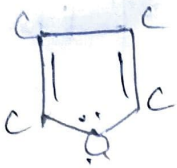
12/2/2021 UNIT-II Heterocyclic Comp

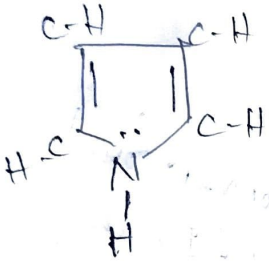
 - Benzene (Homocyclic compound)

Furan - C_4H_4O

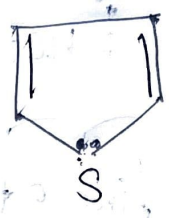
 → Heterocyclic compound.

pyrrole - C_4H_5N

C_4H_4NH

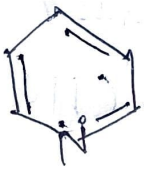


Thiophene C_4H_4S



pyridine

C_5H_5N - 6 member ring



Heterocyclic / Homocyclic

Cyclic compound in which ring includes one type of atoms are called homocyclic compounds

Eg: Benzene

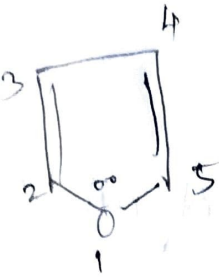
Cyclic compound in which ring includes in addition to C-atom one or more polyvalent atoms (O, N and S) are called heterocyclic compounds.

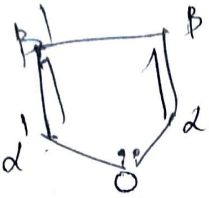
Eg: Furan, Thiophene, pyrrole, pyridine.

Furan C_4H_4O

FURAN - C_4H_4O

OMSGAP





COOH – COOH oxalic acid

CH_2 ← Malic acid

$(CH_2)_2$ ← Succinic acid

$(CH_2)_3$ ← Glutaric acid

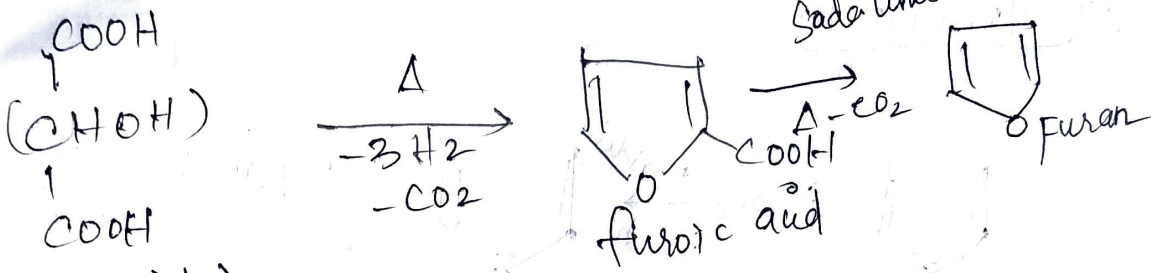
$(CH_2)_4$ ← Adipic acid

$(CHOH)_2$ ← Tartaric acid

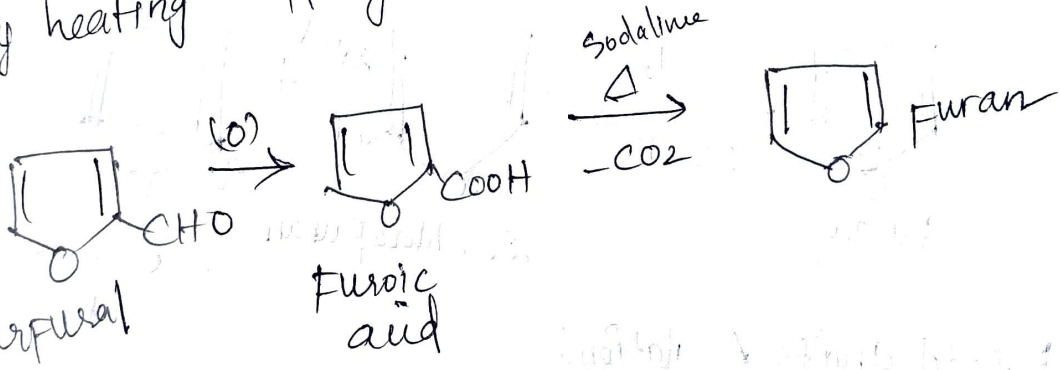
Preparation:

→ Mucic acid is heated we get furoic acid

→ It is distilled with sodalime we get furan



→ When furfural undergoes oxidation and followed by heating it gives furan.



Properties:

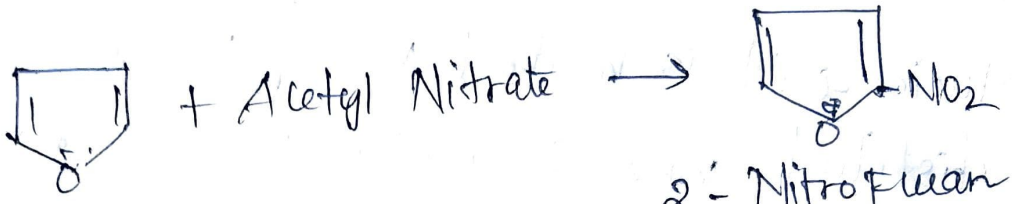
Physical properties:

1) It is colourless liquid
2) It is insoluble in water but soluble in alcohol and ether.

3) It turns pine splint moistant with HCl green.

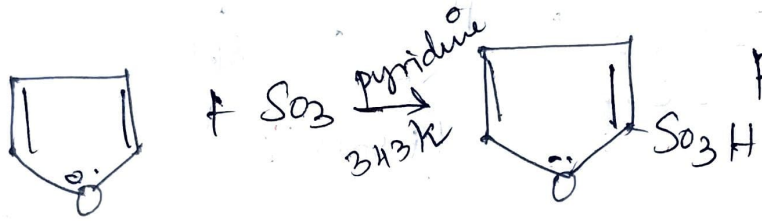
2) Reactions:

1) Nitration: Furan reacts with acetyl nitrate gives Nitrofuran



2-Nitrofuran

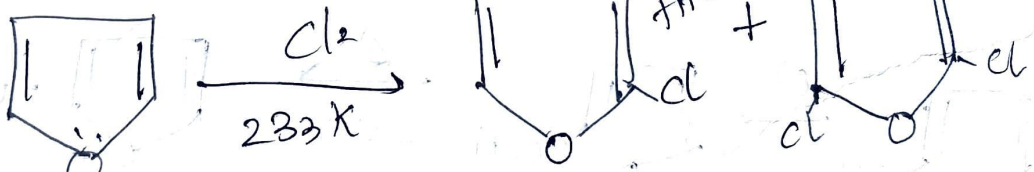
2) Sulphonation:



Furan-2-Sulphonic acid

16/02/2021

3) Halogenation:

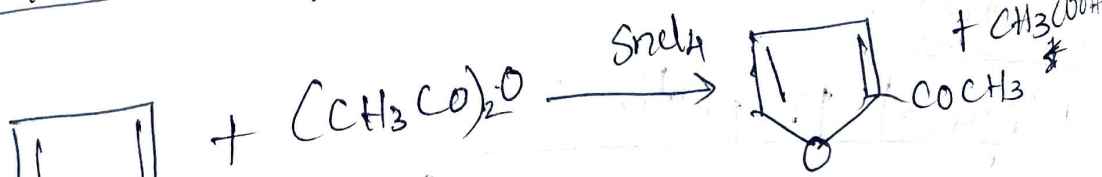


Furan

2-chloro Furan

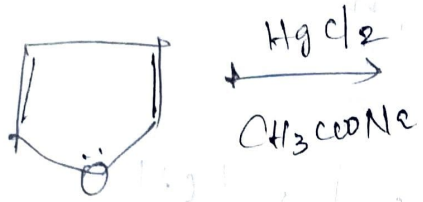
2,5-dichloro Furan

4) Friedel Crafts Acylation:



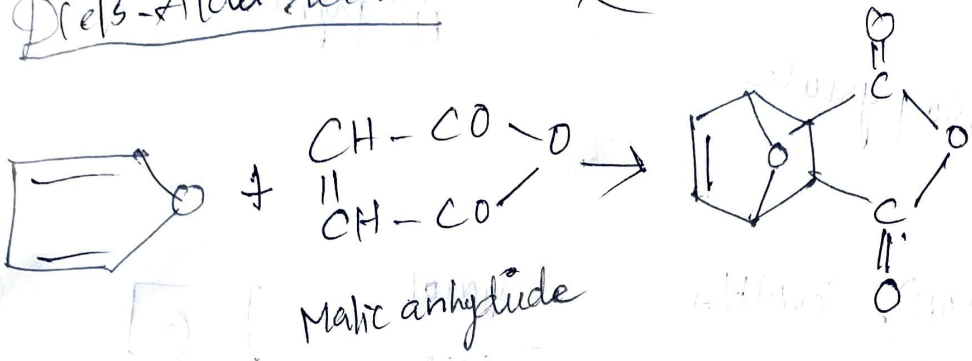
2-acetyl Furan

5) Mercuration:



2-chloromercury Furan

6) Diel's-Alder reaction: (Alder-adduct-addition)

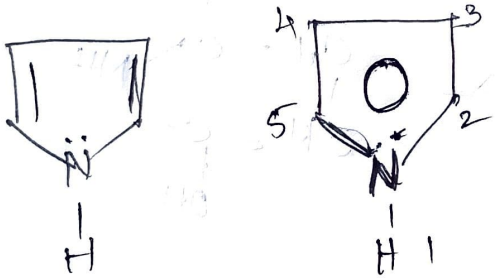


Malic anhydride

Dields Alder adduct

PYRROLE - C_4H_4NH

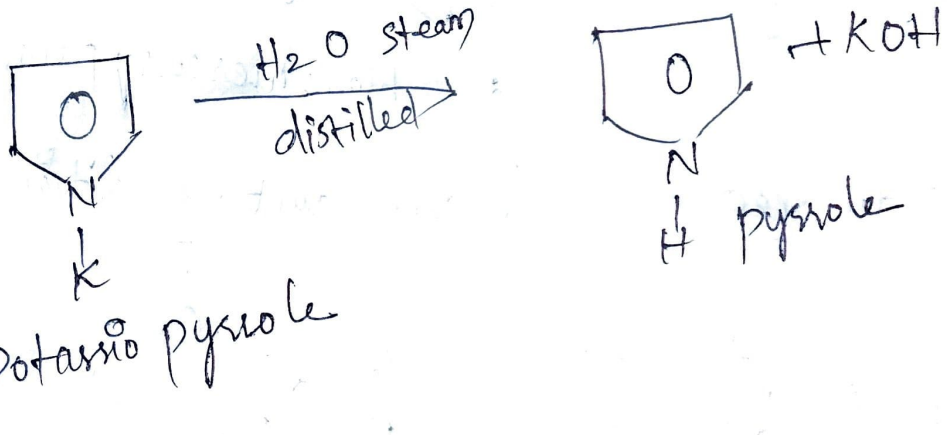
Structure:



Preparation:

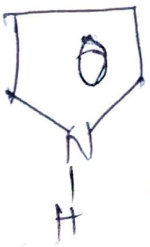
1) Isolation from Bone oil. Bone oil is first washed with dilute alkali to remove acidic impurities and then with acid to remove basic impurities like pyridine. The liquid is then fractionated. Pyrrole distills over in a fraction boiling between 373 K and 423 K. This may be purified by potassium hydroxide.

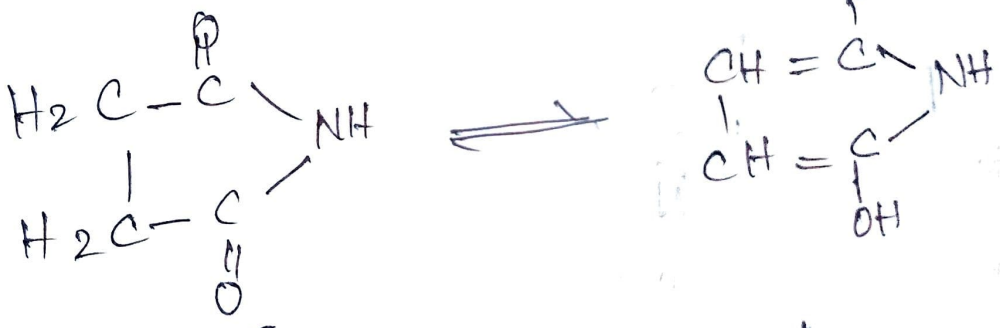
Solid potassio pyrrole is formed. This on steam distillation gives pure pyrrole.



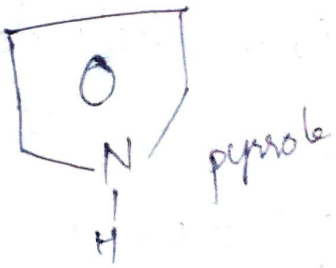
2) $(CHOH)_2COONH_4$
$(CHOH)_2COONH_4$
Ammonium mucate

Glycol
distilled
−200 C
$-2CO_2$
$-NH_3$
$-H_2O$



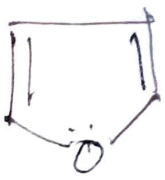
3) 
Succinimide

zinc dust



4) $2\ CH \equiv CH + NH_3 \longrightarrow$

Acetylene — Ammonia

5) 

Furan

$\xrightarrow[Al_2O_3]{NH_3}$

$+H_2O$

pyrrole

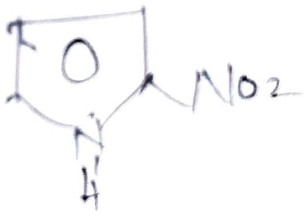
Properties:

1) It is a colourless liquid.
2) It is sparingly soluble in water & readily soluble in alcohol and ether (solvent)

Reactions:

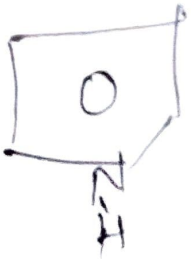
1) Nitration:

$\xrightarrow{HNO_3}$



2- Nitropyrrole

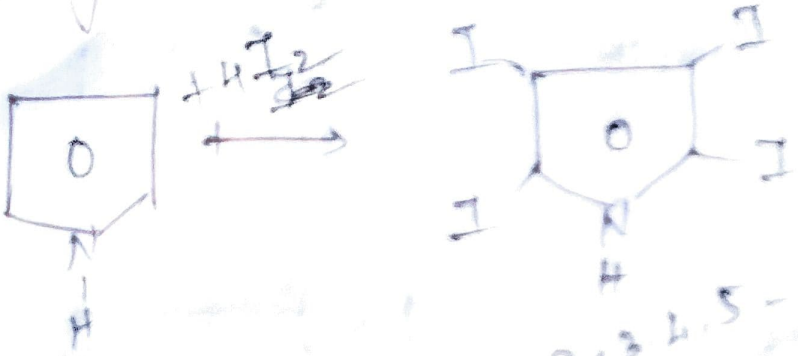
2) Sulphonation:



$\xrightarrow{SO_3}$

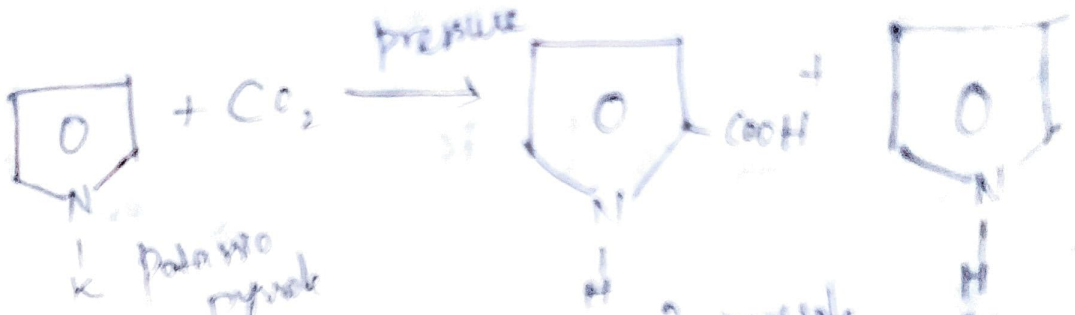
pyrrole-2-sulphonic acid

3) Halogenation:



2,3,4,5 - Tetraiodopyrrole

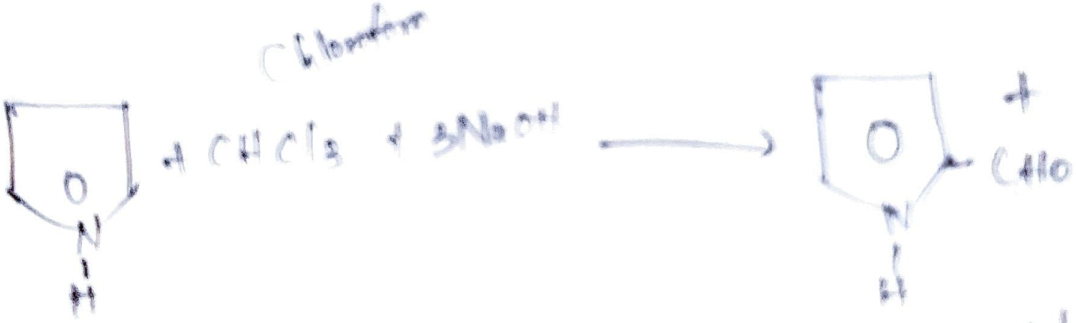
4) Kolbe's Reaction



potassium pyrrole

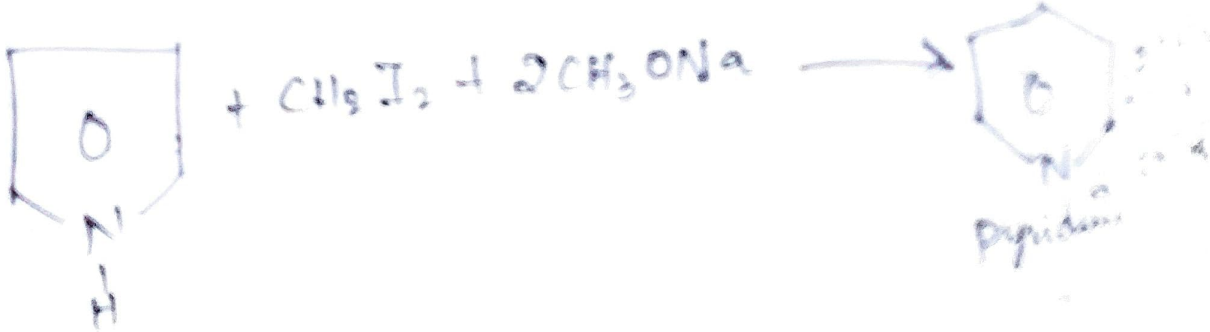
2-pyrrole carboxylic acid

5) Reimer - Tiemann Reaction:

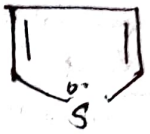
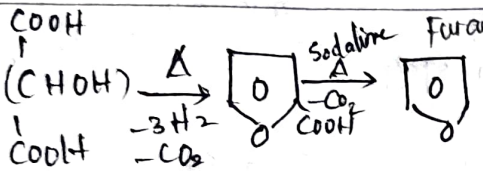
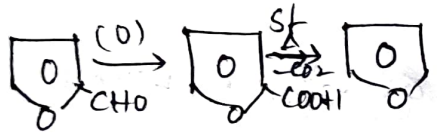


Pyrrole-2-aldehyde

6) Ring expansion Amine:



Pyridine

	Furan	Pyrrole	Thiophene	pyridine
Molecular Formula	C_4H_4O	C_4H_4NH	C_4H_4S	C_5H_5N
Structure				
Preparation	1)  Mucic acid 2)  Furfural → Furan	1) potassium pyrrole $\xrightarrow{H_2O}$ pyrrole + KOH (Steam distilled) 2) Ammonium mucate $\xrightarrow[-200\,C,\ -2CO_2,\ -2NH_3,\ -4H_2O]{\text{Glycerol, distilled}}$ pyrrole 3) Succinimide $\xrightarrow[\text{dust}]{Zn}$ pyrrole 4) Acetylene + Ammonia → pyrrole 5) Furan $\xrightarrow[Al_2O_3]{NH_3}$ pyrrole	1) Isolation from coal tar 2) Sodium Succinate $\xrightarrow{\Delta}$ Thiophene 3) Acetylene + H_2S $\xrightarrow[400^\circ C]{Al_2O_3}$ Thiophene + H_2	1) Isolation from Coal tar 2) Acetylene + HCN $\xrightarrow{\Delta}$ pyridine 3) pentamethylene diamine $\xrightarrow[-NH_4Cl]{\Delta}$ piperidine $\xrightarrow[\text{conc } H_2SO_4]{}$ pyridine
Properties	1) Colourless liquid 2) Insoluble in water, Soluble in solvent 3) Turns pine splint moistant with HCl green	1) Colourless liquid 2) Sparingly soluble in water and readily soluble in alcohol and ether	1) Colourless liquid smelling like benzene 2) Insoluble in water / Soluble in alcohol & ether	1) Colourless liquid. bp is 150 °C 2) gives irritating smell, resembles benzene 3) Immisible with water.

Reactions

- Nitration
- Sulphonation
- Halogenation (only for Furan)
- Friedal crafts Acylation →
- Mercuration →
- Dields Alder reaction →

Furan

1) Furan + Acetyl Nitrate → 2-Nitro Furan

Furan + SO_3 —pyridine, 343K→ Furan-2-Sulphonic acid

Furan —Cl_2, 233 K→ 2 chloro Furan + 2,5-dichloro furan

Furan + $(CH_3CO)_2O$ —Sncl4→ 2 acetyl Furan

Furan —$HgCl_2$, CH_3COONa→ 2-chloromercury furan

Furan + Malic anhydride → diels alder adduct

Pyrrole

pyrrole —HNO_3→ 2-Nitro pyrrole

pyrrole —SO_3→ pyrrole 2-sulphonic acid

pyrrole —$4I_2$→ 2,3,4-5, Tetra Iodo pyrrole

Kolbe's Rxn

potasio pyrrole + CO_2 → 2- and 3-pyrrole Carboxylic acid

Reimer-Tiemann Rxn

pyrrole + chloroform —$+3NaOH$→ pyrrole-2 aldehyde

Ring expansion Rxn

pyrrole + Methyl Iodide —$+2CH_3ONa$ (sodium)→ pyridine + methanol + Sodium Iodide

Thiophene Pyridine

Pyridine Thiophene —Conc. H_2SO_4, HNO_3, 300°C→ 3-nitro pyridine

Pyridine Thiophene —conc H_2SO_4, SO_3/623K→ Pyridine 3-sulphonic acid

pyridine —Br_2→ 3-Bromo pyridine, 3,5-dibromo pyridine

Chichibabin Rxn

pyridine —$NaNH_2$, NO/NH_3→ 2-amino pyridine

Rxn with n-butyl lithium

pyridine —C_6H_5Li→ 2-phenyl lithium pyridine

Reduction

pyridine —H_2/Ni (H)→ piperidine

Thiophene Pyridine

Thiophene —Fuming HNO_3→ 2-Nitro thiophene

Thiophene —H_2SO_4→ Thiophene 2-Sulphonic acid

Thiophene —Cl_2, 30 HCl→ 2-chloro thiophene + 2,5 dichloro thiophene

Mercuration

Thiophene —$HgCl_2$, CH_3COONa→ 2-chloro mercuri thiophene

Friedal Crafts Rxn

Thiophene + $COClCH_3$ → 2-acetyl thiophe

Chloromethylation & Formylation

Thiophene + HCHO + HCl → 2-chloromethyl thiophene

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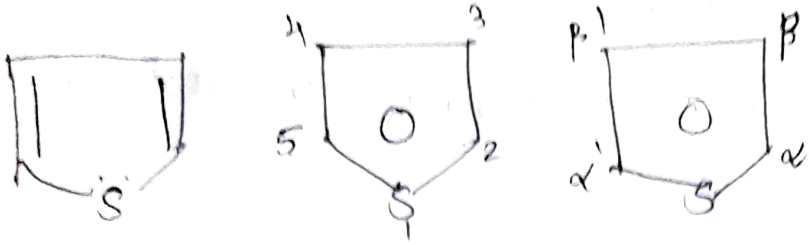
THIOPHENE - C_4H_4S



Preparation:

Isolation from Coal tar:

Coal Tar is fractionally distilled. The fraction collected upto 170°C is known as Light oil. It is purified and again distilled. Benzene is obtained at 80-82°C. This contains Thiophene. Thiophene is separated by refluxing a mixture with aqueous mercuric acetate. Thiophene is mercurated. The mercurated derivative of thiophene is separated & distilled with HCl and we get thiophene.

2) CH_2COONa / CH_2COONa — Heat → Thiophene.

Sodium Succinate

3) $CH \equiv CH + CH \equiv CH + H_2S \xrightarrow[400^\circ C]{Al_2O_3}$ Thiophene $+ 2H_2$

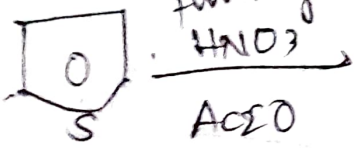
Acetylene

Physical properties:

1) It is colourless liquid smelling like benzene
2) It is insoluble in water & Soluble in Alcohol & Ether

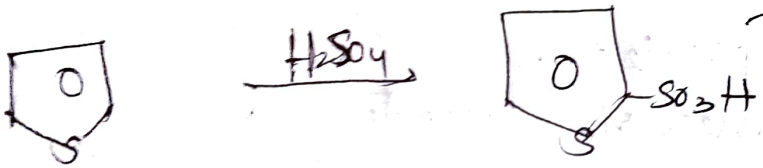
Rxns:

1) Nitration:



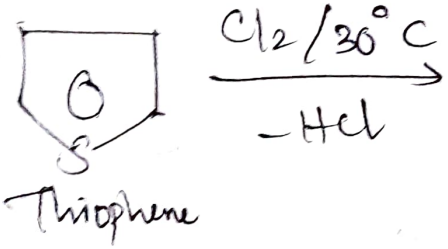
2- Nitro Thiophene

2) Sulphonation:



Thiophene-2-Sulphonic acid

3) Halogenation:

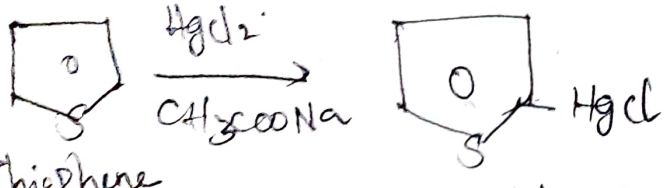


Thiophene

2- chlorothiophene +

2,5, dichlorothiophene

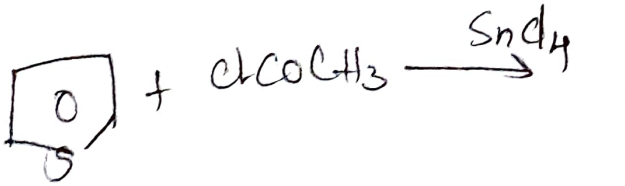
4) Mercuration:



Thiophene

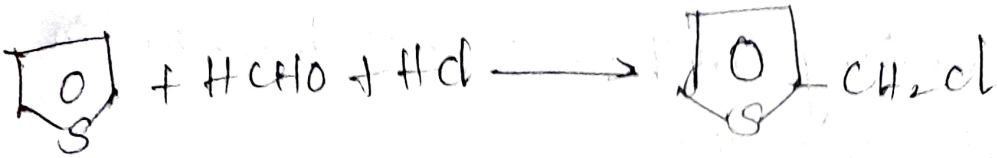
2- Chloromercurithiophene

5) Friedel crafts Rxn:



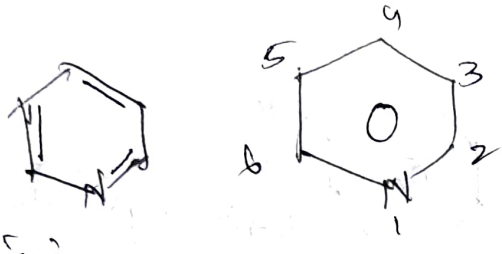
2- acetyl thiophene

b) Chloromethylation & formylation:



2-chloromethyl thiophene

PYRIDINE - C_5H_5N

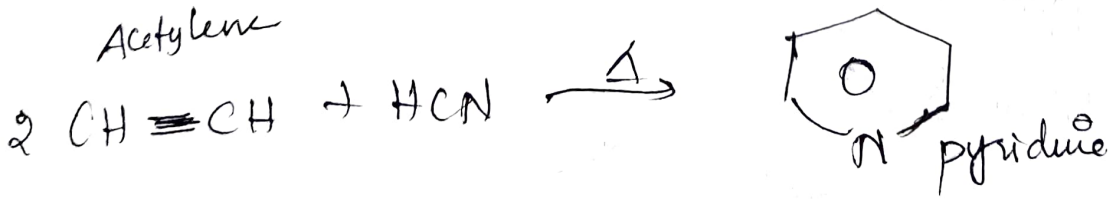


Preparation:

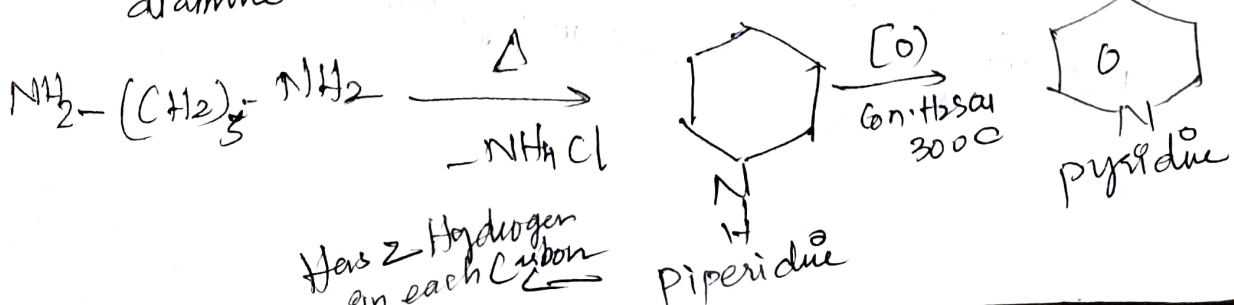
1) Isolation from coal tar:

Coal tar is fractionally distilled upto 440°K is called light oil fraction. It is treated with dil. H_2SO_4 pyridine & other basic compound dissolved. The acid layer is separated and neutralised with NaOH. pyridine and other basis are set free. From them pyridine is separated by fractional distillation.

2) Acetylene



3) Pentamethylene diamine



Has 2 Hydrogen on each Carbon

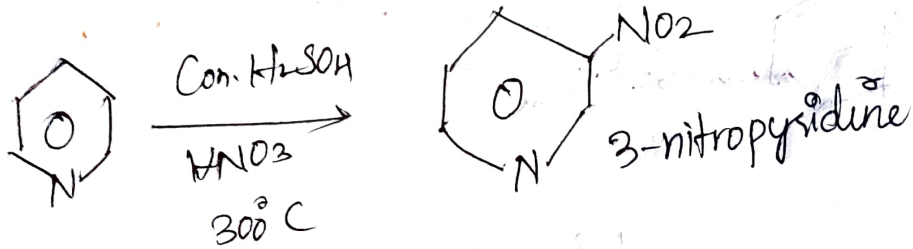
piperidine

Properties:

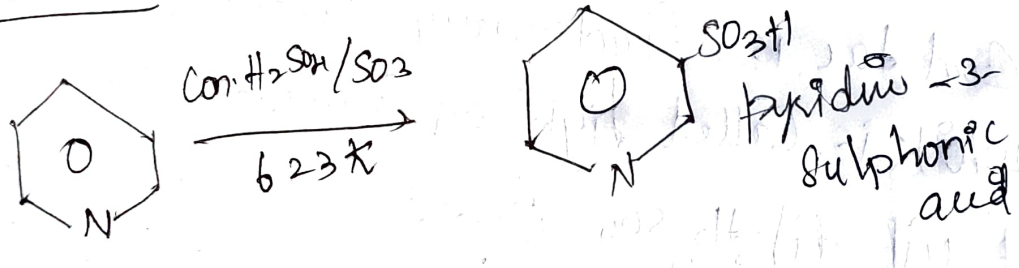
1) Pyridine is colourless liquid, bp is 150°C
* gives irritating smell, resembles benzene in many of its properties.
2) It is immisible with water.

Rxns:

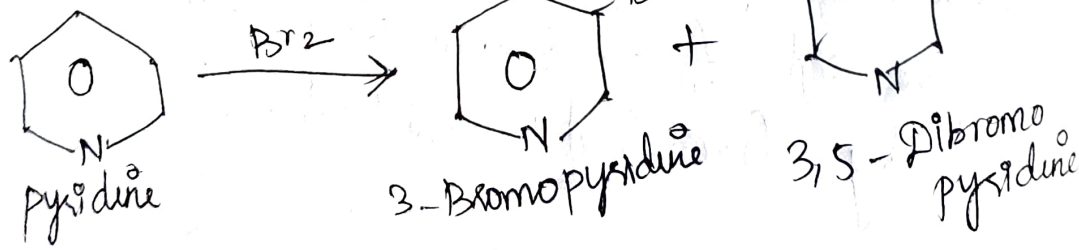
Nitration:



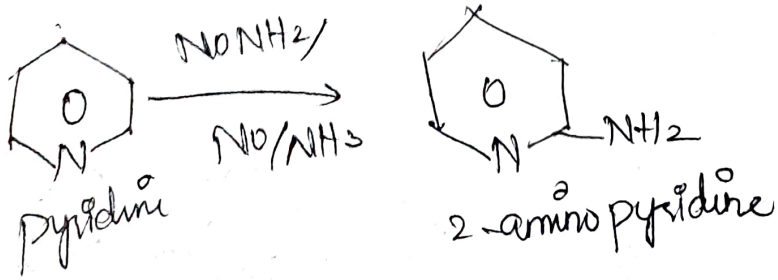
Sulphonation



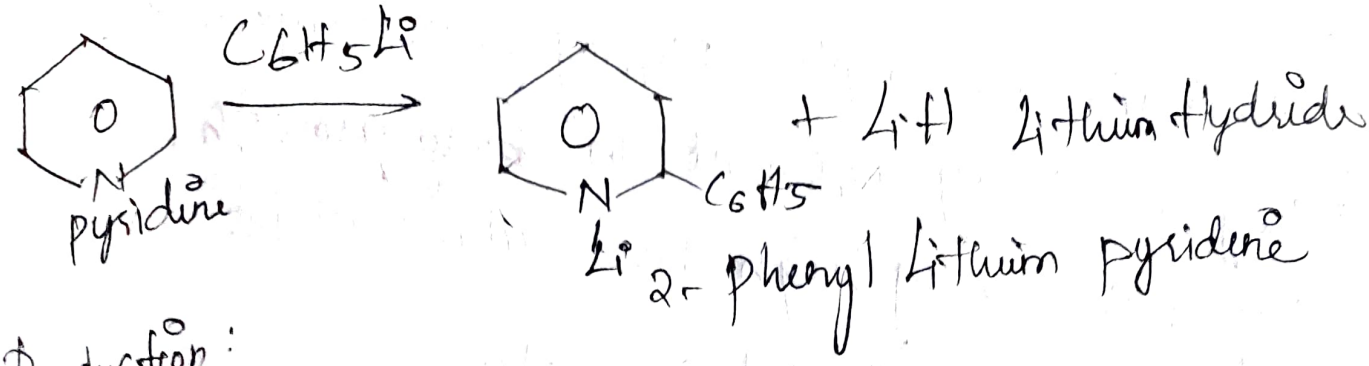
Halogenation



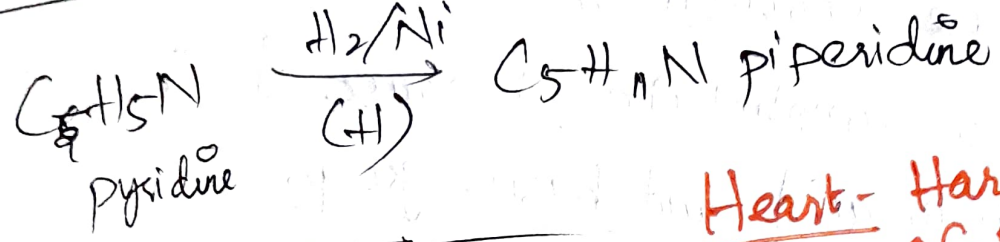
Chichibain Rxn:



Rxn with n-butyl Lithium



Reduction:



Heart - Hardest part of Muscle

18/02/2021

PROTEINS

Classifications of proteins:

According to the shape of the molecules

1) Globular proteins - Sphrical Shape, Relatively soluble

2) Fibrous proteins - Resembles long, ribbon or fibre in nature. They tend to insoluble. Strongest proteins. They found usually in toughest type of tissues

Keratins of skin, hair and feathers.

The collagen of tendons, elastin of ligaments and ~~skin~~ ~~fibrons~~, Silk fibron belongs to this class.

Characteristics of proteins:

=> Proteins are complex Nitrogenous compound.
=> They are very important in body growth.
=> They have very high molecular weight.
=> Proteins are colloidal in nature
=> proteins are amphoteric because their molecules contains both acid and basic groups.
=> Depending on the pH of the medium they can exist as cations or Anions in an electric field. they move either to anode or cathode (Electrophoresis)
=> At a particular pH, which is characteristic for each proteins, the positive & Negative charges are balanced exactly & proteins molecules carry no net charge. This is called Isoelectric point, of the protein and this point protein molecules will not migrate in an electric field.
=> Proteins may be coagulated (denaturated) that is precipitated irreversibly
This irreversible precipitation of protein is called denaturation. This can be brought about by heat, Strong acid or base or various other agent. As a result of denaturation, protein undergoes changes physically and chemically.

Solubility, molecular shape & size, biological activity of protein may change.

Proteins on hydrolysis yield aminoacids. This hydrolysis may be brought abt by acids, alkalis or enzyme.

→ proteins exhibit a number of colour reactions

1) Biuret test → when a very dil. soln of $CuSO_4$ is added to alkaline soln of protein, a red or violet color is obtained.

2) Millon's test → Mercuric Nitrate in Nitric acid containing a trace of Nitrous acid is called millon's reagent. When this reagent is added to a protein soln, a white ppt is formed and this slowly turns pink.

3) Xanthoproteic test: When treated with Con. HNO_3, proteins produces Yellow colour.

4) Ninhydrin Rxn: When the protein in pyridine is treated with Ninhydrin a deep blue to violet pink or even red colour is produced.

25/2/21

Biological Functions of proteins

⇒ Some proteins called enzymes - serve as catalyst to speed up the variety of chemical transportation which living cells are able to accomplish.

⇒ Other protein functions as hormones whose principle activity is to control process which occur in living things.

⇒ The Growth hormone produced by the pituitary gland is an example of such hormones.

⇒ Haemoglobin (transport oxygen) - A protein in the blood serves as an oxygen carrier to transport oxygen from the lungs to the various tissues.

⇒ Actinmyosin - participate in muscular contraction.

Insulin Hormone produced in the pancreas control sugar metabolism in the blood.

⇒ Nucleoproteins (~~conjugated~~ - typical conjugated protein composed of substance called Nucleic acid and simple proteins are the main constituents of genes the carrier of heredity.

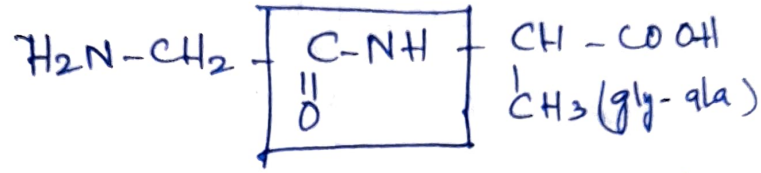
⇒ Antibodies which are proteins, function to protect human beings against diseases.

⇒ Less Spectacular are the proteins such as hair and finger nails which serve as important structural element of the body.

Structure of proteins

primary Structure

The main mode of linkage of aminoacids in proteins is the peptide bond formed by amino carboxylic acid, of one amino acid with amino acid of another as indicated in glycylalanine



The primary Structure of protein deals with the actual arrangement or Sequence of amino acids, leads together by peptide linkage in protein.

(3!) 3-Factorial (Ala-gly-leu). Leu-Leucine
Sequence of amino acid (gly-ala-leu)
(gly-leu-ala)

(N!) – N. Factorial (1x2x3x.....n)

Seconday Proteins (Helical Structure)

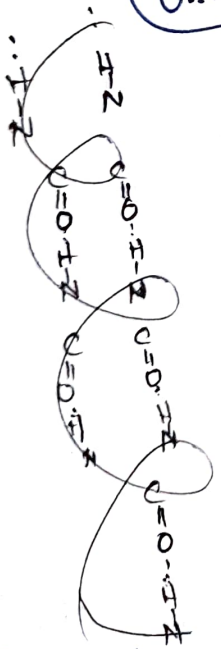
The primary Structure deals with the actual arrangements of amino acids in proteins. It fails to through light on the Shape, Configuration, confirmation of the molecule.

The Seconday Structure of protein deals with the Shape in which the long amino acid chain exists.

The way in which the protein Chain is folded and the nature of the bond which establish the structure. The protein especially globulas proteins - indicate a coiled structure in which peptide bonds are fold in regular manner. Much of the folding is the result of linking of Carbonyl and amide grp of the peptide chain by means of hydrogen bond. Such folding produced are maintained by hydrogen bonding is often called the Secondary structure of the protein. Present evidence Suggest that in many proteins the H-Bonding produces a regular coiled arrangement called α-helix. This see. structure is confirmed by X-ray Study

O···H - Hydrogen Bond

2 marks ⇒ α- Helix



Binding by means of Hydrogen Bond.

26/2/21

Synthetic polymers

Substance which we come across in our daily use like rubber, plastic, adhesive & synthetic fibres are polymers.

polymerisation obtained as large molecule by a process of repeatative addition

The initial material which gives rise to such rxns are called Monomer.

The large molecule formed in the polymerisation rxn are known as macromolecules are simply polymers.

Three types of Solid polymers

1) Elastomers
2) Thermoplastic polymer
3) Thermosetting polymer

TEFLON (polytetrafluro Ethylene) (PTFE) - Teflon

A widely used perfluorocarbon is a plastic material which is produced in quantity by radial polymerisation of tetrafluroethylene.

$$n(CF_2 = CF_2) \xrightarrow{R} -(CF_2 - CF_2)_n-$$

($R = CH_3COO-$ Acetoxy Radical)

The strong chemical bond between the Carbon and fluorine atoms in teflon gives its unique property.

1) It is not affected by temperature upto 573 K/ down to 23 K.

2) It has dielectric strength.

3) It has got low coefficient of friction.

4) It has also got zero water absorption and non-flammable.

5) It possess high resistance to oxidation, organic solvent and concentrated acid.

6) It makes excellent electrial insulation and gasuit material.

7) It has self lubricating property, which are exploited in the prepation of low adhesion surfaces.

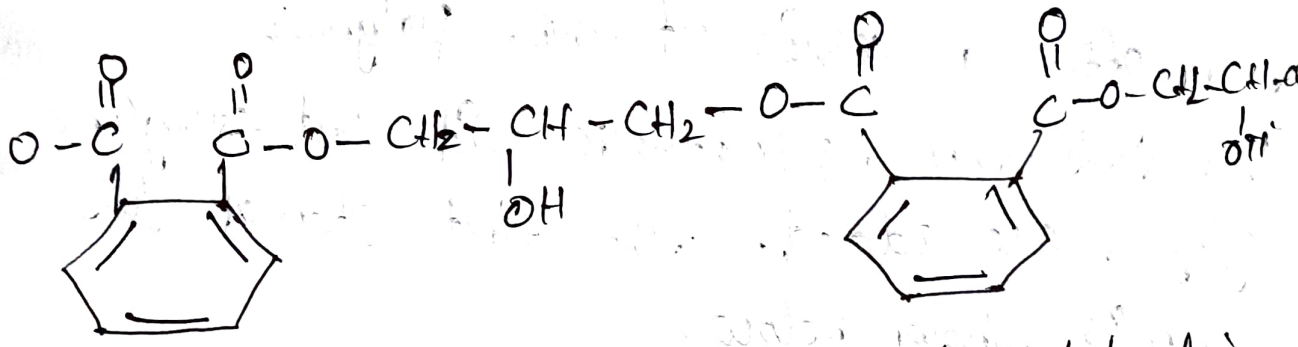
8) They dissolve large quantity of oxygen, this fact combined with non-toxicity has lead to their use as blood replacement in heart surgery on experimental animals.

9)

Alkyd Resin

Alkyd Resin is a term which is applied to the group of Synthetic Resins. The term alkyd was coined from the "Al- alcohol and "kyd" - being the representative of the acid. Alkyd resin are known as GLYPTOLS (2m)

Alkyd Resin was prepared from glycerol and tartaric acid, the glyceryl ~~phthalate~~ phtalat is industrially important and given as



The following polybasic acids and polyhydric alcohols are polyhydric ingreeidients in alkyd formulation.

Acid → Succinic acid, Mali caid, Isophthalic acid

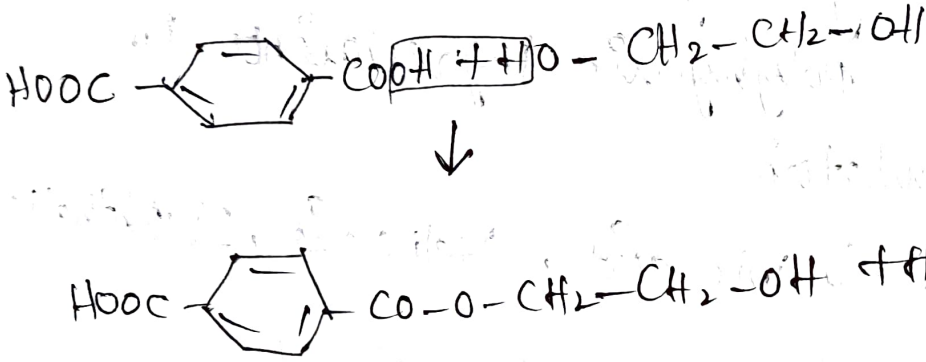
polyhydric alcohol → Ethylene glycol,
propylene glycol

Alkyd resins are Thermosetting polymers and are very hard.

Uses:
1) These are used for synthetic fibres.
2) These resins are used in every type of organic coating. Eg: paint, varnishes and Lacquers.
3) They impart high glow, good adhesion and long life at reasonable Cost.

POLYESTER

If a molecule has functional groups at 2 sites it can react with another bifunctional grp to form often a series of rxn, polymer.
In this rxn, pterpthalic acid and ethylene glycol are added. The first step of this rxn is shown below.



The monoester thus formed is capable of further esterification. The resulting polyester is melt and is drawn at an elevated temperature.
The polyester have the following properties/uses:

1) polyester have resilience
2) when blended with wool, they confer excellent wrinkle, recover.
3) Very recently polyester replace nylon in tyre.

*

Uses of furan

i) Furan is used in the formation of lacquers and as solvent for resins.

ii) It is used in the production of agricultural chemicals (insecticides), stabilizers and pharmaceuticals.

uses of pyrrole

i) procyclidine is an anti-muscarinic drug used in the treatment of parkinsonism

ii) pyrrole and its derivatives are widely used as intermediate in synthesis of pharmaceuticals, medicines, agrochemicals, dyes, photographic chemicals, perfumes and other organic compounds.

uses of Thiophene

1) In medicine, thiophene derivative shows
   1) antimicrobial 2) analgesic
   3) antiinflammatory 4) antihypertensive
   5) antitumor activity
2) They are also used as inhibitors of corrosion of metals or in fabrication of light-emitting diodes in material Science.

Isolated.

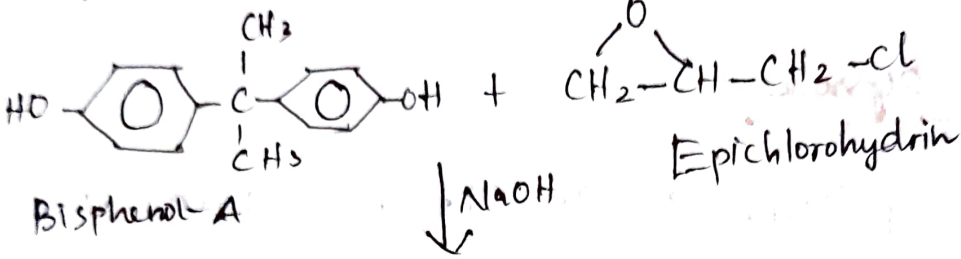
uses of pyridine

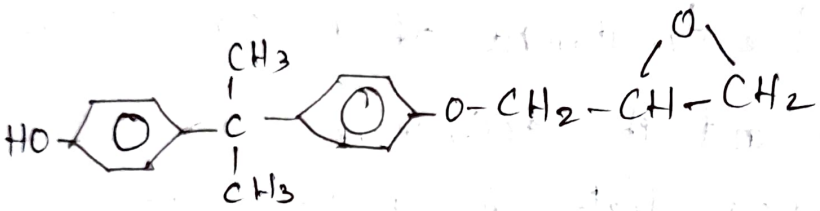
1) Pyridine uses in the chemical industries and enterprises as significant crude material,
- used in dental consideration items for cleaning
- used as dissolvable which is appropriate for dehalogenation,
- It is used in pharmaceuticals, radiator, fluid blends as denaturant.
- It is used as sulfonating specialist.

EPOXY RESINS

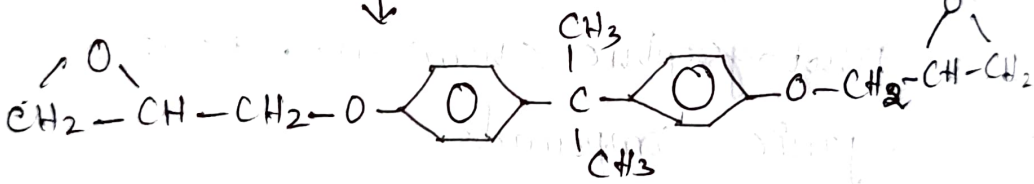
A very useful group of adhesives and plastics is based on condensation polymers of bisphenol A and epichlorohydrin. $CH_2-CH-CH_2Cl$ (O)

The lower molecular weight liquid epoxy resins were synthesised in the following way:

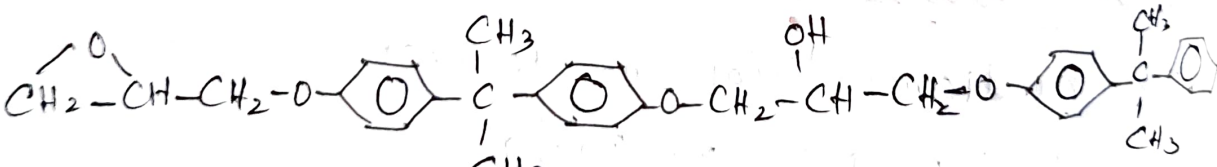




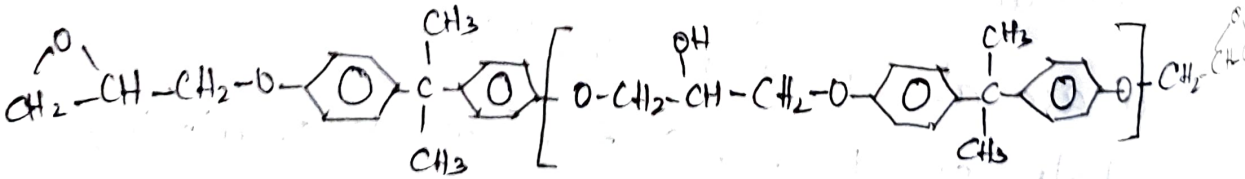
Epichlorohydrin



Bisphenol-A



n-epichlorohydrin + (n-1) bisphenol-A



The high molecular weight solid epoxy resins were synthesised from the same intermediates by using nearly stoichiometric quantities of epichlorohydrin.

The liquid epoxy resins are used as casting resins and adhesives. Solid epoxy resins may be used in the formulation of molding powders and in adhesive formulation.

The epoxy resin solution coatings are valuable as electrical varnishes and corrosion resistant paints.