# ORGANIC REACTIONS MECHANISM

# 335 CHEM - 3

## { Lap Manual }


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Level 6

1439/1440$^{H}$

# الرؤية و الرسالة و الأهداف لقسم الكيمياء

# Vision, Mission and Goals of Chemistry Department

**الرؤيــة**

أن يكون من الأقسام الرائدة في مجال الكيمياء علي المستوي المحلي و العالمي.

**الرسالة**

يسعي قسم الكيمياء في كلية العلوم بجامعة جازان لإعداد كيميائيين ذوي كفاءة عالية ، و إنجاز بحوث علمية متميزة تسهم بفاعلية في التنمية الشاملة للمجتمع ، و ذلك من خلال توفير بيئة تعليمية و بحثية ذات جودة تنمي المعارف و المهارات و تحترم أخلاقيات التعليم و البحث العلمي.

**الأهداف**

- تزويد الطلاب بمعرفة واسعة النطاق من المجالات الرئيسية للكيمياء: العضوية وغير العضوية والتحليلية والفيزيائية والحيوية.
- يجب أن يمتلك الطلاب قدرات التفكير الناقد وحل المشكلات.
- تزويد الطلاب بالمهارات اللازمة لأداء وفهم البحوث الكيميائية.
- تزويد الطلاب بالمهارات المطلوبة لوصف العمليات والإجراءات الكيميائية ، كتابةً أو شفوياً.
- تزويد الطلاب بالمهارات اللازمة للنجاح في العمل الكيميائي أو مجال آخر ذي صلة.

**Vision**

**To be one of the leading departments in the field of chemistry at the local and global levels.**

**Mission**

**The Department of Chemistry, Faculty of Science at Jazan University seeks to develop highly qualified chemists and carry out outstanding scientific research that contributes effectively to the overall development of society by providing a quality educational and research environment that develops knowledge and skills and respects the ethics of education and scientific research.**

**Goals**

- **To provide students with a broad foundation knowledge of the main areas of chemistry: organic, inorganic, analytical, and physical.**
- **Students should possess critical thinking and problem-solving abilities.**
- **To provide students with the skills required to perform and understand chemical research.**
- **To provide students with the skills required to describe, both in writing and orally, chemical processes and procedures.**
- **To provide students with the skills required to succeed in a chemical work or related field**

# Safety Rules

1- Listen to or read instructions carefully before attempting to do any thing .

2- Wear safety goggles to protect your eyes from chemical, hot materials, or things that might be able to shatter .

3- Notify your teacher if any spills or accidents occur .

4- After handling chemicals , always wash your hands with soap and water .

5- During lab work , keep your hands always away from your face .

6- Tie back long hair .

7- Roll up loose sleeves .

8- Know the location of the fire extinguisher , fire blanket , eyewash station, and first aid kit.

9- Keep your work area uncluttered . Take to the lab station only what is necessary .

10- It is suggested that you wear glasses rather than contact lenses .

11- Never put anything into your mouth during a lab experiment .

12- Clean up your lab area at the conclusion of the laboratory period .

13-Never "horse around" or play practical jokes in the laboratory .

# Introduction

## Mixture :-

*A mixture contains two or more substances that are chemically not combined.

*Study a mechanism of organic reaction practically involve two phases :

1) Mixture Separation

2) Mixture Components Identification

## Organic Compounds :-

**1) Acids** :- * Aliphatic Acids ( Oxalic , Tartaric , Citric Acid ).

* Aromatic Acids ( Salicylic , Benzoic , Phthalic Acid).

**2) Bases :-** * Aromatic Amine ( *P*-Toluidine , Diphenyl amine ,α-Naphthyl amine ).

**3) Phenols :-** * Water soluble phenol ( Catechol , Hydroquinone Resorcinol).

*Water insoluble phenol ( α- Naphthol , β- Naphthol ).

**4) Neutral compounds :-** * Carbohydrates ( Monosaccharaides , Disaccharides ,Starch).

* Salts of Acids ( salt of aliphatic acid , salt of aromatic acid).

* Hydrocarbons ( Naphthalene , Anthracene ).

- The method of separation depends on the solubility of the mixture components in selected solvents.

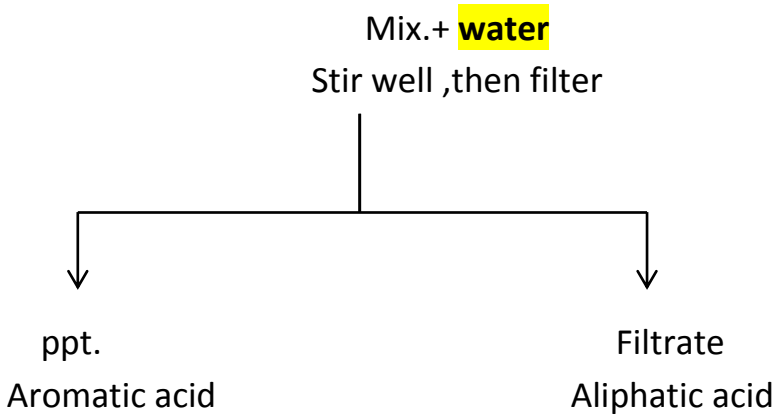
# 1 . Mix. {A + A}

# Acid + Acid

*Aliphatic Acid + Aromatic Acid

(Notice : All aliphatic acids soluble in cold water, while the aromatic acids insoluble in cold water.)

## ❖ Separation:-




## ❖ Identification :- ( for aliphatic and aromatic acids)

**Preparation of Neutral Solution:-** Take a few amount of acid (ppt. , filtrate) in a test tube or beaker. Add $NH_4OH$ gradually drop by drop to the acid till it just alkaline (using litmus paper). Boil the solution until the odor of ammonia is completely removed.

## Precipitate :-

**1- $FeCl_3$** **N.S of ppt. + $FeCl_3$**

| Observation | Result |
|---|---|
| Violet color | Salicylic Acid |
| Buff ppt. | Benzoic or phthalic acid |

## 2- Fluorescein Test

(Test to differentiate between benzoic and phthalic acid).

In a clean dry beaker , fuse carefully few crystals of resorcinol and an equal quantity of solid acid (ppt.) then add 2-3drops of $H_2SO_4$(conc.). Pour into excess of NaOH.

****( If the aromatic acid in form of salt solution add conc. HCl first then filter )**

| Observation | Result |
|---|---|
| Green fluorescence | Phthalic acid |
| (-ve )No fluorescence | Benzoic acid |

## Filtrate :-

### $CaCl_2$ Test

**N.S filtrate + $CaCl_2$**

| Observation | Result |
|---|---|
| White ppt. immediately on cold | Oxalic Acid |
| White ppt. after warming and scratching | Tartaric Acid |
| White ppt. after boiling | Citric Acid |

**Conformation Tests**

**N.S +Amm.$AgNO_3$** $\xrightarrow{\Delta}$

| Observation | Result |
|---|---|
| White ppt. $\xrightarrow{\Delta}$ Still white ppt. | Oxalic Acid |
| white ppt. after $\xrightarrow{\Delta}$ gray $\xrightarrow{\Delta}$ sliver mirror | Tartaric Acid |
| white ppt. $\xrightarrow{\Delta}$ Gray ppt. only. | Citric Acid |

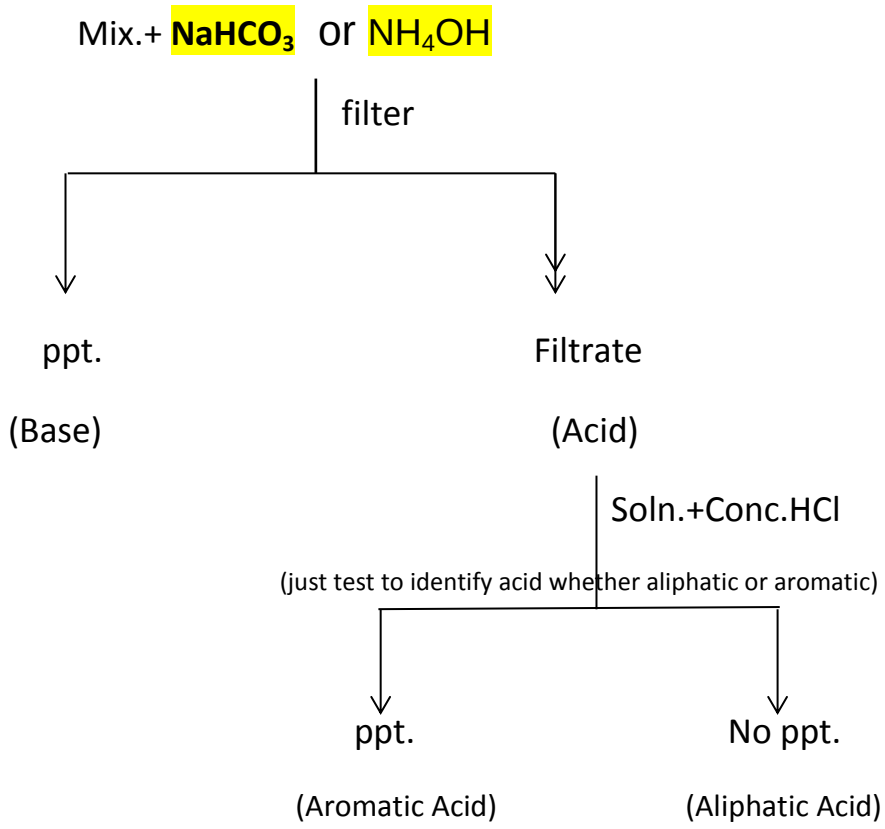
## 2 . Mix. {A + B}

## Acid + Base

*Base + Aliphatic Acid

* Base + Aromatic Acid

### ❖ Separation:-



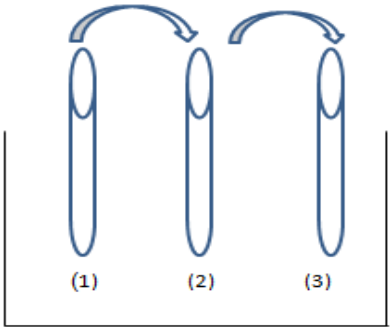
❖ **Identification :-** ( for aliphatic and aromatic acids it was as illustrated previously at page no.(4,5 ) ,but it's no need to prepare N.S as the filtrate is in form of salt of acid )

❖ **Chemical properties of Aromatic Amine :-**

## 1- Azo –dye Test

-Prepare 3 tubes as shown in the figure, allow them to cool in an ice bath, then pour test tube (1) to (2) and finally pour into (3)

(1) $NaNO_2+H_2O$ , (2) solid + dil. HCl , (3) β-naphthol + excess NaOH




| Obs. | Res. |
|---|---|
| (-ve) | Diphenyl Amine |
| Red orange color | *p*- toludine |

## 2-Effect of $FeCl_3$

- **ppt.+dil HCl +$FeCl_3$**

| Obs. | Res. |
|---|---|
| Green color | Diphenyl Amine |
| (- ve) | *p*- toluidine |

## 3- (oxidation ) Test

- **ppt.+dil $HNO_3$ + drops of conc.$H_2SO_4$**

| Obs. | Res. |
|---|---|
| Dark or blue violet color appear | Diphenyl Amine |
| (- ve) | *p*- toludine |

# 3 . Mix. {A + Ph}

# Acid + Phenol

There are four types :-

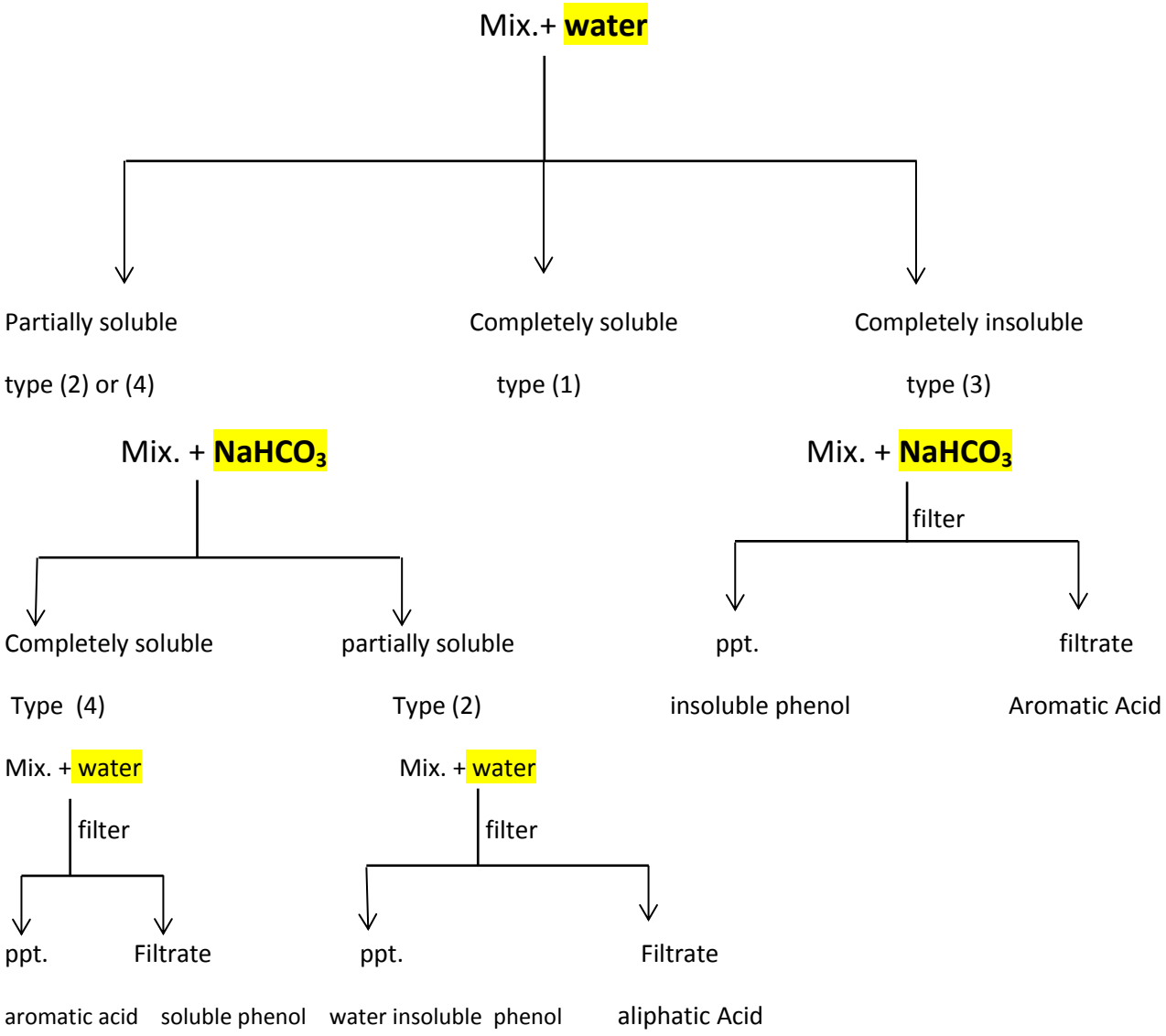
(1) Aliphatic Acid + water soluble phenol

(2) Aliphatic Acid + water insoluble phenol

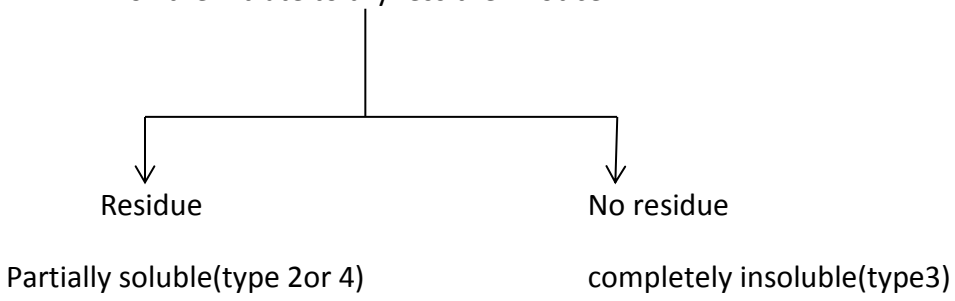
(3) Aromatic Acid + water insoluble phenol

(4) Aromatic Acid + water soluble phenol

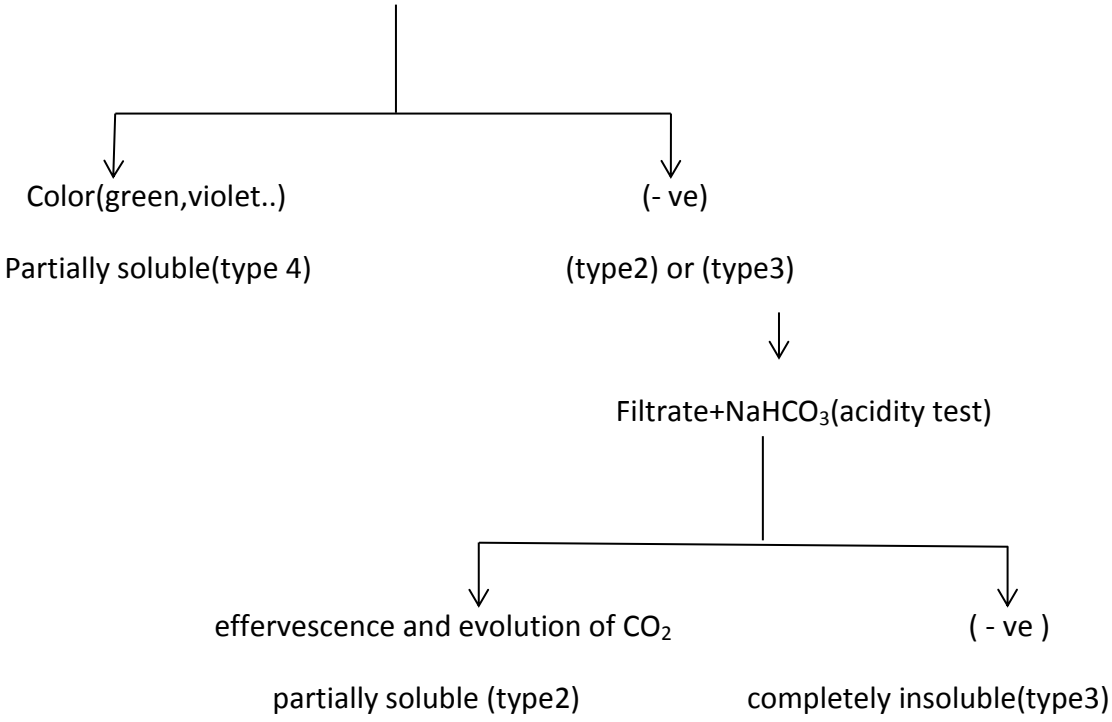
## ❖ Separation:-



- To make sure if the mixture is partially soluble or completely insoluble in water we can do one of two tests.
- 1/ Boil the filtrate to dryness then notice




- 2/ Filtrate + $FeCl_3$




## ❖ **Identification :-** ( For aliphatic and aromatic acids it was as illustrated previously ,page no.(4,5 )

- For type (1) completely soluble ( aliphatic acid + water soluble phenol) , directly identify each one in the presence of the other, so no need the step of separation.

## Chemical properties of phenol soluble in water :-

### 1- Effect of $FeCl_3$

- Place 1 ml of phenol solution in test tube then add few drops of $FeCl_3$

| Obs. | Res. |
|---|---|
| Green color NaOH → red | Catechol |
| Red/green crystals then turn to yellow | Hydroquinone |
| Violet color | Resorcinol |

### 2- Chloroform Test

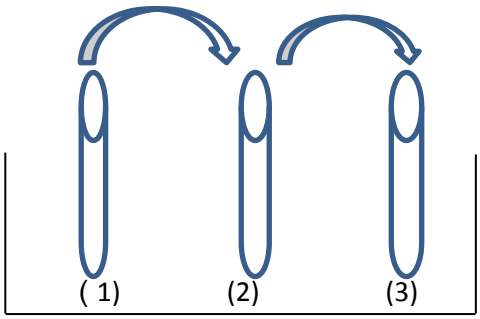
Phenol solution + chloroform +NaOH (30%) then heat gently(W.B)

| Obs. | Res. |
|---|---|
| Green color | Catechol |
| Brown color | Hydroquinone |

## Chemical properties of phenol insoluble in water :-

### 1- Azo – Dye Test

- Prepare 3 tubes as shown in the figure below , allow them to cool in an ice bath, then pour test tube (1) to (2) and finally pour into (3)




(1) $NaNO_2+H_2O$ , (2) $AnilineHCl+H_2O$ , (3) phenol + excess NaOH

| Obs. | Res. |
|---|---|
| Reddish brown ppt. | α- Naphthol |
| Red ppt. | β-Naphthol |

### 2- Chloroform Test

- In a test tube dissolve phenol in ethanol +chloroform +NaOH then heat gently in(w.B)

| Obs. | Res. |
|---|---|
| Dark blue color turned into green fast. | α- Naphthol **&** β-Naphthol |

# 4 . Mix. {B +Ph}

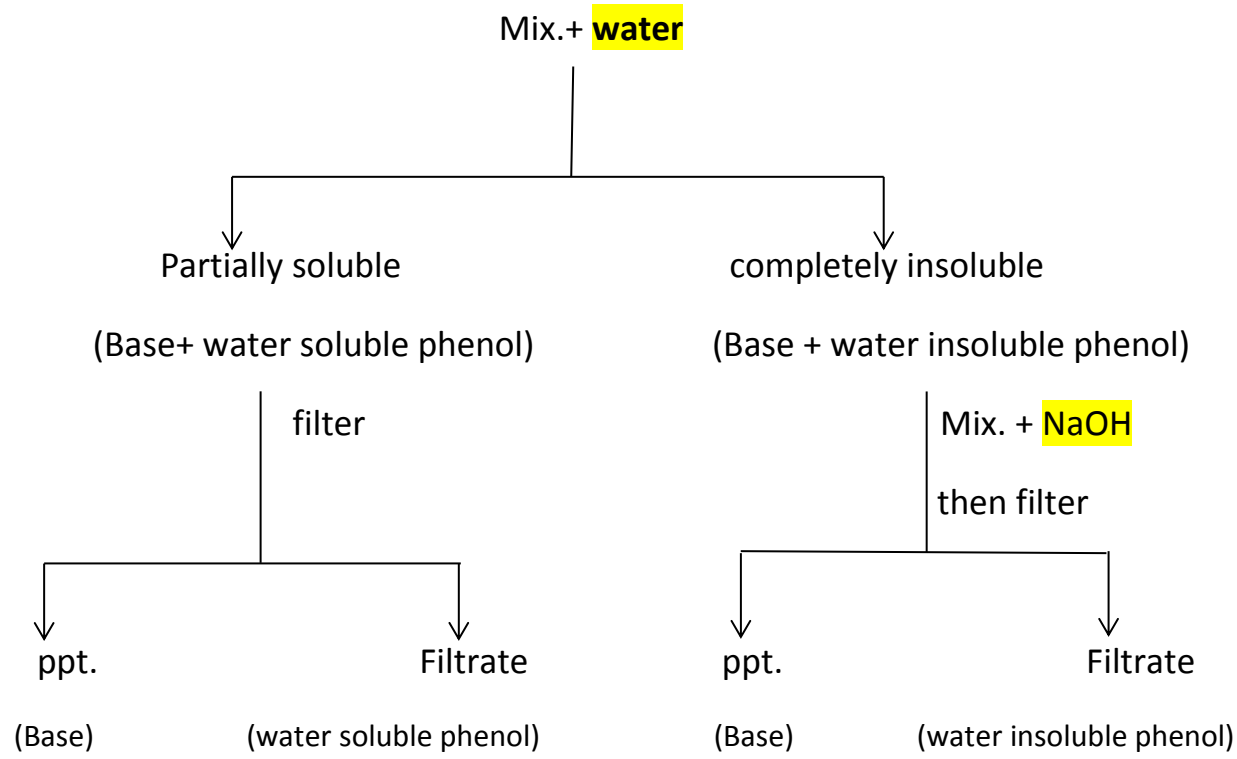
# Base + Phenol

Two main types :-

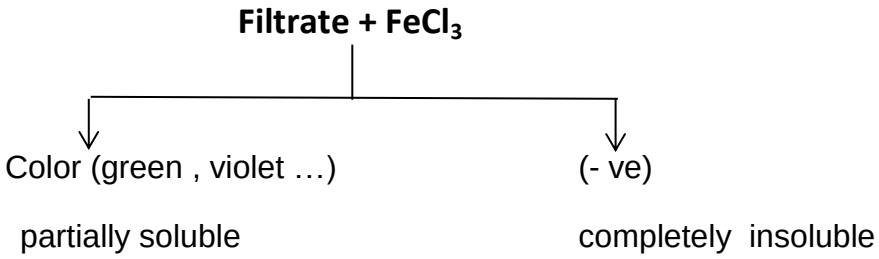
1) Base + water soluble phenol.

2) Base + water insoluble phenol.

## ❖ Separation:-




- To make sure if the mixture is partially soluble or completely insoluble in water, we can test the filtrate.




**Identification :-** [ for bases and phenols it was as illustrated previously ,page no(7 , 10) ].

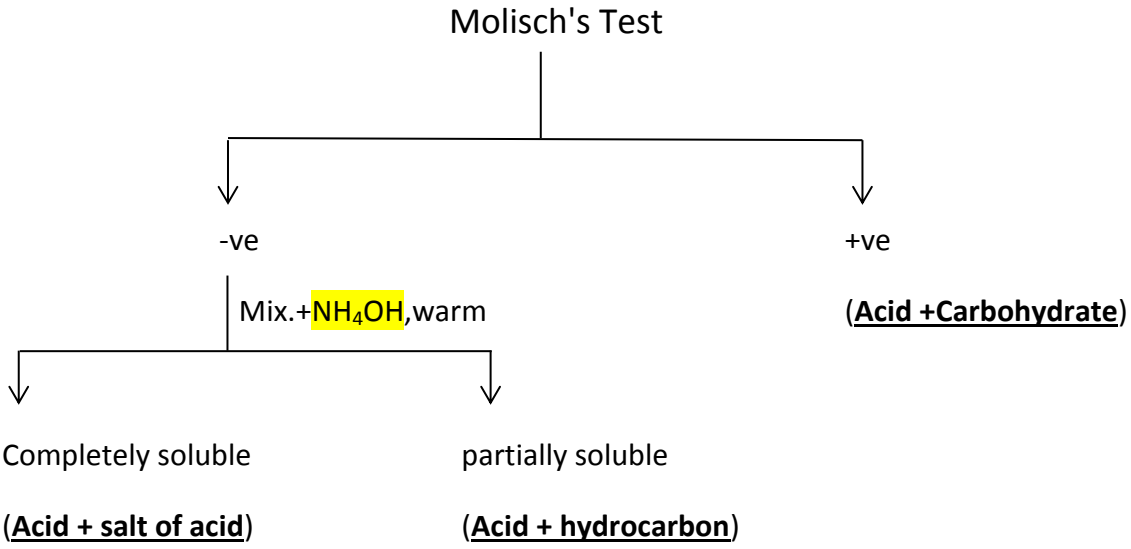
# 5 . Mix. {A +N}

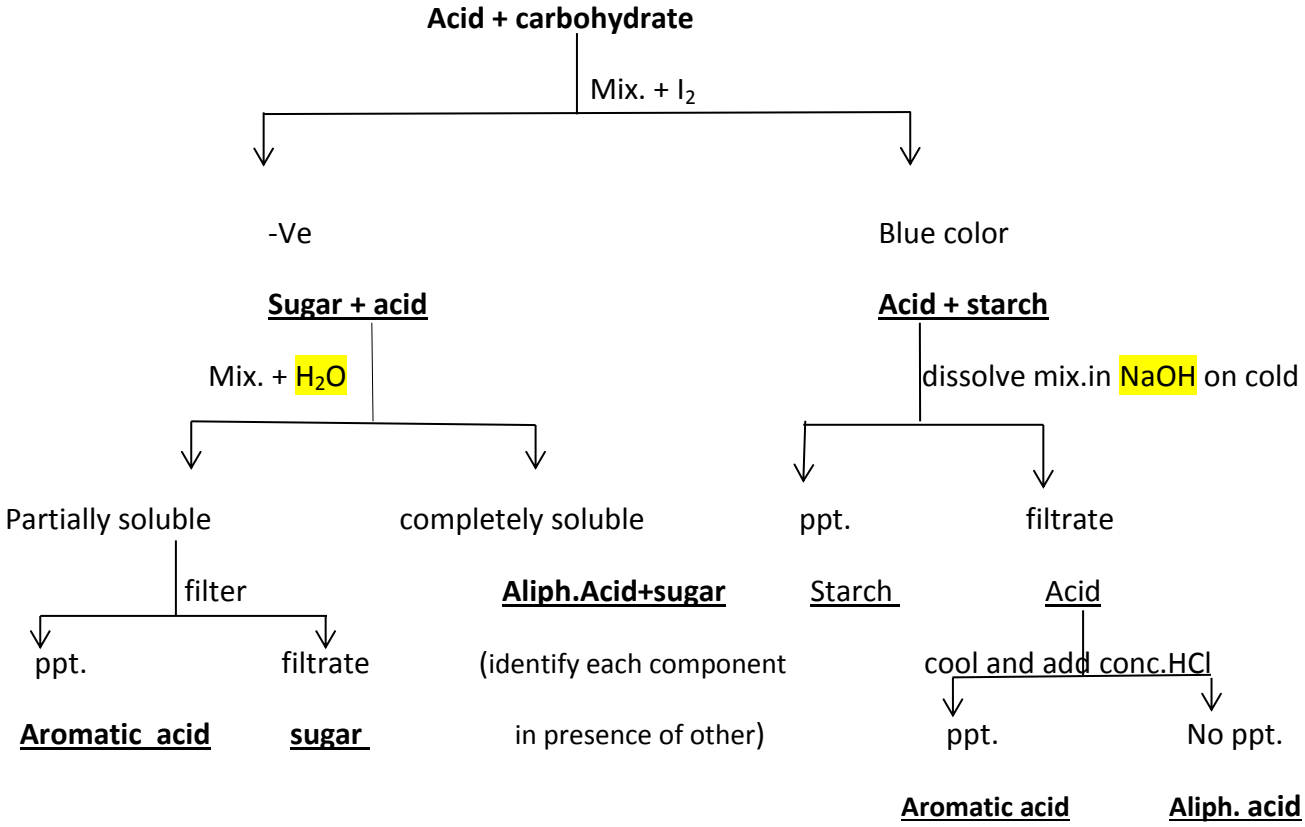
# Acid + Neutral

**(Notice :- Neutral compounds are Carbohydrates , salts of acids and hydrocarbons)**

## ❖ Separation:-

**Molisch's Test :-** 1 ml of soln. + 1 ml of α-naphthol + conc.$H_2SO_4$ ⟶ violet ring spreads by shaking



## Identification :- * Identify acids as illustrated in page no.( 4, 5) . For carbohydrates as follow:-

**1-Barfoid Test**

1 ml of soln. +2-3ml of Barfoid soln.then heat in W.B

| EXP. | Obs. | Res. |
|---|---|---|
| **Barfoid Test** | Red ppt. after 3-5 min. ⟶ | Monosaccharide |
| | Red ppt. ftter 5-7 min. ⟶ | Disaccharide |

Differentiation between Monosaccharaides(Glucose – Fructose and Glactose )

**2- Rapid furfural**

1ml of sugar soln. + 1 ml of α-naphthol + 5-7ml of conc.HCl then heat

| EXP. | Obs. | Res. |
|---|---|---|
| Rapid furfural | immediate violet color appear ⟶ | Fructose |
| | violet color appears after boiling for 1-2min ⟶ | Glucose |
| | ( -ve ) ⟶ | Glactose |

Differentiation between disaccharides (Maltose – Lactose and Sucrose )

**3- Fehling's Test**

1 ml of sugar soln. + Fehling soln. heat in W.B

| EXP. | Obs. | Res. |
|---|---|---|
| Fehling's Test | Reddish brown ppt. ($Cu_2O$) ⟶ | Maltose – Lactose ( which have reduction properties) |
| | ( -ve ) ⟶ | Sucrose (which has no reduction properties) |

Differentiation between Maltose and Lactose

4- **Osazone Formation** Dissolve 0.2g of sugar +0.4g of phenylhydrazine hydrochloride + 0.6 of sod.acetate in 5 ml water, then heat on W.B for 20min. cool. The osazone separates a yellow crystalline ppt. transfer some of the wet crystals to a microscope slide and try to see the shape of the crystals.

Maltosazone ⟶ needles shape 

Lactosazone ⟶ Spherical shape 

# Mix. {A +N}

# Acid + Salt of acid

At first we must determine the type of salt if it's a metallic salt or an ammonium salt

**NaOH Test**

Mix. + NaOH (30%) shake well or warm

- $NH_3$ odor → amm.salt of acid
- No odor (-ve) → Metallic salt of acid

Types of acid + salt of acid :-

**a**) Aliphatic acid + salt of aromatic acid

**b**) Aromatic acid + salt of aromatic acid

**c**) Aromatic acid + salt of aliphatic acid

Mix. + $H_2O$

- Partially soluble (Type **b** or **c**) → Filter
  - ppt. → **Aromatic acid**
  - filtrate → **salt of acid** → Soln.+conc.HCl (just test)
    - ppt. → **salt of aromatic acid**
    - No ppt. → **salt of aliphatic acid**
- Completely soluble (Type **a**) → Cool in ice.then add conc. HCl and filter
  - filtrate → **Aliphatic acid**
  - ppt. → **Aromatic salt ofacid**

*(prepare N.S for identification)

[Notice :- salts of acids give all characteristic reactions of the corresponding acids without preparing neutral solution , identify acids as illustrated in page no.( 4, 5) ].

# Mix. {A +N}

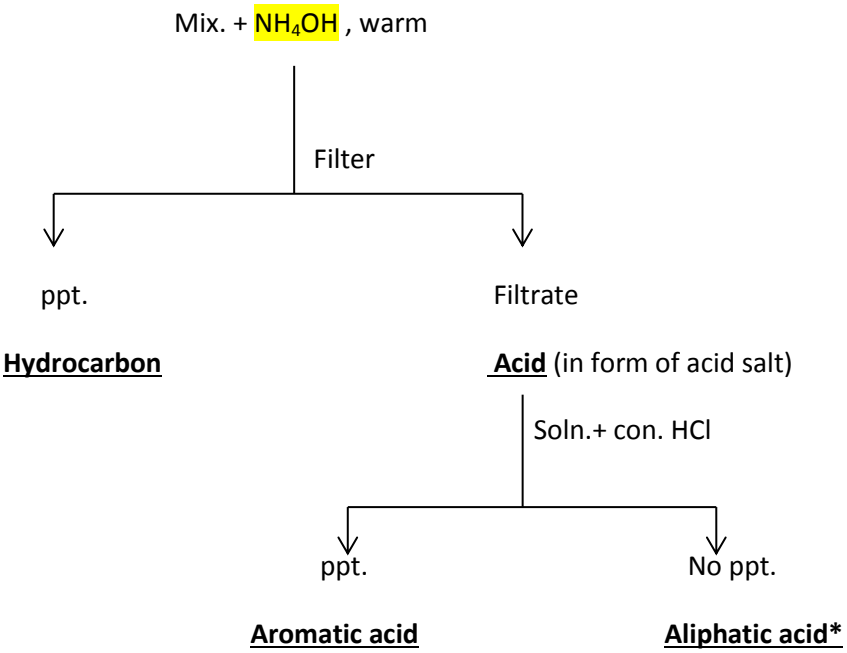
# Acid + Hydrocarbon

## ❖ Separation :-

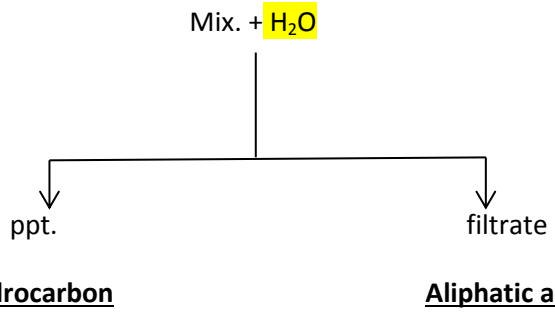
Types of acid + hydrocarbon :-

a) Aliphatic acid + hydrocarbon

b) Aromatic acid + hydrocarbon




*In case of the mixture is hydrocarbon+ aliphatic acid, it's better to separate the mix. as follow :-




## ❖ Identification :-

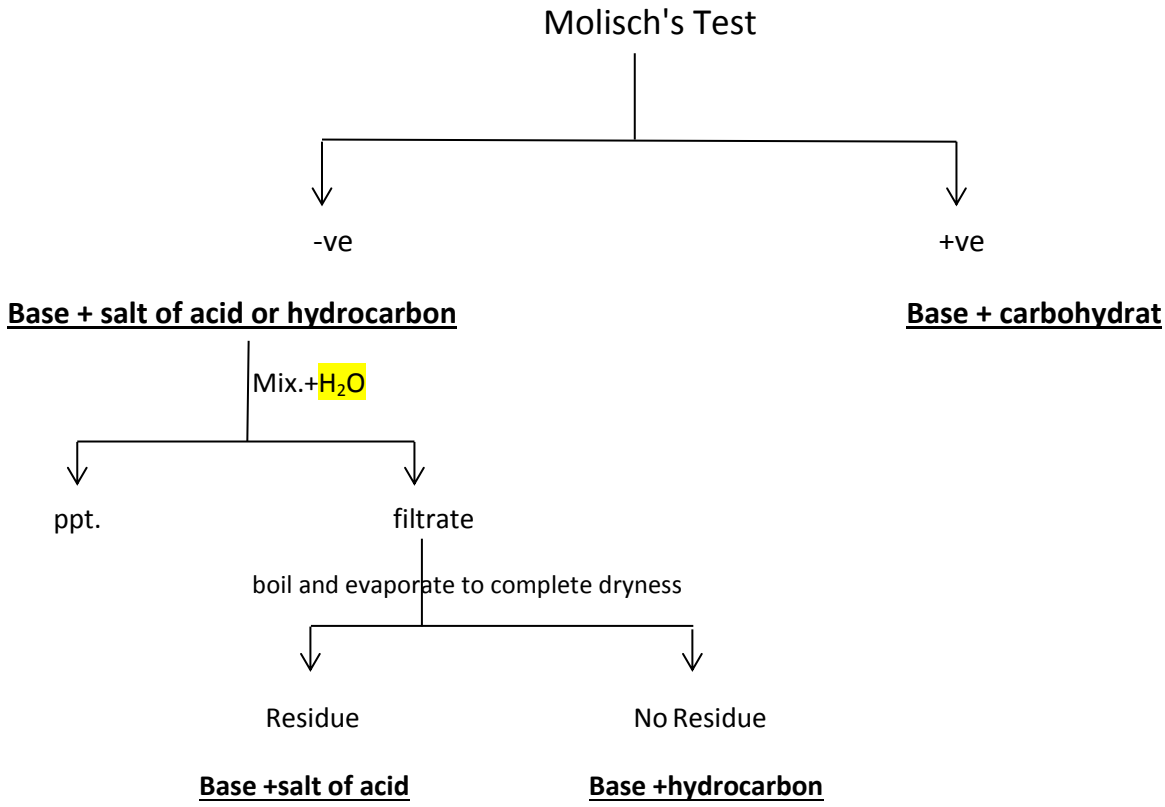
**Chemical properties of hydrocarbons :-**

**Picrate Test** **PPT. + 1-2 drops of picric acid** $\xrightarrow{\Delta}$ **to dryness then cool**

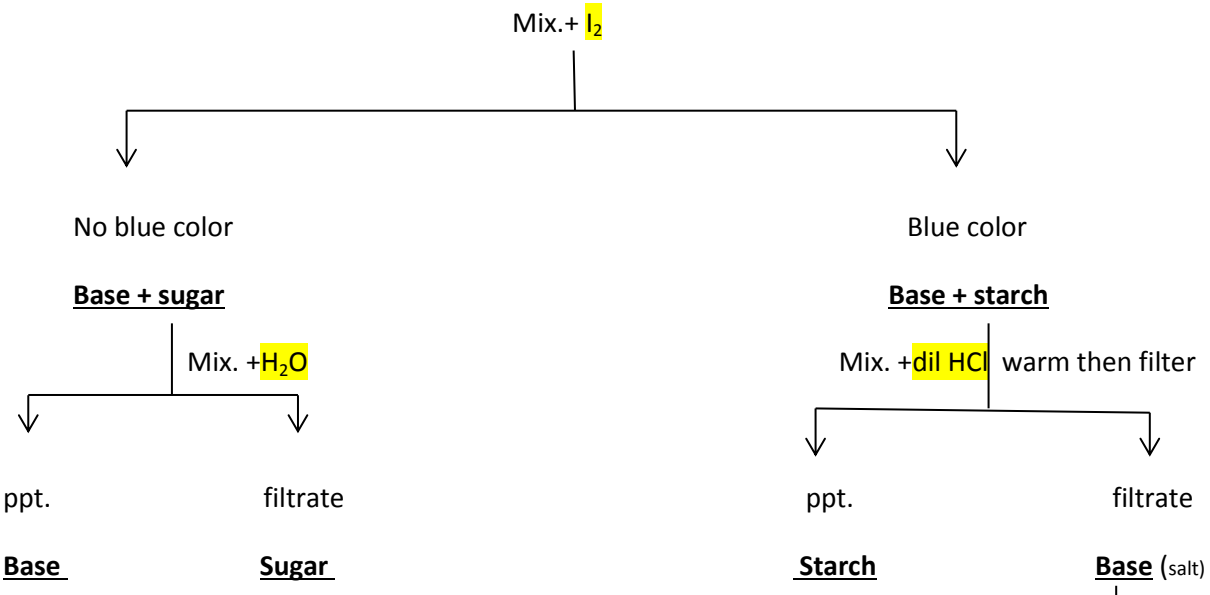
| EXP. | Obs. | Res. |
|---|---|---|
| **Picrate Test** | yellow crystals ⟶ | **Naphthalene** |
| | Red crystals ⟶ | **Anthracene** |

# 6 . Mix. {B +N}

## Base + Neutral



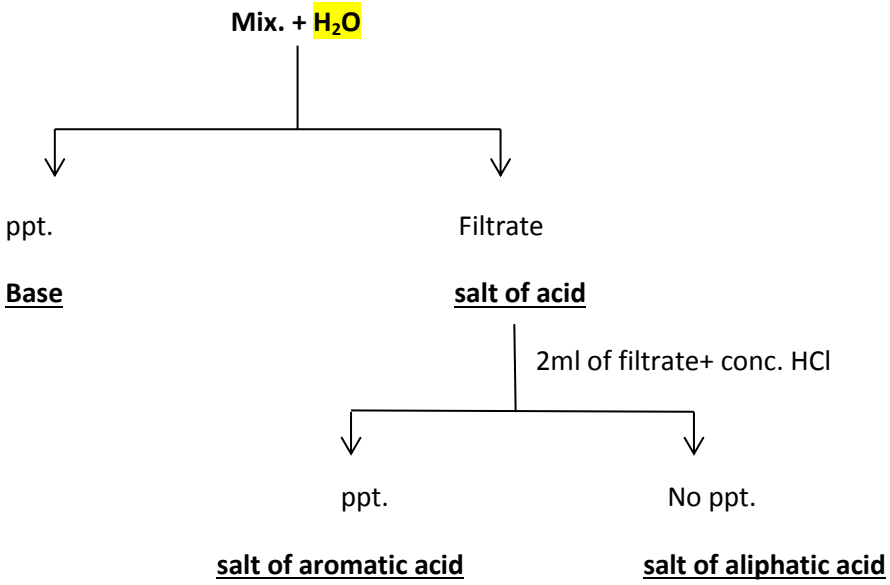

**(A) Base + Carbohydrate**



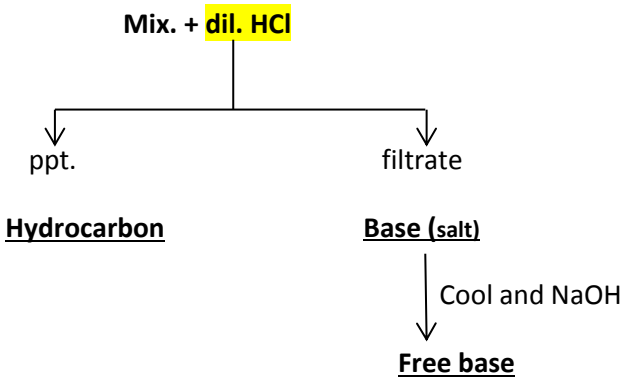

*Identify base & sugar as illustrated in page no.(7,13)

## (B) Base+ salt of acid

* First the type of salt should be determine ( NaOH Test).




## (C) Base + hydrocarbon




*Identify base and hydrocarbon as illustrated in page no.(7 , 15 )

# 7 . Mix. {N +N}

# Neutral + Neutral

There are four types :-

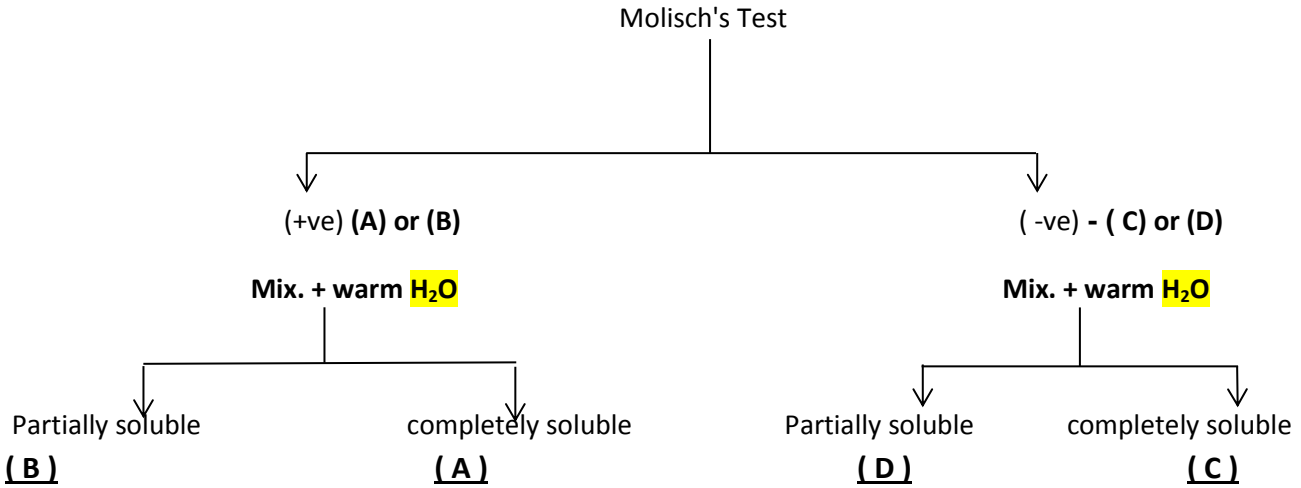
(A) Carbohydrate + salt of acid

(B) Carbohydrate + hydrocarbon

(C) Salt of aliphatic + salt of Aromatic

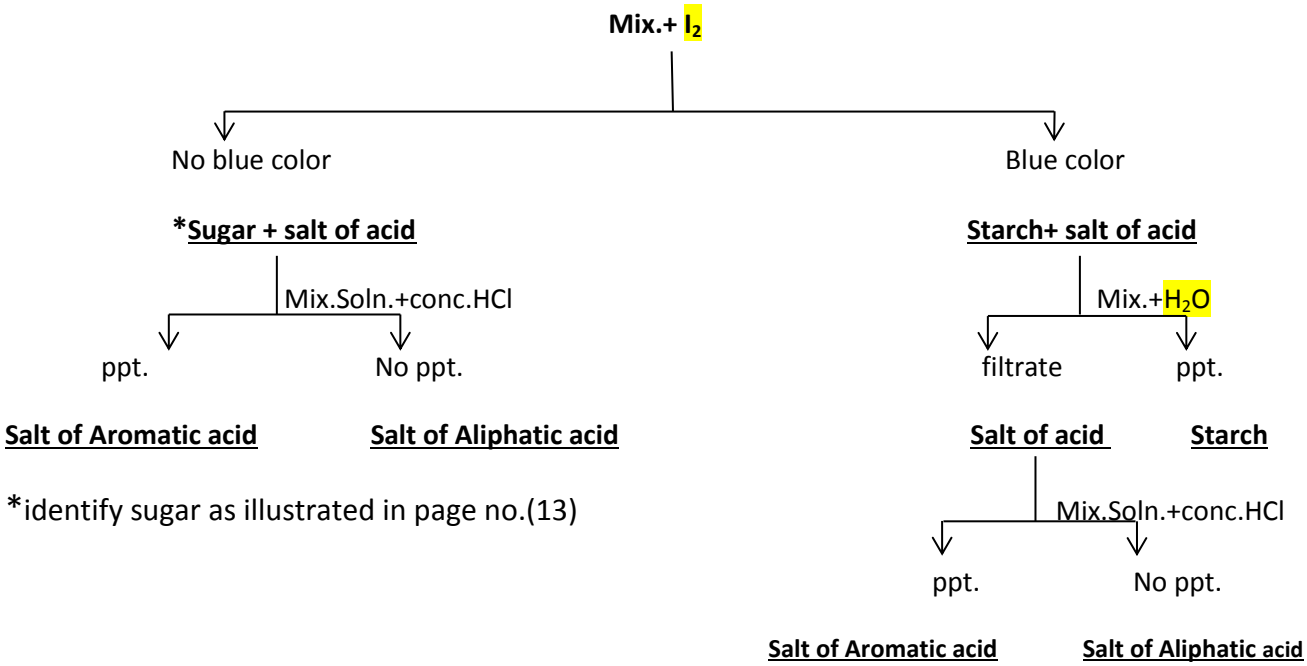
(D) Salt of Acid + hydrocarbon

## ❖ Separation :-



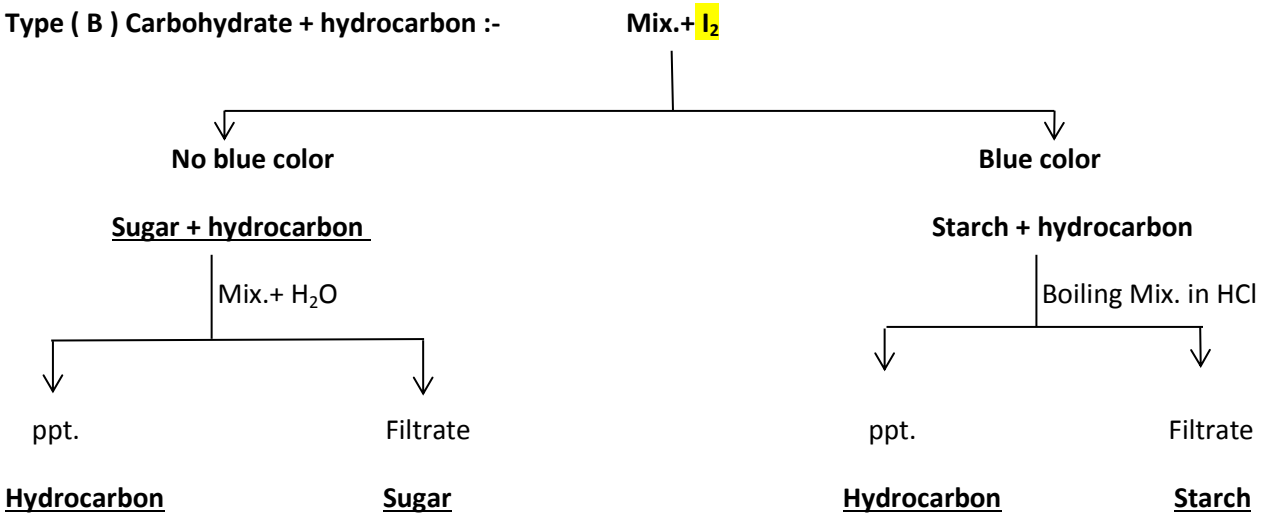

**Type ( A ) carbohydrate + salt of acid :-**

* First the type of salt should be determined ( NaOH Test).

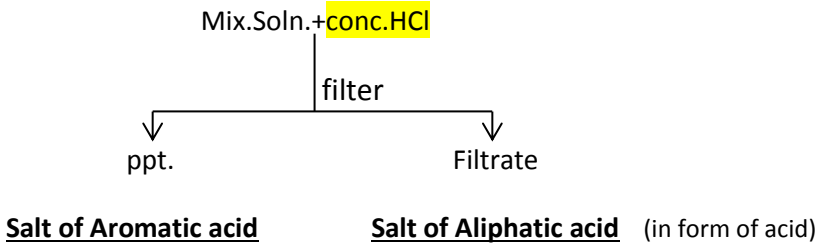



*identify sugar as illustrated in page no.(13)

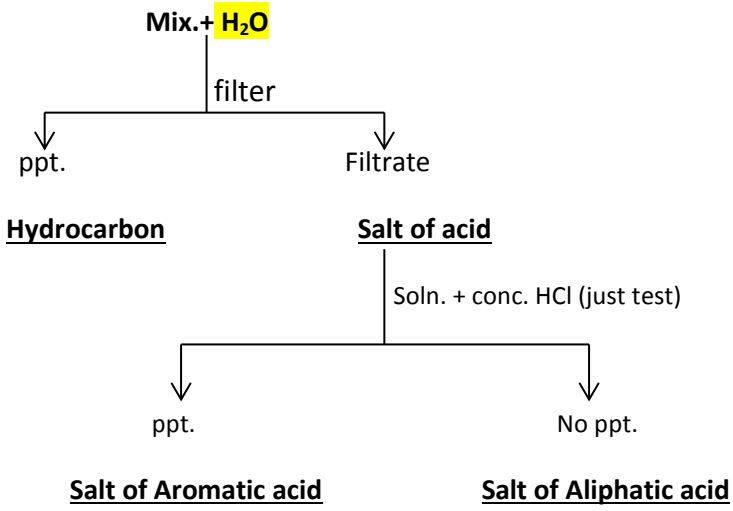
**Type ( B ) Carbohydrate + hydrocarbon :-**




**Type ( C ) Salt of Aliphatic acid + Salt of Aromatic acid : *** First the type of salt should be determined ( NaOH 30% Test).




**Type ( D ) Salt of acid + Hydrocarbon :-*** First the type of salt should be determined ( NaOH Test).




*identify sugar & hydrocarbon as illustrated in page no.(13 ,15).