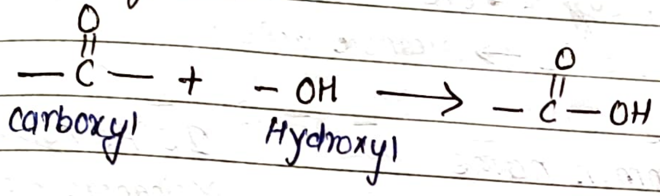
CHAPTER-6 (-16th poush, friday)

Carboxylic acids

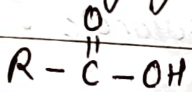
Introduction → Organic compounds having one or more carboxyl group $(-\overset{O}{\overset{\|}{C}}-OH)$ are called ~~are~~ carboxylic acids. carboxyl group is made by the combination of carboxyl and hydroxyl group and hence its name is carboxyl



$$-\overset{O}{\overset{\|}{C}}- + -OH \longrightarrow -\overset{O}{\overset{\|}{C}}-OH$$

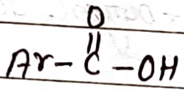
carboxyl Hydroxyl

→ carboxyl acid may be alphatic or aromatic depending up on whether the carboxyl group is linked to the alkyl or aryl group.



$$R-\overset{O}{\overset{\|}{C}}-OH$$

Alphatic



$$Ar-\overset{O}{\overset{\|}{C}}-OH$$

Aromatic

→ Alphatic monocarboxylic acid are also called fatty acids, because some of their higher members like palmitic acid, stearic acid etc are present in the natural fats as their esters.

1# Nomenclature →

1. Common system →

In this system carboxylic acids are named on the basis of their source from which was obtained first time

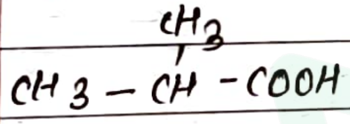
- $HCOOH$:- Named as formic acid, because it was first obtained by the distillation of formica (ants)
- CH_3COOH :- Named as acetic acid because it was obtained from acetum (vinegar)
- $CH_3CH_2CH_2COOH$ → Named as butyric acid because it was obtained from butyrum (butter).

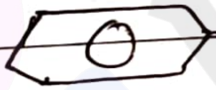
classmate

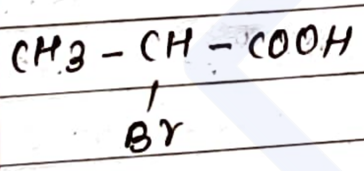
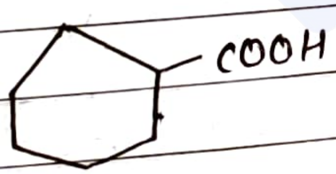
2) IUPAC System →

In this system carboxylic acids are known as alkon c acid. The name is obtained by replacing terminal 'e' of the corresponding alkane by suffix -oic acid

Alkane – e + ~~[illegible]~~ oic acid → Alkanoic acid.

Formula	Common name	IUPAC name
$HCOOH$	Formic acid	Methanoic acids.
CH_3COOH	Acetic acid	ethanoic acids.
CH_3CH_2COOH	propionic acid	propanoic acids
$CH_3CH_2\ COOH$	n-butyric acid	Butanoic acid
 $CH_3-\underset{}{\overset{CH_3}{CH}}-COOH$	Iso-butyric acid	α-methyl propanoic ac
$CH_3-CH_2-CH_2-CH_2-COOH$	n-valeric acid	pentanoic acid.

Example :-  COOH, Benzoic acid

 $CH_3-\underset{Br}{CH}-COOH$		α-Bromo propanoic acid.
	cyclohexane	carboxylic acid.
		p-nitro benzoic acid.

Bipo's notes

DATE

General Methods of Monocarboxylic acids.

1. From aldehydes → By this oxidation of aldehydes with acidified $KMnO_4$ or $K_2Cr_2O_7$.

General reaction:-

$$R-CHO + [O] \xrightarrow{KMnO_4/H^+} R-COOH.$$

Example:-

$$CH_3-CHO + [O] \xrightarrow{KMnO_4/H^+} CH_3COOH.$$

Imp.

2. From nitriles → By the hydrolysis of alkyl cyanides with dilute acids or alkali gives carboxylic acids.

G.R

$$R-C\equiv N + 2H_2O \xrightarrow{dil\cdot HCl} R-COOH + NH_4Cl.$$

$$R-C\equiv N + 2H_2O \xrightarrow{NaOH} R-COONa + NH_3.$$

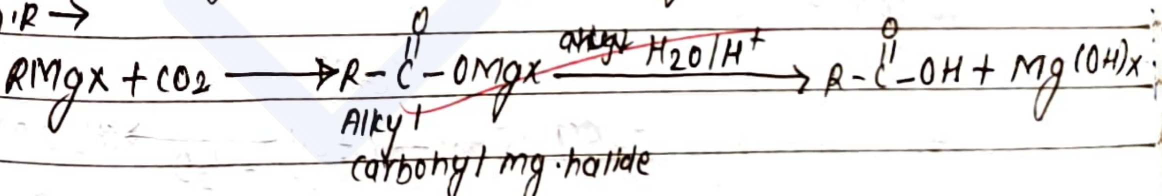
Example

$$CH_3-C\equiv N + 2H_2O \xrightarrow{dil\cdot HCl} CH_3COOH + NH_4Cl.$$

$$CH_3-C\equiv N + H_2O \xrightarrow{NaOH} CH_3COONa + NH_3.$$

3. From Grignard reagents → By carbonation of grignard reagent - when CO_2 is passed through etherial solution of Grignard reagent an addition compound is formed which on hydrolysis gives carboxylic acids.

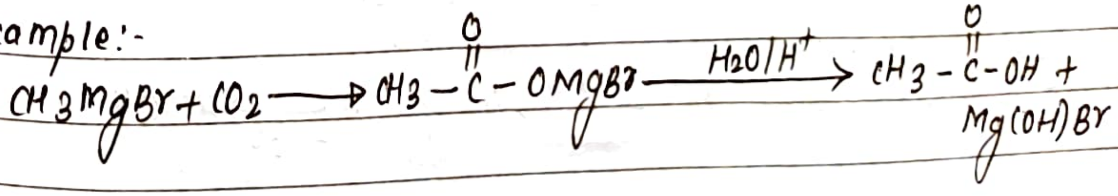
G.R →



$$RMgX + CO_2 \longrightarrow R-\overset{O}{\overset{\|}{C}}-OMgX \xrightarrow{\text{~~alkyl~~}\ H_2O/H^+} R-\overset{O}{\overset{\|}{C}}-OH + Mg(OH)X$$

Alkyl carbonyl mg.halide

Example:-

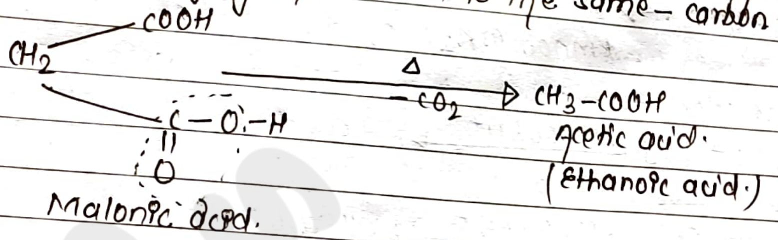


$$CH_3MgBr + CO_2 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OMgBr \xrightarrow{H_2O/H^+} CH_3-\overset{O}{\overset{\|}{C}}-OH + Mg(OH)Br$$

PAGE

classmate

4. From dicarboxylic acids → By heating dicarboxylic acid in which both carboxyl group is linked to the same carbon atom.



5. From sodium alkoxide → when sodium alkoxide are treated with carbomonoxide give sodium carboxylate which on acidic hydrolysis gives carboxylic acid.

G.R →

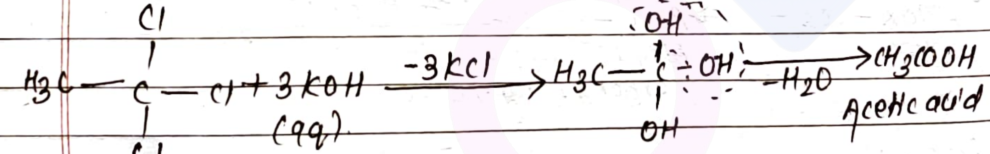
$$\underset{\text{Sod. Alkoxide}}{R\bar{O}\overset{+}{Na}} + \underset{\text{carbon monoxide}}{CO} \xrightarrow{\Delta,\ \text{under pressure}} \underset{\text{Sod. carboxylate.}}{RC\bar{O}O\overset{+}{Na}} \xrightarrow[-NaCl]{H^+/H_2O} RCOOH$$

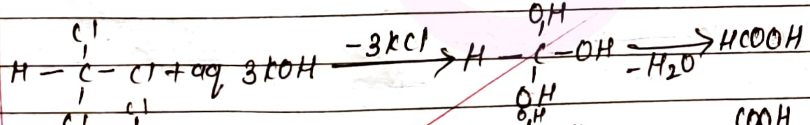
Example →

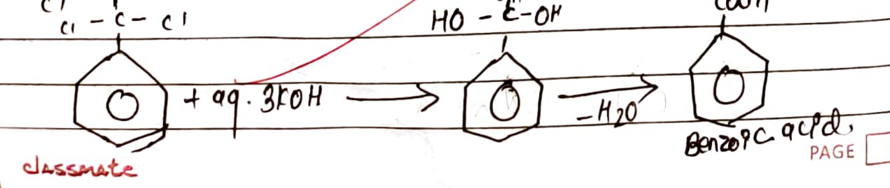
$$CH_3CH_2\bar{O}\overset{+}{Na} \xrightarrow[\text{under pressure}]{\Delta} CH_3COO\overset{+}{Na} \xrightarrow{H^+/H_2O} CH_3COOH.$$

6. From trihaloalkane → By hydrolysis of trihaloalkane in which all halogen atoms are linked to the same carbon with aqueous alkali.

Example :-

(I)


(II)


(III)


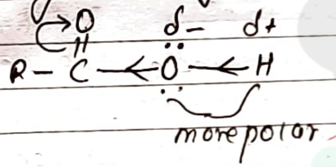
physical propertise →

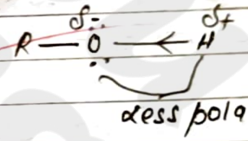
1. physical state :→

1st three member → colorless pungent smelling liquid
Next - 6 members → oily liquid with pleasant odour.
The rest are: colorless and oderless waxy solids.

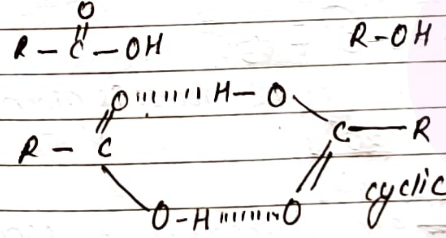
v. Imp
2. Boiling point :→ carboxylic acids have higher boiling point than that of alcohols of comparable molecular mass. for ex:- Acetic acid at 118°c and propanal boils at 97°c although they have same molecular mass 60. The reasons are :-

I) The -OH bond of carboxylic acids is more strongly polarised than that of alcohol due to presence of carboxyl group adjacent to it. Hence carboxylic acids form stronger H-bond compared to alcohols.





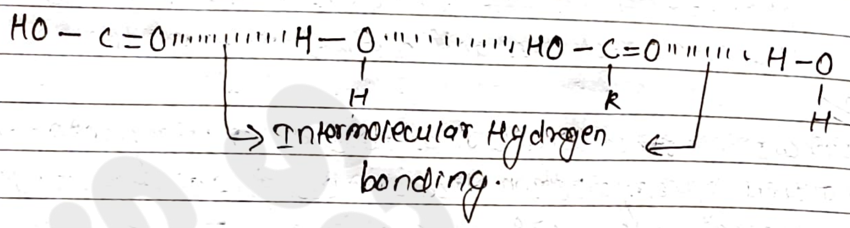
II) The alcohol can form H-bonding only through -OH group but carboxylic acids can form H-bondings through -OH group and carboxyl group leading to the dimeric structure. Hence the observed molecular mass becomes double the actual molecular mass. Hence it makes carboxylic acid higher boiling than alcohol.



cyclic dimeric structure. of Acetic acid.

→ The boiling point of high aliphatic and aromatic carboxylic acid increase with increase in molecular size due to a corresponding increase in Vander waals force of attraction.

3. Solubility :- 1st 4-member are soluble in water due to formation of intermolecular H-bonding with water molecules.

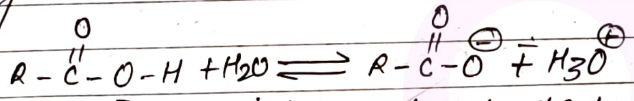


→ The solubility in water decrease with increase in the size of alkyl groups. All carboxylic acid are soluble in organic solvents.

Chemical propertise →

1. Acidic nature → Reactions due to H-atoms of the -OH group carboxylic acids are weaker than minerals acids but stronger than water, alcohol, phenol and carbonic acid. The acidity of carboxylic acids can be explained in the following terms.

Ⓐ Ionization constant → When a carboxylic acids is dissolved in water it ionizes to give carboxylate anion and hydronium ions. These ions are in dynamic equilibrium with the carboxylic acid molecules.



$$R-\overset{O}{\overset{\|}{C}}-O-H + H_2O \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O} + H_3\overset{\oplus}{O}$$

The equilibrium constant for the process is given by

$$keq = \frac{[RCOO^-][H_3O^+]}{[RCOOH]\ [H_2O]}$$

Water is present in ~~larger~~ large excess therefore its concentration is taken as constant.

$$\therefore keq \times [H_2O] = \frac{[RCOO^-][H_3O^+]}{[RCOOH]}$$

$$K_e = \frac{[RCOO^-][H_3O^+]}{[RCOOH]}$$

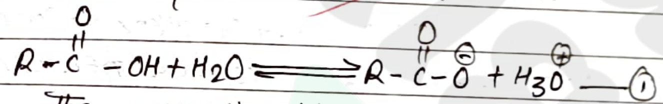
where K_a = ionization constant or acid dissociation constant

→ A larger value of Ka signifies higher degree of dissociation of the acids and stronger the acids. The acid strength is also described by the pKa value,

~~Eq~~ $pK_a = -\log K_a$.

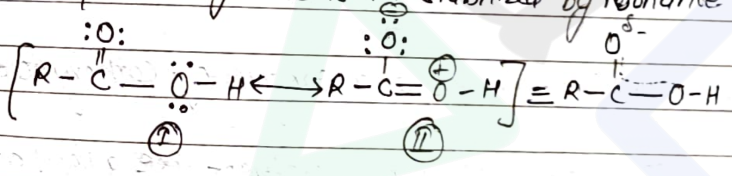
∴ A stronger acids will have larger value of Ka and smaller value of pKa.

Ⓑ Resonance stabilization → In ageous solution the ions are equilibrium with the undissociated acid molecule.



$$R-\overset{O}{\overset{\|}{C}}-OH + H_2O \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O} + H_3\overset{\oplus}{O} \quad ①$$

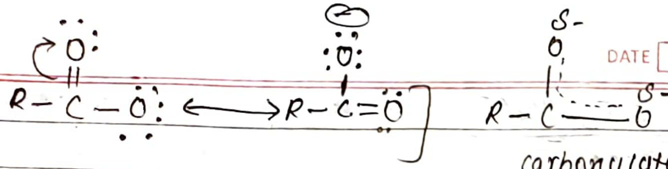
The carboxylic acids are stabilized by resonance as follows:-



The positive charge on the O-atom of the -OH group of acids makes the release of H-atoms as hydrogen ion easier. Hence carboxylic acids are acidic in nature.

→ carboxylate anion is also stabilized by resonance as follows:-

classmate



carbonylate anion.

carboxylate anion is more stablized by resonances then carboxylic acid. It is because the resonating structures of carboxylate anion are identical and involve dispersal of negative charge where as that of carboxylic acid are not identical and involve charge separation as a result the equilibrium first proceeds in forward direction producing more hydronium ion. Hence carboxylic acids behaves as fairly strong acids

Carboxylic acids is more stronger acids than alcohols? why?

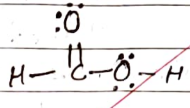
$$RCOOH + H_2O \rightleftharpoons RCOO^{\ominus} + H_3O^{\oplus}$$
$$R\text{-}OH + H_2O \rightleftharpoons RO^{\ominus} + H_3O^{\oplus}$$

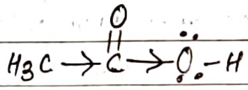
In alcohol neither alcohol nor alkoxide ion are stabilized by resonance. Hence alcohol are weaker acid then carboxylic acids.

Effects of substiuent on the acid strength of carboxylic acids:-

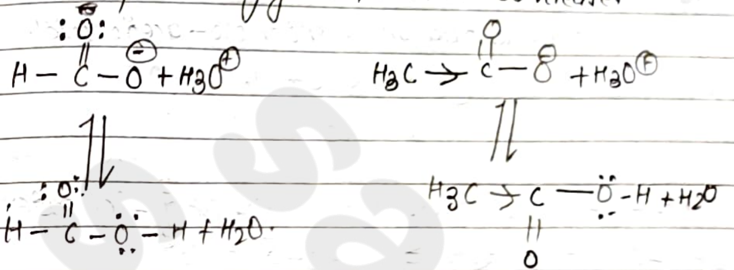
The electron releasing substituent like alkyl group (CH_3, $CH_3\text{-}CH_2$, etc) decreases the acid strengths of the carboxylic acids because it increases electron density at the oxygen atom of -OH group and makes release of $H^{\oplus}$ ion difficult.

→ It also destabilizes the carboxylate anion by the concentration of negative charge on the oxygen atom. Let us consider formic acid and acetic acid





→ -CH3 group makes the release of H+ difficult Beca use e-density is hight at O-atom of -OH group and cannot pull the bond electron pair strongly and $H^{\oplus}$ cannot be release.

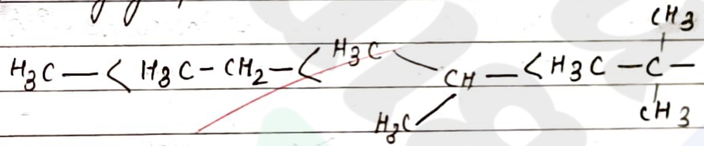


$$H-\overset{\overset{\ominus}{:O:}}{\overset{\|}{C}}-\overset{\ominus}{O}+H_3O^{\oplus} \rightleftharpoons H-\overset{:O:}{\overset{\|}{C}}-\ddot{\underset{..}{O}}-H+H_2O$$

$$H_3C\rightarrow\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}+H_3O^{\oplus} \rightleftharpoons H_3C\rightarrow\underset{\overset{\|}{O}}{C}-\ddot{\underset{..}{O}}-H+H_2O$$

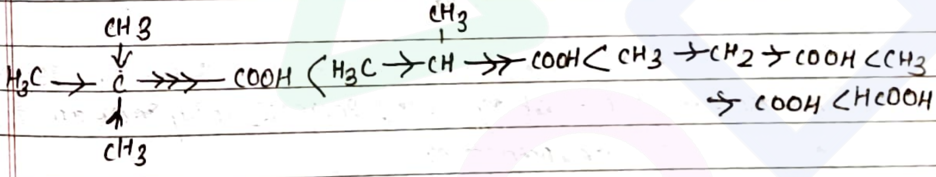
i.e. Hence ~~formule ac~~ formic acid is more stronger acid than acetic acid.

→ The electron releasing effect of alkyl group is described as +I effect. The +I effect alkyl group increase in this order:-



$$H_3C- < H_3C-CH_2- < (H_3C)_2CH- < H_3C-\overset{CH_3}{\underset{CH_3}{C}}-$$

Therefore, the acid strength carboxylic acids increase in the order:-



$$H_3C\rightarrow\overset{CH_3}{\underset{CH_3}{C}}\rightarrow COOH < H_3C\rightarrow\overset{CH_3}{CH}\rightarrow COOH < CH_3\rightarrow CH_2\rightarrow COOH < CH_3\rightarrow COOH < HCOOH$$

2,2-dimethyl propanoic acid.

→ the electron withdrawing group such as Halogen, $-NO_2$, $-CN$ etc increase the acid strength of the carboxylic acid. It decreases electron density at the O-atom of -OH group and make release of H^+-ion easier.

It stabilizes the carboxylate anion by the dispersal of nega tive charge.

For eg:-

Consider acetic acid and monochloro-acetic acid.

a) $CH_3 \rightarrow \overset{\|}{C}-O-H$ ⓑ $\underset{\underset{Cl}{\downarrow}}{CH_2} \leftarrow \underset{\underset{O}{\|}}{C}-OH$

This -Cl- atom makes the release of $H^{\oplus}$ - ion easier.

a) $CH_3-\overset{\overset{O}{\|}}{C}-O-H + H_2O \rightleftharpoons CH_3-\overset{\overset{O}{\|}}{C}-O^{\ominus} + H_3O^{\oplus}$

Less stable.

b) $\underset{\underset{Cl}{\downarrow}}{CH_2} \leftarrow \overset{\overset{O}{\|}}{C}-O-H + H_2O \rightleftharpoons CH_2 \leftarrow \overset{\overset{O}{\|}}{C}-O^{\ominus} + H_3O^{\oplus}$

More stable

i) The acid strength of carboxylic acids increases with increase in the number of halogen atoms. That's why

$$Cl-\underset{\underset{Cl}{|}}{\overset{\overset{Cl}{|}}{C}}-COOH > H-\underset{\underset{Cl}{|}}{\overset{\overset{Cl}{|}}{C}}-COOH > Cl-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-COOH$$

Tri-chloroacetic acid | Di-chloroacetic acid | Mono-chloroacetic acid

ii) The acid strength of carboxylic acid increases with increase in electronegativity of halogen atoms

$F > Cl > Br > I$ Then order of strength is :-

$F-CH_2COOH > Cl-CH_2COOH > Br-CH_2COOH > I-CH_2COOH$

iii) The acid strength of carboxylic acid decreases with increase in distance of the electrowithdrawing group from -COOH group due to decrease in -I effect.

$CH_3-CH_2-\underset{\underset{Cl}{\downarrow}}{CH}-COOH$

2-chlorobutanic acid

$CH_3-\underset{\underset{Cl}{\downarrow}}{CH}-CH_2-COOH$ 3-chlorobutanoic acid

$\underset{\underset{Cl}{\downarrow}}{CH_2}-CH_2-CH_2-COOH$ 4-chloro-butanoic acid.

classmate

Ⓐ Reaction with Metals → Carboxylic acids reacts with metals Zn, Na, K etc to liberate H_2 gas.

$2RCOOH + 2Na \longrightarrow 2RCOONa + H_2$

$2RCOOH + Zn \longrightarrow (RCOO)_2Zn + H_2$

Example:-

$2CH_3-COOH + 2Na \longrightarrow 2CH_3COONa + H_2$

$2CH_3-COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2$

Ⓑ Reaction with alkali → Carboxylic acids reacts with alkali to give salt and water.

$R-COOH + NaOH \longrightarrow R-COONa + H_2O$.

eg:- $CH_3-COOH + NaOH \rightarrow CH_3-COONa + H_2O$.

Ⓒ Reaction with carbonates and bicarbonates → carboxylic acids evolve carbondioxide gas from carbonates and bicarbonates.

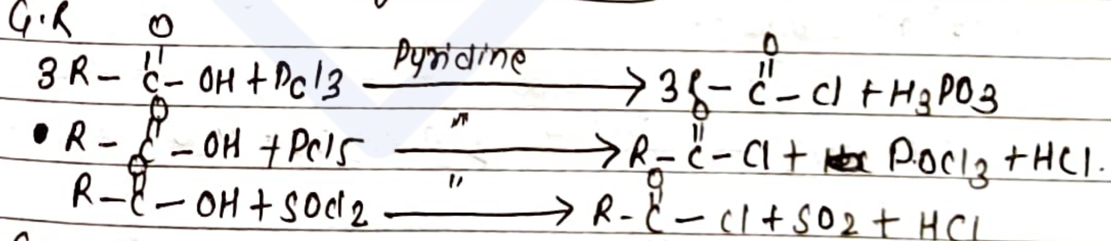
G.R

$2RCOOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2 + H_2O$.

$RCOOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 + H_2O$.

Ⓓ Reaction with PCl_3, PCl_5 or $SOCl_2$ → Carboxylic acid reacts with PCl_3, PCl_5, $SOCl_2$ to give acid chloride.

G.R

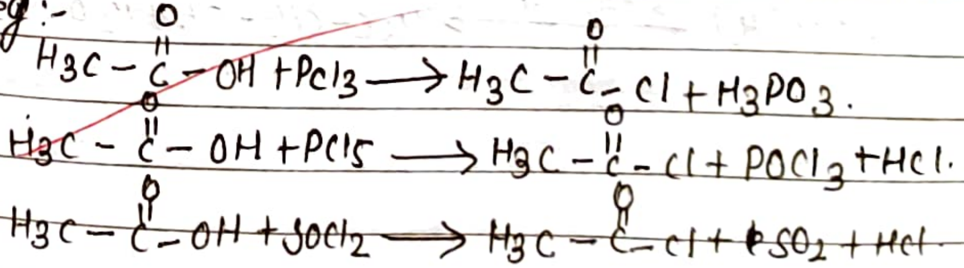


$$3R-\overset{O}{\overset{\|}{C}}-OH + PCl_3 \xrightarrow{\text{Pyridine}} 3R-\overset{O}{\overset{\|}{C}}-Cl + H_3PO_3$$

$$R-\overset{O}{\overset{\|}{C}}-OH + PCl_5 \xrightarrow{\text{"}} R-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl.$$

$$R-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \xrightarrow{\text{"}} R-\overset{O}{\overset{\|}{C}}-Cl + SO_2 + HCl$$

Eg:-



$$H_3C-\overset{O}{\overset{\|}{C}}-OH + PCl_3 \longrightarrow H_3C-\overset{O}{\overset{\|}{C}}-Cl + H_3PO_3.$$

$$H_3C-\overset{O}{\overset{\|}{C}}-OH + PCl_5 \longrightarrow H_3C-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl.$$

$$H_3C-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \longrightarrow H_3C-\overset{O}{\overset{\|}{C}}-Cl + SO_2 + HCl.$$

Bipin's Notes

(E) Esterification reaction → Carboxylic acids reacts with alcohol in the presence of conc. H_2SO_4 to form ester.

G.R

$$R-\overset{O}{\overset{||}{C}}-OH + H-OR' \xrightarrow{conc.H_2SO_4} R-\overset{O}{\overset{||}{C}}-OR' + H_2O$$

Eg:-

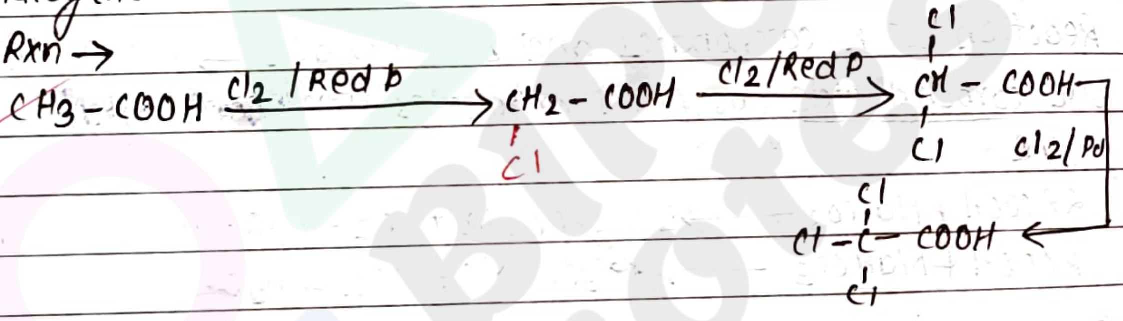
$$H_3C-\overset{O}{\overset{||}{C}}-OH + HOC_2H_5 \underset{}{\overset{conc.H_2SO_4}{\rightleftharpoons}} H_3C-\overset{O}{\overset{||}{C}}-OC_2H_5 + H_2O$$

Ethyl acetate

(F) Halogenation reaction → (Hell volnard zelinsky reaction) or HVZ reaction

carboxylic acids when treated with chlorine or bromine in the presence of red phosphorous the α- H-atom are replaced by halogens.

Rxn →



$$CH_3-COOH \xrightarrow{Cl_2/Red P} \underset{Cl}{CH_2}-COOH \xrightarrow{Cl_2/Red P} \underset{Cl}{\overset{Cl}{CH}}-COOH \xrightarrow{Cl_2/P} Cl-\underset{Cl}{\overset{Cl}{C}}-COOH$$

Trichloro acetic acid

(G) Reduction reaction → with LiAlH4:- Carboxylic acids are reduced to alcohol with LiAlH4 or H_2 in presence of copper chromite $(CuCr_2O_7)$ as catalyst.

G.R:-

$$R-COOH + 4[H] \xrightarrow{LiAlH_4} R-CH_2OH + H_2O$$

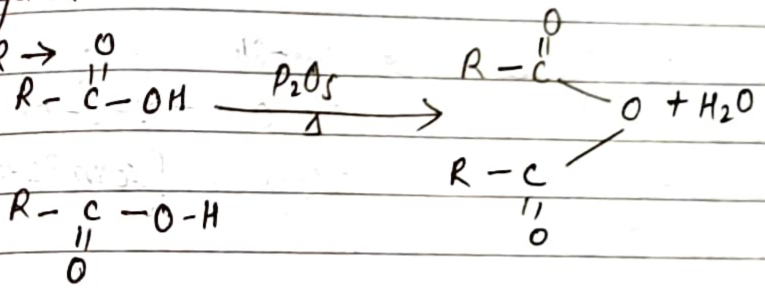
eg:-

$$H_3C-COOH + 4[H] \xrightarrow{LiAlH_4} H_3C-CH_2-OH + H_2O.$$

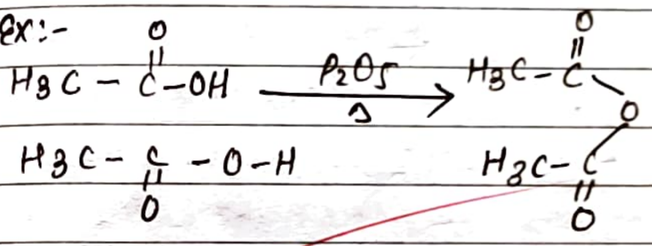
4. Dehydration reactions → Formation of acid anhydride.

Carboxylic acids when heated with P_2O_5 gives acid anhydride.

G.R →



Ex:-



ethanoic anhydride

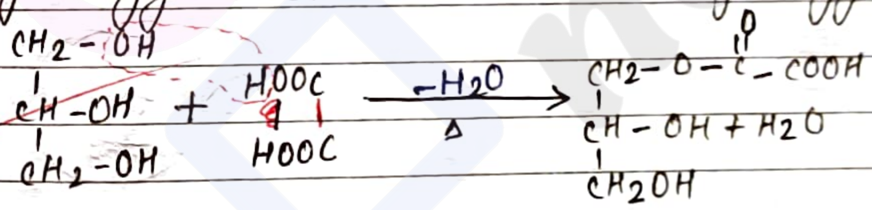
Not in course

Laboratory preparation of formic acid (Methanoic acid)

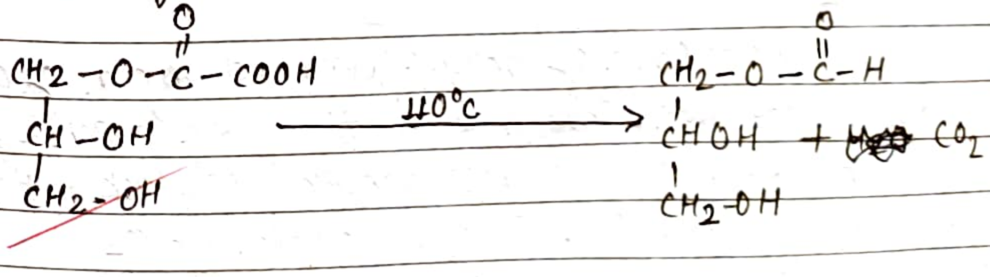
Principle:- theory:-

It is obtained in lab by heating anhydrous glycerol with oxalic acid crystals at 110°C

I) At first, glycerol reacts with oxalic acid to form glycerol monoxalate.

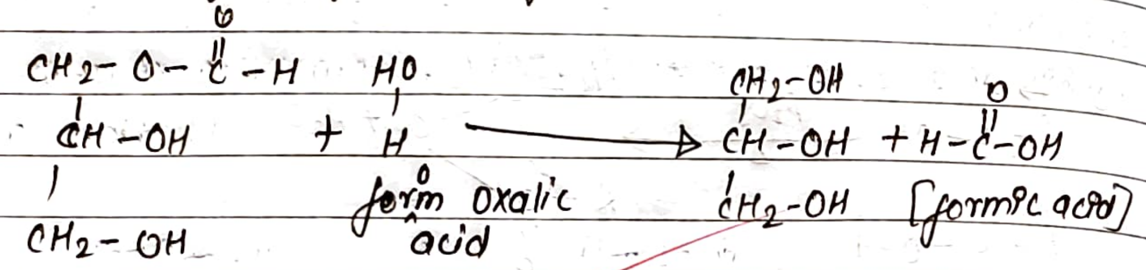


II) Thus formed glycerol monoxalate decomposes at 110°C to give glycerol monoformate and CO_2.



classmate

(iii) Finally glycerol monoformate reacts with water from oxalic acid crystals to give glycerol and formic acids.



$$\begin{array}{l} CH_2-O-\overset{O}{\overset{\|}{C}}-H \\ \quad | \\ CH-OH \\ \quad | \\ CH_2-OH \end{array} + \begin{array}{c} HO \\ | \\ H \end{array} \longrightarrow \begin{array}{l} CH_2-OH \\ \quad | \\ CH-OH \\ \quad | \\ CH_2-OH \end{array} + H-\overset{O}{\overset{\|}{C}}-OH$$

form oxalic acid

[formic acid]

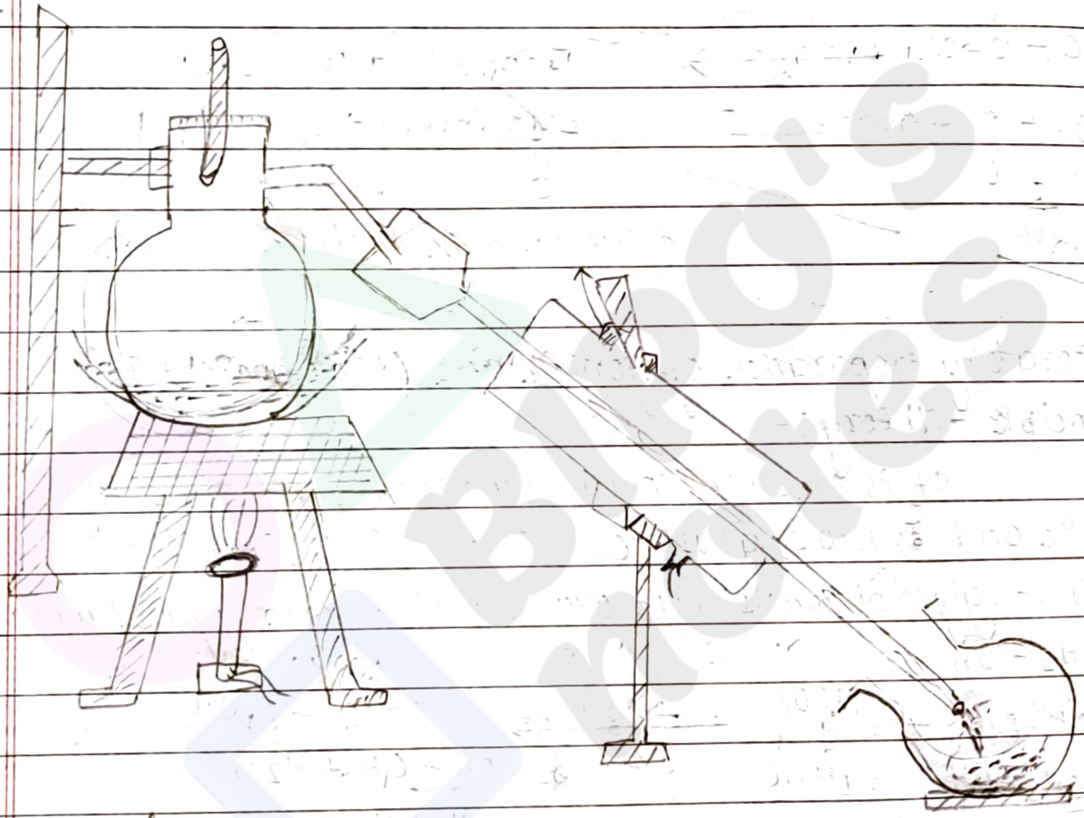


fig:- Lab preparation of formic acid

Procedure:-

About 50 ml of anhy. glycerol and 40 gm of oxalic acid crystals are taken into a distillation flask which is fitted with a thermometer and water condenser. The flask is heated over a sand bath at 110 °C till the evolution of CO_2 . then the flask is cooled and 40 gm of oxalic acid crystal are

Bipo's notes

classmate

again added and heated at 110°c. the formic acid distill over and is collected in a receiver in the form of its aqueous solution.

Ageous formic acid cannot fractioned to get anhydrous formic acid. It is because the bpt of formic acid is nearly same to that of water (100.5°c). Hence anhydrous formic acid is obtained as follows:-

The aqueous formic acid is neutralized with $PbCO_3$ soln. the solution is than evapourated (concentrated) to obtain the crystals to lead formate

$$2HCOOH + PbCO_3 \longrightarrow \underset{\text{lead formate.}}{(HCOO)_2Pb} + CO_2 + H_2O.$$

→ The crystal of lead formate are seperated, dried and heated in a current of hydrogen sulfide gas to obtain anhydrous formic acids.

$$(HCOO)_2Pb + H_2S \longrightarrow \underset{\text{Anhy. formic acid,}}{2HCOOH} + PbS\downarrow$$

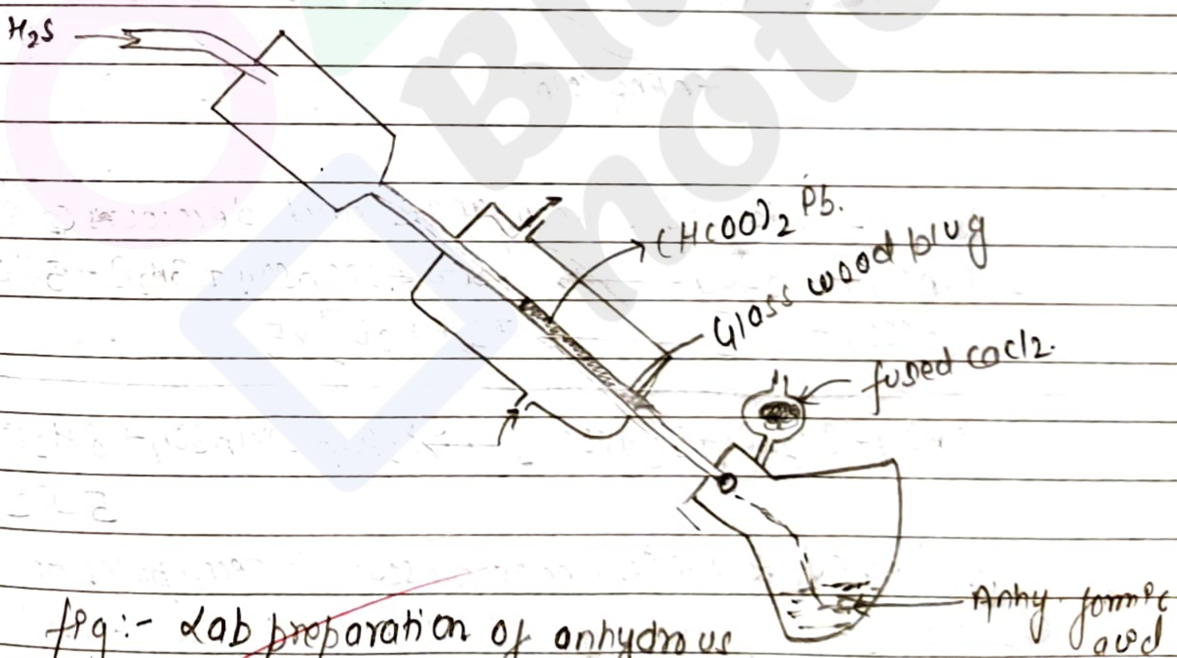
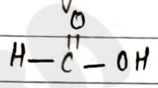


fig:- Lab preparation of anhydrous formic acid.

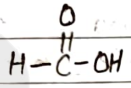
Abnormal behaviour of methanoic acid →

Formic acid contains both carboxyl group and aldehyde group as functional group. Hence it gives some of the reaction of aldehydes.



$H-\overset{O}{\overset{\|}{C}}-OH$

Carboxyl group



$H-\overset{O}{\overset{\|}{C}}-OH$

Aldehyde group.

(1) It reduces tollens reagents to the silver mirror

$$HCOOH + 2[Ag(NH_3)_2]OH^- \longrightarrow 2Ag\downarrow + 4NH_3 + CO_2 + 2H_2O$$

(2) It reduces fehling solution to the cuprous oxide

$$HCOOH + \underbrace{Cu^{++} + 4OH^-}_{\text{Fehling soln}} \xrightarrow{\Delta} Cu_2O + CO_2 + 3H_2O$$

(3) It reduces acidified permanganate and decolourises it

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$HCOOH + [O] \longrightarrow CO_2 + H_2O] \times 5$$

$$2KMnO_4 + 3H_2SO_4 + 5[HCOOH] \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5CO_2$$

(4) When heated to 160°c under pressure it decomposes to give CO_2 and H_2.

$$HCOOH \xrightarrow[160^\circ C]{\text{High pressure}} CO_2 + H_2$$

When heated with conc. H_2SO_4 it undergoes dehydrations to form carbonmonoxide.

$$HCOOH \xrightarrow{conc.\ H_2SO_4} CO + H_2O$$

It reads with PCl_5 to give formylchloride which at decomposes to give carbomonoxide.

$$H-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{PCl_5} H-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl$$

$$\downarrow$$

$$HCl + CO$$

Uses of some carboxylic acids →

1. Formic acid →
- In the lab preparation of carbonmonoxide
- In medicine.
- Ni-salts are used in the hydrogenation of vegetable ion.
- As coagulating agent for laten.

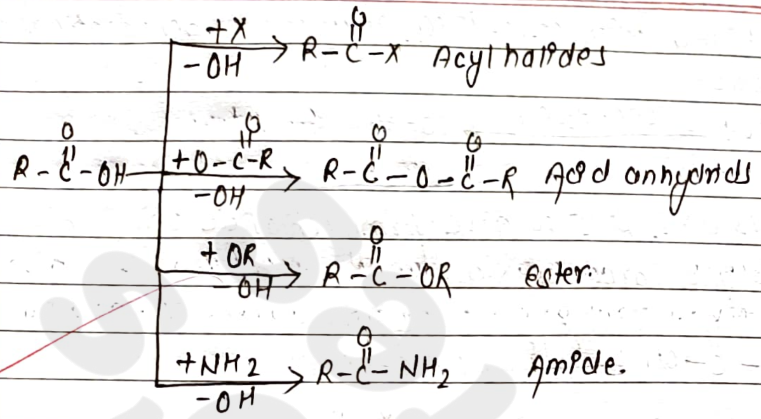
2. Acetic acid ⟶
- In the manufacture of dyes, raysons (fibres) and perfumes.
- As solvent.
- As vinegar for the preparation of pickles.
- For coagulation of laten.

* Derivatives of Monocarboxylic acids ⟶

Compounds formed by replacement of −OH group of carboxylic acid by $-X$, $-O-\overset{O}{\overset{\|}{C}}-R$, $-OR$ and $-NH_2$ are called derivates of carboxylic acids.

P.T.O

classmate



$$R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[-OH]{+X} R-\overset{O}{\overset{\|}{C}}-X$$ Acyl halides

$$R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[-OH]{+O-\overset{O}{\overset{\|}{C}}-R} R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$$ Acid anhydrides

$$R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[-OH]{+OR} R-\overset{O}{\overset{\|}{C}}-OR$$ ester

$$R-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[-OH]{+NH_2} R-\overset{O}{\overset{\|}{C}}-NH_2$$ Amide.

[1] Acid halides → $R-\overset{O}{\overset{\|}{C}}-X$ R = Alkyl / Aryl

Among the aryl halide acyl chlorides are most reactive and common compounds.

Nomenclature :→ -ic acid replaced by -yl halide.

Formula	common name	IUPAC name
$H-\overset{O}{\overset{\|}{C}}-Cl$	Formyl chloride	Methanoyl chloride
$H_2C-\overset{O}{\overset{\|}{C}}-Cl$	Acetyl chloride	ethanoyl chloride
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-Cl$	Proponyl chloride	Propanoyl chloride
$CH_3-\underset{2}{\overset{Cl}{\overset{\|}{C}H}}{}^{\alpha}-\underset{1}{\overset{O}{\overset{\|}{C}}}-Cl$	α-chloro-propionyl chloride	α-chloro propanoyl chloride
$C_6H_5-\overset{O}{\overset{\|}{C}}-Cl$	Benzoyl chloride	Benzoyl chloride

Preparation→

1. Acyl chlorides are obtained by treating carboxylic acids with PCl_3, PCl_5 or $SOCl_2$. [good chloro releasing group]

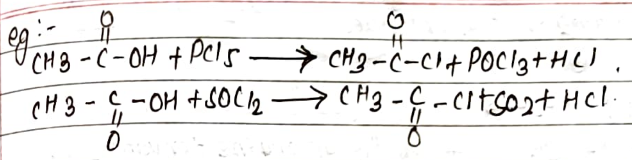
G.R

$$3R-\overset{O}{\overset{\|}{C}}-OH + PCl_3 \longrightarrow 3R-\overset{O}{\overset{\|}{C}}-Cl + H_3PO_3$$

$$R-\overset{O}{\overset{\|}{C}}-OH + PCl_5 \longrightarrow R-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl$$

$$R-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \longrightarrow R-\overset{O}{\overset{\|}{C}}-Cl + SO_2\uparrow + HCl\uparrow$$

eg:-

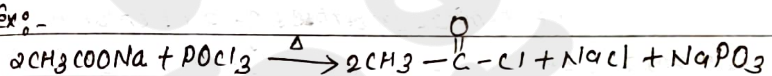


$$CH_3-\overset{O}{\overset{\|}{C}}-OH + PCl_5 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl.$$

$$CH_3-\underset{O}{\underset{\|}{C}}-OH + SOCl_2 \longrightarrow CH_3-\underset{O}{\underset{\|}{C}}-Cl + SO_2 + HCl.$$

2. In industrial scale acyl-chloride are obtained by distilling Na- or Ca-salts of carboxylic acids with phosphoryl chloride ($POCl_3$) or sulphuryl chloride.

Ex:-



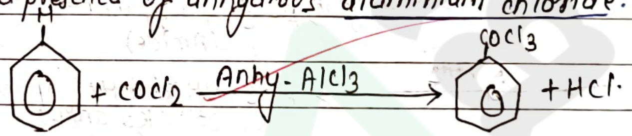
$$2CH_3COONa + POCl_3 \xrightarrow{\Delta} 2CH_3-\overset{O}{\overset{\|}{C}}-Cl + NaCl + NaPO_3$$

sod. metaphosphate

$$2CH_3COONa + SOCl_2 \xrightarrow{\Delta} 2CH_3-COCl + Na_2SO_4$$

$$(CH_3COO)_2Ca + SOCl_2 \xrightarrow{\Delta} 2CH_3-COCl + CaSO_4.$$

3. Benzyl chloride is obtained by heating benzene with carbonyl chloride in the presence of anhydrous aluminium chloride.



Physical properties →

1. Physical states → Lower acyl chlorides are colourless liquid whereas the higher acyl chlorides are colourless solids with pungent smell both.

2. Solubility → Acyl chlorides
   ↳ dissolves slowly in water due to hydrolysis.

→ All acyl chlorides are readily soluble in organic solvents.

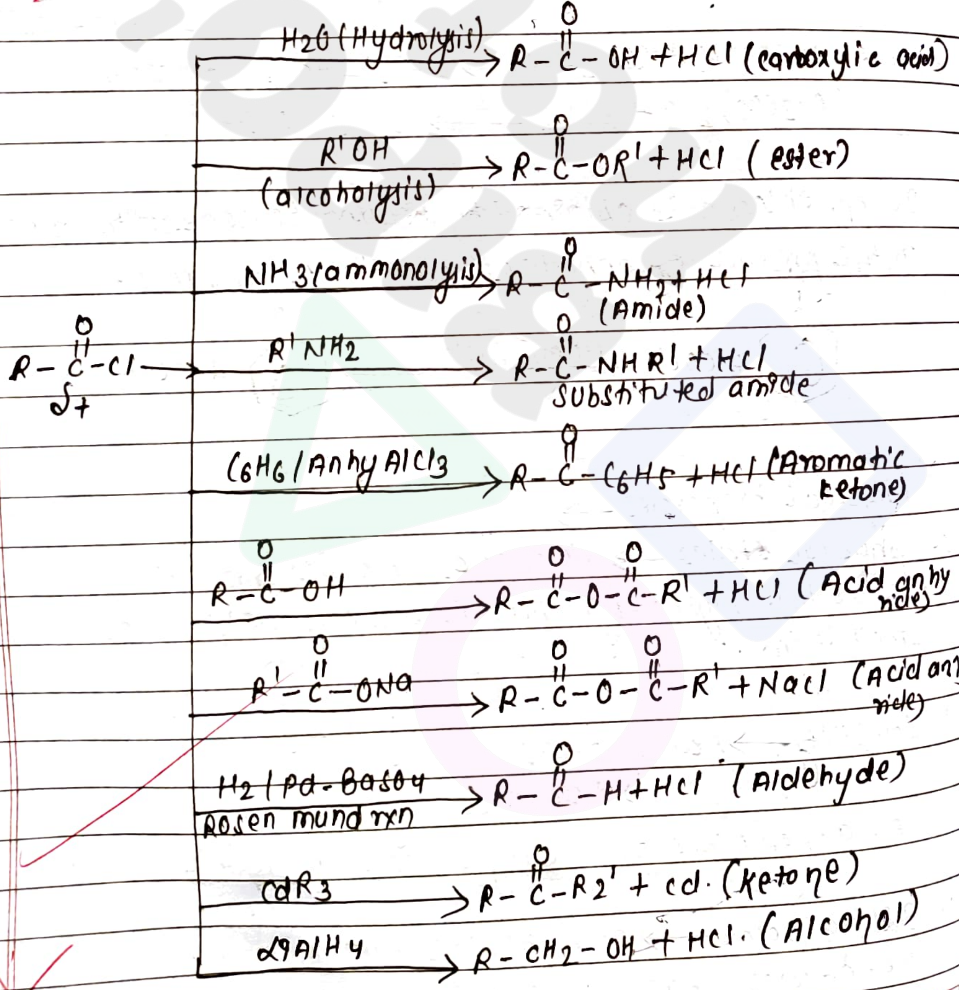
2. Boiling points → Acyl chlorides have lower boiling points than that of corresponding carboxylic acid. It is due to absence of intermole

culor H-bonding in acyl chlorides.

Chemical properties →

Acyl chlorides are most reactive among the derivatives of carboxylic acids. In acyl chlorides the highly electronegative chlorine atoms is linked to the carboxyl groups. It makes the carboxyl carbon electron deficients. Hence they undergo nucleophilic substitution easily.

The chemical properties of acyl chloride are summarized below:-



$$R-\overset{O}{\overset{\|}{C}}-Cl \ (\delta+)$$

$$\xrightarrow{H_2O\text{ (Hydrolysis)}} R-\overset{O}{\overset{\|}{C}}-OH + HCl \text{ (carboxylic acid)}$$

$$\xrightarrow[\text{(alcoholysis)}]{R'OH} R-\overset{O}{\overset{\|}{C}}-OR' + HCl \text{ (ester)}$$

$$\xrightarrow{NH_3\text{ (ammonolysis)}} R-\overset{O}{\overset{\|}{C}}-NH_2 + HCl \text{ (Amide)}$$

$$\xrightarrow{R'NH_2} R-\overset{O}{\overset{\|}{C}}-NHR' + HCl \text{ Substituted amide}$$

$$\xrightarrow{C_6H_6\text{ / Anhy }AlCl_3} R-\overset{O}{\overset{\|}{C}}-C_6H_5 + HCl \text{ (Aromatic ketone)}$$

$$\xrightarrow{R-\overset{O}{\overset{\|}{C}}-OH} R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R' + HCl \text{ (Acid anhydride)}$$

$$\xrightarrow{R'-\overset{O}{\overset{\|}{C}}-ONa} R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R' + NaCl \text{ (Acid anhydride)}$$

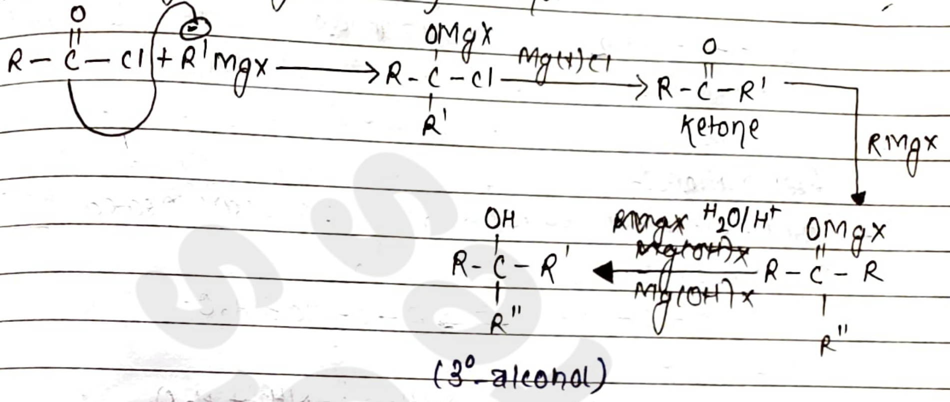
$$\xrightarrow[\text{Rosen mund rxn}]{H_2/Pd-BaSO_4} R-\overset{O}{\overset{\|}{C}}-H + HCl \text{ (Aldehyde)}$$

$$\xrightarrow{CdR_2} R-\overset{O}{\overset{\|}{C}}-R_2' + Cd. \text{ (Ketone)}$$

$$\xrightarrow{LiAlH_4} R-CH_2-OH + HCl. \text{ (Alcohol)}$$

classmate

② Reaction with Grignard reagent → when acid chlorides reacts with grignard reagent ketone is formed, which further reacts with Grignard's reagent to give tertiary alcohol.



* Uses of acylhalides:-

- They are used as acylating agent.
- They are used for preparation of several derivatives, dyeshuft and pharmaceuticals.

* Acid amides → Amides are named by replacing the suffix 'ic' acid of common name and 'oic' acids as IUPAC, name of the corresponding carboxylic acid with 'amide'.

Formula	Common name	IUPAC name
$H-\overset{O}{\overset{\parallel}{C}}-NH_2$	Formamide	Methanamide
$CH_3-\overset{O}{\overset{\parallel}{C}}-NH_2$	~~Aceta~~ Acetic ~~Acetic~~ acid	Ethanamide.
$CH_3-CH_2-\overset{O}{\overset{\parallel}{C}}-NH_2$	propionamide	Propanamide.
$CH_3-\overset{O}{\overset{\parallel}{C}}-NH-CH_3$	N-Methyl acetamine	N-methyl ethanamide.

$CH_3-\overset{\overset{O}{\|}}{C}-N\begin{matrix}\diagup CH_3\\ \diagdown CH_3\end{matrix}$	N,N-dimethyl ~~alcohol~~ acetamide	N,N ~~N,N~~-dimeth ethanamide
$C_6H_5-\overset{\overset{O}{\|}}{C}-NH_2$	Benzamide	Benzamide.

Preparations:-

1. When amonium salts of carboxylic acids are heated amides are formed.

$$R-\overset{\overset{O}{\|}}{C}-ONH_4 \xrightarrow{\Delta} R-\overset{\overset{O}{\|}}{C}-INa+H_2O.$$

e.g:-

$$CH_3-\overset{\overset{O}{\|}}{C}-ONH_4 \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-NH_2+H_2O$$

C_6H_5.

2. When acids chlorides ~~are~~ or acid anhydride reacts with ammonia, amides are formed.

$$R-\overset{\overset{O}{\|}}{C}-Cl+NH_3 \longrightarrow R-\overset{\overset{O}{\|}}{C}-NH_2+HCl.$$

$$R-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-R'+NH_3 \longrightarrow R-\overset{\overset{O}{\|}}{C}-NH_2+R'COOH.$$

E.g

$$CH_3-\overset{\overset{O}{\|}}{C}-Cl+NH_3 \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-NH_2+HCl$$

$$CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-CH_3+NH_3 \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-NH_2.$$

3. By the partial ~~an~~ hydrolysis of alkyl canide (alkane nitrile) with conc. HCl

$$R-C\equiv N+H_2O \xrightarrow{conc.HCl} R-\overset{\overset{O}{\|}}{C}-NH_2$$

E.g

$$CH_3-C\equiv N+H_2O \xrightarrow{Conc.HCl} CH_3-\overset{\overset{O}{\|}}{C}-NH_2.$$

$$C_6H_5-C\equiv N+H_2O \xrightarrow{conc.HCl} C_6H_5-\overset{\overset{O}{\|}}{C}-NH_2.$$

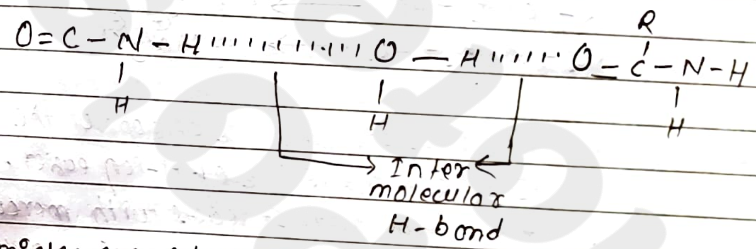
classmate

DATE

physical properties:-

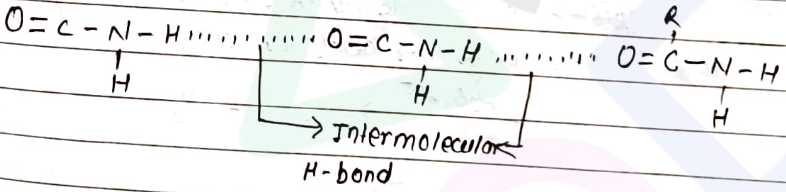
1) physical state:- Except formamide all other amides are colorless crystalline solids.

2) solubility :- Amides up to 5 carbon ~~am~~ atoms are soluble in water due to formations of intermolecular H-bonds between amides and water molecules.



→ All amides are soluble in organic solvents.

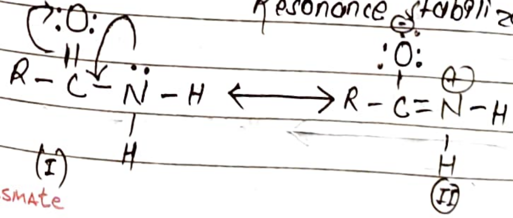
3) Mpt and Bpt → The melting point ~~and~~ & Boiling point of amide are higher than those expected from their molecular masses. It is due to formation of intermolecular H-bonds between its own molecule



Chemical properties

→ Amides are least reactive among derivatives of carboxylic acids. It is due to lower point of $C-NH_2$ bond.

Resonance stabilization of molecule.



classmate

PAGE

1. **Amphoteric nature** ⟶ Amides act as weak acids as well as weak bases. Hence they are amphoteric in nature.

ⓐ **Basic nature:-** Due to presence of lone pair of electron on the nitrogen atom amide act as bases but they are less basic than ~~amides~~ amines, because according to structure (II) the lone pair is not easily available for protonation. Hence it reacts with strong acids to form salts.

$$R-CONH_2 + HCl \longrightarrow RCO\overset{+}{N}H_3\overset{-}{Cl}$$

$$CH_3-CONH_2 + HCl \longrightarrow CH_3CO\overset{+}{N}H_3\overset{-}{Cl}$$

ⓑ **Acidic nature:** → The positive charge develops on the N-atom (structure-II) makes the release of H-ion easier. Hence amides act as weak acid. It reacts with mercuric oxide to form salt and with sodium to evolve H_2 gas.

$$2CH_3-CONH_2 + HgO \longrightarrow (CH_3CONH)_2Hg + H_2O$$

Mercuric ethanamide.

$$2CH_3CONH_2 + 2Na \longrightarrow 2CH_3CO\overset{-}{N}H\overset{+}{Na} + H_2\uparrow$$

Sodium acetamide

② **Hydrolysis:** → Amides are hydrolysed to carboxylic acids when boiled with dil acids or alkali.

$$\begin{tikzcd} & R-COOH + NH_3 \\ RCONH_2 \arrow[ur, "H_2O/H^{\oplus}", "Boil"'] \arrow[dr, "NaOH(aq)", "Boil"'] & \\ & R-COONa + NH_3 \end{tikzcd}$$

$$\begin{tikzcd} & CH_3COOH + NH_3 \\ CH_3-CONH_2 \arrow[ur, "H_2O/H^{\oplus}", "Boil"'] \arrow[dr, "NaOH(aq)", "\Delta"'] & \\ & CH_3COONa + NH_3 \end{tikzcd}$$

classmate

DATE

3. **Dehydration →** when amides are heated with P_2O_5 phosphorous pentaoxide gets dehydrated to form alkyl cyanide (alkane nitrile)

$$R-\overset{O}{\overset{\|}{C}}-N\begin{matrix}H\\H\end{matrix} \xrightarrow[\Delta]{P_2O_5} R-C\equiv N + H_2O$$

eg:-

$$CH_3-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[\Delta]{P_2O_5} CH_3-C\equiv N + H_2O$$

4. **Reduction →** when amides are reduced in the presence of $LiAlH_4$ primary amines are formed. Ex:-

$$R-\overset{O}{\overset{\|}{C}}-NH_2 + 4[H] \xrightarrow{LiAlH_4} R-CH_2-NH_2 + H_2O$$

e.g:-

$$CH_3-\overset{O}{\overset{\|}{C}}-NH_2 + 4[H] \xrightarrow{LiAlH_4} CH_3-CH_2-NH_2 + H_2O$$

5. ~~Reduction~~ Reaction with nitrous acid → when amide reacts with nitrous acids carboxylic acids and nitrogen gas are formed.

$$RCONH_2 + HNO_2 \xrightarrow[0-10^\circ C]{NaNO_2/HCl} R-COOH + N_2 + H_2O$$

eg:-

$$CH_3-CO-NH_2 + HNO_2 \xrightarrow[0-10^\circ C]{NaNO_2/HCl} CH_3COOH + N_2 + H_2O$$

V. Imp

6. Reaction with Br_2 and Alkali → (Hoffman's bromomide rxn or hypobromamide):-

when amides are heated with bromine and alkali., primary amines are formed having one carbon atom less than that of parent amine. This reaction is called decarboxylation reaction.

classmate

$R-\overset{\overset{O}{\|}}{C}-NH_2 + Br_2 + 4NaOH \xrightarrow{\Delta} \underset{1^\circ \text{ amine}}{R-NH_2} + Na_2CO_3 + 2NaBr + 2H_2O.$

Eg:- $CH_3-\overset{\overset{O}{\|}}{C}-NH_2 + Br_2 + 4$ ~~KOH~~ $NaOH \xrightarrow{\Delta} CH_3-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O.$

$C_6H_5-\overset{\overset{O}{\|}}{C}-NH_2 + Br_2 + 4KOH \xrightarrow{\Delta} C_6H_5NH_2 + K_2CO_3 + 2H_2O.$

Uses:-

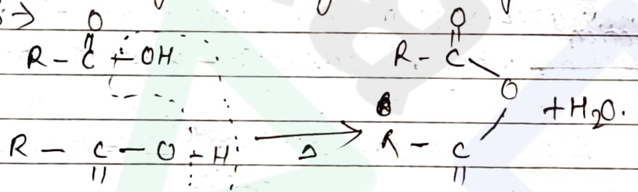
(*) In the preparation of 1° amine.

→ Dimethyl formamide (DMF) and dimethyl acetaamide (DMA) are used as solvent.

[3] Acid anhydride. → $R-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-R$

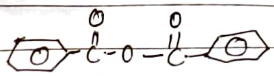
Acid anhydride are to be consider to be derived from carboxylic acid by the loss of water molecule

G.Rxn :->



Acid anhydride

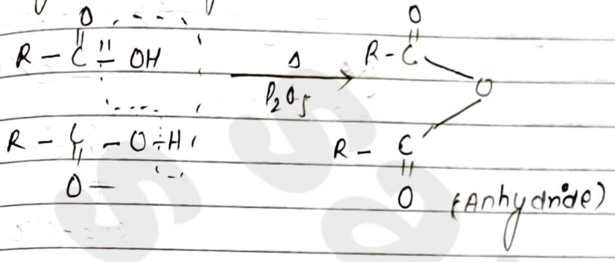
Nomenclature:-

Formula	common name	IUPAC Name
$CH_3-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-CH_3$	Acetic anhydride	Ethanoic anhydride
$C_2H_5-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-C_2H_5$	Proponic anhydrie	Propanoic anhydride
$CH_3-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-C_2H_5$	Acetic propionic anhydride	ethanoic propanoic anhydride
	Benzoic anhydride	Benzoic anhydride

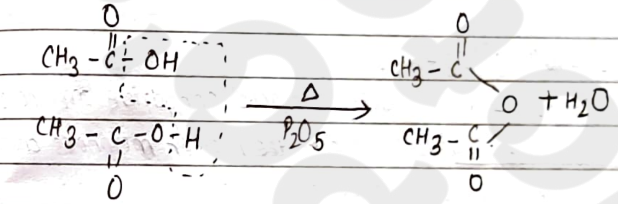
Preparations :→

1. When carboxylic acids are heated in the presence of P_2O_5, anhydrides are formed.

G.R

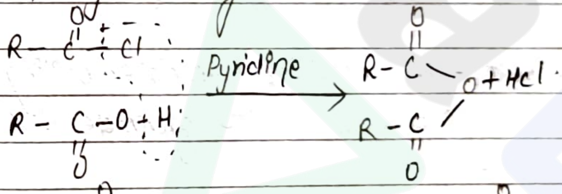


e.g

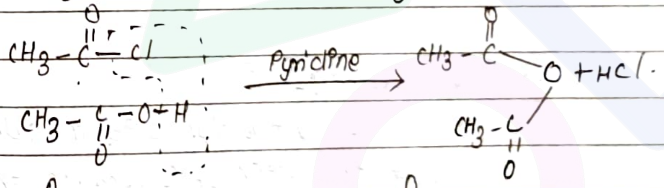


2. When acid chloride is treated with carboxylic acid or its sodium salt, anhydride is formed.

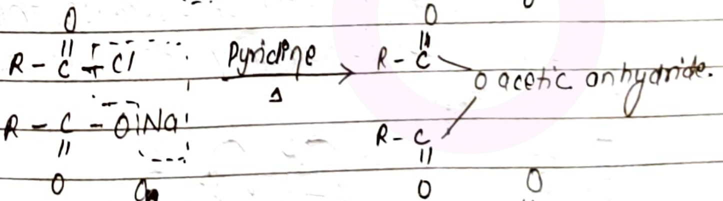
I)



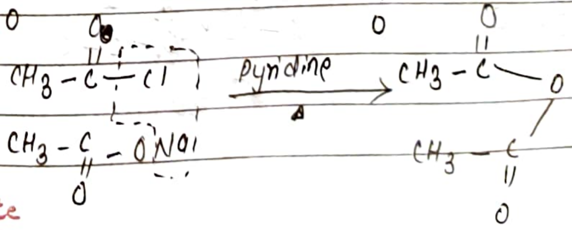
eg :-



II)

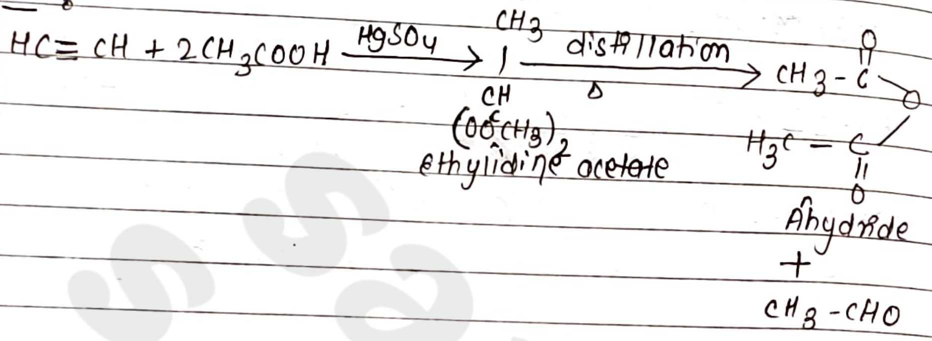


e.g :-



3) When actylene is treated with acetic acid in the presence of mercuric sulfate anhydride is formed.

Rx



Physical properties :-

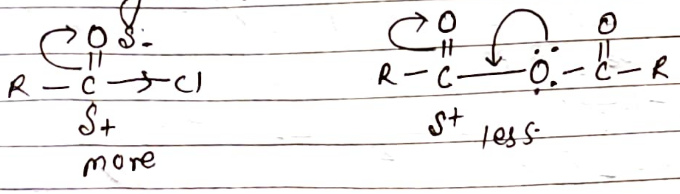
1. physical states :- Lower aliphatic acid anhydride are colorless pungent smelling liquids where as the higher members aromatic acid anhydrides are colorless solid.

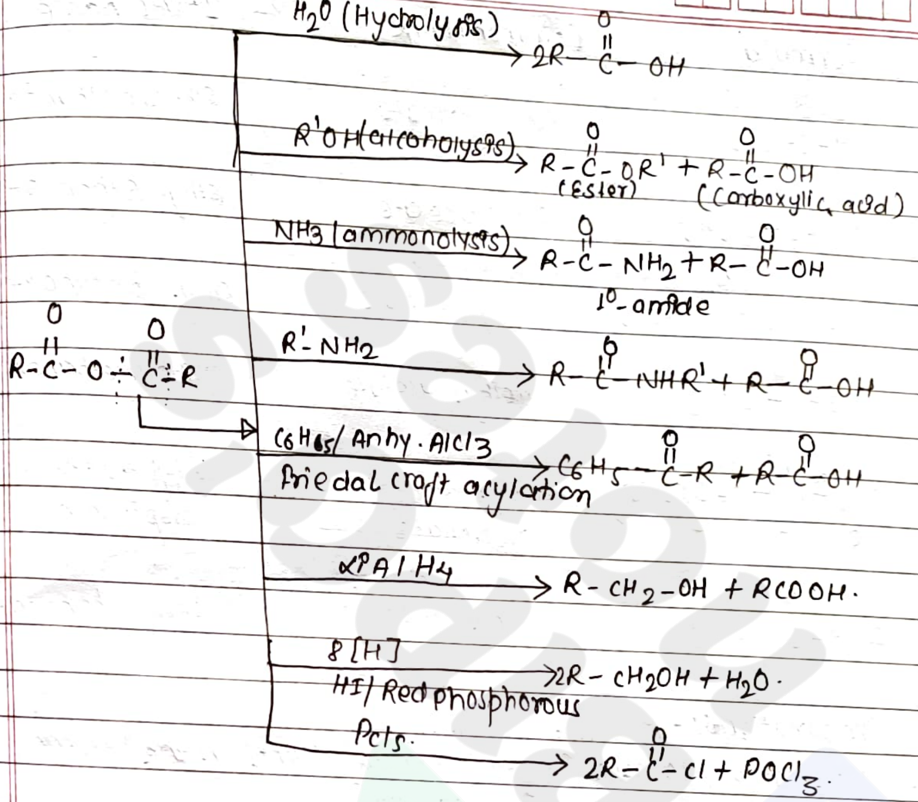
2. Solubility :- Acid anhydride are sparingly (slightly) soluble in water but readily soluble in organic solvents.

3. Boiling point :- Acid anhydride have higher boiling point than that of corresponding acids due to bigger molecular size and molecular mass.

Chemical properties :-

1. Acids anhydrides are less reactive than acid chlorides towards nucleophilic substitution reaction. It is because the +ve charge on the acyl carbon of acid anhydride is decreased by resonance as follows :-





Uses:-

1. Acid anhydrides are used as acyleting agent. they are better acylating agents then acyl chloride because the reactions are not vigrous and can be easily controlled.

[4] Ester → $R-\overset{O}{\overset{\|}{C}}-OR'$

Nomenclature:-

Ester's are ~~are~~ named by replacing suffix -ic acid of the common and IUPAC name of corresponding carboxylic acids with 'ate' and adding the name of alkyl before it.

Formula	Commonname	IUPAC name
$H-\overset{O}{\overset{\|}{C}}-OC_2H_5$	Ethyl formate	Ethyl methanoate.
$CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5$	Ethyl acetate	Ethyl ethanoate.
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OC_2H_5$	Ethyl propionate	Ethyl propanoate
$CH_3-\overset{O}{\overset{\|}{C}}-OCH_3$	methyl acetate	Methyl ethanote.
$\underset{3}{\overset{\beta}{CH_3}}\overset{\alpha}{-}\underset{2}{\overset{CH_3}{\overset{\|}{CH}}}-\underset{1}{\overset{O}{\overset{\|}{C}}}-OC_2H_5$	Ethyl α-methyl propionate	Ethyl-2-methyl propionate
$C_6H_5-\overset{O}{\overset{\|}{C}}-OC_6H_5$	phenyl benzoate	phenyl benzoate

Preparations:-

1. When carboxylic acid is heated with alcohol in the presence of conc. H_2SO_4 gives ester (esterification)

$$R-\overset{O}{\overset{\|}{C}}-OH + HOR' \underset{\Delta}{\overset{conc.H_2SO_4}{\rightleftharpoons}} R-\overset{O}{\overset{\|}{C}}-OR' + H_2O$$

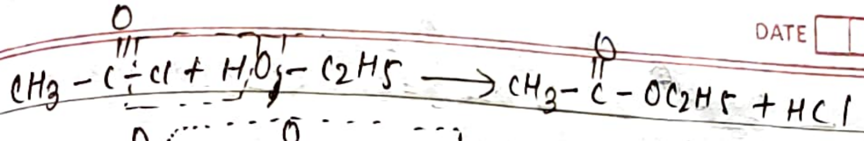
e.g

$$CH_3-C\boxed{-OH+H}-O-C_2H_5 \rightleftharpoons CH_3-C-OC_2H_5 + H_2O$$

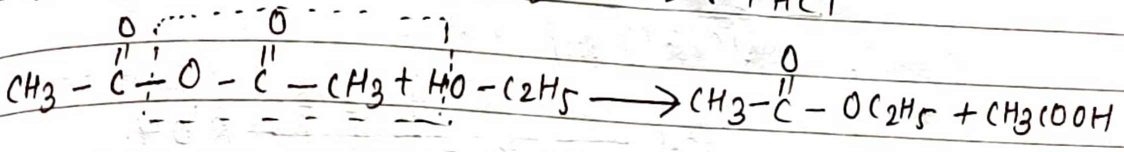
2. when acid chlorides or acid anhydrides are treated with alcohol gives ester.

$$R-\overset{O}{\overset{\|}{C}}\boxed{-Cl+H}-O-R' \longrightarrow R-\overset{O}{\overset{\|}{C}}-OR' + HCl$$

$$R-\overset{O}{\overset{\|}{C}}\boxed{-O-\overset{O}{\overset{\|}{C}}-R'+H}-O-R' \longrightarrow R-\overset{O}{\overset{\|}{C}}-OR' + RCOOH$$

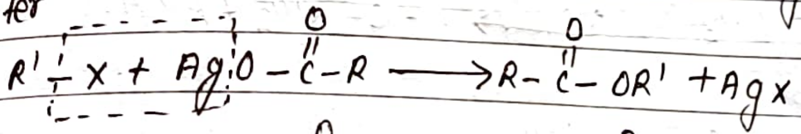


$$CH_3-\overset{O}{\overset{\|}{C}}-Cl + H-O-C_2H_5 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5 + HCl$$



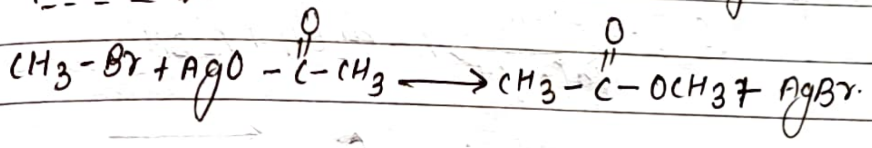
$$CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + H-O-C_2H_5 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5 + CH_3COOH$$

3. when haloallcane is heated with silver salts of carboxylic acid gives ester



$$R'-X + Ag-O-\overset{O}{\overset{\|}{C}}-R \longrightarrow R-\overset{O}{\overset{\|}{C}}-OR' + AgX$$

e.g



$$CH_3-Br + AgO-\overset{O}{\overset{\|}{C}}-CH_3 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OCH_3 + AgBr.$$

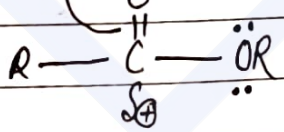
Properties :-

1. physical state :- Esters are colorless liquids or solids with characteristics pleasant fruity smell.

ethyl butanoate → pineapple.
Octyl ethanote → Orange.

2. Solubility :- Esters are sparingly soluble in water but readily soluble in organic solvent.

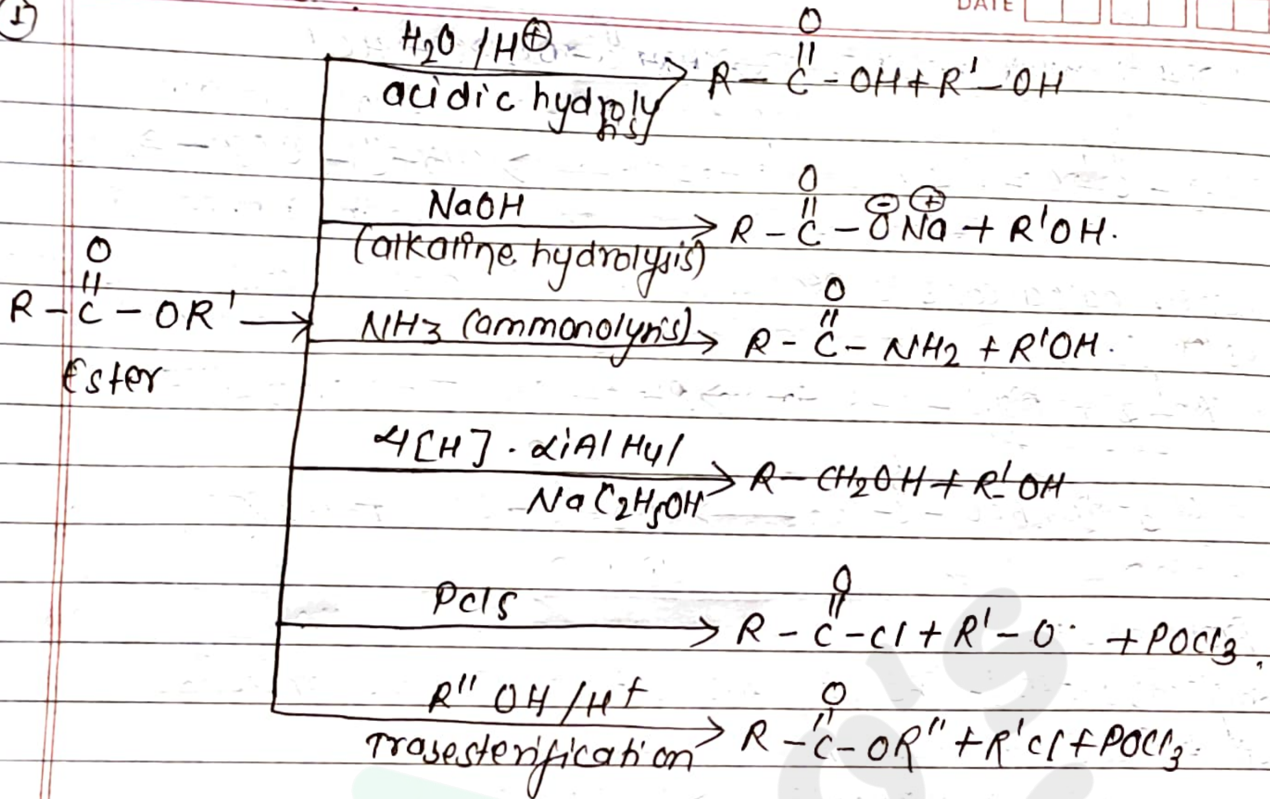
3. Bpt :- They have lower boiling point as compare to that of corresponding carboxylic acids ie due to absence of intermolecular bond.



P.T.O.

Bipin's Notes

①



$R-\overset{O}{\overset{\|}{C}}-OR'$ Ester

$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow[\text{acidic hydrolysis}]{H_2O\,/H^{\oplus}} R-\overset{O}{\overset{\|}{C}}-OH+R'-OH$

$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow[\text{(alkaline hydrolysis)}]{NaOH} R-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}\overset{\oplus}{Na}+R'OH.$

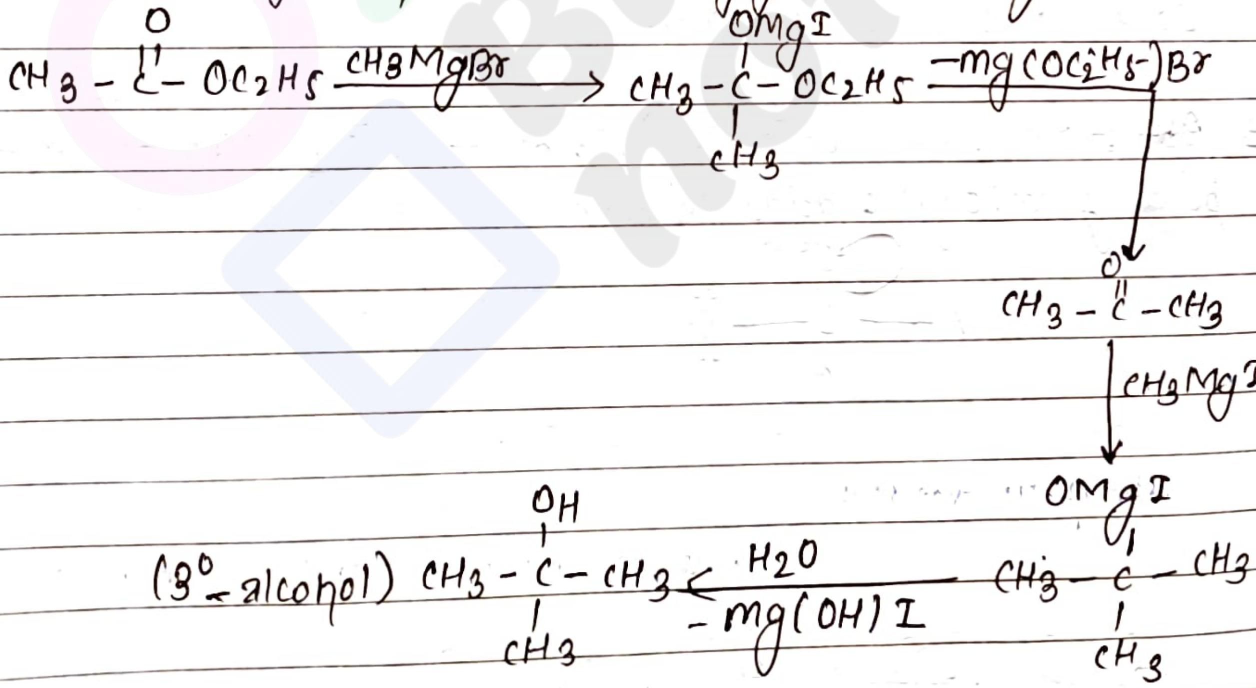
$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow{NH_3\ \text{(ammonolysis)}} R-\overset{O}{\overset{\|}{C}}-NH_2+R'OH.$

$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow[Na\,C_2H_5OH]{4[H]\cdot LiAlH_4/} R-CH_2OH+R'OH$

$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow{PCl_5} R-\overset{O}{\overset{\|}{C}}-Cl+R'-O\cdot+POCl_3.$

$R-\overset{O}{\overset{\|}{C}}-OR' \xrightarrow[\text{Trasesterification}]{R''OH/H^+} R-\overset{O}{\overset{\|}{C}}-OR''+R'Cl+POCl_3.$

② Reaction with Grignard's reagent ⟶ when esters except esters of formic acids reacts with Grignard reagent to give tertiary alcohol as final product. esters of formic acid gives 2° alcohol



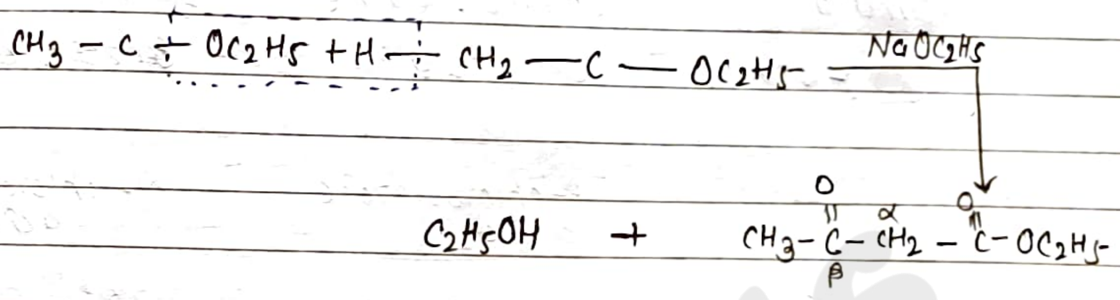
$CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5 \xrightarrow{CH_3MgBr} CH_3-\underset{CH_3}{\underset{|}{\overset{OMgI}{\overset{|}{C}}}}-OC_2H_5 \xrightarrow{-Mg(OC_2H_5)Br} CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{CH_3MgI} CH_3-\underset{CH_3}{\underset{|}{\overset{OMgI}{\overset{|}{C}}}}-CH_3$

$CH_3-\underset{CH_3}{\underset{|}{\overset{OMgI}{\overset{|}{C}}}}-CH_3 \xrightarrow[-Mg(OH)I]{H_2O} CH_3-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$ (3°-alcohol)

③ claisen's condensation → ~~When ester's ha~~

When ester's having α-hydrogen atom undergoes self condensation in the presence of strong base sodium ethoxide gives β keto ester. This reaction is known as claisen's condensation.



$$CH_3-C-OC_2H_5 + H-CH_2-C-OC_2H_5 \xrightarrow{NaOC_2H_5} CH_3-\underset{\beta}{\overset{\overset{O}{\|}}{C}}-\overset{\alpha}{CH_2}-\overset{\overset{O}{\|}}{C}-OC_2H_5 + C_2H_5OH$$

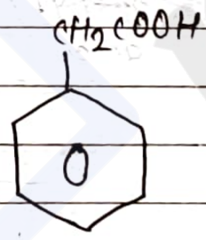
ethyl acetoacetate (β-ketoester)

Uses :-

1) As industrial solvents for paints, oils fat resins etc.
2) In the preparation of artificial favours & essences.

Aromatic carboxylic acid

In aromatic carboxylic acids the COOH group is either linked to benzene ring or to the side chain of the benzene ring

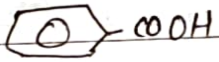
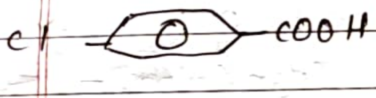
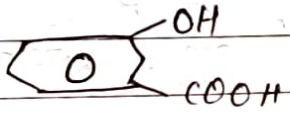
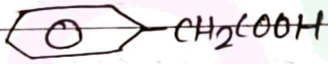
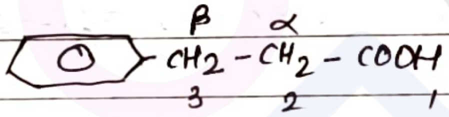


Nomenclature:-

Aromatic carboxylic acids in which the -COOH groups are directly linked to benzene ring or ~~to~~ ~~the~~ ~~Ae~~ are named as derivatives of Benzoic acids, both in common and IUPAC system.

classmate

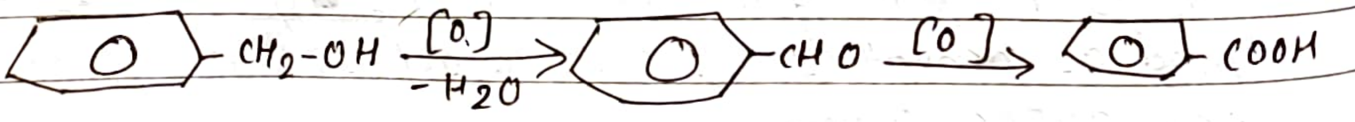
Some carboxylic acids may have their special common name also, but aromatic carboxylic acids in which the – COOH group are present in the side chain are known as phenyl derivatives of aliphatic acids.

Formula	Common Name	IUPAC Name
	Benzoic acid	Benzoic acid.
	P-chlorobenzoic acid	4-chloro benzoic acid.
	O-hydroxy benzoic acid (Salicylic acid)	2-hydroxy benzoic acid.
	O-methyl benzoic acid	2-methyl benzoic acid
	Phenyl acetic acid	Phenyl ethanoic acid.
	β-phenyl proponoic acid	3-phenyl proponoic acids

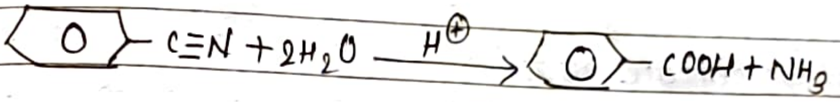
~~Uses of Benzoic acid~~

* Preparation of Benzoic acids (C_6H_5 COOH)

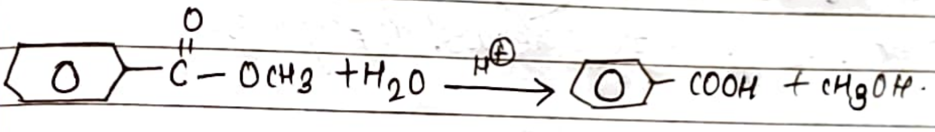
1. When benzyl alcohol or benzaldehyde react with alk pottas permagnate ($KMnO_4$, benzoic acid is formed)



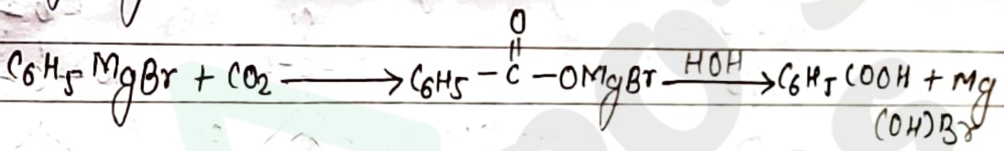
2. When benzonitrile (phenyl cyanide) undergoes hydrolysis with dil. HCl gives benzoic acid.



3. When methyl benzoate undergoes acid hydrolysis gives benzoic acid.



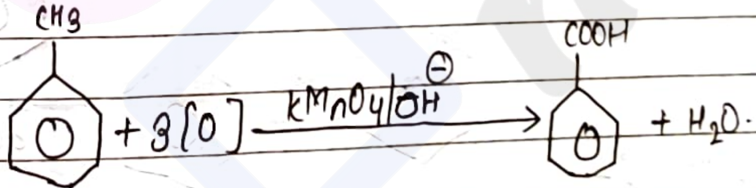
4. When phenyl magnesium bromide reacts with carbondioxide followed by hydrolysis gives benzoic acid.

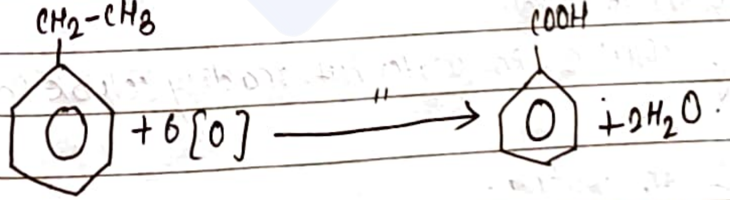


$$C_6H_5MgBr + CO_2 \longrightarrow C_6H_5-\overset{O}{\overset{||}{C}}-OMgBr \xrightarrow{HOH} C_6H_5COOH + Mg(OH)Br$$

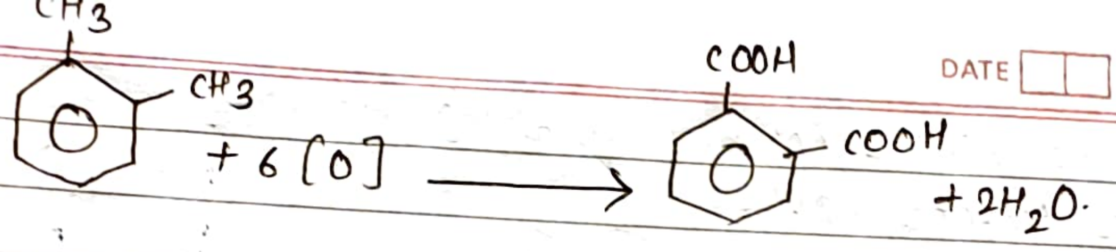
5. When alkyl benzene reacts with alk. KMnO₄ benzoic acid is formed.

In this process the alkyl group is oxidised to –COOH irrespective of the nature & length of the alkyl group.





classmate

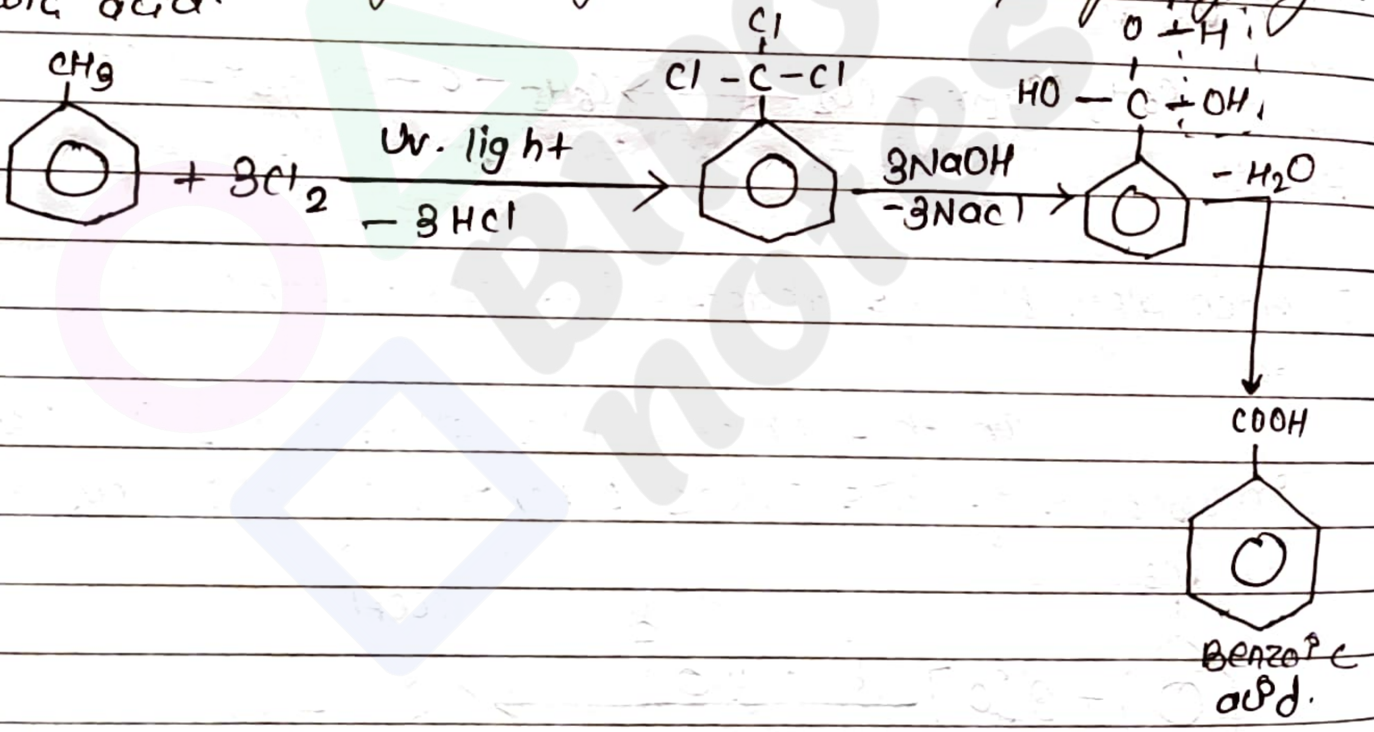


Uses of benzoic acid:-

1) As food preservative
2) Lab reagent.
3) In the manufacture of dyes, drugs etc.
4) Methyl & ethyl benzoates are used as perfumes.

Industrial preparations:-

When toluene is boiled with bubbling Cl gas in the presence of UV light and alkaline hydrolysis gave benzoic acid.



Bipin notes

Physical properties:-

1. colourless crystalline solid.
2. It is slightly soluble in water but readily soluble in organic solvent.
3. It sublimes on heating.

chemical properties:-

It ressembles aliphatic carboxylic acids in its chemical properties but it is more stronger acid's then aliphatic carboxylic like acetic acids.

(A) Reaction due to – COOH group.

$C_6H_5COOH \rightarrow$

$\xrightarrow{Na} C_6H_5COONa + H_2$.

$\xrightarrow{NaOH} C_6H_5COONa + H_2O$.

$\xrightarrow{Na_2CO_3} C_6H_5COONa + CO_2 + H_2O$

$\xrightarrow{NH_3} C_6H_5COONH_4 \xrightarrow{\Delta} C_6H_5CONH_2 + H_2O$

Es

$\xrightarrow[conc \cdot H_2SO_4]{C_2H_5OH} C_6H_5-COOC_2H_5 + H_2O$

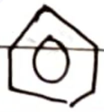
Ester

$\xrightarrow{PCl_5} C_6H_5-\overset{O}{\overset{||}{C}}-Cl + POCl_3 + HCl$

$\xrightarrow[P_2O_5]{\Delta} C_6H_5-\overset{O}{\overset{||}{C}}-O-\overset{O}{\overset{||}{C}}-C_6H_5 + H_2O$

$\xrightarrow[4[H]]{LiAlH_4} C_6H_5CH_2OH + H_2O$.

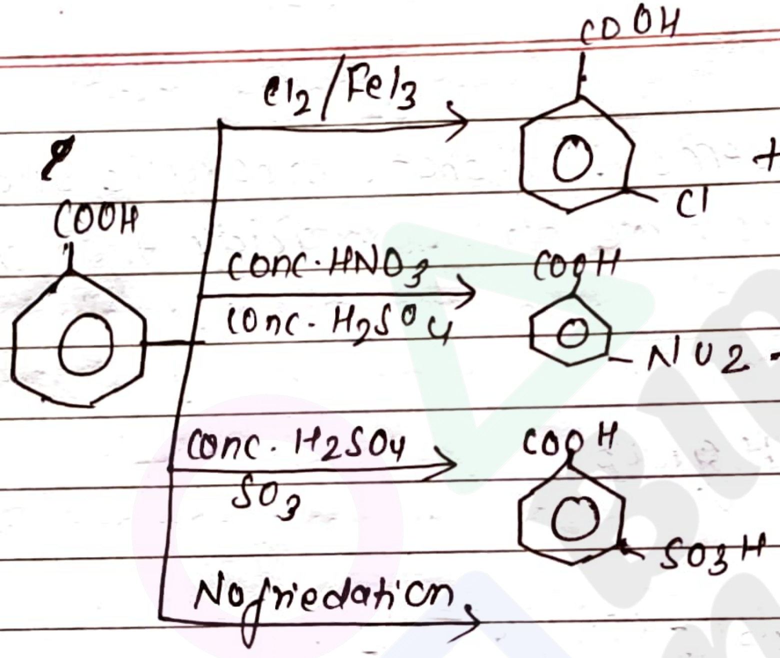
$\xrightarrow[\Delta]{6[HI]/Red\ P} C_6H_5-CH_3 + 2H_2O + 3I_2$
Toluene

$\xrightarrow[lime]{NaOH/CaO}$  $+ Na_2CO_3$

(B) Reaction due to benzene ring → The –COOH group is an electron withdrawing group, hence it deactivates the benzene ring and gives meta-products during electrophilic substitution rxn.

fig of R.S (Resonance Structure) & R.H.S (Resonance hybrid structure)

Pipo's notes



$+ HCl$: m-chlorobenzoic acid

$-NO_2 + H_2O$: m-Nitrobenzoic acid

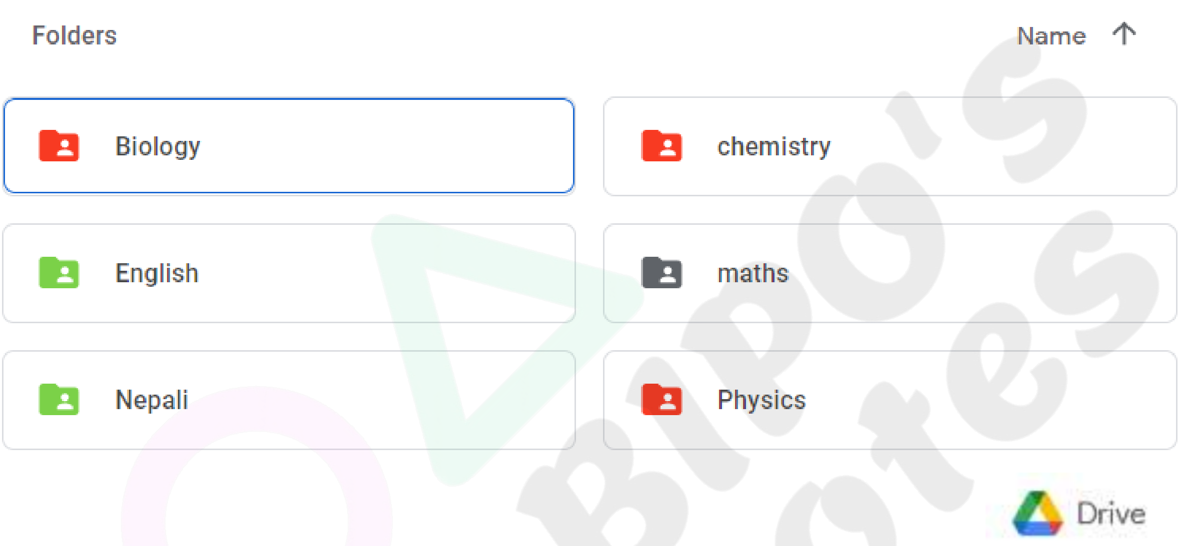
: m-sulphobenzoic acid.

Bipos notes

Bipin Khatri

(Bipo)

Class 12 complete notes and paper collection.



Folders

Name ↑

Biology

chemistry

English

maths

Nepali

Physics

Drive

Feedbacks:

admin@bipinkhatri.com.np | bipinkhatri.ram@gmail.com

Contact:

@im.bipo www.bipinkhatri.com.np @im.bipo

Bipo's notes