ORGANIC CHEMISTRY- I

IMPORTANT QUESTIONS

UNIT 5

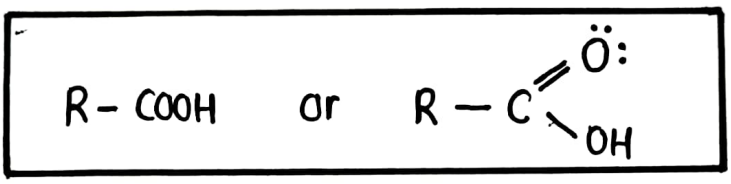
IMPERFECT
PHARMACY

QUESTION - 1

1 DISCUSS ACIDITY OF CARBOXYLIC ACIDS AND EFFECT OF SUBSTITUENTS ON ITS ACIDITY

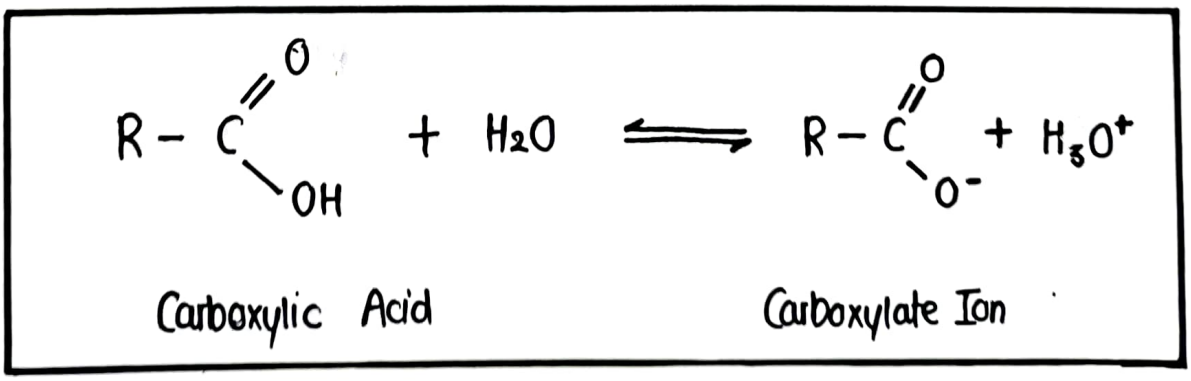
Carboxylic Acids

- Carboxylic Acid is an organic compound that contains a carboxyl group (-COOH).
- This group consist of a carbonyl group (C=O) attached to hydroxyl group (-OH).
- They can be either aliphatic or aromatic.



Acidity Of Carboxylic Acids

- Carboxylic acids are Acidic in nature.
- The acidity of carboxylic acids refers to their ability to donate a proton (H^+) from the carboxyl group (-COOH) to form a Carboxylate ion ($-COO^-$).
- When carboxylic acids dissociate in water, they form carboxylate ion & hydronium ion by donating H^+ to the water



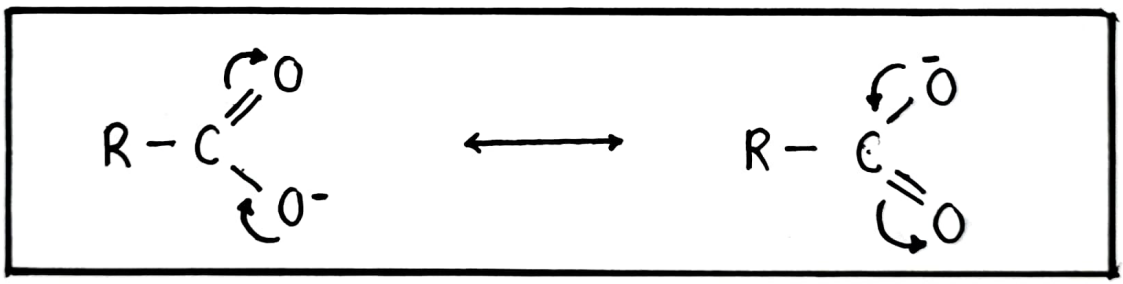
Now this carboxylate ion becomes very stable due to two major key factors :

① Resonance stabilization

② Electronegative Oxygen Atoms

① Resonance Stabilization

- When a carboxylic acid loses a proton (H^+), it forms a carboxylate ion ($R-COO^-$)
- This anion is stabilized by resonance, as negative charge can be delocalized between the two oxygen atoms.
- This delocalization lowers the energy of carboxylate ion making it more stable thus making loss of proton more favourable.



② Electronegative Oxygen Atoms

- The two oxygen atoms in carboxyl group are highly electronegative
- They pull electron density away from hydrogen in -OH group making it easier for proton to leave & dissociate.
- Now these electronegative oxygen atoms stabilizes the negative charge on carboxylate ion.

- Also the pka value of carboxylic acids are very less i.e., 4-5 indicating it as a strong acid compare to Alcohols & many other organic acids.

Effect Of Substituents On Acidity Of Carboxylic Acids

There are mainly two types of substituents that generally shows their effect on acidity of carboxylic acids:

① Electron Withdrawing Group
② Electron Releasing Group

Effect Of Electron Withdrawing Group

- Electron withdrawing groups increases the acidity of carboxylic acids because EWGs stabilizes the negative charge on the carboxylate ion through Inductive or resonance effect.
- In a carboxylic acid, the electron withdrawing groups pull electron density away from carboxylic group.
- This makes carboxylate ion more stable and thus making carboxylic acid more acidic

Effect Of Electron Releasing Group

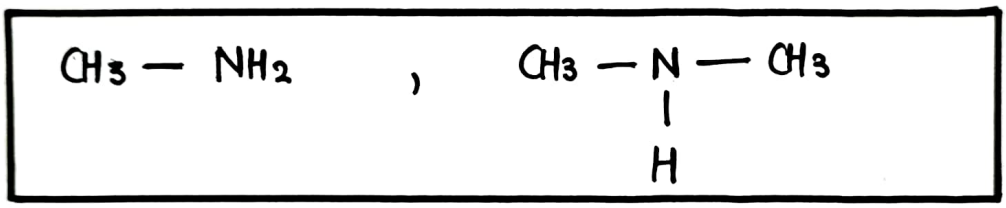
- Electron Releasing Groups (ERGs) decreases the acidity of carboxylic acids
- This is because ERGs increases electron density to the carboxyl group, which destabilizes the carboxylate ion by reducing the ability of carboxylate ion to stabilizes the -ve charge.

QUESTION - 2

2 DISCUSS BASICITY OF ALIPHATIC AMINES AND EFFECT OF SUBSTITUENTS ON ITS BASICITY

BASICITY OF ALIPHATIC AMINES

- Aliphatic amines are organic compounds that contains an amino group ($-NH_2$) attached to an aliphatic carbon chain.
- It can also be defined as aliphatic derivatives of Ammonia (NH_3) in which 1 or more hydrogen atom of amonia is replaced by alkyl groups.



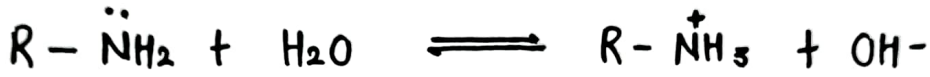
Classification of Aliphatic Amines

- Aliphatic Amines are classified as Primary, Secondary or Tertiary depending upon whether 1, 2 or all 3 atoms of hydrogen have been replaced by Alkyl Groups

① Primary Aliphatic Amines (NH_2CH_3)
② Secondary Aliphatic Amines ($NH(CH_3)_2$)
③ Tertiary Aliphatic Amines ($N(CH_3)_3$)

Basicity Of Aliphatic Amines

- Aliphatic amines are basic in nature.
- The basicity of aliphatic amines refers to their ability to accept protons (H^+ ions) from acids, which is a measure of their strength as bases.
- Also they have the ability to donate their lone pair of electrons present on nitrogen atom



Factors Influencing basicity of Aliphatic Amines

Several factors influences basicity of aliphatic amines :

① Alkyl Groups

Alkyl Groups attached to the nitrogen atom increases its electron density, enhancing its ability to donate lone pair of electrons & thus increasing basicity.

② Steric Effects

In tertiary amines, steric hindrance can reduce the availibility of lone pair, potentially decreasing its ability compared to primary & secondary amines.

③ Hybridization

In aliphatic amines, there is sp^3 hybridization compared to aromatic amines (sp^2) making stronger base than other amines.

Order of basicity of Aliphatic Amines

2° Amines > 3° Amines > 1° Amines > Ammonia

- 2° Amines have greatre basicity compared to 3° Amines because of steric hindrance affect.

EFFECT OF SUBSTITUENTS ON BASICITY OF ALIPHATIC AMINES

① Effect of Electron Releasing Groups

- Electron Releasing Groups increases the electron density on ~~Aromatic Amines~~ Aliphatic Amines, hence they tends to increases the basicity of aliphatic amines.
- example : $-CH_3$, $-OH$ etc.

② Effect of Electron Withdrawing Groups

- Electron Withdrawing Groups due to their high electronegativity decreases electron density on nitrogen atom, reducing its ability to accept protons & thus decreases basicity.
- Example : $-CH_3$, $-OH$ etc.

QUESTION - 3

3 DISCUSS INDUCTIVE EFFECT AND QUALITATIVE TEST FOR

- **CARBOXYLIC ACIDS**
- **AMIDES**
- **ESTERS**

Inductive Effect

- The partial shift / displacement of electrons from a less electronegative atom towards a more electronegative atom is known as Inductive effect.
- Now this inductive effect is of two types :

① Positive Inductive Effect (+I)
② Negative Inductive Effect (-I)

① +I Effect

- This effect occurs when a substituent or group in a molecule increases electron density to the rest of the molecule.
- Basically this effect is shown by Electron Releasing Groups
- example : Alkyl Groups (Methyl, Ethyl).

② -I Effect

- This effect occurs when a substituents or group in a molecule decreases electron density to the rest of the molecule.
- Basically, this effect is shown by Electron Withdrawing Groups
- example : Halogens (Cl, Br).

Qualitative Test For Carboxylic Acids

① Litmus Test

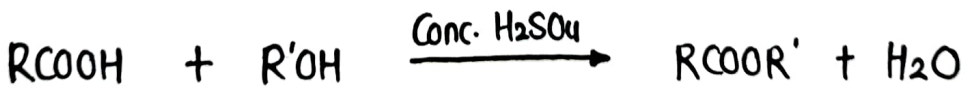
Place a drop of solution of carboxylic acid sample on a blue litmus paper.
If blue litmus turns red, it indicates the presence of acid

② Sodium Bicarbonate Test

Carboxylic acids reacts with sodium bicarbonate to produce salt of carboxylic acid along with effervescence of CO_2

③ Ester Formation Test

On heating carboxylic acids with an alcohol in presence of small amount of sulphuric acid, a fruity smell of Ester is obtained.



QUALITATIVE TEST FOR ESTERS

① Hydroxamic Acid Test

Esters upon reaction with hydroxylamine yeilds hydroxamic acid, which upon treatment with ferric chloride forms ferric hydroxamate complex with Bluish red/ violet colour.

$$R-COO-R' + NH_2OH \longrightarrow R-CONHOH + R'-OH$$

$$\downarrow FeCl_3$$

$$(RCONHO)Fe^{2+} + H^+$$

(Bluish Red Complex)

② Hydrolysis Test

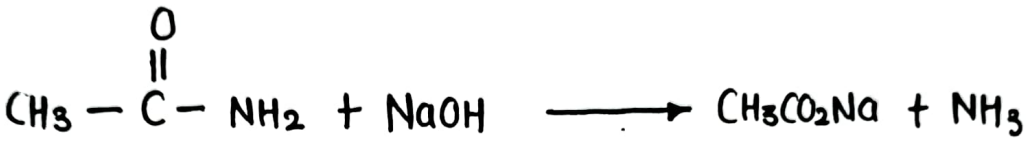
Alkaline hydrolysis of esters converts esters into acid salt and alcohol.

$$RCOOR' + NaOH \longrightarrow RCOONa + R'OH$$

QUALITATIVE TEST FOR AMIDE

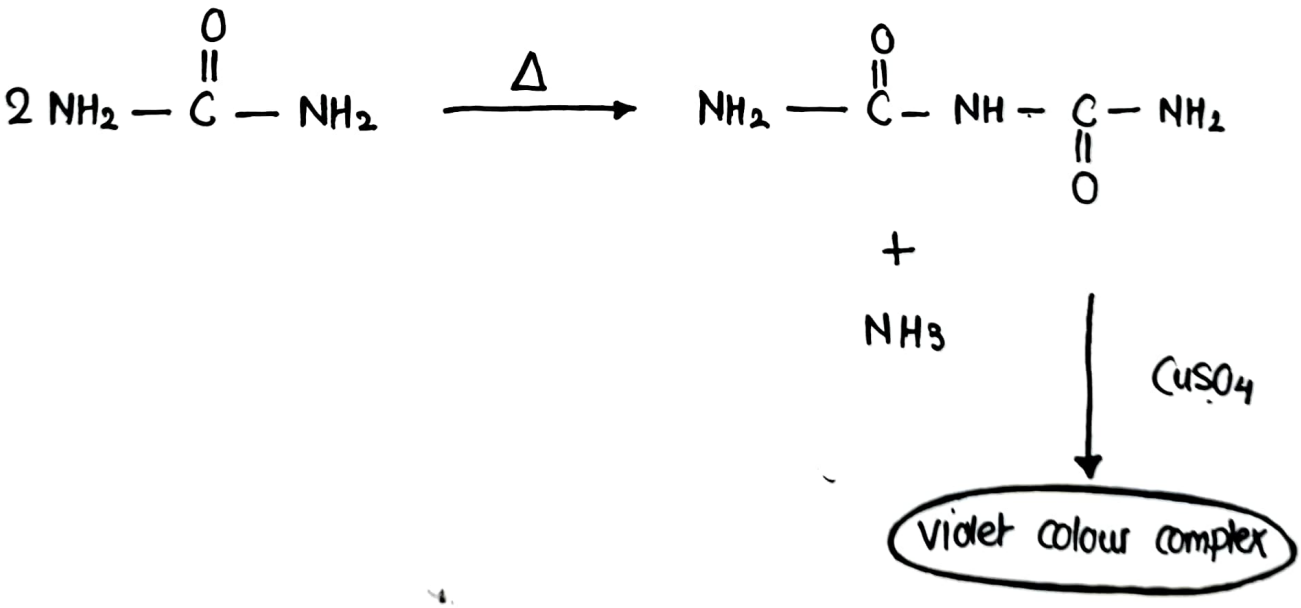
① Alkali Test

Simple primary amide can be decomposed by boiling with Alkali and thereby evolving ammonia



② Biuret Test

When aliphatic diamide is heated at temperature above its melting point, ammonia is evolved, this biuret in alkali medium gives violet colour with a drop of copper sulphate solution



QUESTION - 4

4 DEFINE STRUCTURE AND USES OF :

- **ACETIC ACID**
- **CITRIC ACID**
- **SALICYLIC ACID**
- **BENZOIC ACID**
- **ETHYLENE DIAMENE**
- **AMPHETAMINE**

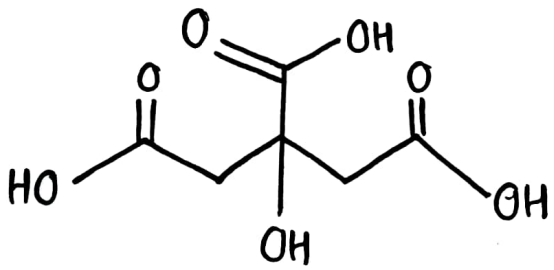
① Acetic Acid

$CH_3 - COOH$

Uses

- It is widely used in food industry
- It serves as precursor for synthesis of various chemicals.
- It is also used as cleansing agent.
- It is used as preservatives.

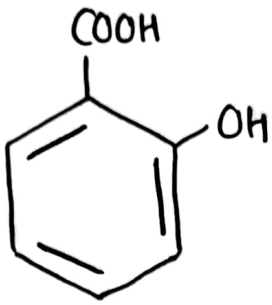
② Citric Acid



Uses

- It is used as flavour enhancer
- It is used as cleansing agent
- It is used in cosmetic industry
- Also used in various medications

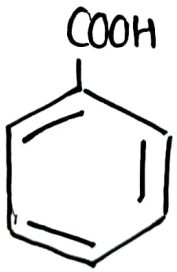
③ Salicylic Acid



Uses

- Precursor of aspirin
- In various cosmetic products
- As plant hormone
- For acne treatment

④ Benzoic Acid



Uses

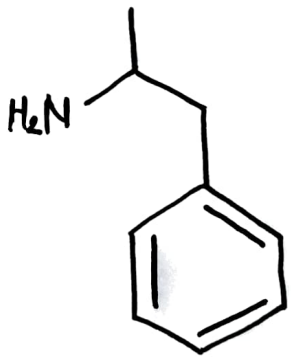
- As preservatives
- In cosmetics
- As antiseptics

⑤ Ethylene Diamene

Uses

- Formulation of fertilizers
- Used in various pharmaceuticals.
- synthesis of various chemicals.

⑥ Amphetamine



Uses

- Apetite supresant
- performance enhancer

THANK YOU

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