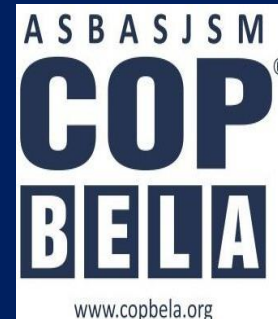




Amar Shaheed Baba Ajit Singh Jujhar Singh Memorial
COLLEGE OF PHARMACY
(An Autonomous College)
BELA (Ropar) Punjab



Name of Unit	Carboxylic acid & Amines
Subject /Course	Pharmaceutical Organic Chemistry-I
Subject/Course ID	BP202T
Class: B.Pharm.Semester	II
Course coordinator	Ms. Sukhwinder Kaur, Ms. Mandeep Kaur
Mobile No.	7888826881,8968246077
Email id	sukhwindersaini1611@gmail.com,mandeepkt95@gmail.com

Learning Outcome of Module 05

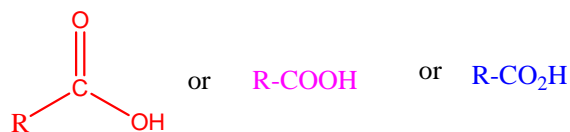
LO	Learning Outcome	Course Outcome Code
LO1	To understand the classification and nomenclature of Carboxylic acid and amines.	BP202.1
LO2	To gain the knowledge of structure of carboxylic acid and amines.	BP202.2
LO3	To gain the knowledge about identification tests.	BP202.3
LO4	To understand the properties of Carboxylic acid and amines.	BP202.4
LO5	To understand the acidic behaviour of Carboxylic acid	BP202.4
LO6	To gain the knowledge about basic behaviour of Amines	BP202.4
LO7	To gain knowledge about method of preparation of Carboxylic acid and amines.	BP202.4
LO8	Structure and medicinal uses of compounds	BP202.6

Content Table

Topic
<ul style="list-style-type: none">• Introduction of Carboxylic acid and amines• Structure of Carboxylic acid and amines• Nomenclature• Method of preparation• Properties(Physical and Chemical)• Qualitative test• Acidity and basicity• Structure and medicinal uses of some compounds.

CARBOXYLIC ACID

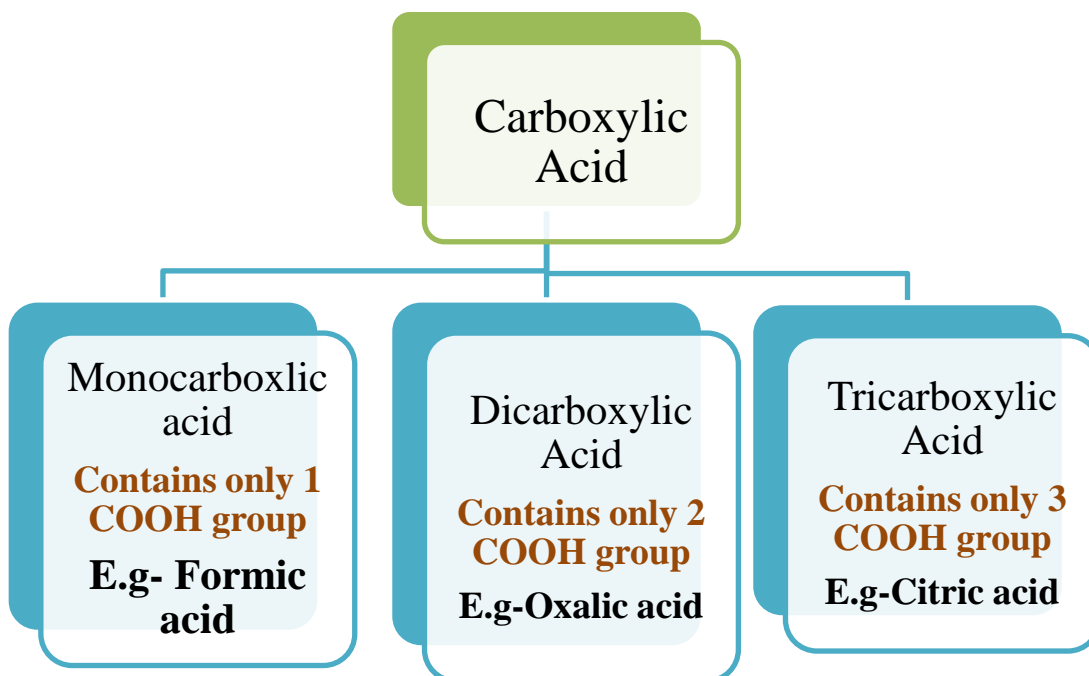
Organic compounds which contains the carboxyl functional group(-COOH) are called the carboxylic acid. The general formula of is



Where R=Alkyl

The name of carboxyl is derived from **CARBonyl** (C=O) and **hydroxyl** (-OH) because in the carboxyl group these two groups are directly bonded to each other. The properties of carboxyl groups are not simply those of carbonyl and hydroxyl groups combined, the two groups interact to give carboxylic acids their own distinctive properties.

CLASSIFICATION



NOMENCLATURE

There are three ways of naming carboxylic acids.

- 1. Common System-** The simple carboxylic acid are better known by their common name. The common names are derived from latin or Greek words that indicates the original source of acid. They do not follow any rule that all common names of acids end in -ic acid. For examples

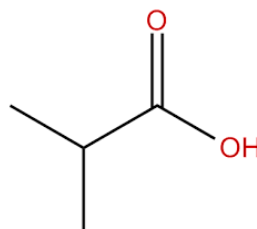
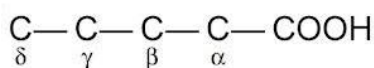
HCOOH – Formic acid

CH₃COOH- Acetic acid

CH₃CH₂COOH- Propionic acid

CH₃CH₂CH₂COOH-Butyric acid

In the common system Greek letters are used to indicate the position of substituent. The carbon atom adjacent to the carboxyl carbon is assigned the letter α the next carbon on the chain β , the next one γ and so on. For example



- 2. Derived System** – Some carboxylic acid may be named as substituted acetic acid. E.g-

(CH)₃CCOOH- Trimethyl acetic acid

C₆H₅CH₂COOH- Phenyl acetic acid

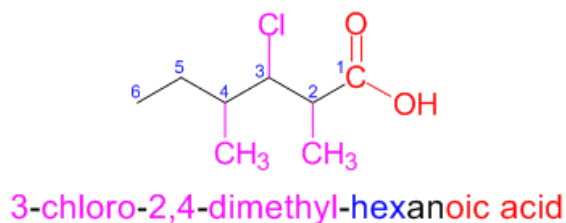
- 3. IUPAC System** – In the IUPAC system, the carboxylic acids are named **Alkanoic acids**. The systemic name of the individual acid is obtained by replacing the ending “e” of the corresponding alkanes by –oic acid. E.g

HCOOH- Methanoic acid

CH₃COOH- Ethanoic acid

CH₃CH₂COOH- Propanoic acid

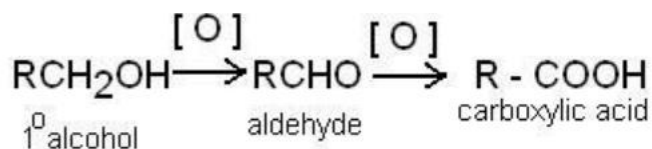
For naming higher members, the longest continuous chain containing the carboxyl group (-COOH) is selected. The number of carbon atom in this chain give the name of parent alkanes. The position of substituent is indicated by numbers. The carboxyl carbon is always given number 1, the carbon adjacent to it is given the number 2, and so on. E.g



METHOD OF PREPARTION

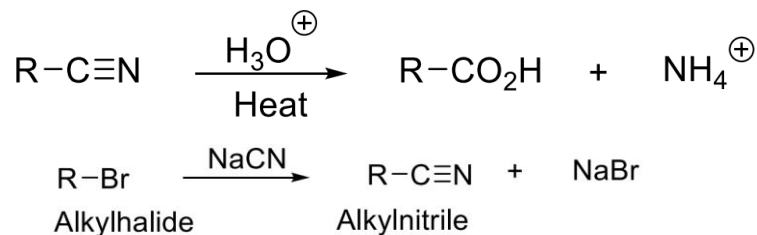
Carboxylic acids are prepared by the following methods.

- 1. Oxidation of Primary Alcohol or aldehyde** – Primary alcohols or aldehyde undergoes oxidation with a mixture of potassium dichromate and sulphuric acid to form carboxylic acid. The alcohol is first oxidized to an aldehyde, and then to a carboxylic acid.

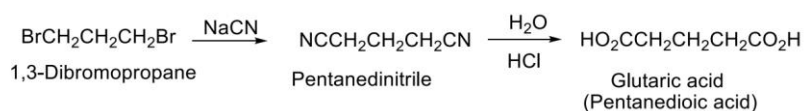


Potassium permanganate can also be used in place of potassium dichromate.

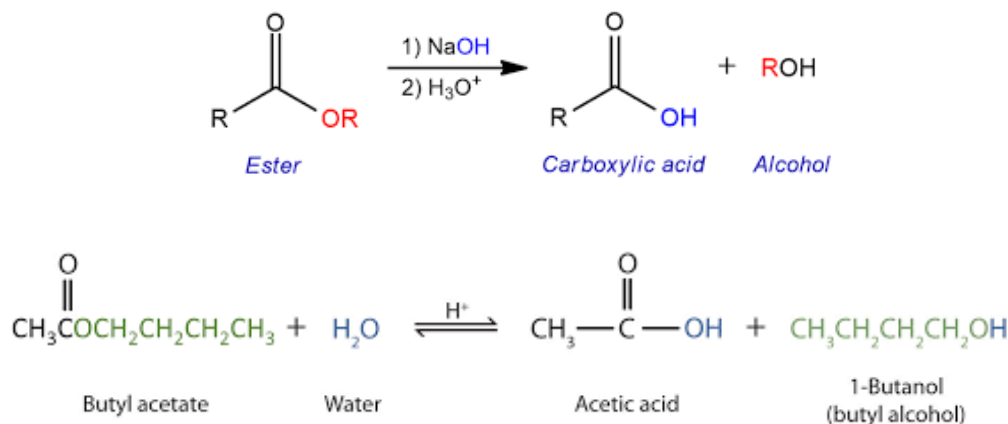
- 2. Hydrolysis of nitriles (Alkyl Cyanides)**- They are prepared by treating alkyl halides with sodium cyanide. The nitriles on acid hydrolysis forms carboxylic acids.



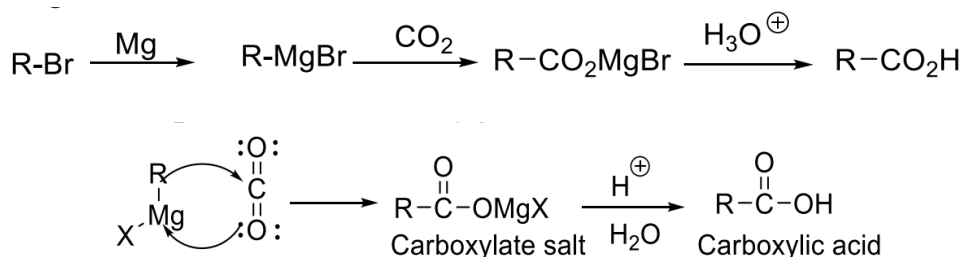
Example



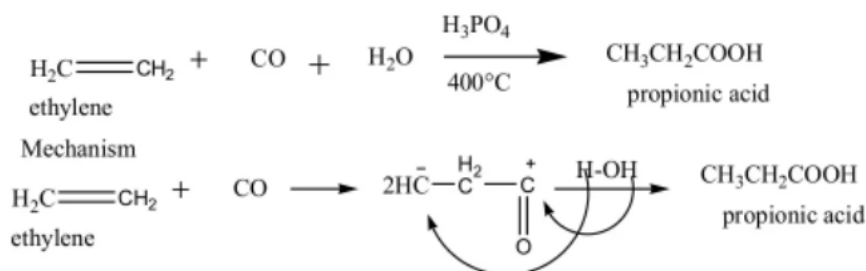
- 3. Hydrolysis of ester-** When an ester is boiled with concentrated aqueous NaOH, sodium salt of the acid is formed. This on treatment with dilute HCl gives the corresponding Carboxylic acid.



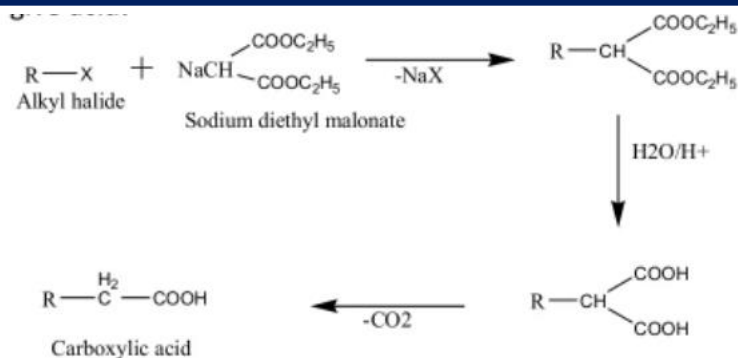
- 4. Reaction of Grignard reagent with CO₂-** Grignard reagent (RMgX) reacts with carbon dioxide to form addition products that can be hydrolysed to carboxylic acid.



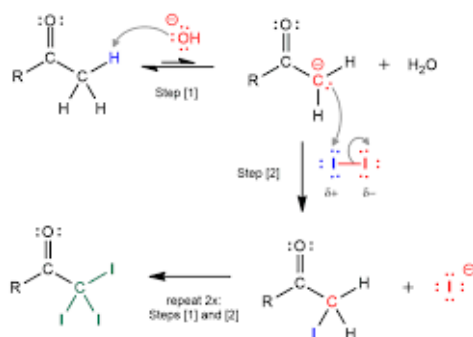
- 5. Carboxylation of Alkenes-** When an alkene is heated with CO and steam under pressure with phosphoric acid (H₃PO₄) at 400° C, the carboxylic acid is formed. This is a recent industrial method of making carboxylic acid and is called as **Koch Reaction**.



- 6. From Malonic Ester-** Alkyl halide treated with sodium derivative of diethyl malonate to give a substituted malonic ester and this on hydrolysis and decarboxylation to give acid.



- 7. Haloform reaction-** When a methyl ketone is halogenated in basic solution, the halogen replaces all three α -hydrogen atoms. This trihaloketone reacts further, resulting in the cleavage of a carbon-carbon bond. After acidification, the products are a carboxylic acid and a trihalomethane known as a haloform.



PHYSICAL PROPERTIES

1. Lower carboxylic acid (up to C_{10}) is liquid with sharp or disagreeable odors. Higher members are wax like solid and almost odorless.
2. Boiling point of carboxylic acid increase regularly with increase in molecular weight.
3. Melting point of carboxylic acids increase irregularly with increase of molecular weight. The 'even' members have markedly higher melting point than 'odd' members.
4. Boiling point of carboxylic acids are higher than those of alcohols of same molecular weight. This is attributed to hydrogen bonding between acid molecules..
5. First four members are completely soluble in water. This is due to the ability of carboxyl group to form hydrogen bond with water molecule. As the hydrocarbons chain lengthens, the solubility of acid in water falls out very rapidly. Carboxylic acids are readily soluble in ethanol.

ACIDITY OF CARBOXYLIC ACID

The most important chemical property of carboxylic acid is their acidic nature. In aqueous solution, carboxylic acid is partially ionized and an equilibrium exists between the ionized and unionized form. They can donate a proton and form a salt with base.



As for any equilibrium the concentration of the components are related by the expression.

$$K_{\text{eq}} = \frac{[\text{RCOO}^-][\text{H}_3\text{O}^+]}{[\text{H}_2\text{O}][\text{RCOOH}]}$$

Since the concentration of water remains constant, it can be combined with K_{eq} to obtain the expression.

$$K_a = \frac{[\text{RCOO}^-][\text{H}_3\text{O}^+]}{[\text{RCOOH}]}$$

$$K_a = K_{\text{eq}} [\text{H}_2\text{O}] . K_a \text{ is called as } \mathbf{acidity \ constant}.$$

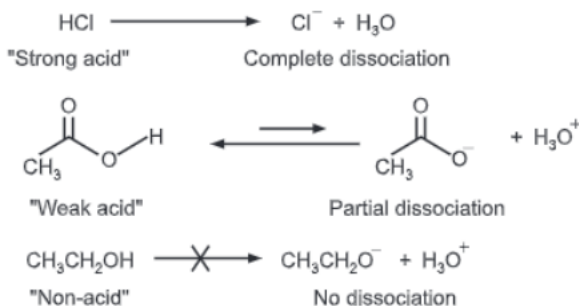
Acidity constant is defined as the concentration of product of ionization in moles per litre divided by the concentration of unionized acid. Since the acidity constant is the ratio of ionized to unionized acid, the larger the K_a the greater the extent of ionization and the stronger the acid. Stronger acids will have a higher numerical value of acidity constant.

High K_a	\implies	Strong acid
Low K_a	\implies	Weak acid

$$\text{p}K_a = -\log K_a$$

High $\text{p}K_a$	\implies	Weakening acidity
Low $\text{p}K_a$	\implies	Increasing acidity

Carboxylic acids are referred to as ‘**weak acids**’ because they partially dissociate in water.



Explanation of Acidity of Carboxylic acid

- In aqueous solution a carboxylic acid dissociates to give resonance stabilized carboxylate anion and hydronium ion. Carboxylic acid and Carboxylate ions both are stabilized by resonance two resonating structures can be drawn. Resonance is much more important between exactly equivalent structure.



- The stability of carboxylate ion can also be explained on the basis of its molecular orbital structure. The carbon atom of carboxylate ion is sp^2 hybridized. It is bound to each oxygen atom by a sigma bond. the unused carbon p orbital overlaps with p orbital of both oxygen atom to form stable delocalized molecular orbital.

EFFECT OF SUBSTITUENTS ON ACIDITY OF CARBOXYLIC ACID

- Effect of electron donating groups-** Electron releasing/donating group decrease the acidity of carboxylic acid. This is because electron donating groups intensify the negative charge on the oxygen atom and destabilized the carboxylate ion. Then the loss of proton became more difficult. As the size of alkyl group increase, acidity decrease.

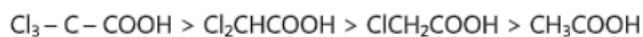
HCOOH	CH ₃ COOH	CH ₃ CH ₂ COOH
Formic acid	Acetic acid	Propionic acid
$K_a = 17.7 \times 10^{-5}$	$K_a = 1.76 \times 10^{-5}$	1.34×10^{-5}

2. Effect of electron withdrawing groups- The electron withdrawing groups increase the acidity of carboxylic acid as the electron withdrawing substituent decrease the negative charge on carboxylate ion and stabilize it. The loss of negative charge became easy.

E.g Chloroacetic acid is about 100 times stronger acid than the acetic acid. Fluoroacetic acid is more acidic than chloroacetic acid because fluorine is more electronegative than chlorine.



The electron withdrawing substituent such as halogen increase the acidity of carboxylic acid. Based on the inductive effect the strength of acidity decrease in the given order.



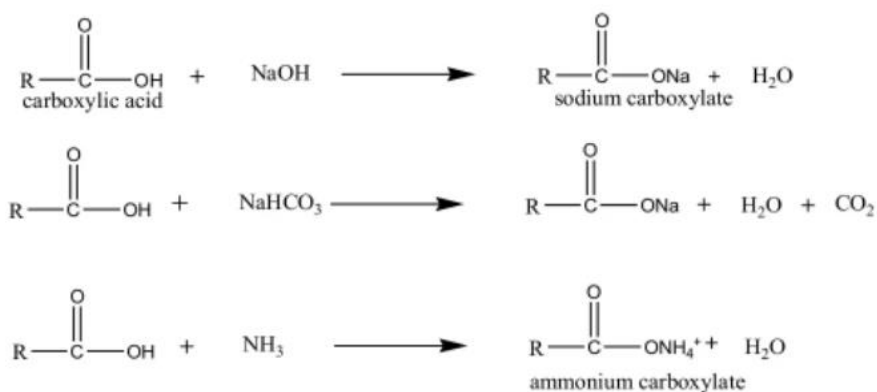
The inductive effect decrease as the distance between substituent and carboxyl group increase.



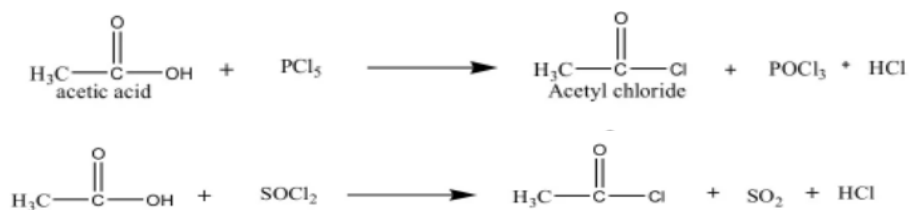
More the halogen group near to COOH group the more will be the acidity.

CHEMICAL PROPERTIES

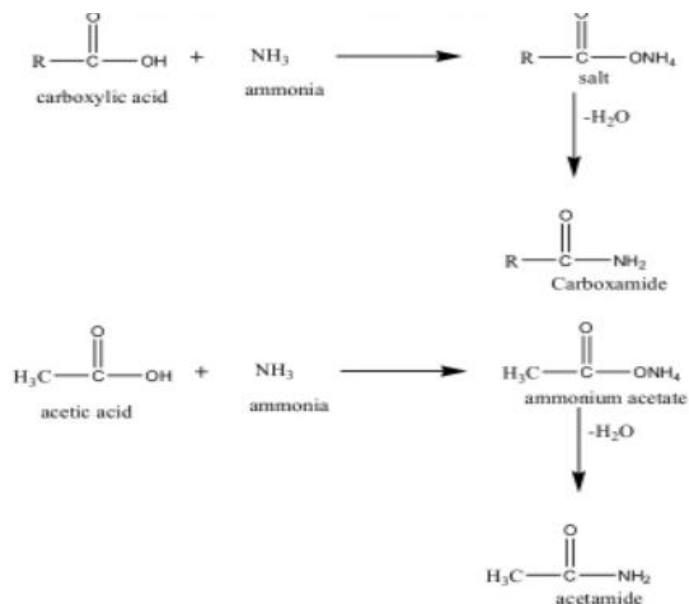
1. Salt formation-



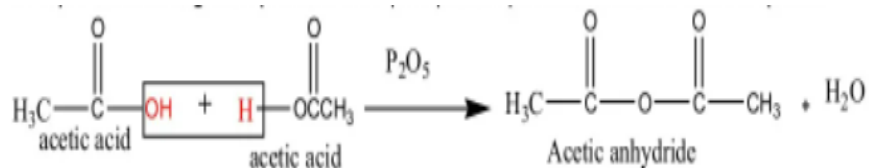
2. Formation of acyl halides



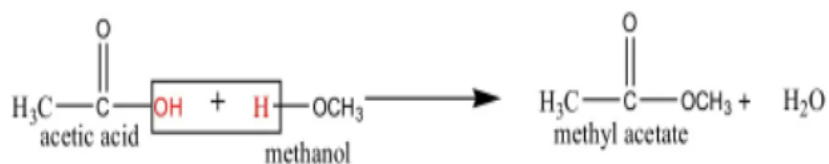
3. Formation of amides



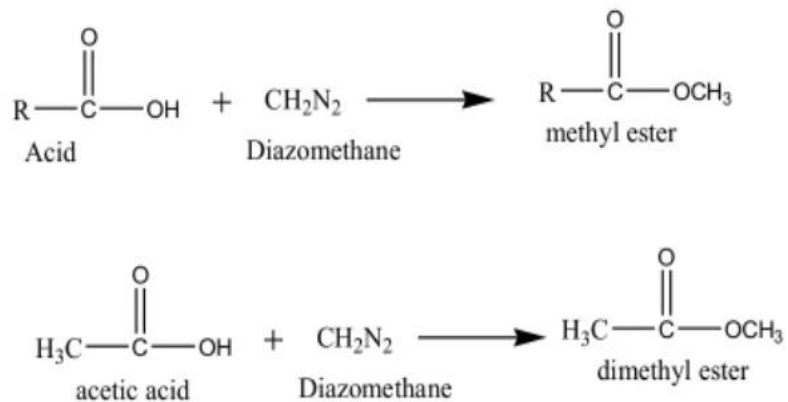
4. Formation of anhydride-



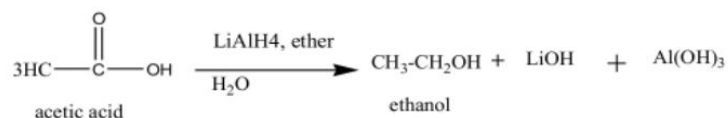
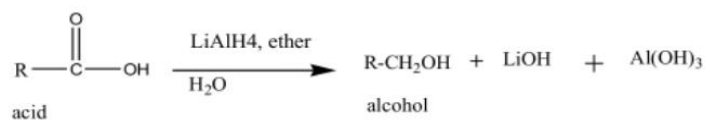
5. Formation of ester



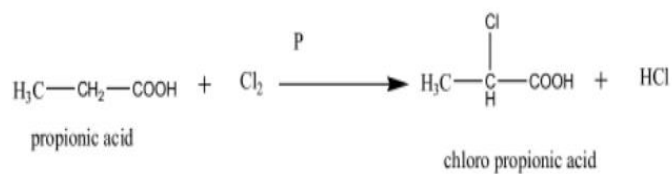
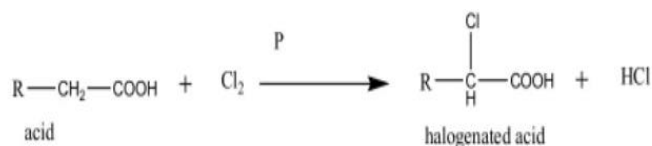
6. Esterification using diazomethane



7. Reduction with lithium aluminium hydride

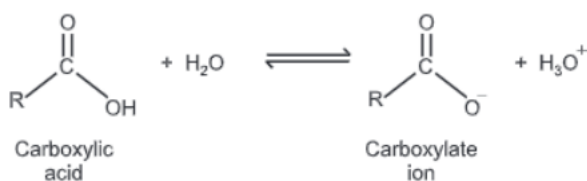


8. Alpha halogenation/Hell Volhard Zelinsky Reaction



QUALITATIVE TESTS OF CARBOXYLIC ACID

1. Litmus test- Carboxylic acid turns blue litmus red. The hydroxyl group of carboxyl is far more acidic than alcohol. The dissociation of carboxylic acid is represented as:



2.Sodium Bicarbonate test- Carboxylic acid on reaction with sodium bicarbonate to produce CO₂ which can be seen with brisk effervescence.



3.Ester test- Carboxylic acid react with alcohol in the presence of conc. Sulphuric acid to form ester that is identified by fruity smell.



QUALITATIVE TESTS FOR ESTER

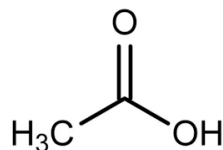
- 1. Hydroxamic acid test-** Substance+ alcoholic hydroxylamine hydrochloride solution+ NaOH, heat to boil, cool and neutralized by dil.HCl add 2-3 drops of FeCl₃ solution red violet colour develops.
- 2. Phenolphthalein test-** Substance + water +1 drop of phenolphthalein+ very dil. NaOH till pink colour persists . Pink colour disappears after heating.

QUALITATIVE TESTS FOR AMIDES

- 1. Litmus test-** Amide shows no colour change for litmus. It shows the presence of neutral substances.
- 2. Alkaline hydrolysis test-** Amide reacts with NaOH, there is evolution of NH₃ which turns turmeric paper red.

STRUCTURE AND USES OF COMPOUNDS.

ACETIC ACID

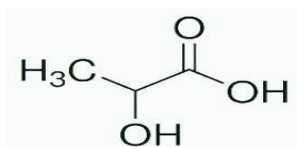


USES

1. Acetic acid is used as vinegar.
2. It is used as eardrop to treat infection of the ear canal. It is generally used with an ear wick.
3. In the form of gel it is used to adjust the pH of vagina.
4. It is used to produce vinyl acetate monomer which is used to make paints, adhesives, packaging etc.
5. It is used in production of cellulose acetate films that is used in photography.

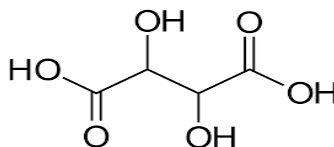
6. It is used in the production of ester like ethyl acetate and isobutyl acetate. These esters are used in inks, paints and coating.
7. It is used as coagulant in the production of rubber.
8. It is used as solvent.
9. It is used in manufacturing of rayon fibers.
10. It is used in manufacturing of various dye stuffs and perfumes.

LACTIC ACID



1. It is used in topical preparation and cosmetics to adjust acidity and has disinfect and keratolytic properties.
2. It is used in Pharmaceutical technology to produce water soluble lactates.
3. It is present in sour milk product.
4. The casein in fermented milk is coagulated by lactic acid. It is also present in sour bear.
5. It is also used as food additives, food preservatives, curing agent and flavouring agent. It is also used as a decontaminat during meat processing.
6. It is used as descaler , soap scum remover and as a antibacterial agent. It is environmental safe and natural agent do not cause any side effect.
7. It is used as mosquito attractant.
8. It is also used in treatment of facial dermatosis and in prevention of dermatitis.

TARTARIC ACID

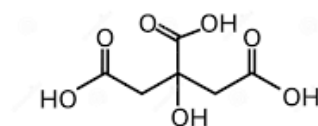


USES

1. Tartaric acid has natural sour taste and when added to food it gives sharp, tart flavour. It is used to set gel and to preserve foods.

2. Sometime it is added to product like carbonate beverages, fruit jellies etc.
3. It is an ingredient in the cream of tartar.
4. It is used in the gold and silver plating process, cleaning and polishing metals, tanning leathers and making blue ink for blueprints.
5. Ester derivatives of tartaric acid is used in dyeing fabrics.
6. It is used as an ingredient in Rochelle salts, which react with silver nitrate to create the silvering on mirrors.
7. It is a good source of antioxidants that protect our body from various disease in long run.
8. It helps to prevent flatulence and used as an aids the digestion.
9. It is used to make solutions for the determination of glucose.
10. It also improve intestinal absorption and hence increase the rate at which nutrients flow into blood stream.

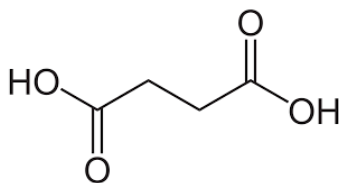
CITRIC ACID



USES

1. Citric acid is an excellent chelating agent, bind with metals and make them soluble.
2. It is used to remove the build up of lime scale from boiler and evaporators.
3. It has powerful cleansing property in so it is active ingredient in bathroom and kitchen cleaning solution.
4. It is used for flavours and as preservatives in food and beverages, soft drinks.
5. It has a buffering property so used to control pH in pharmaceuticals.
6. It is used as emulsifying agent in ice creams.
7. It is used in effervescent powders and tablets for ingestion.
8. It is used as an acidulent in creams, gels and liquids. It is used as active ingredient in chemical peels.
9. It is odorless alternative to white vinegar for home dyeing.
10. It is used as processing aid in food and dietary supplements.

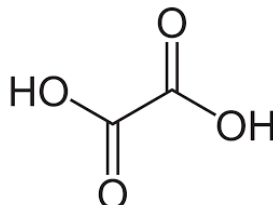
SUCCINIC ACID



USES

1. It is generally safe as food additive and dietary supplement.
2. It is used as an astringent.
3. It is used as precursor for to some polymers, and resins.
4. It is used as base for biodegradable polymers.
5. It is used in preparation of vitamin A, and in different medicines.
6. During seed treatment it is used to promote germination.
7. It is used as root stimulator and has soil chelating properties.
8. It is used as adhesive, corrosion inhibitors and for coating different powders.
9. It is main components of various depilatories preparation.
10. It is used in perfumery and pharmaceutical industries.

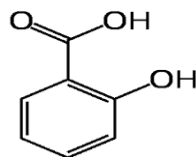
OXALIC ACID



USES

1. Oxalic acid is used as cleaning and bleaching agent. It forms a stable water soluble salt with ferric ion that is why it is used in rust removal agent.
2. It is an important reagent in lanthanide chemistry.
3. It is used in mineral processing mechanisms.
4. It is used as precipitating agent for recovering several rare earth metal.
5. It is used as reactant in synthesis of various pharmaceutical reactions.
6. It is used as pickling agent in leather industries.
7. It is used as protective agent against incrustation and crusts.

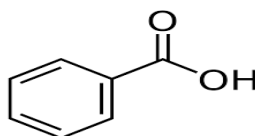
SALICYLIC ACID



USES

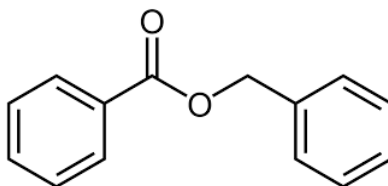
1. It is used as medication to remove the outer layer of the skin.
2. It is used to treat warts, psoriasis, dandruff, acne and itches.
3. It is used as key ingredients in many skin care products.
4. It is used in preparation of aspirin and various pharmaceutical preparation.
5. It is used as bactericidal and as an antiseptic.
6. It also acts as an antacid.
7. It is used to relieve the pain of mouth ulcers.

BENZOIC ACID



1. It is used in production of various chemicals.
2. It is used as an antifungal agent in ointments to treat athlete foot and ring worms.
3. Benzoic acid also has expectorant, analgesic and antiseptic properties.
4. It is the main ingredient of tincture.
5. It is used as preservatives.
6. It is used as precursor for the plasticizers.

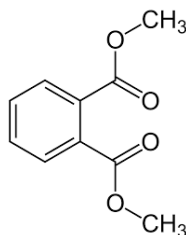
BENZOYL BENZOATE



USES

1. It is used for topical treatment of human scabies.
2. It is an excipient in some testosterone replacement medicines.
3. It is also present in many asthma and whooping cough drugs.
4. It is used in cosmetic preparation.
5. It is used as a mosquitoes and ticks repellent.
6. It is used as a solvent for cellulose derivatives, plasticizers in perfume industries.

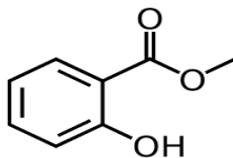
DIMETHYL PHTHALATE



USES

1. It is used as antiparasitic drug.
2. It is used as an insect repellent.
3. It is used as plasticizer, solvent and fragrance ingredient in wide variety of cosmetics.
4. It is also used as camphor substitute.
5. It is used as carrier for various substitutes.

METHYL SALICYLATE

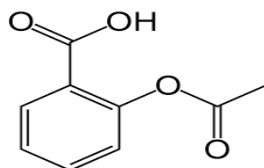


USES

1. It is used as rubefacient.
2. It is used as flavouring agent.
3. It is used as antiseptic in Listerine mouthwash.

4. It exhibit antifungal property.
5. It is used to relief aches and pain caused by backache, arthritis, sprains and strains.

ACETYL SALICYLIC ACID



USES

1. It is used as pain reliever.
2. It is used as Anti-inflammatory agent.
3. It is use in combination with other Cardiovascular drugs in treatment of stroke.
4. It is used to inhibit platelet aggregation.
5. It is used in treatment of coronary artery disease and in treatment of Myocardial infarction.

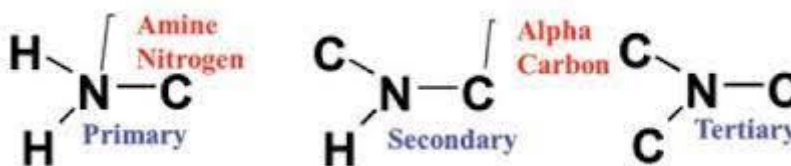
AMINES

Derivative of ammonia in which one or more hydrogen of atom have been replaced by alkyl group. E.g- Methylamine, ethylamine and trimethylamine.

CLASSIFICATION

Amines are classified into three categories.

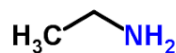
1. Primary Amines- A primary amine has one alkyl group replaced
2. Secondary amines.
3. Tertiary amine.



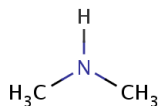
NOMENCLATURE

The following rules are applied in naming amines:

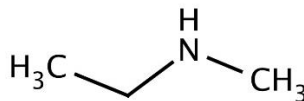
1. Amines are named by naming the alkyl groups attached to the nitrogen atom followed by the ending -amine. Notice that the names are written as one word.



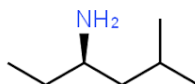
2. When two or three identical alkyl groups are attached to the nitrogen atom, the prefix di- or tri- is added to the name of the amine.



3. When two or three different alkyl groups are attached to the nitrogen atom, they are named in alphabetical order.



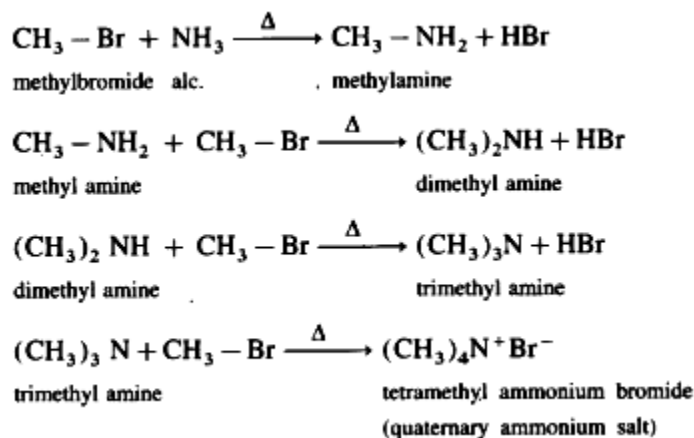
4. If the amines are too complex, the IUPAC system of nomenclature is used. In this system the amino group is considered as a substituent, and its position on the chain is indicated by the lowest possible number. E.g-5-Methyl-3-aminohexane



METHOD OF PREPARATION

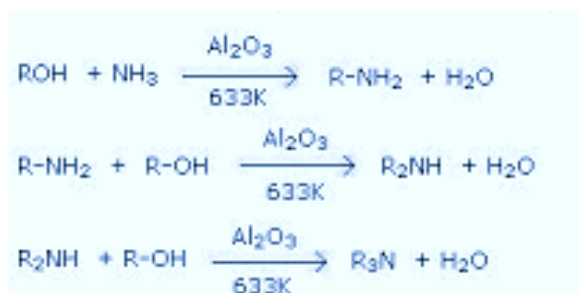
METHOD YIELDING MIXTURE OF AMINE

1. **Reaction of alkyl halide with ammonia** – Amines can be prepared by heating an alkyl halide with alcoholic ammonia in a sealed tube. A mixture of primary, secondary and tertiary amine and quaternary ammonium salt is obtained.



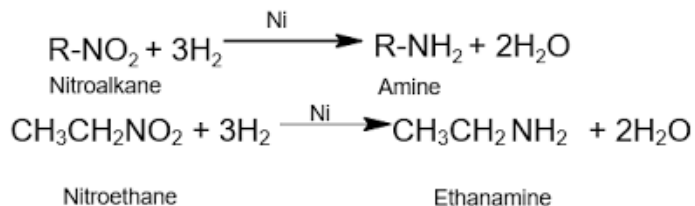
Thus in actual practice, the resulting mixture consists of different amine salts and the quaternary ammonium salt. This is not suitable for laboratory synthesis because the mixture is often difficult to separate. On industrial scale the mixture is separated by adding alkali to liberate the free amines and fractional distilling.

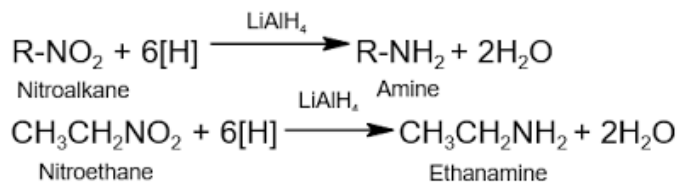
- 2. Reaction of alcohol with ammonia** - Amines can be prepared by passing the vapour of alcohol and ammonia is heated over alumina at 400°C. A mixture of primary, secondary and tertiary amine is produced.



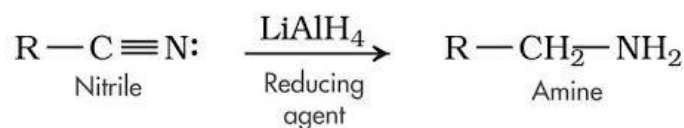
METHOD OF PREPARATION OF PRIMARY AMINE

- 1. Reduction of nitroalkanes-** Primary amines can be obtained by reduction of nitroalkanes with H_2 + Pt or lithium aluminium hydride.

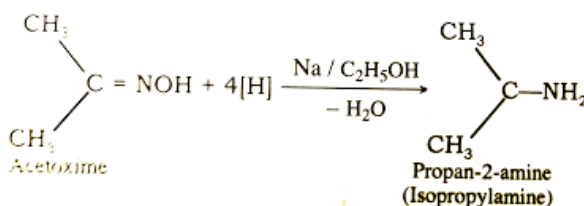




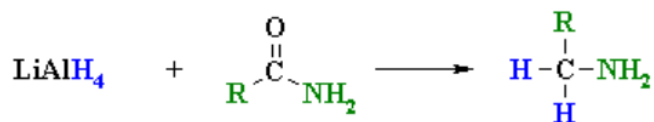
2.Reduction of nitriles – Primary amines can be prepared by reduction of nitriles with $\text{H}_2 + \text{Ni}$ or lithium aluminiumhydride.



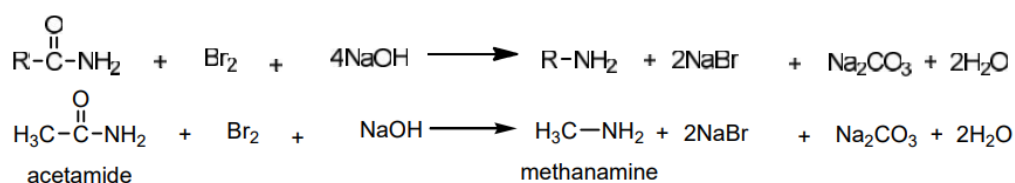
3.Reduction of oxime- Primary amines may be obtained by reduction of oximes of aldehyde and ketones with lithium aluminium hydride. Other reducing agent used at the place of lithium aluminium hydride are $\text{H}_2 + \text{Ni}$ and $\text{Na} + \text{C}_2\text{H}_5\text{OH}$.



4.Reduction of Amides- Primary amine can be obtained by reduction of simple amide.

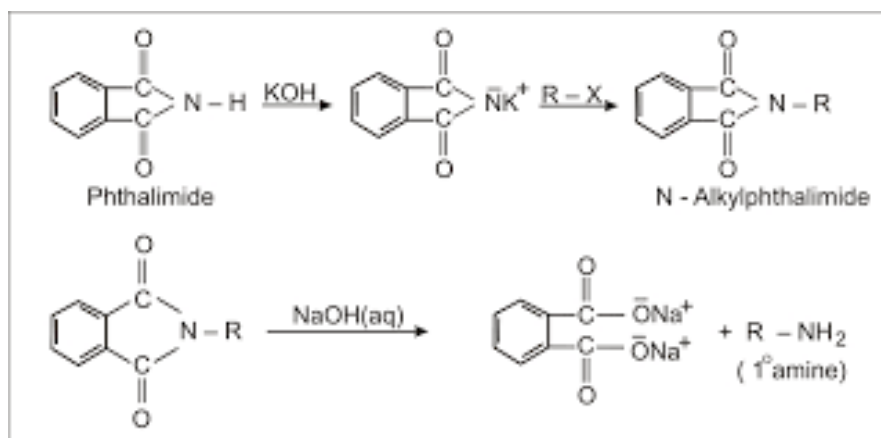


5.Hoffman's degradation of amides- This is a good laboratory method for conversion of an amide to a pure primary amine. The amide is warmed with bromine and concentrated aqueous NaOH solution.

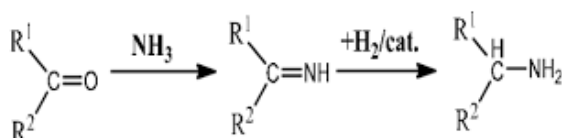


This reaction is also called **Hofmann's rearrangement**. Notice that the overall result is the removal of the carbonyl groups from amide. The product contains one carbon less than the original amide.

6. Gabriel Phthalimide Method- This involves the treatment of phthalimide with potassium hydroxide to form the potassium salt. The salt is then heated with an alkyl halide to give n-alkylphthalimide, which in turn react with NaOH to form sodium Phthalate salt and a pure primary amine.

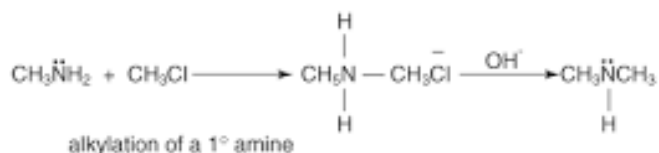


7.Reductive amination of Aldehyde and ketone – Primary amines may be obtained by passing aldehyde and ketone, hydrogen and ammonia over nickel catalyst at high temperature. The reaction probably goes through the formation of amine.

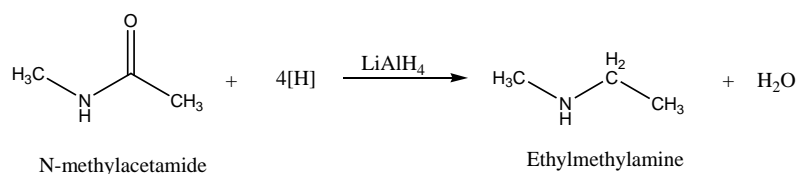


METHOD FOR SECONDARY AMINES

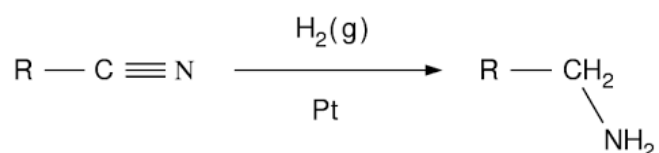
Reduction of Primary amines with alkyl halide- When a primary amine is heated with an alkyl halide, a dialkylammonium salt is formed. This when treated with NaOH solution yields the free secondary amine.



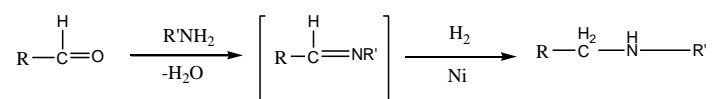
Reaction of N-substituted Amide- Secondary amines can be obtained by reduction of N-substituted amides with lithium aluminium hydride.



Reduction of Isonitriles- Secondary amines may be obtained by reduction of isonitriles with H_2 + Pt. Notice that the secondary amines produced by this method will always have one $-\text{CH}_3$ group.

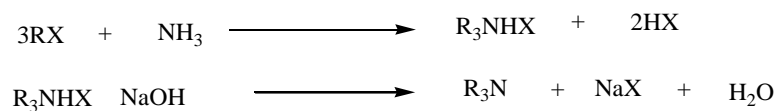


Reductive Amination of Aldehyde and ketones- Secondary amines may be obtained by passing aldehyde or ketone, hydrogen, and RNH_2 over nickel catalyst at high temperature.

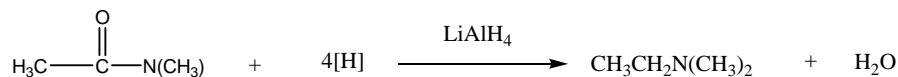


METHOD OF TERTIARY AMINES

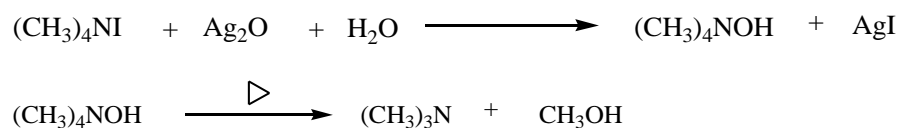
1. Reaction of Alkyl halide with Ammonia- When an alcoholic ammonia solution is heated with an excess of alkyl halide, a trialkylammonium halide is formed. This when treated with NaOH solution gives the free tertiary amine.



- 2. Reduction of N,N-disubstituted Amides** – Tertiary amines may be obtained by reduction of N,N-disubstituted amides with lithium aluminium hydride.

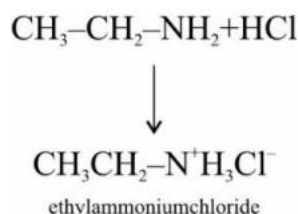


- 3. Decomposition of Tetraalkylammonium Hydroxide-** Tertiary amines may be obtained by strongly heating tetraalkylammonium hydroxide. The hydroxide are prepared by treating the corresponding tetraalkylammonium iodide with moist silver oxide.

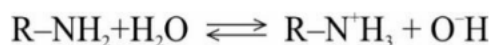


BASICITY OF AMINES

Amines are basic in nature. This is because they possess an unshared pair of electron on nitrogen. This lone pair of electron is available for the formation of a new bond with a proton or lewis acid. Thus, amnes react with acids to form salt.



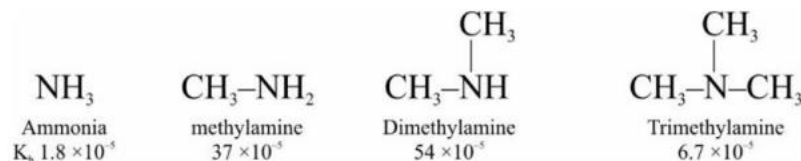
Strong bases (e.g. NaOH or KOH) completely ionise in aqueous solution. Amines are weak bases. They are only partially ionised in aqueous solution and the equilibrium exists between the ionised and un-ionised forms.



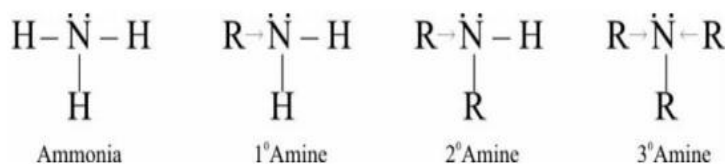
The extent of ionisation is described by an equilibrium constant Kb, which is known as Basicity constant. It is defined as the concentration of the products of ionisation in moles per litre divided by the concentration of the un-ionised base.

$$K_b = \frac{[RNH_3^+][OH^-]}{[RNH_2]}$$

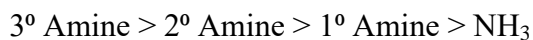
The basicity constant describes the relative strength of a weak base. Stronger bases have higher numerical values of basicity constants.



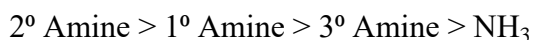
Aliphatic amines are stronger bases than ammonia. This is due to the presence of alkyl groups because we know that the alkyl groups are electron donating groups. As a result, electron density on the nitrogen atom increases and thus they donate a lone pair of electrons more easily than ammonia.



On the basis of the electron donating inductive effect of the alkyl groups, the order of expected basicity of amines are



However, the actual order of basicity is

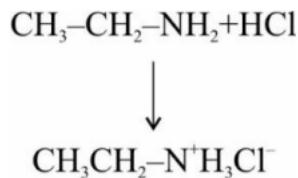


Dimethylamine is a stronger base than methylamine. However, trimethylamine is a weaker base than both dimethylamine and methylamine. Although in trimethylamine the electron density is further increased, the steric crowding of three methyl groups makes the approach and bonding by a proton relatively difficult. The electrons are there but the path is blocked.

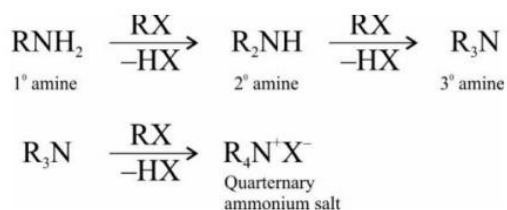
CHEMICAL PROPERTIES

The main reactions of amines are due to the presence of the lone pair of electrons on nitrogen. This lone pair of electron is available for donation to electron seeking reagents. Amines are nucleophilic reagents.

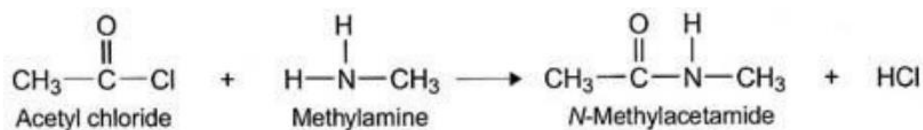
1. Salt formation – Amines are basic compounds. They react with mineral acids to form salt.



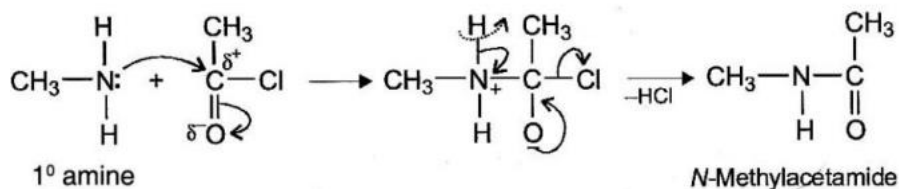
2. Reaction with alkyl halide – When an amine is treated with alkyl halide, hydrogen atoms are successively replaced by alkyl groups. In the final step, the tertiary amine adds one molecule of alkyl halide to yield quaternary ammonium salt.



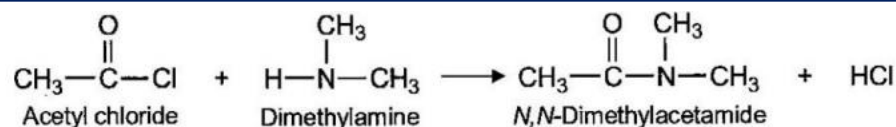
3. Reaction with acid chloride(Acylation)- Primary amine react with acid chlorides or acid anhydride to form N-substituted amide



- (a) Mechanism involves the nucleophilic attack by the amine on the electrophilic carbon.



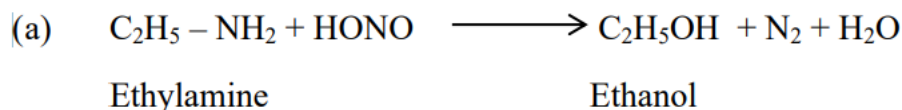
- (b) Secondary amines react with acid chlorides to form N,N- disubstituted–amides



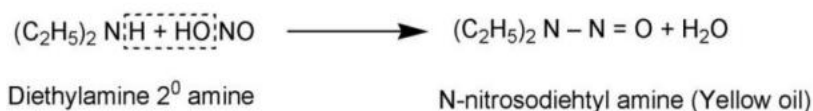
(c) Tertiary amines do not react since they do not have replacable hydrogen atoms.

4. Reaction with Nitrous acid-

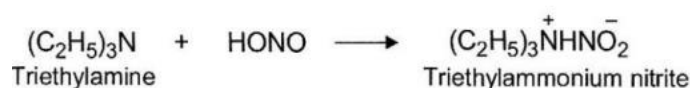
Primary amine reacts with HNO₂ to form alcohol and N₂ gas.



(b) Secondary amine reacts with nitrous acid to form N- nitrosoamine.



Tertiary amines react with nitrous acid to form trialkylammonium nitrite salts which are soluble in water.



This reaction is used as the basis of a test to distinguish between 1⁰, 2⁰, 3⁰ amines and is known as **Nitrous Acid Test**.

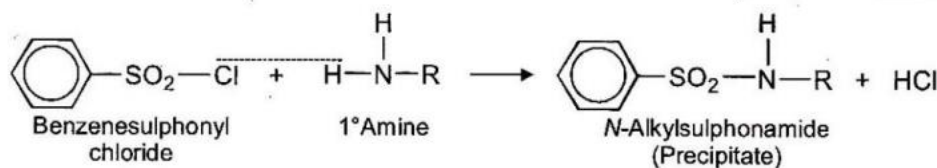
(i) 1⁰ Amine reacts with HNO₂ to produce nitrogen gas (as bubbles)

(ii) 2⁰ Amine reacts with HNO₂ to produce a yellow oil layer.

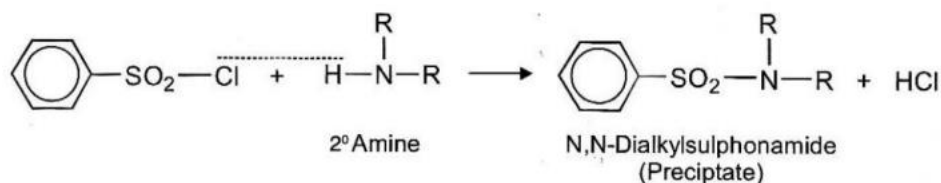
(iii) 3⁰ Amine reacts with HNO₂ to form soluble nitrile salt. (Not visible)

5. Reaction with Benzenesulphonyl Chloride (Sulphonylation)

(a) Primary amines react with benzene sulphonylchloride to form N- alkyl-sulphonamide.



(b) Secondary amines react with benzenesulphonyl chloride to form N,N-dialkylbenzene sulphonamide.



(c) Tertiary amines do not react since they do not possess a replaceable hydrogen atom.

These reactions are used to distinguish between Primary, secondary and tertiary amines. This test is known as **Hinsberg Test**.

(a) Primary amines react with benzenesulphonylchloride to form a precipitate that is soluble in NaOH.

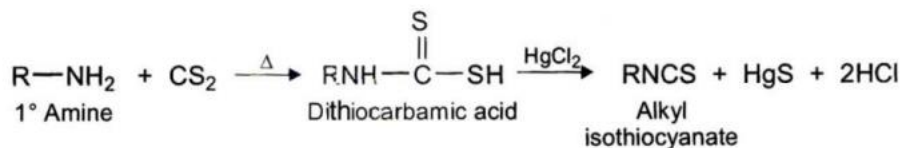
(b) Secondary amines react with benzenesulphonylchloride to form a precipitate that is insoluble in NaOH.

(c) Tertiary amines do not react with benzenesulphonylchloride.

6. Carbylamine reaction- Primary amines react with chloroform and alcoholic KOH solution to form isocyanides (isonitriles or carbylamines).



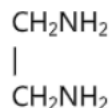
7. Reaction with Carbondisulphide-



Primary amines react with CS₂ to form a dithiocarbamic acids. Dithiocarbamic acids undergo decomposition with mercurichloride to give the corresponding alkyl isothiocyanate

STRUCTURE AND USES OF COMPOUNDS

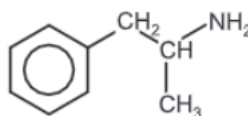
1. ETHYLENEDIAMINE



USES

1. Ethylenediamine is used in large quantities for production of many industrial chemicals.
2. Ethylenediamine is approved for use within allergenic epicutaneous patch tests which are indicated for use as an aid in the diagnosis of allergic contact dermatitis (ACD).
3. It is also used as an excipient in many pharmacological preparations such as creams, bronchodilators.

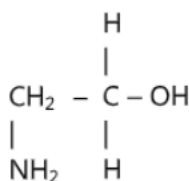
2. AMPHETAMINE



USES

1. It is used in nasal spray to shrink the mucous membrane.
2. Amphetamine is a central nervous system stimulant that affects chemicals in the brain and nerves that contribute to hyperactivity and impulse control.
3. Amphetamine is used to treat attention deficit hyperactivity disorder (ADHD).

3. ETHANOLAMINE



USES

1. Ethanolamine is a drug is used to help prevent bleeding of esophageal varices (abnormally enlarged veins in the esophagus).
2. Ethanolamine has several important industrial uses: as a “scrubber” to remove carbon dioxide, hydrogen sulfide, and other acidic pollutants from waste gas streams.
3. as a starting material for manufacturing surfactants, chelating agents, and even pharmaceuticals; as an agent for softening leather.

QUESTION (2 MARKS)

1. Define carboxylic acids.
2. Give the classification of amines with example.
3. Name the test used to differentiate primary, secondary and tertiary amines.
4. Write the carbylamine reaction.
5. Define Hinsberg test.
6. Give the identification tests for COOH.
7. How will you separate a mixture of primary, secondary and tertiary amines.
8. What is Koch reaction.
9. Why aliphatic amines are more basic than aromatic amines?
10. Give the structure and uses of Benzoic acid and Amphetamine.

MARKS QUESTION (5 OR 10)

1. Explain the acidity of Carboxylic acid.
2. Give the method of preparation of Carboxylic acid.
3. Explain in detail the identification tests of Acid and amines.
4. Elaborate in detail the basicity of Amines.
5. Write different chemical reactions of Carboxylic acid.
6. Write the method of preparation of primary and secondary amines
7. Explain in detail Nitrous acid test and Hinsberg test.
8. Enlist various chemical properties of Amines.
9. Write a note on method of preparation, chemical properties and classification of Amines.
10. Explain the nomenclature of both carboxylic acid and amines.