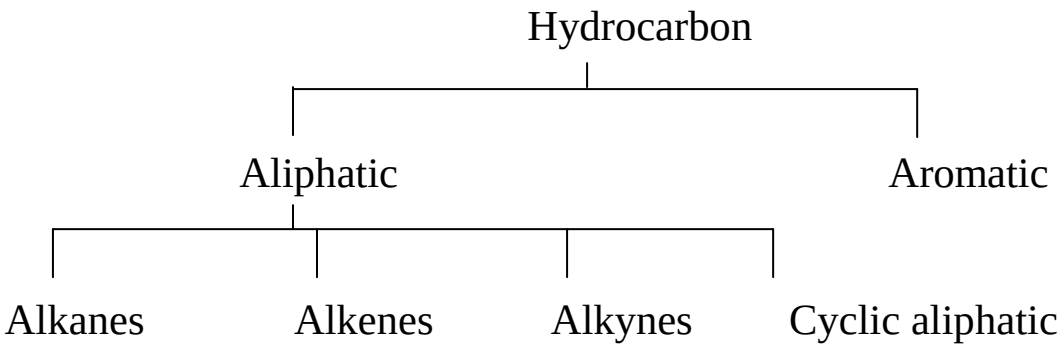
Q10 : (3.8 gm) of a sample contain iodide ion (I) the sample added 10 the solution silver nitrite ($AgNO_3$) to make AgI which weighted (0.786 gm) .
What is the percentage of chloride ion (I) in this sample .

Organic Chemistry

It is the chemistry of the carbon compounds.

Hydro carbons

Are the compounds containing only two element hydrogen and Carbon? One the basis of structure, hydrocarbons is divided into two main classes.



<u>Alkanes</u> $\mathbf{C_nH_{2n+2}}$

Nomenclature

CH_4	methane	gas at room temp.
C_2H_6	ethane	liquid
C_3H_8	propane	liquid under high pressure
C_4H_{10}	butane	liquid
C_5H_{12}	pentane	liquid
C_6H_{14}	hexane	liquid
C_7H_{16}	heptane	
C_8H_{18}	octane	
C_9H_{20}	nonane	
$C_{10}H_{22}$	decane	
$C_{11}H_{24}$	undecane	
$C_{12}H_{26}$	dodecan	

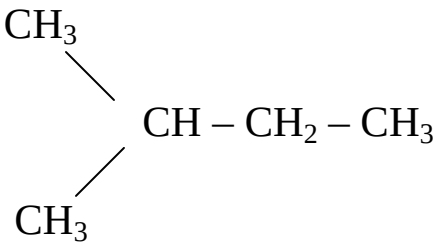
Methan is the simplest compound of all organics heavier alkanes are found in kerosene , diesel fuel , lubricating oils and in the paraffin's used to make candies .

<u>Alkyl groups</u> C_nH_{2n+1}

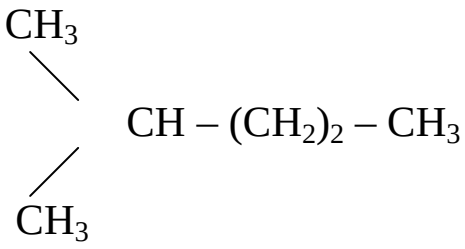
CH_3 - methyl C_2H_5- ethyl C_3H_7- propyl
C_4H_9 - butyl ← C_5H_{11}- pentyl ---- ext.

The groups are named simply by dropping (ane) from the name of the corresponding alkane and replacing it by (yl) .

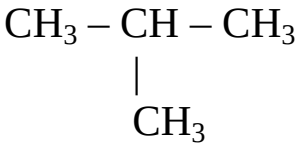
An iso alkaneis a compound in which all carbon atoms except are from a continuous chain and that one carbon atom is attached to the next ? carbon .



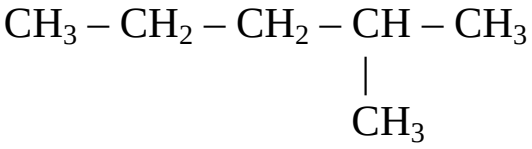
iso pentane
2- methyl butane



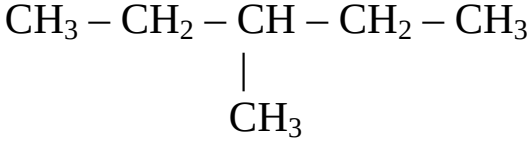
iso hexane
2- methyl pentane



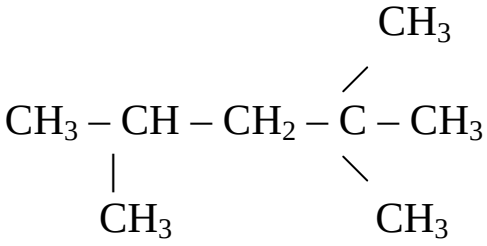
2- methyl propane
(iso butane)



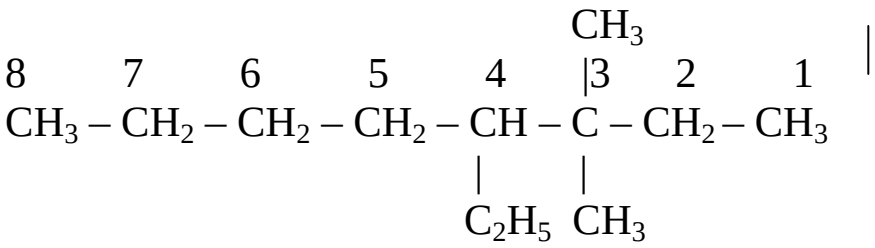
2- methyl pentane
(iso hexane)



3- methyl pentane



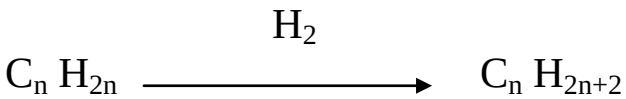
2,2,4 - Tri methyl pentane



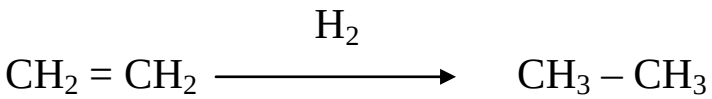
3,3 – di methyl 4- ethyl octane

Preparation التحضير

1- Hydrogenation of alkenes هدرجة الالكينات



alkene alkane



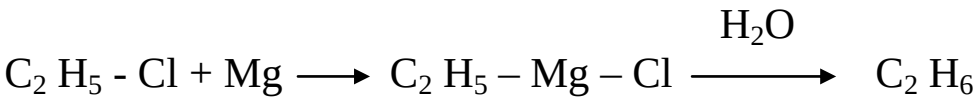
ethene ethane

2- Reduction of alkyl halides اختزال هاليد الالكيل

a / hydrolysis of Grinyard reagent

Grinyand reagent

Ex :



b - Reduction by metal and air

$$Rx + Zn + H^+ \longrightarrow RH + Zn^{+2} + X^-$$

Ex :

$$CH_3Cl + Zn \xrightarrow{H^+} CH_4 + ZnCl_2$$

C – Coupling of alkyl holides with metallic compound

$$Rx \xrightarrow{Li} \underset{\text{Alkyl Lithium}}{RLi} \xrightarrow{CuX} \underset{\text{lithium di – ethyl Copper}}{R_2CuLiX} + R.X \longrightarrow R.R + CuLiX_2$$

$$2RX + 2Na \longrightarrow R - R + 2NaI$$

Reaction **التفاعلات**

1- Halogenations $R - H + X_2 \xrightarrow[\text{or light}]{250\text{-}400^0C} R - X + HX$

Ex / $CH_3 - \underset{\text{iso butane}}{\underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3} \xrightarrow[280\text{-}400^0c]{Cl_2} CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - Cl + \%30$

$$CH_3 - \underset{\displaystyle Cl}{\underset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}} - CH_3 \quad \%70$$

2- chloro , 2 methyl -propane

2- Combustion الاحتراق

$$C_n H_{2n+2} + O_2 \text{ (excess)} \xrightarrow{\text{flame}} n\,CO_2 + (n+1)\,H_2O + \text{Fnergy}$$

Ex / $C_5 H_{12} + 8O_2 \xrightarrow{\text{flame}} 5CO_2 + 6H_2O +$ طاقة

$\Delta H = -845$ HCal.

حرارة الاحتراق

3- Cracking التكسير الحراري

$$\text{Alkane} \xrightarrow[\text{with or without Catalyst}]{400 - 600C^0} H_2 + \text{Smaller alkanes + alkenes}$$

هو عملية تكسير الاواصر الكسيرة

Physical properties of Alkanes

1- The B.p and M.p rise the number of Carbon increase .
2- The boiling points and melting point increases because those inter molecular forces increase as the molecules get larger .
3- The inter molecular forces become weaker and are overcoming at a lower temperature .
4- The density increase with increasing of alkane size but ten thus all alkanes are less dense than water .

Alkenes $C_n H_{2n}$ **الاوليفينات**

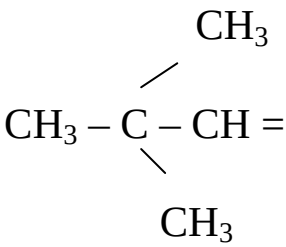
Name of alkene : Select the longest continuous chain that contains the carbon – carbon double bond

$CH_2 = CH_2$ Ethane

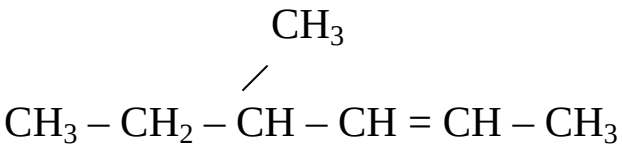
$CH_3 – CH = CH_2$ propene

`

$CH_3 – CH_2 – CH = CH_2$ Butene



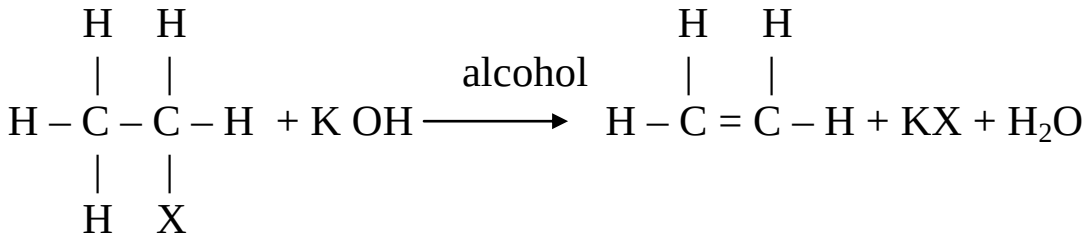
3,3– di methyl butane

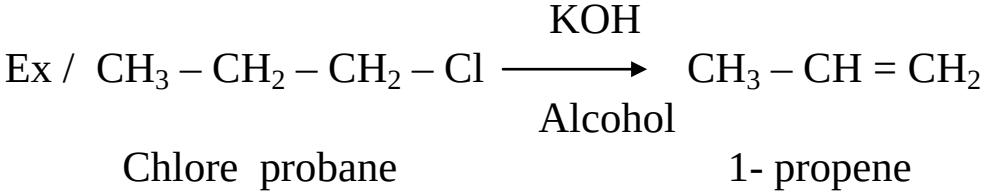


4- methyl 2- hexene

Preparation **التحضير**

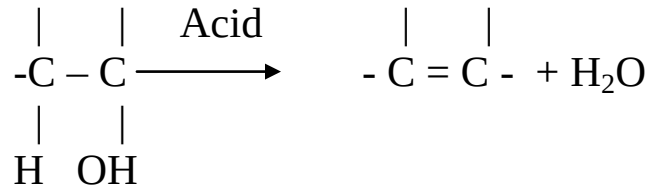
1) Dehydrohalogenation of alkyl halides

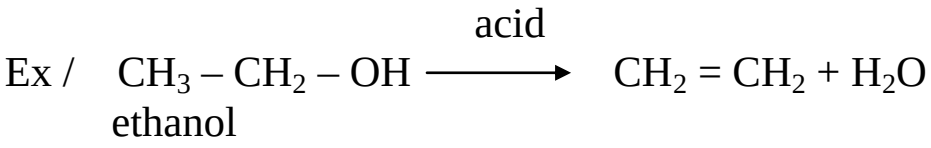




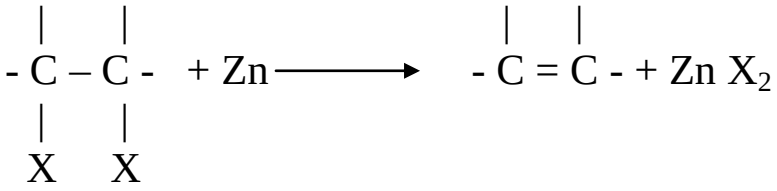
Chlore probane — 1- propene

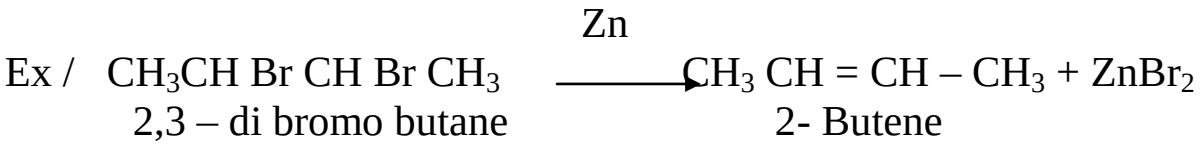
2) Dehydration alcohol سحب جزيئة ماء من الكحول



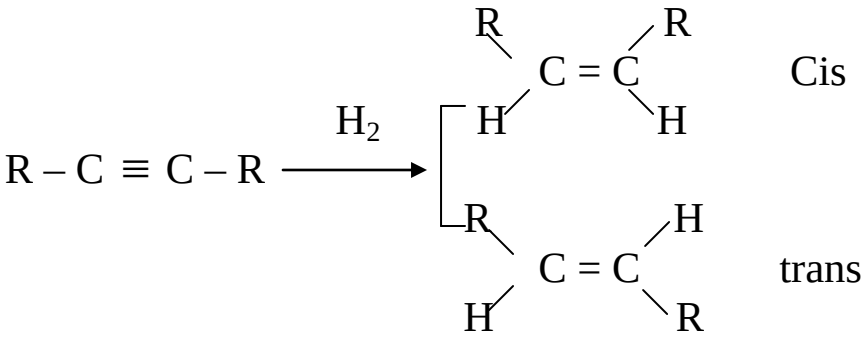


3 – Dehalogenation of di halides

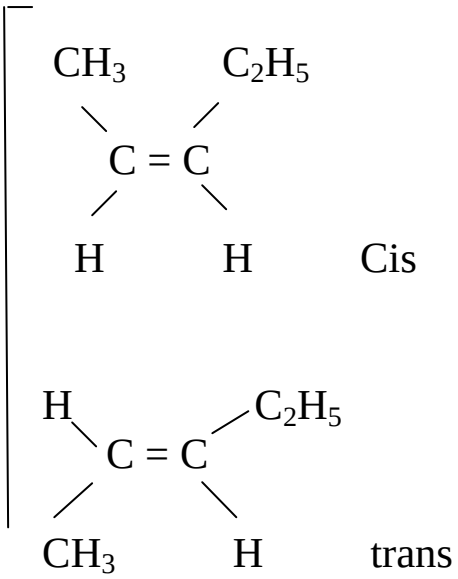




4- Reduction of alkynes اختزال الالكاينات



Ex / $CH_3 - C \equiv C - CH_2 - CH_3$ $\xrightarrow{H_2}$



Reactions of alkenes **تفاعلات الالكينات**

1/ Addition of hydrogen

$$-\overset{|}{C}=\overset{|}{C}- + H_2 \xrightarrow{pt\ ,\ pb\ ,\ Ni} -\overset{|}{C}-\overset{|}{C}-$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad H \quad H$$

ethane

Ex / $CH_3 - CH = CH_2 \xrightarrow[Ni]{H_2} CH_3 - CH_2 - CH_3$

Propene propane

2- Addition of halogens

$$-\overset{|}{C}=\overset{|}{C}- + X_2 \xrightarrow{CCl_4} -\overset{|}{C}-\overset{|}{C}-$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\quad X \quad X$$

Ex/ $CH_3 - CH = CH_2 \xrightarrow[CCl_4]{Br_2} CH_3 - \underset{Br}{\underset{|}{CH}} - \underset{Br}{\underset{|}{CH_2}}$

Propene — 1,2 – Di bromo propane

3- Addition of hydrogen halids

$$-\overset{|}{\underset{|}{C}} = \overset{|}{\underset{|}{C}}- + Hx \longrightarrow -\overset{|}{\underset{X}{C}} - \overset{|}{\underset{H}{C}}-$$

Ex/ $CH_3 - CH = CH_2 \xrightarrow{HI} CH_3\,\underset{I}{\underset{|}{CH}} - CH_3$

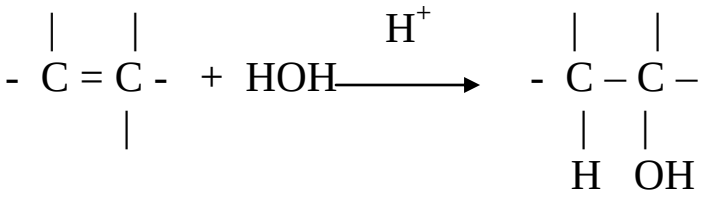
Propene — 2 – Iodo propane

4- Addition of Sulforic acid (H_2SO_4)

$$-\overset{|}{\underset{|}{C}} = \overset{|}{\underset{|}{C}}- + H_2SO_4 \longrightarrow -\overset{|}{\underset{H}{C}} - \overset{|}{\underset{OSO_3H}{C}}-$$

Ex / $CH_3 - CH = CH_2 \xrightarrow[H_2SO_4]{Conc.} CH_3 - \underset{OSO_3H}{\underset{|}{CH}} - CH_3$

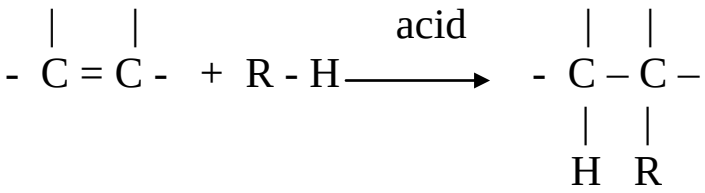
5- Addition of water (hydration)

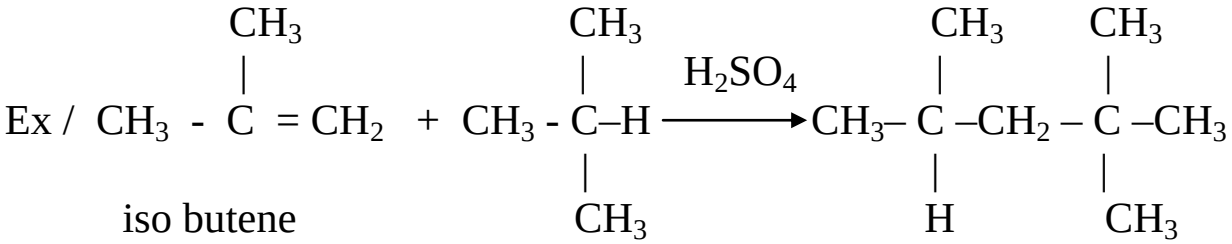


Ex / $CH_3 - CH = CH_2 \xrightarrow[H^+]{H_2O} CH_3 - CH(OH) - CH_3$

Propene — 2- propanol (iso propyl alcohol)

6- Alkylation الالكلة





iso butene — iso butane

2 – methyl propene — او 2-methyl propane

2,2,4–Tri methyl pentane

Alkenes Physical Properties

1- They are insoluble in water , but quite soluble in polar solvent such as benzene .

2- They are less dense than water .

3- The B.P rise with increasing Carbon content . The rise is 20 – 30^0C for each Carbonation .

4- Branching lowers the B.P and difference in polarity and hence the difference in m. p. and B.P. are grater for alkenes that contains elements whose electro negativity differ widely from that of Carbone .

<u>Alkynes</u>

Nomenclature :-

$CH_3 – C \equiv CH$
Propyne

$H – C \equiv C – C_2H_5$
Butyne

$CH_3 – C \equiv C – CH_3$
2- Butyne

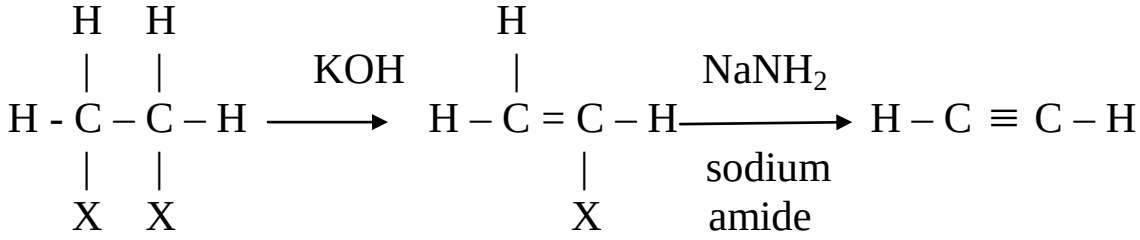
$CH \equiv C – CH – CH_3$
|
CH_3
3 – methyl butyne

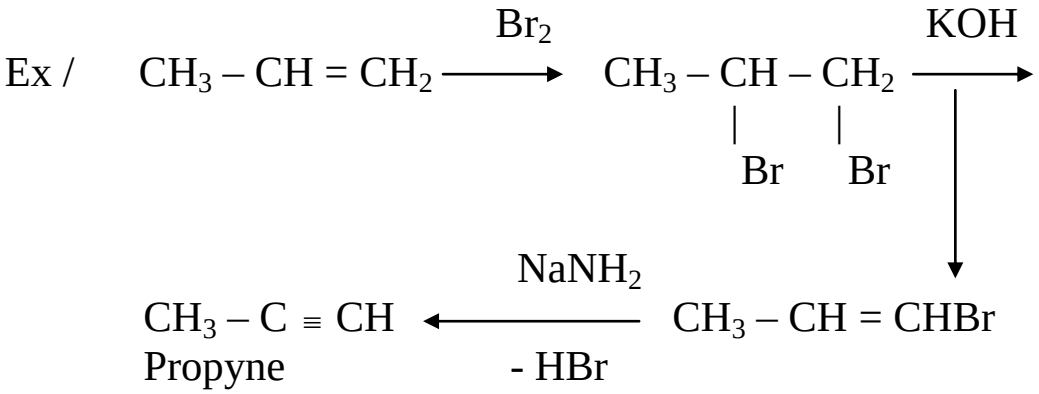
$CH_3 – CH_2 – C \equiv C – CH_2 – CH_3$
3 – hexyne

$H – C \equiv C – H$
ethyne
or acetylene

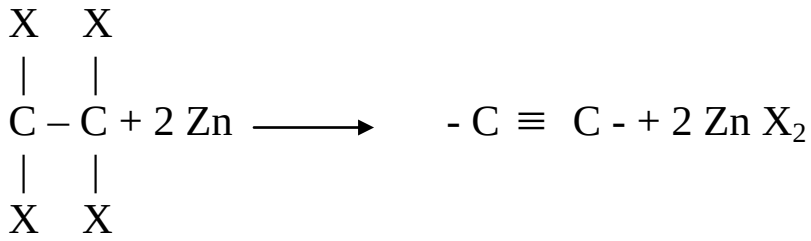
Preparation of Alkynes

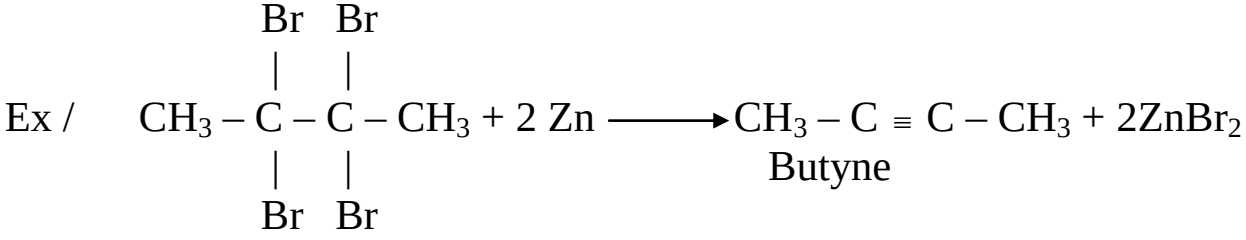
1- Dehydrohalogenations of alkyl di halides :-





2- Dchalogenation of tetra halides





3- Hydration of Calcium Carbide

$$CaO + 3C \xrightarrow{\Delta} CaC_2 + CO$$

$$CaC_2 + 2H_2O \longrightarrow HC \equiv CH + Ca(OH)_2$$

Reactions **التفاعلات**

Addition Reaction :-

$$-C \equiv C- + y\ z \longrightarrow \underset{\begin{array}{cc} | & | \\ y & z \end{array}}{C = C} \xrightarrow{yz} \underset{\begin{array}{cc} | & | \\ y & z \end{array}}{\overset{\begin{array}{cc} y & z \\ | & | \end{array}}{C - C}}$$

1/ Addition of Hydrogen

$$-C \equiv C- \xrightarrow[Ni]{2H_2} \underset{\begin{array}{cc} | & | \\ H & H \end{array}}{\overset{\begin{array}{cc} H & H \\ | & | \end{array}}{C - C}}$$

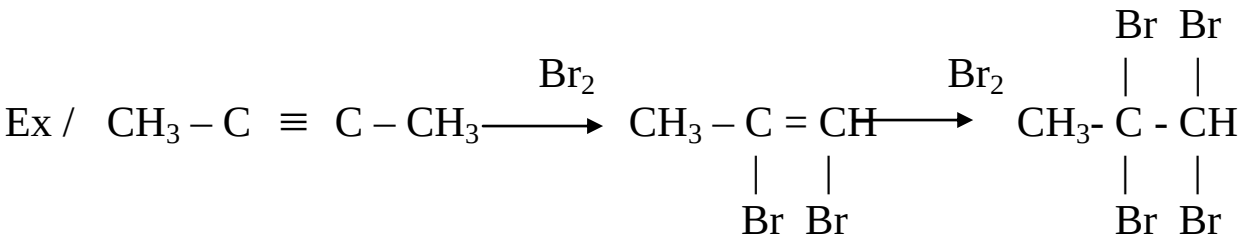
Alkane

Ex / $CH_3 - C \equiv C - CH_3 \xrightarrow[Ni]{2H_2} CH_3 - CH_2 - CH_2 - CH_3$

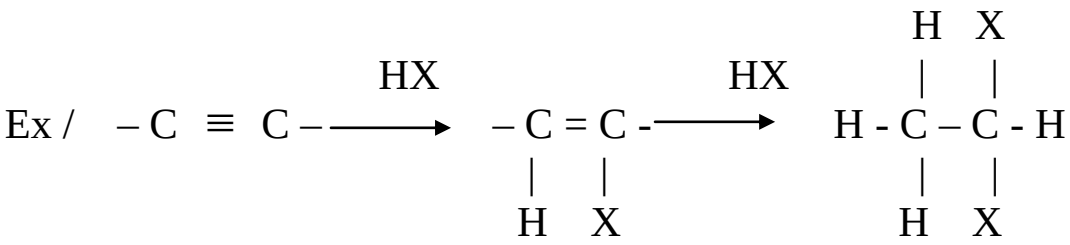
Butane

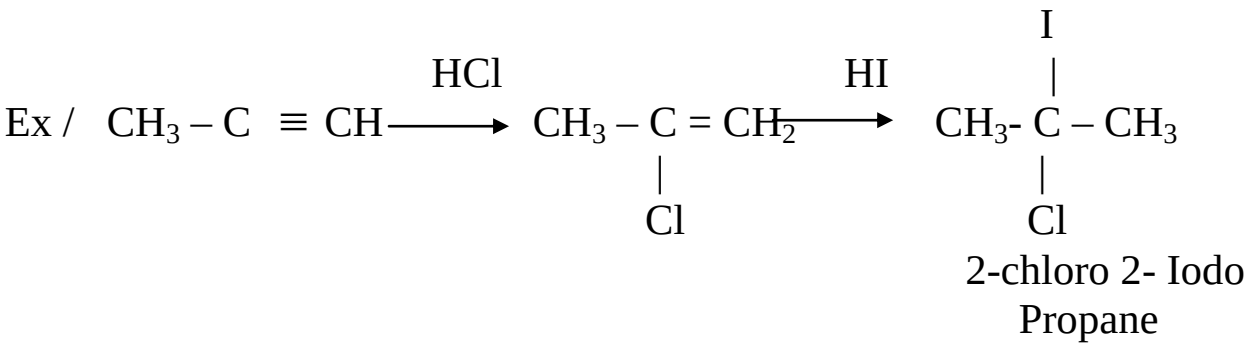
2/ Addition of Halogen

$$-C \equiv C- \xrightarrow{X_2} \underset{\begin{array}{cc} | & | \\ X & X \end{array}}{C = C} \xrightarrow{X_2} \underset{\begin{array}{cc} | & | \\ X & X \end{array}}{\overset{\begin{array}{cc} X & X \\ | & | \end{array}}{- C - C -}}$$



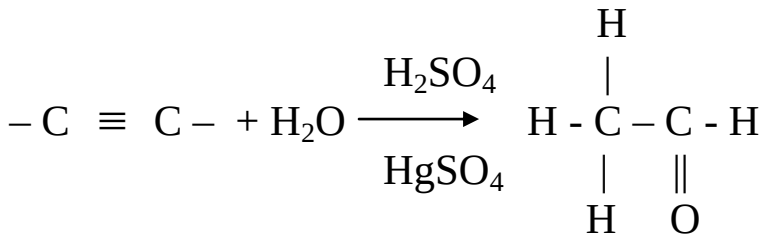
3- Addition of hydro halides



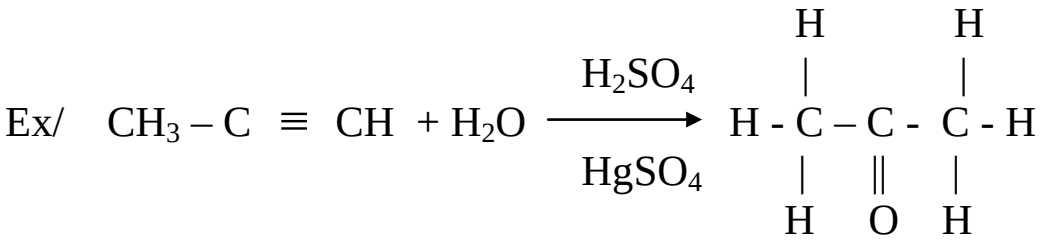


2-chloro 2- Iodo Propane

4- Addition of water (Hydration)



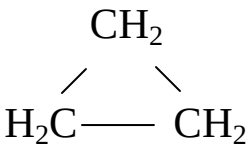
Acetaldehyde



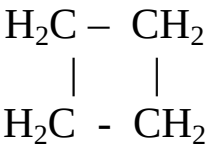
Acetone

Cyclo alkanes

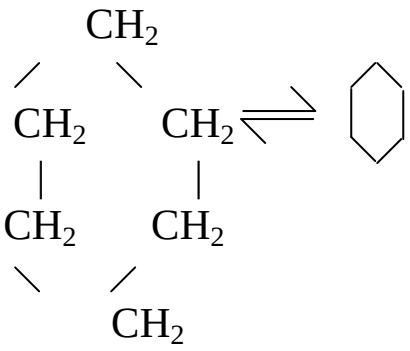
The empirical formula for these compound is (C_nH_{2n}) , they contain two hydrogen atoms than straight alkanes because there is one more carbon – to – carbon bond , aring of carbon atoms so formed



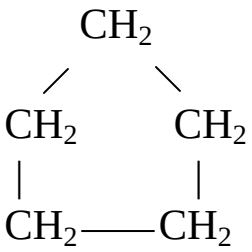
Cyclo propone
$C_3 H_6$



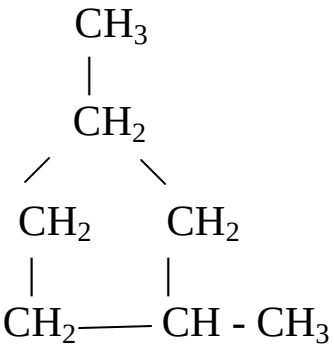
Cyclo butane
$C_4 H_8$



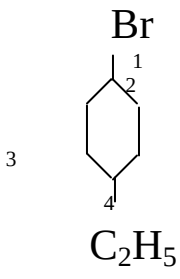
Cyclo hexane



Cyclo pentane



1 , 3 – Dimethyl cyclo pentane



1- Bromo – 4 – ethyl cyclo hexane

Aliphatic and Aromatic Compounds

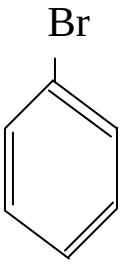
Aliphatic compounds : are open chain compounds and those cyclic compounds that resemble the open chain compounds .

The families we have studied , so fare , Alkanes , Alkenes , Alkynes and their cyclic – analogs are all members of the aliphatic compounds.

Aromatic compounds : are benzene and compounds resemble benzene in chemical behavior .

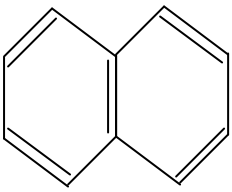
The name aromatic was applied to benzene and to compounds containing one or more benzene ring in their structure .

Some aromatic compounds have a structure differ from the structure of benzene .

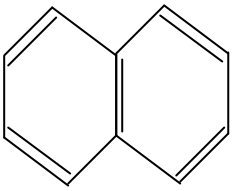


Bromo benzene

Benzoic aromatic



Naphthalene



azalene

non – benzoic aromatic

Properties of Aromatic compounds

1- High degree of un saturation .

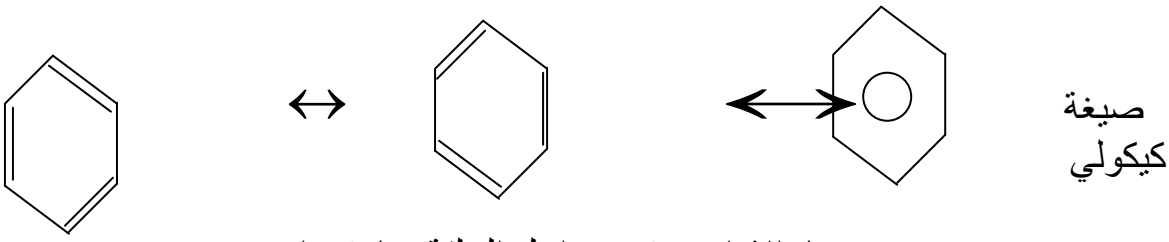
2- Resistance to addition reactions .

3- up normal of stability , Law heat of hydrogenation and low heat of formation .

Benzen , $C_6 H_6$,

Is the simplest aromatic hydro carbon . The molecular formula of benzene is $C_6 H_6$. The formula suggests that it is a highly unsaturated substance , but its properties are quite different from those of open chain unsaturated hydro carbon .

Benzene was intermediate between two structures that now we call resonance structure .



معناه الاواصر تدور داخل الحلقة وباستمرار

Reaction of benzene

1- Nitrogenation النترجة

$$C_6 H_6 + HNO_3 \xrightarrow{H_2SO_4} C_6 H_5 NO_2 + H_2O$$

Nitrobenzene او 

2- Sulfanation السلفنة

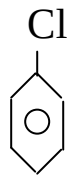
$$C_6 H_6 + H_2SO_4 \longrightarrow C_6 H_5 SO_3H + H_2O$$

Benzene Sulfonic acid او 

3- Halogenations الهلجنة

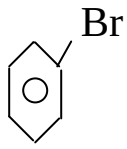
$$C_6 H_6 + X_2 \longrightarrow C_6 H_5 X + HX$$

$C_6H_6 + Cl_2 \longrightarrow C_6H_5Cl + HCl$ او



Chloro Benzene

$C_6H_6 + Br_2 \longrightarrow C_6H_5Br + HBr$ او

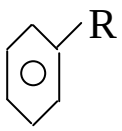


Bromo Benzen

4- Friedel – Craft reaction

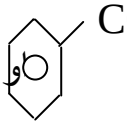
a- Alkylation : addition of Alkyl group (R-)

$$C_6H_6 + RCl \xrightarrow{Al_2Cl_6} C_6H_5R + HCl$$ او

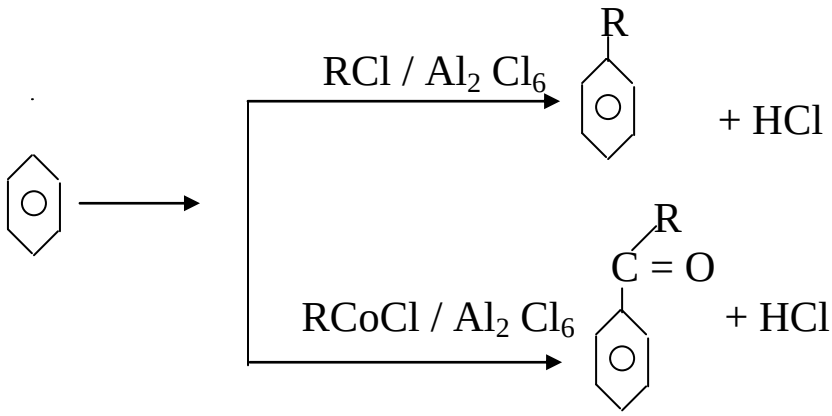


b- Addition of acyl group

$$C_6H_6 + RCO\text{-}Cl \xrightarrow[50\ C^0]{Al_2Cl_6} C_6H_5COR + HCl$$ او

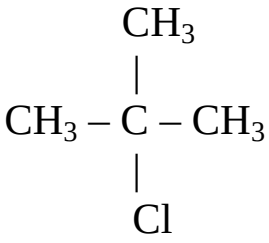


Or Friedel – Craft reaction is

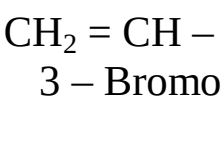


Alkyl Halides **R. X , Ar. X**

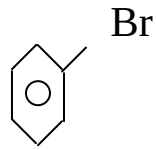
General formula is R . X where R: is any simple alkyl group , while X: is a halid Cl I F Br



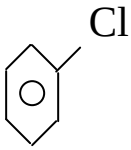
2 – chloro 2- methyl propane



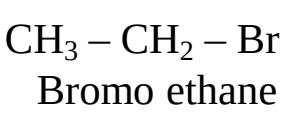
3 – Bromo – 1 - propene



Cyclo hexyl – Bromide

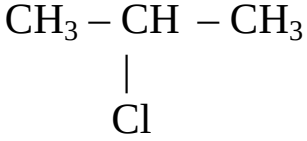


Benzyl chloride



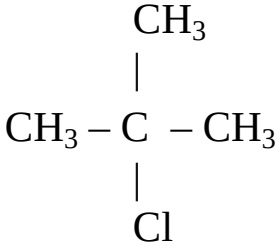
Bromo ethane

1^0 Primary اولي



2- chloro propane

2^0 Secondary ثانوي



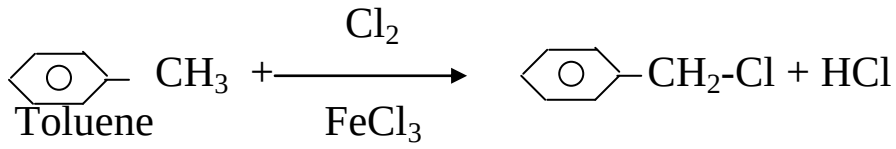
2- chloro 2- methyl propane

3^0 tertiary ثلاثي

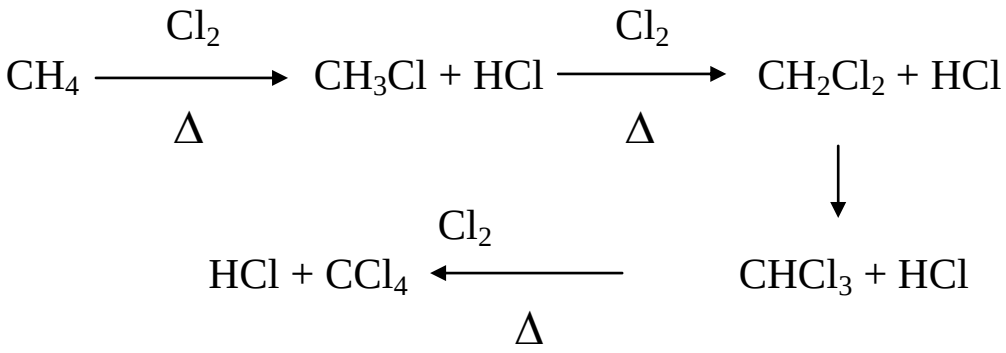
Preparation التحضير

1- Halogenation Reaction of hydro Carbons تفاعلات الهلجنة

A-

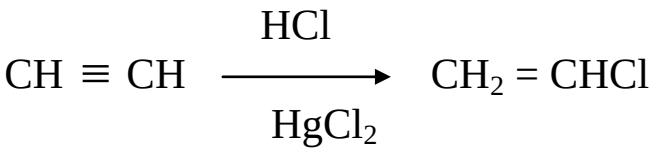


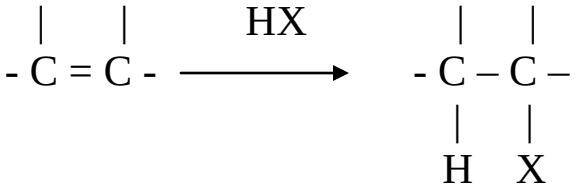
B-

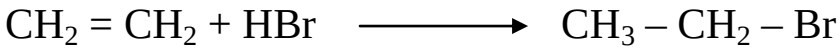


2- Addition Reaction to alkynes or alkenes تفاعلات الاضافة

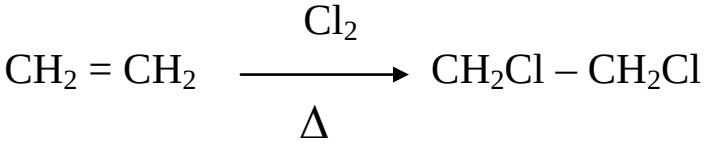
a- Addition of HX







b- Addition of X_2



$$CH \equiv CH + Cl_2 \longrightarrow Cl\text{-}CH = CH\text{-}Cl$$

3- From alcohols

$$R - OH \xrightarrow{HX} RX + H_2O$$

$$CH_3 - CH_2 - CH_2 - OH \xrightarrow{HBr} CH_3 - CH_2 - CH_2\,Br + H_2O$$

Physical Properties

1- Great molecular weight .

2- High boiling point and melting point than alkanes having the same structure .

3- Boiling point and melting point increases by increasing the atomic weight of halogen
F < Br < Cl < I

4- Insoluble in water .

5- Soluble in some organic compounds .

6- More dense than water .

7- The order of the boiling points is

Tertiary 3^0 < Secondary 2^0 < primary 1^0

Alcohols

Nomenclature التسمية

$CH_3\ OH$	$CH_3\ CH_2\ OH$	$CH_3\ CH_2\ CH_2\ OH$
methyl alcohol	Ethyl alcohol	propyl alcohol

$CH_3 - \underset{\displaystyle OH}{\underset{\vert}{CH}} - CH_3$	$CH_3 - \underset{\displaystyle CH_3}{\underset{\vert}{CH}} - CH_2\ OH$	$CH_3 - \underset{\displaystyle OH}{\underset{\vert}{\overset{\displaystyle CH_3}{\overset{\vert}{C}}}} - CH_3$
Sec – propane alcohol	2- methyl propanol	2– methyl 2- propanol

Classification التصنيف

$R - \underset{\displaystyle H}{\underset{\vert}{\overset{\displaystyle H}{\overset{\vert}{C}}}} - OH$	$R - \underset{\displaystyle R}{\underset{\vert}{\overset{\displaystyle H}{\overset{\vert}{C}}}} - OH$	$R - \underset{\displaystyle R}{\underset{\vert}{\overset{\displaystyle R}{\overset{\vert}{C}}}} - OH$
Primary	Secondary	Tertiary

$CH_3\ CH_2 - OH$	$CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{\vert}{CHOH}}$	$CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle CH_3}{\overset{\vert}{C}}}} - OH$
n- Ethanol	sec – butane alcohol	t – pentane alcohol

preparation

1- Hydration of Alkenes :- اضافة الماء الى الالكينات

$$H_2C = CH_2 + H_2O \xrightarrow{H_2SO_4} CH_3 - CH_2 - OH$$

2- Hydrolysis of alkyl halides التحلل المائي لهاليدات الالكيل

$$CH_3\,CH_2 - Cl + H_2O \xrightarrow[\text{تسخين}]{\Delta} CH_3\,CH_2\,OH + HCl$$

3- Reaction between aliphatic amine with netrose acid

$$R - NH_2 + HNO_2 \longrightarrow R - OH + N_2 + H_2O$$

$$CH_3 - CH_2 - NH_2 + HONO \longrightarrow CH_3\,CH_2\,OH + N_2 + H_2O$$

Reaction التفاعلات

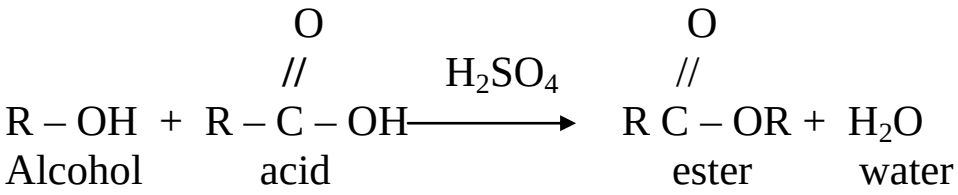
1- Combustion **الاحتراق**

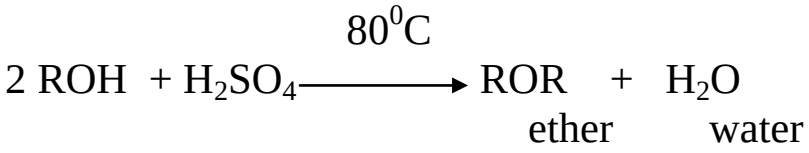
$$C_2\,H_5\,OH + 3O_2 \xrightarrow{\phi} 2CO_2 + 3H_2O + \text{Energy طاقة}$$

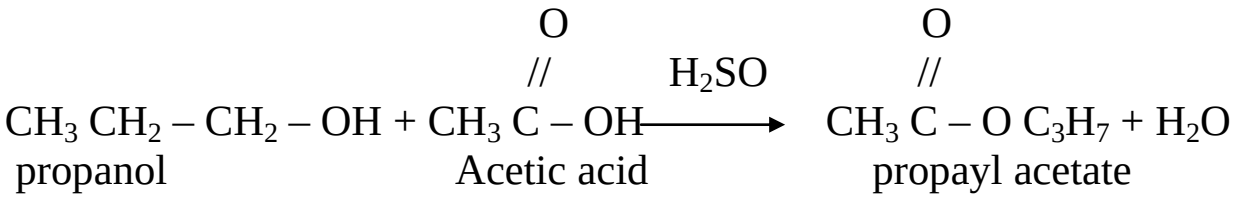
2- Formation of olefins الاولفين

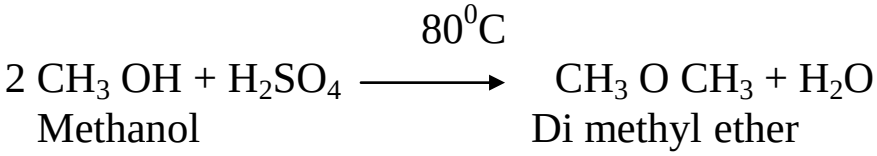
$$C_2\,H_5 - OH \xrightarrow{H_2SO_4} CH_2 = CH_2 + H_2O$$

3- Reaction with Acids









Physical Properties of Alcohols

1- Very polar

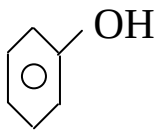
2- Polar OH groups are held together by inter molecular forces as those holding together water molecules .

3- The first three primary alcohols soluble in water .

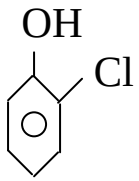
4- The boiling point increase with increasing carbon number , and they usually decrease with branching .

Phenols

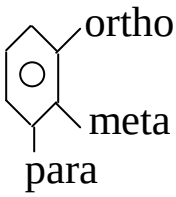
Nomenclature

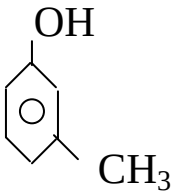


phenol

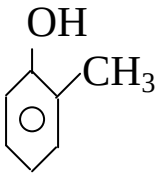


ortho-chloro phenol
o- chloro phenol



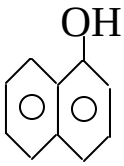


m- methyl phenol
(m – cresol)

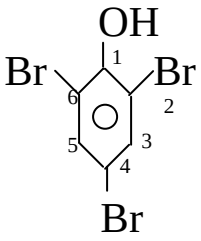


o- Cresol

p- cresol



α - nephthol



2,4,6 – tri bromo phenol

Structure (differ and like) with alcohol

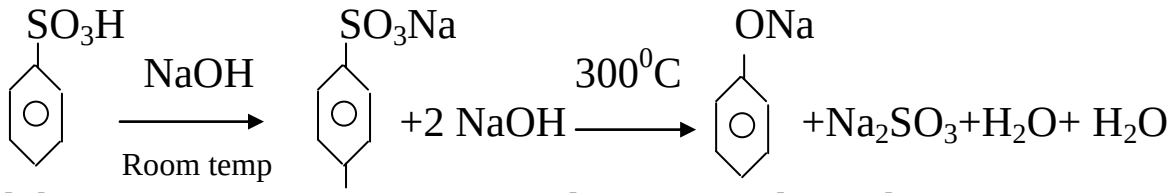
1- Both phenol and alcohol contains (OH) group .

2- Both phenol and alcohol can convert into ether and esters .

3- The two kinds of compound differ greatly in physical properties but seems to be a like in chemical behavior .

Preparation

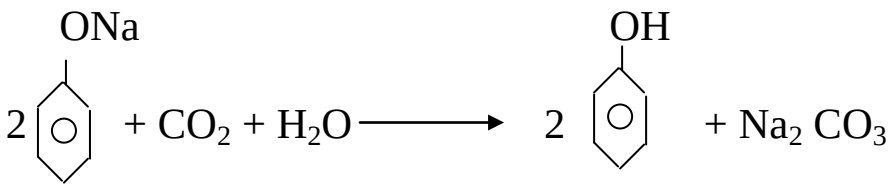
1- Sulfonation process



Selphono Benzene or Benzene Sulfonate

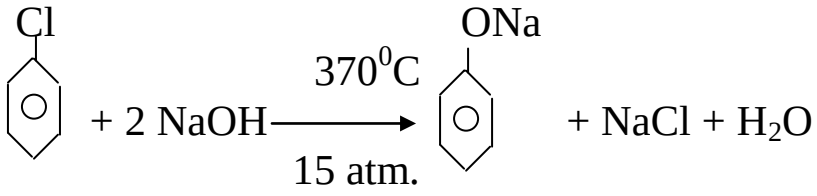
Benzene Sodium Sulfonate

Sodium phenexo

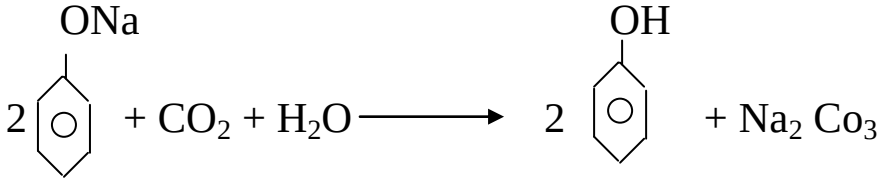


Phenol

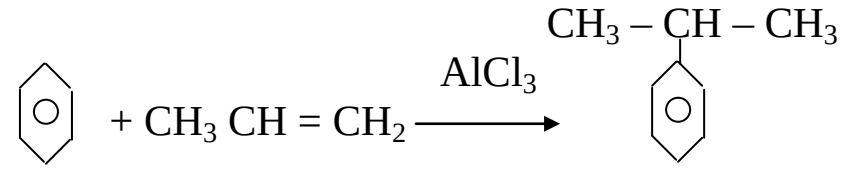
2- Dow process عملية دو



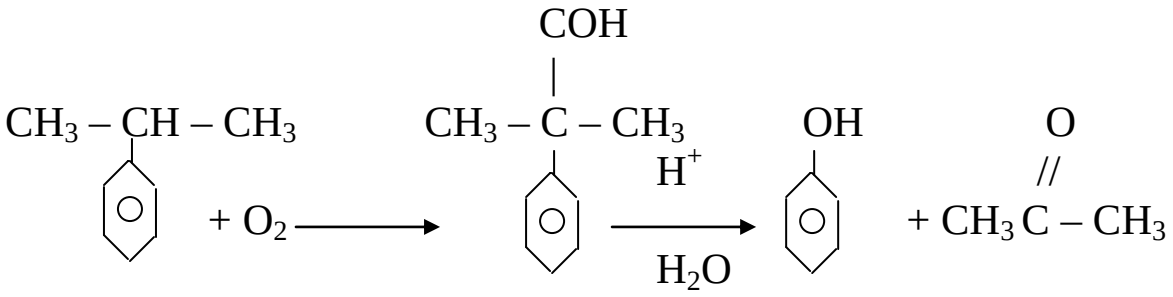
Sodium phenoxid



3- Using Kumene reaction (iso propyl Benzene)



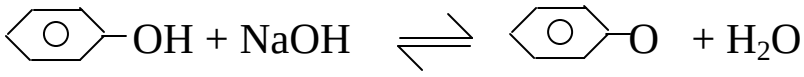
Benzene propene Kumene



Kumene Kumen hydroxid acetone

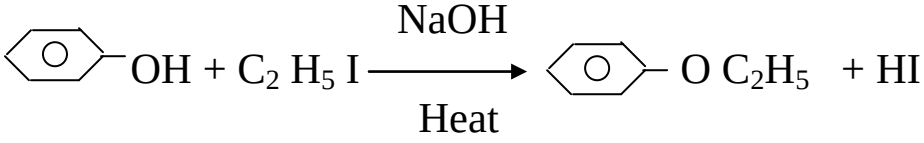
Reactions التفاعلات

1- Acidity , Salt formation



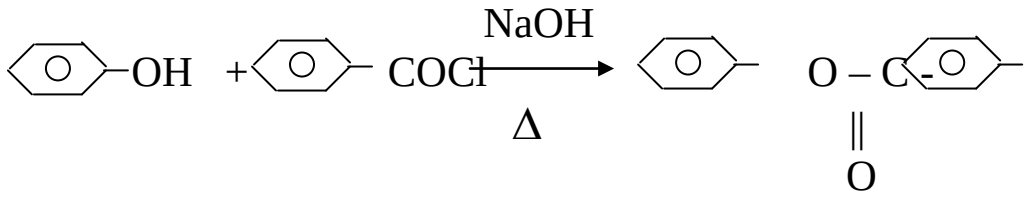
Sodium phenoxide

2- Eather formation تكوين الاثيرات



ethyl Iodide methyl phenyl ether

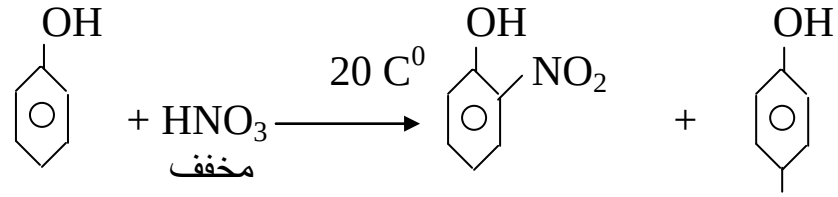
3- Ester formation



Phenol benzoate

4- Ring Substitution الاستبدال الحلقي

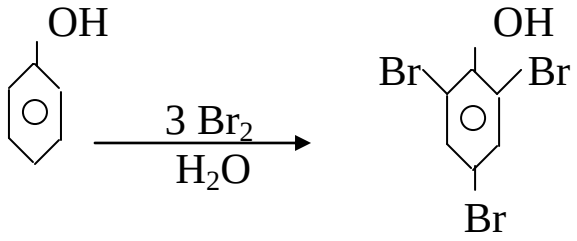
1- nitrogenation



o-pheno nitrite

p-pheno nitrite

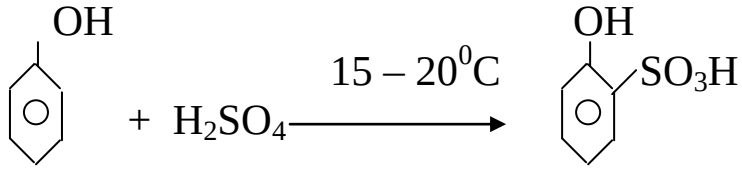
2- halogenations



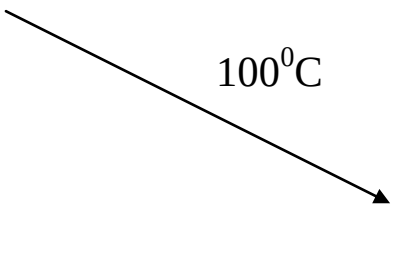
+ 3 HBr

2 , 4 , 6 – tri Bromo phenol

3- Sulfonation

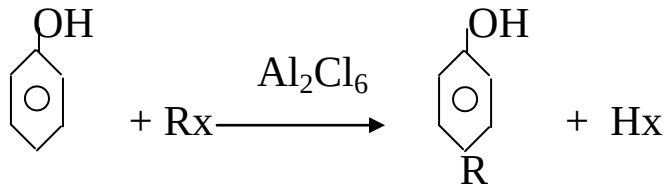


O–pherw sulfonic acid



p- phenol sulfonic acid

4- Fridlcrafts alkylation



Physical properties of phenol

1- Simple phenols are liquids or low melting solids because of hydrogen bonding they never get high boiling points .

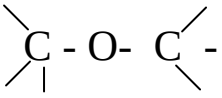
2- Solubility in water because of hydrogen bonding .

3- Phenols are color less .

4- Phenols are easily oxidized .

<u>Ethers</u>

Are compounds in which an oxygen atom is bonded to two organic groups



Three kinds of ether are known :

1- Aromatic	2- Aliphatic	3- Mixed
Ar – O – Ar	R – O – R	Ar – O – R

Nomenclature

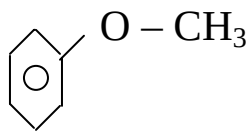
$CH_3 – O – CH_3$	$C_2 H_3 – O – C_2 H_5$
Di methyl ether	Di ethyl ether

$C_2H_5 - O - CH_3$

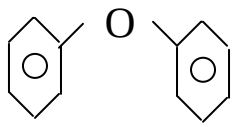
Methyl ethyl ether

$CH_3 - O - CH(CH_3) - CH_3$

iso propyl methyl ether



Methyl phenyl ether



Di phenyl ether

Preparation

1- Dehydration of alcohol

$$2\ R\,CH_2OH + H_2SO_4 \xrightarrow{140^0C} R\,CH_2 - O - CH_2 - R + H_2O$$

$$\text{Ex}\quad \begin{matrix} CH_3\,CH_2 - OH \\ CH_3\,CH_1 - OH \end{matrix} \xrightarrow[H_2SO_4]{140^0C} \begin{matrix} CH_3\,CH_2 - O - CH_2 - CH_3 \\ \text{Di ethyl ether} \end{matrix}$$

2- Williamson Synthesis تخليق وليمسون

تفاعل هاليد الالكيل مع الكوكسيدات

$$R\,O^-\,Na^+ + R - X \longrightarrow R\,O\,R + Na^+\,X^- \quad \text{تفاعل الكوكسيدات}$$

$$R\,O\,Na + Ar - X \longrightarrow \text{N . R.} \quad \text{بالظروف العادية}$$

$$Ar\,.\,O\,.\,R + NaX \quad \text{تحت ضغط ودرجة}$$

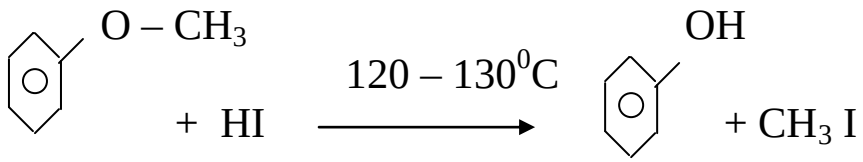
$$2R - OH + 2\,Na \longrightarrow 2\,R\,O\,Na + H_2\uparrow \quad \text{حرارة معينة}$$

Reactions

1- $R - O - R + Hx \longrightarrow R - OH + R - X \xrightarrow[120\text{-}130^0C]{Hx} Rx + H_2O$

Ex. $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - O - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3 + HBr \xrightarrow{120 - 130^0C} CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - OH + CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - Br$

Di isopropyl ether



methyl phenyl ether

Physical Properties الخواص الفيزيائية للأثيرات

1- Ethers posses a small dipole moment .

2- This weak polarity doesn't appreciably affect the boiling point of ethers

Ex . B. P of n – heptane is 98^0C
B. P of ethyl n – pentyl ether is 100^0c

3- The hydrogen bonding that holds alcohol molecules strongly together is not possible for ethers .

4- Ethers are hardly soluble in water because of hydrogen bonding .

5- Di methyl ether and methyl ethyl ether are gases while di – ethyl ether and higher member of aliphatic ether are liquids . Aromatic ethers are liquids or solids .

6- Ethyl ether has low boiling point 35^0c and it is flame - able . Also it is highly oxidized forming un volatile peroxide – (H_2O_2) .

Esters

By heating Carboxylic acid with primary or secondary alcohol in presence of small amount of ametalic acid , an ester and water will formed .

$$R-\overset{\overset{O}{\parallel}}{C}-OH + R-OH \overset{H^+}{\rightleftharpoons} R-\overset{\overset{O}{\parallel}}{C}-OR + H_2O$$

Carboxylic acid Alcohol Ester

Nomenclature

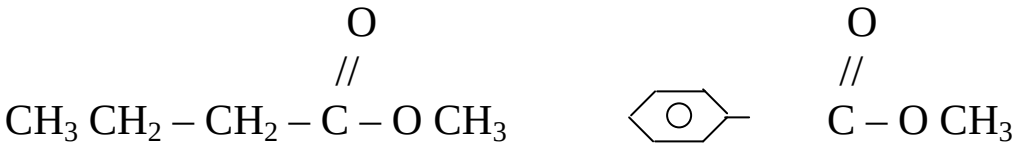
Aliphatic $R-\overset{\overset{O}{\parallel}}{C}-OR$

Aromatic $Ar-\overset{\overset{O}{\parallel}}{C}-Ar$

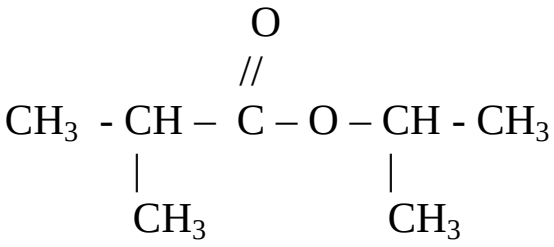
Mixed $Ar-\overset{\overset{O}{\parallel}}{C}-OR$

$CH_3-\overset{\overset{O}{\parallel}}{C}-OCH_3$
Methyl acetate

$CH_3-\overset{\overset{O}{\parallel}}{C}-O-C_2H_5$
Ethyl acetate

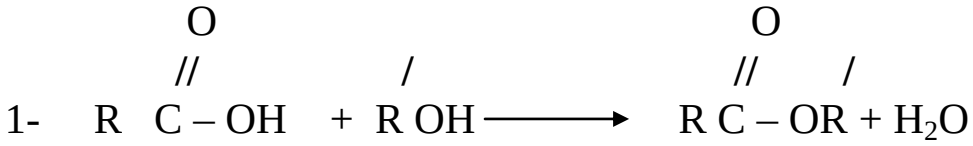


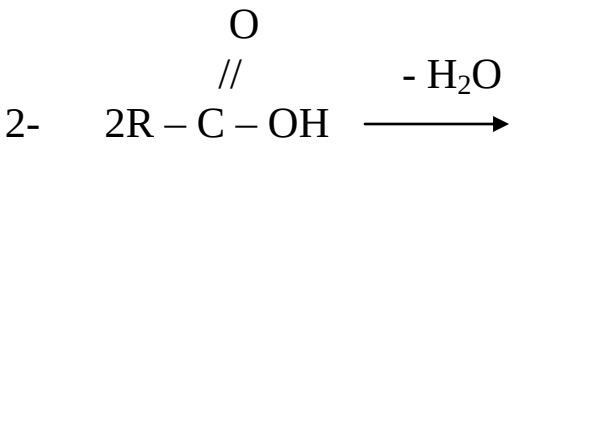
Methyl butanuate methyl benzoate

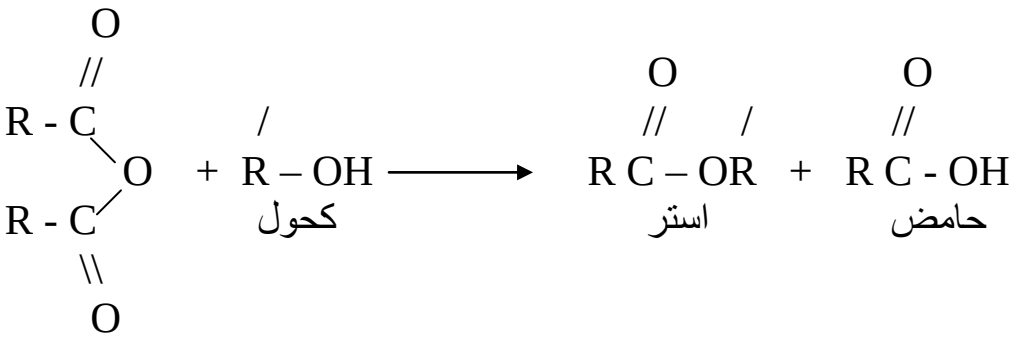


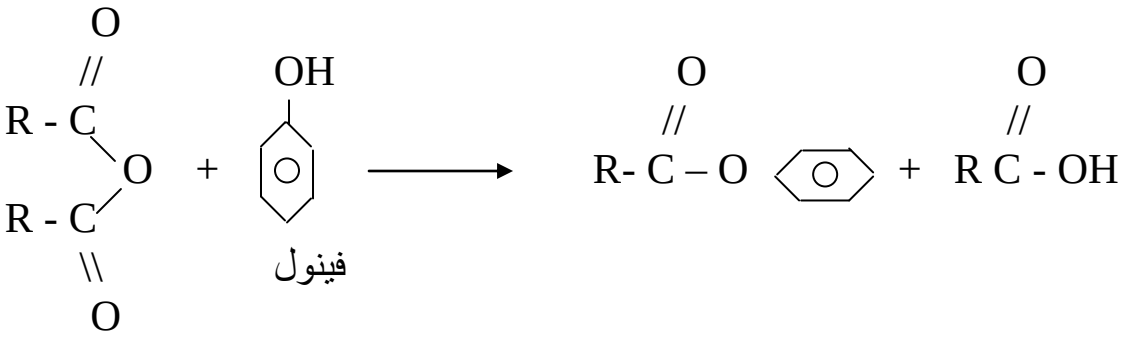
iso propyl iso butanuate

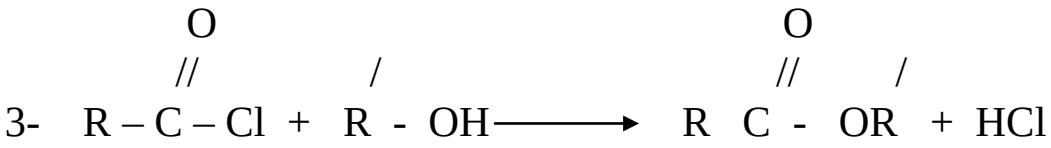
Preparation

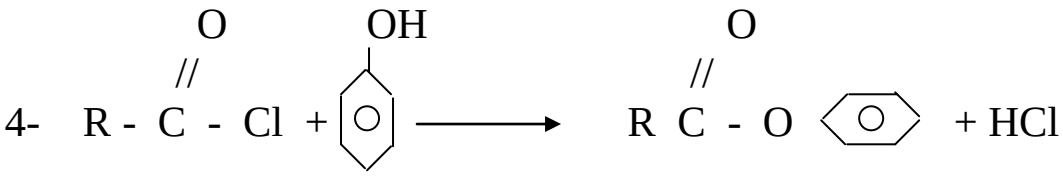








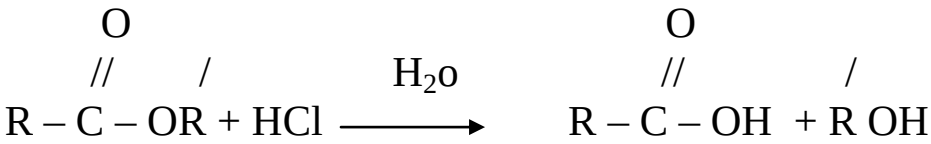


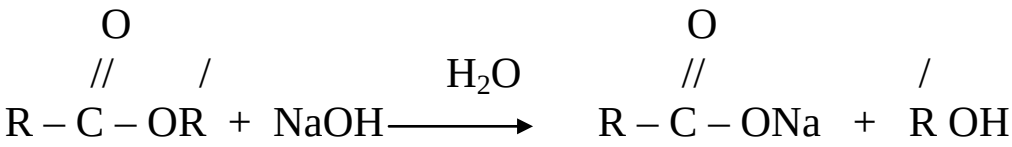


Acyl chloride

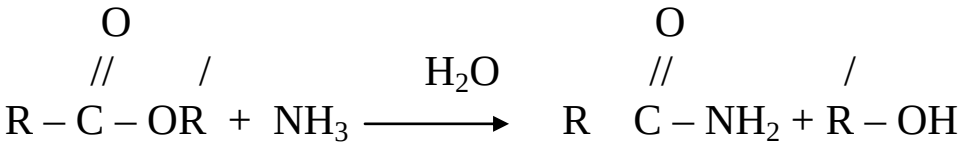
Reactions

1- Hydrolysis in water (using acid or base)



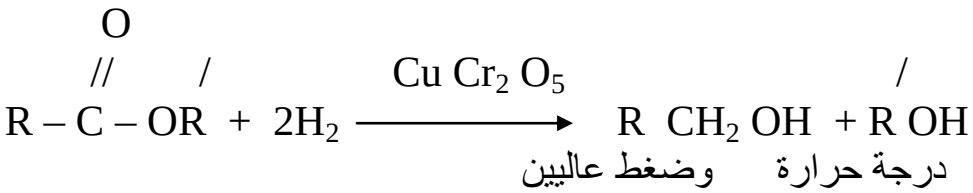


2- Formation of amide

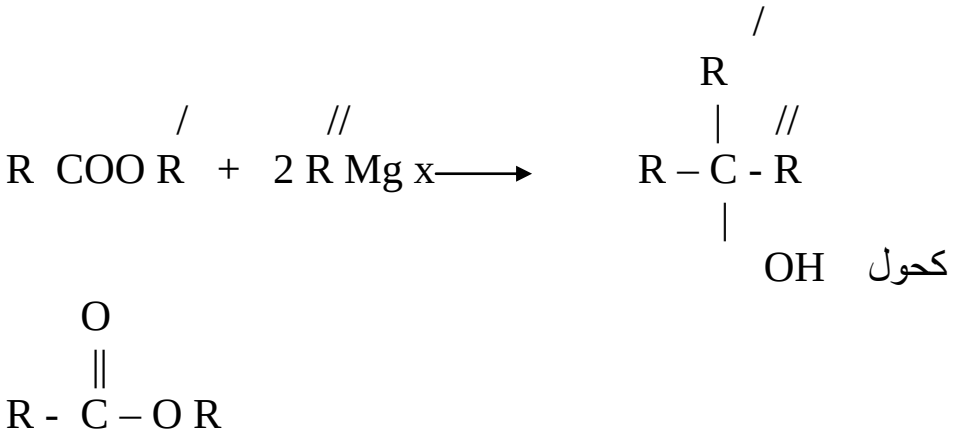


Amide

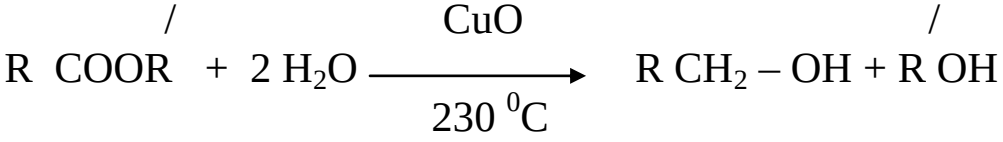
3- Reduction



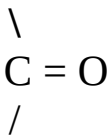
4- Reaction with Grenyard reagent

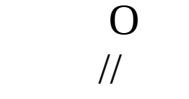


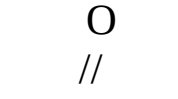
5- Alcohol Formation



Aldehydes and Ketones

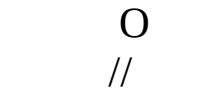
Are compound contains carbonyl group 



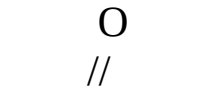


(aliphatic)

Aldehyde Keton



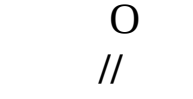
(aromatic)



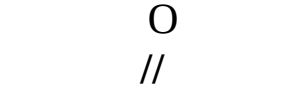
(mixed)

Nomenclature

For a**ldehyde we use (-al)**



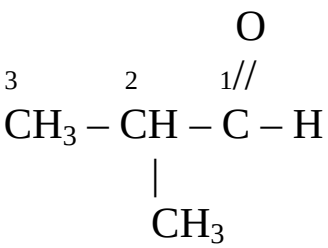
Methanol
(for maldehyde)



Ethanol
(acetaldehyde)

propanol
(propane aldehyde)

Butanal
(butane aldehyde)



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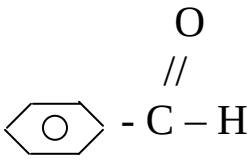
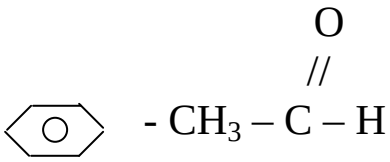
2- methyl – propanal
(iso butane aldehyde)

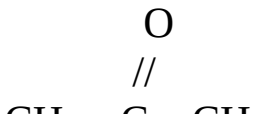


Benzaldehyde

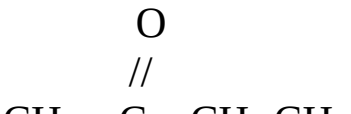


Phenyl ethenal

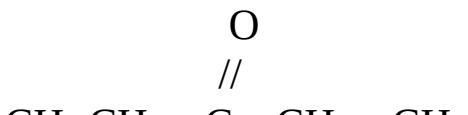
For ketone we use (- one)



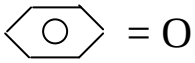
(Acetone)
Propanone



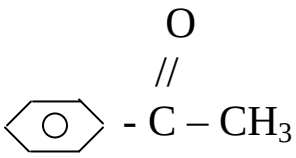
Methyl – Ethyl ketone
(2- butanone)



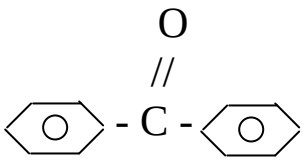
Di ethyl ketone
3- pentanone



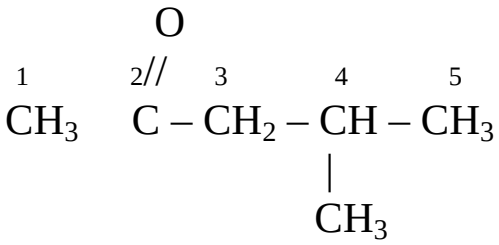
Cyclic hexanone



Methyl phenyl ketone
(aceto phenone)



Di phenyl ketone

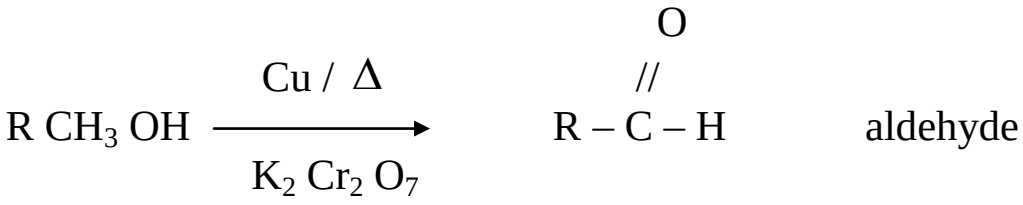


4 – methyl -2- pentanone

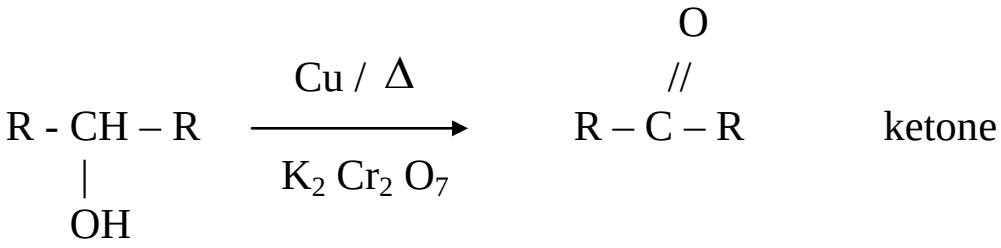
Preparation

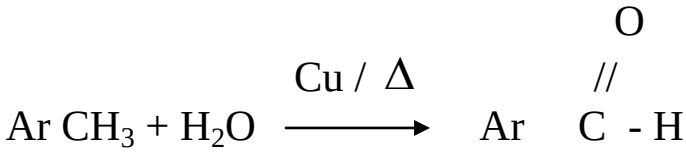
1- Oxidation of alcohols

Aldehydes may be prepared by oxidation of primery alcohols

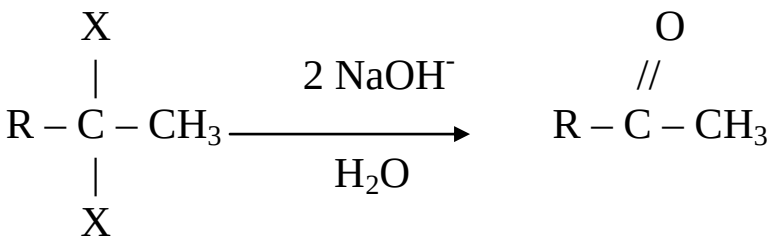


While ketones may be prepared by oxidation of secondary alcohols .



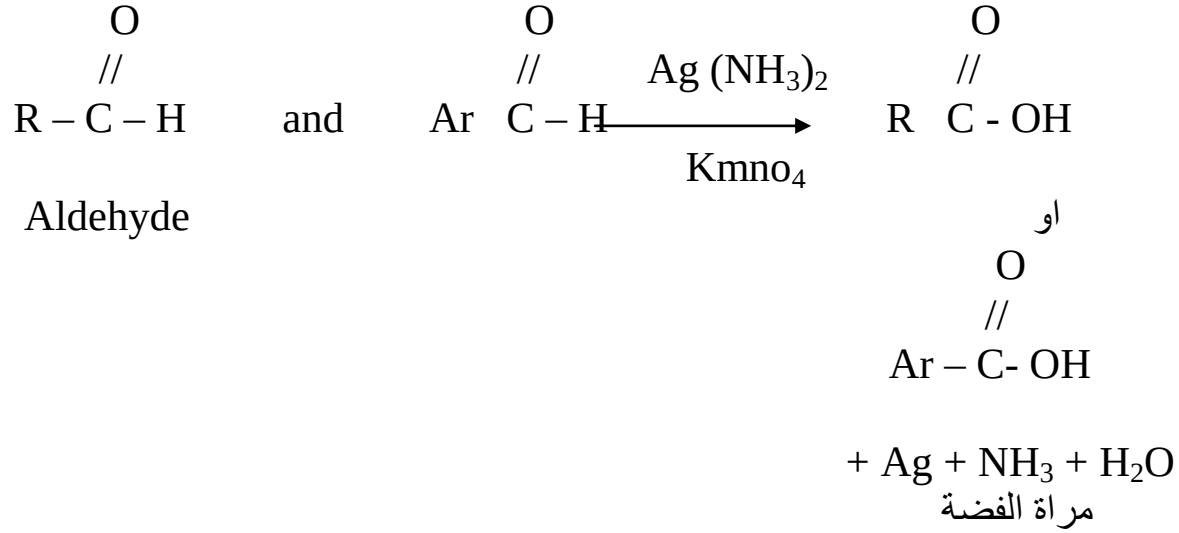


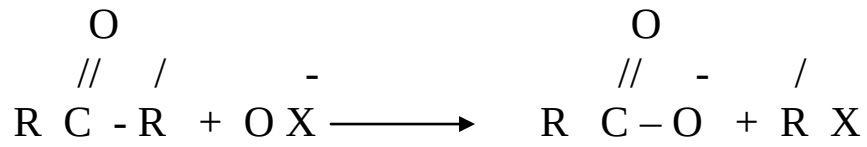
2- Hydrolysis of Di - halids

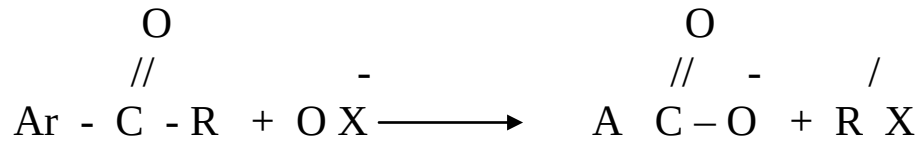


Reactions

1- Oxidation

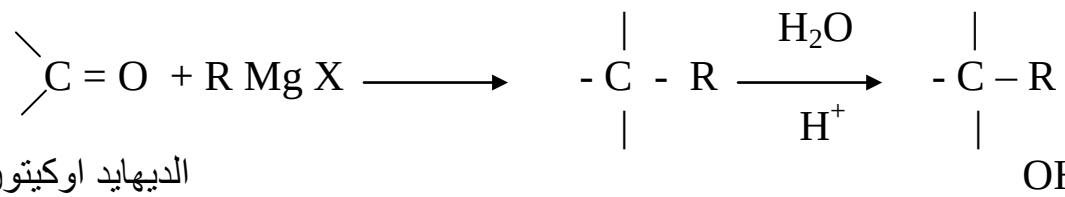


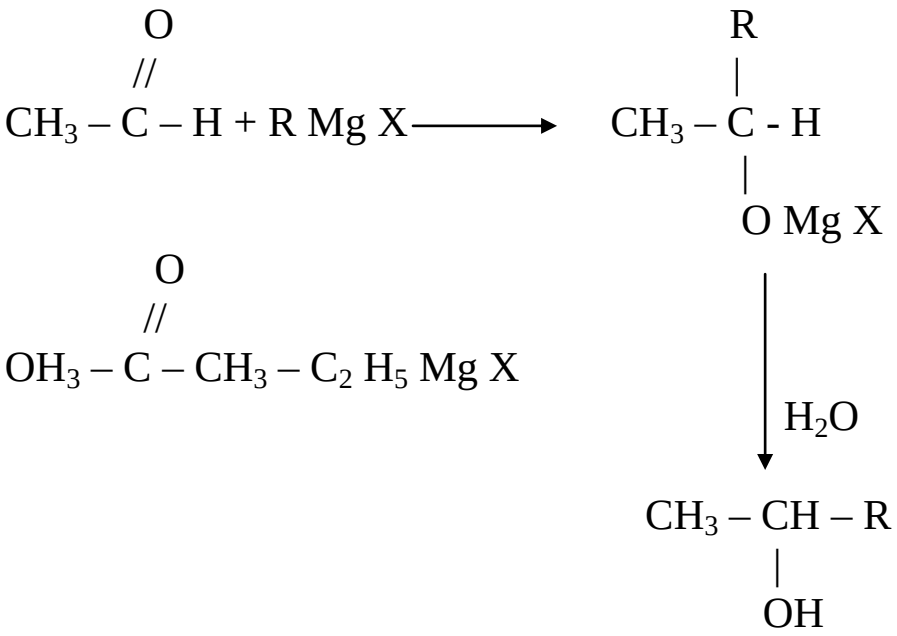




$NaOH + X – X \longrightarrow Na\ OX + HX$

2- Addition of Garinuard reagent





Physical Properties

1- Polar compounds .

2- Soluble in organic solvent .

3- They have higher boiling point than non – polar compounds of comparable molecular weight .

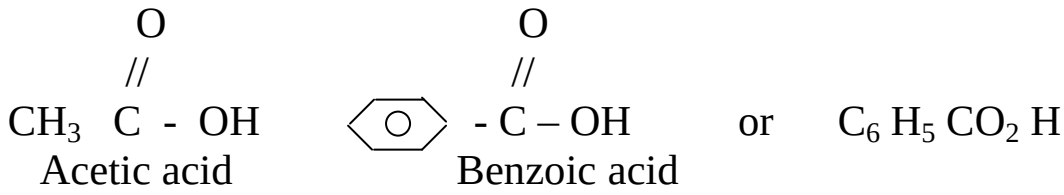
4- They have lower boiling points than non – polar carboxylic acids .

Carboxylic Acids

The word carboxyl (C – OH) is the abbreviation of the two consisting groups (Carbonyl and hydroxyl)

C – OH	R C – OH	Ar – C – OH
Carboxyl group	Aliphatic Carboxyl	Aromatic Carboxyl acid

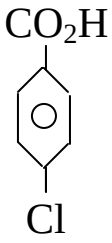
Ex :



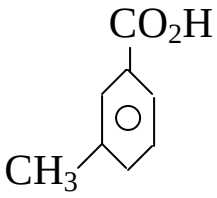
Nomenclature

Here we use (OIC) at the end of the name with applying other rucls

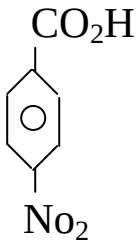
Formula	Name using	Popular name
HCOOH	Methanoic acid	Formic acid
CH_3 COOH	Ethanoic acid	Acetic acid
CH_3CH_2COOH	Propanoic acid	Propunic acid
$CH_3CH_2CH_2COOH$	Butanoic acid	n – Butteric acid
$CH_3(CH_2)_3$ COOH	Pentanoic acid	Valeric acid
CH_3 $(CH_2)_4$ COOH	Hcxanoic acid	n – caprouic acid
$CH_3(CH_2)_{10}$ COOH	Dodecanoic acid	Louric acid
CH_3 $(CH_2)_{16}$ COOH	Octadecanoic acid	Setyaric acid
CH_3 $(CH_2)_{14}$	Hexadecanoic acid	Palemtic acid



Para – chloro benzoic



meta – tolouic acid



O,P – Di Nitro Benzoic acid

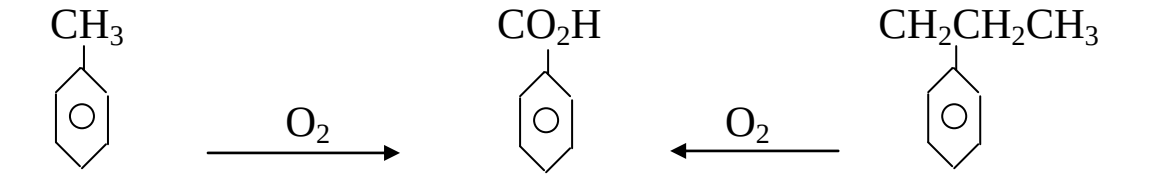
Preparation

1- Oxydation

يمكن الحصول على الحوامض الكاربوكسيلة بأكسدة المركبات العضوية الاخرى كالبرافينات او الاوليفينات والكحولات والالديهايدات والكيتونات .

$$R\,CH_2OH \xrightarrow{Na_2Cr_2O_7} RCO_2H \xleftarrow{Kmno_4} RCHO$$

كحولات — الديهايدات



Toluene — Benzoic acid — n- propyl benzene

$$CH_2 = CH - CH_3 + [O] \xrightarrow{H_2SO_4} CO_2 + CH_3COOH$$

2- Carbonation of Grinyard reagent

$$CO_2 + R\,Mg\,X \longrightarrow R\,COO\,Mg\,X \xrightarrow{H_2O} RCOOH$$

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$$CO_2 + Ar\,Mg\,X \longrightarrow Ar\,COOMg\,X \xrightarrow{H_2O} Ar\,COOH$$