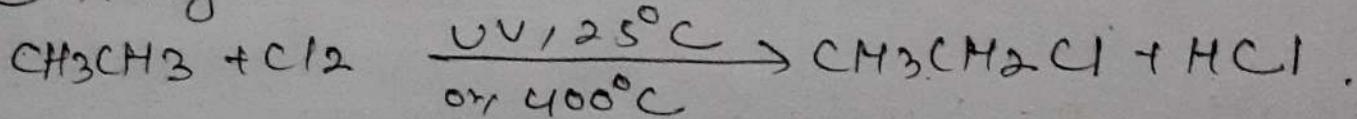


Halo-Alkanes

Preparation of Mono Halo Alkanes

① From Alkanes:

① Halogenation

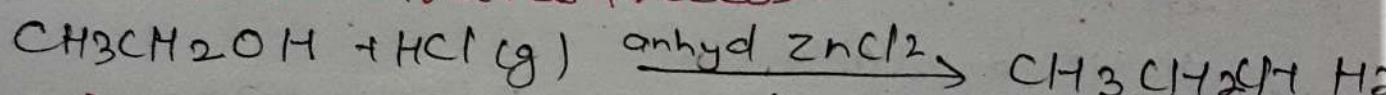


② From Alkenes: Hydrohalogenation.

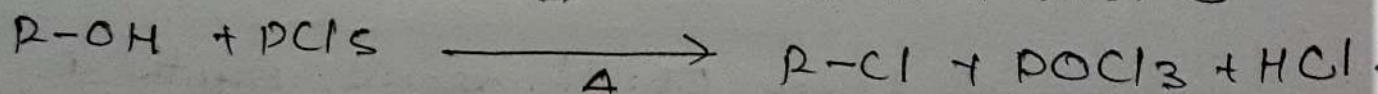
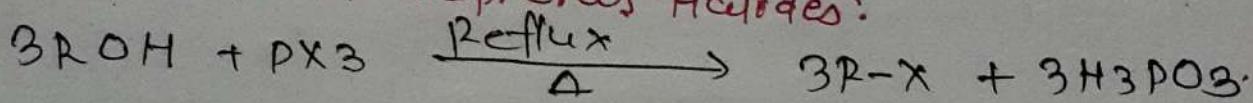


③ From Alcohols:

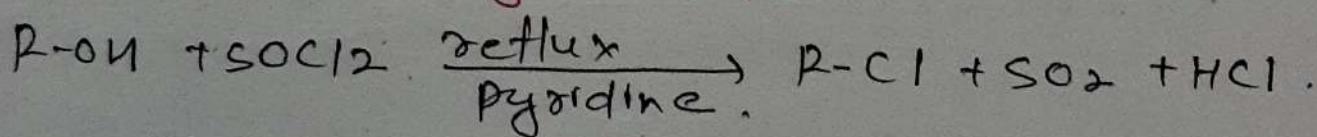
① with HCl : Grignard Process.



② Rx² with Phosphorus Halides:



③ Rx² with Thionyl chloride.



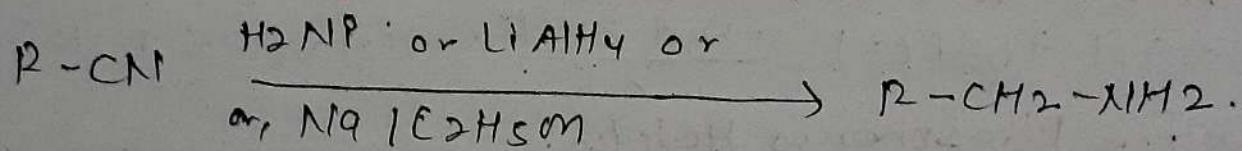
Formation of Alcohol.



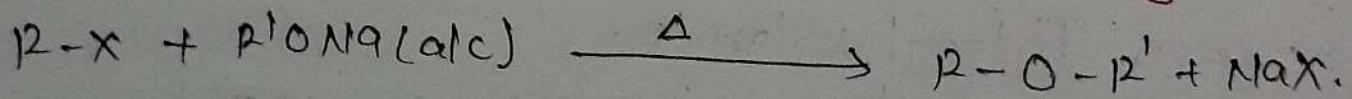
Formation of Nitrole.



Formation of Primary Amines: (Reduction)



Formation of ether. (Williamson's synthesis)



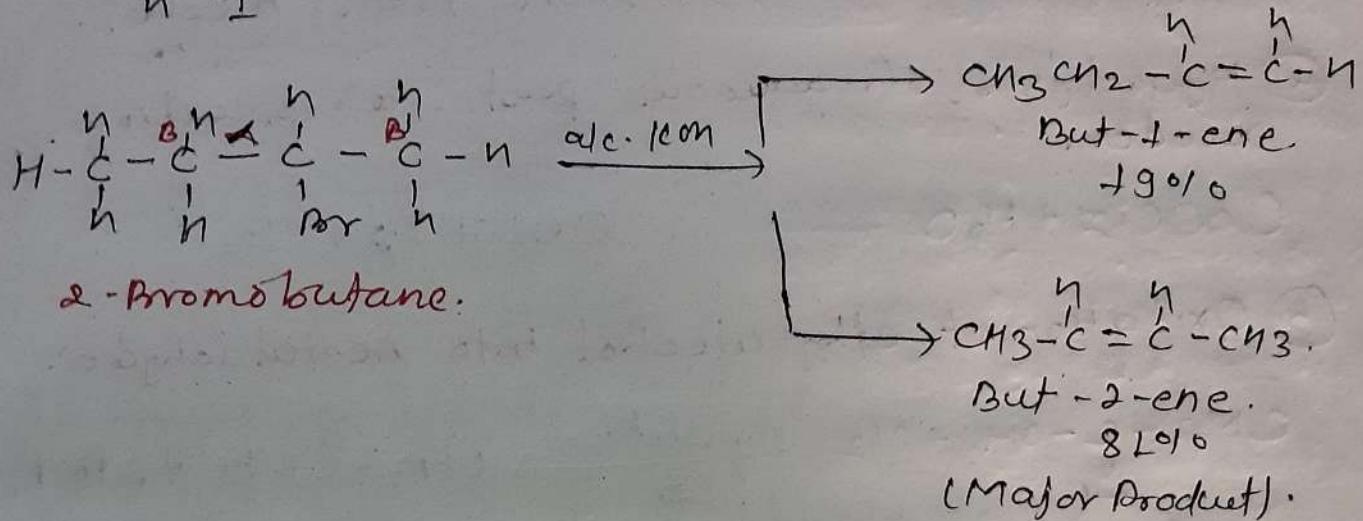
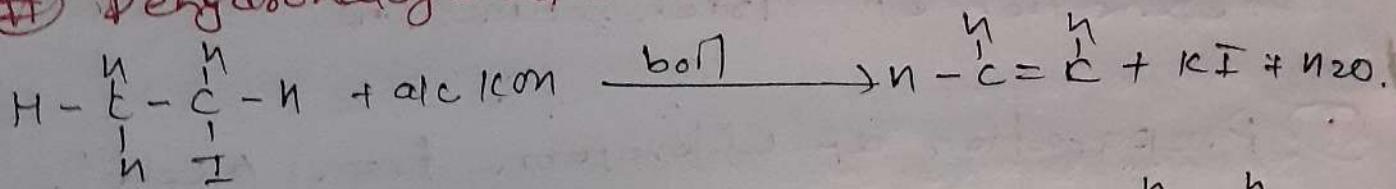
Formation of Nitro-Alkane



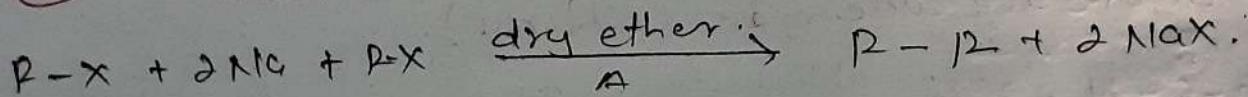
Formation of Alkyl Nitrate.



④ Dehydrohalogenation:



⑤ Wurtz P_x^2 .



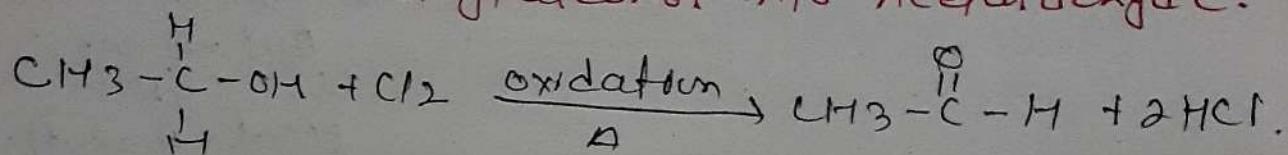
Preparation of Trichloromethane.

① Preparation of Chloroform from Alcohol.

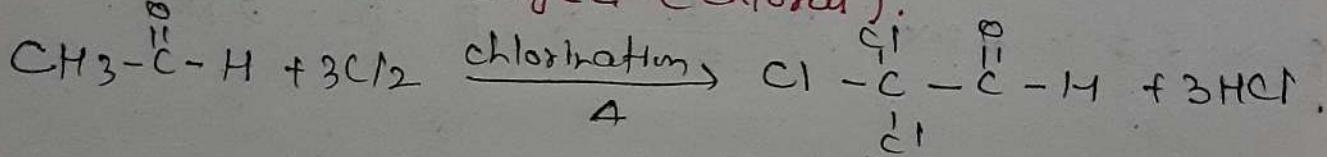
a) Hydrolysis of aqueous paste of bleaching powder.



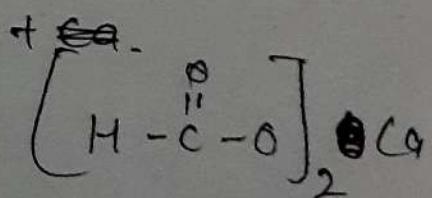
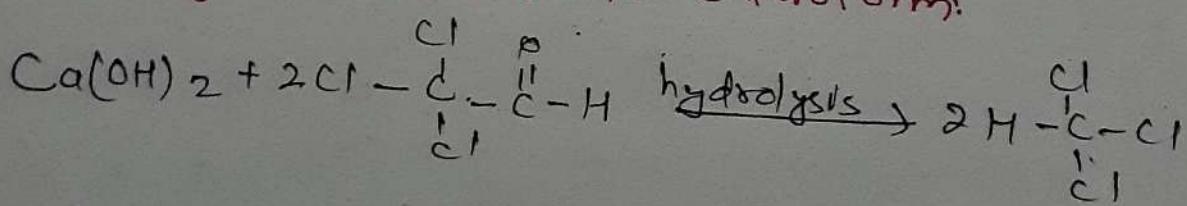
b) Oxidation of ethyl alcohol into Acetaldehyde:



c) Chlorination of Acetaldehyde into trichloroacetaldehyde (Chloral).



d) Hydrolysis of chloral into chloroform:



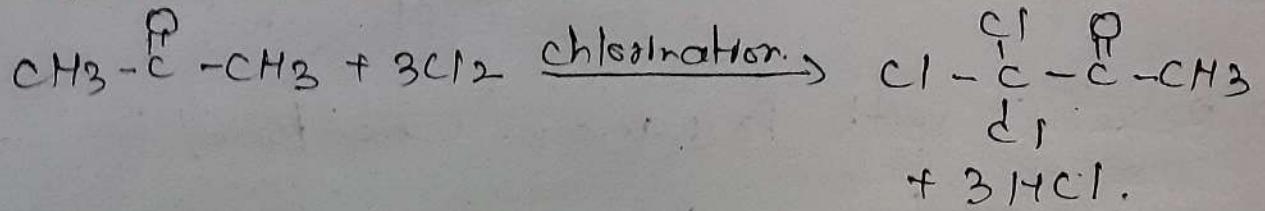
Calcium formate.

(1) Preparation of Chloroform from Acetone

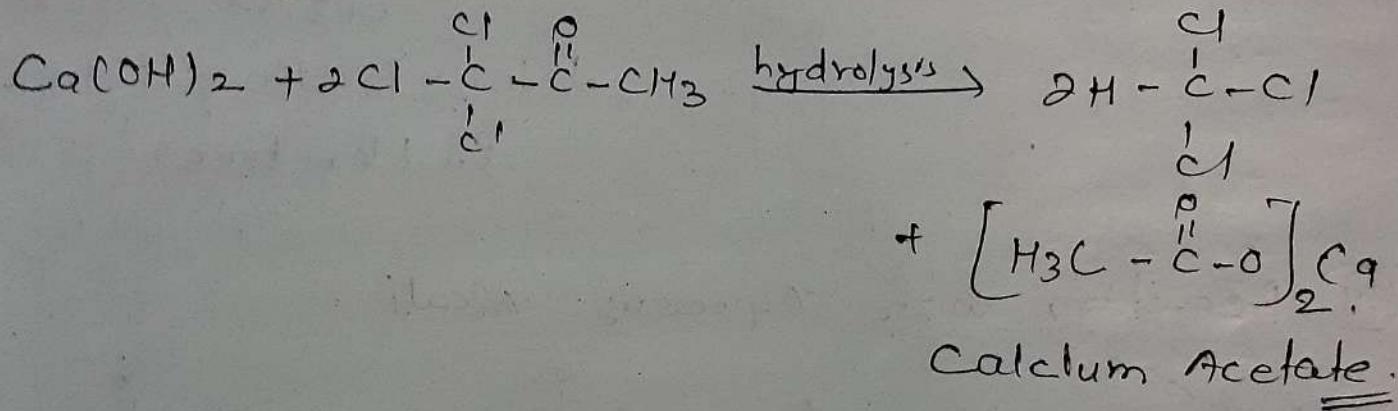
(a) Hydrolysis of aqueous-paste of bleaching powder into water



(b) Chlorination of Acetone into trichloroacetone:

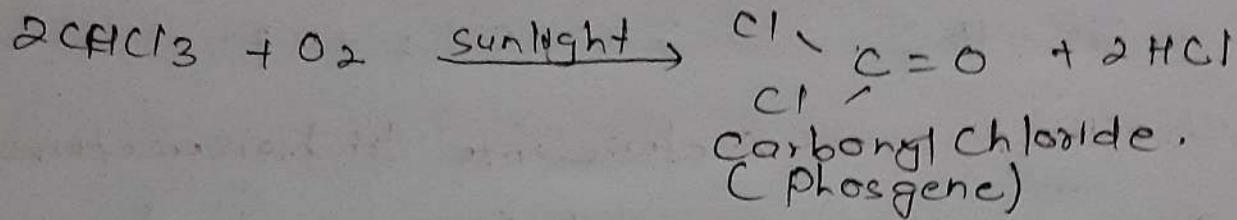


(c) Hydrolysis of trichloroacetone into chloroform:

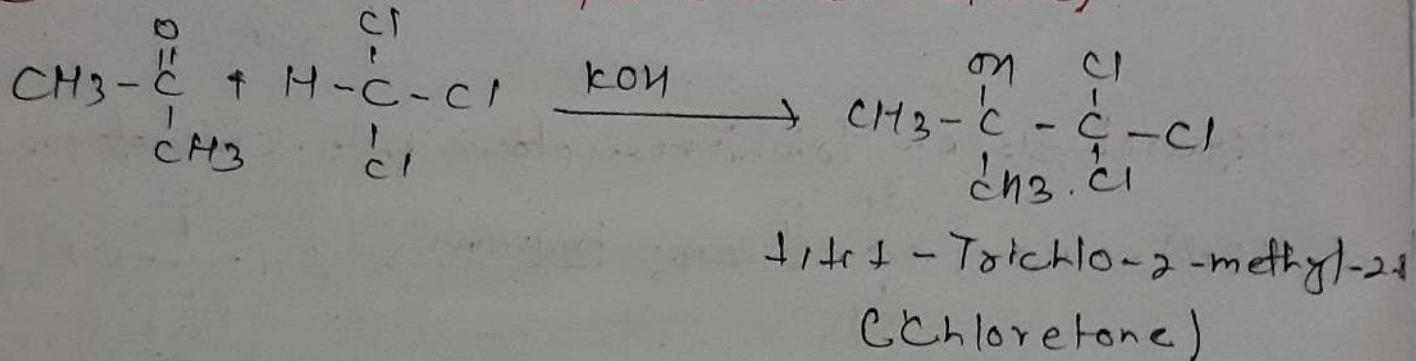


Chemical Properties of Trichloromethane.

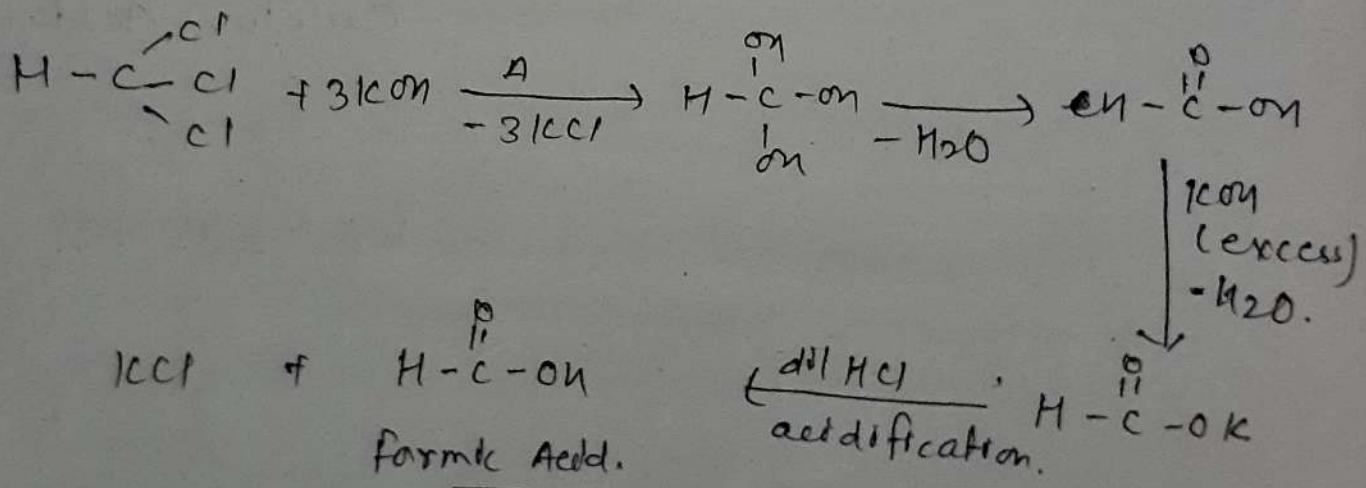
① Oxidation.



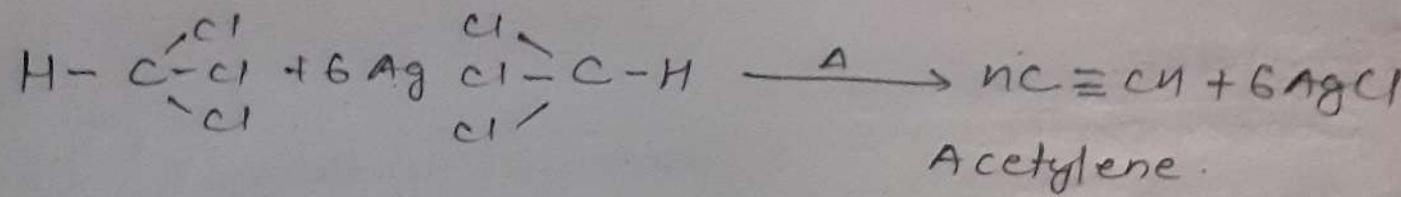
② Reaction with Propanone (Acetone)



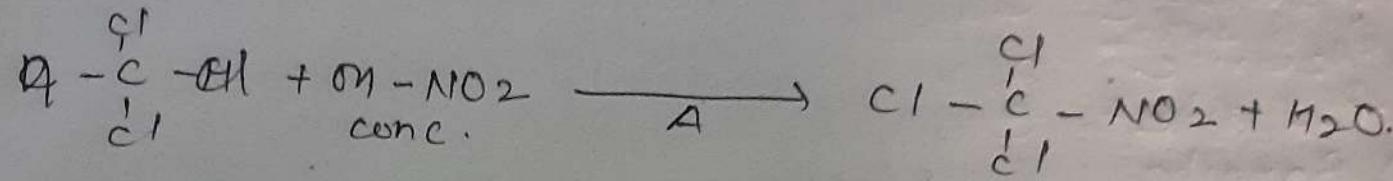
③ Reaction with Aqueous Alkali



(iv) Action with Silver Powder.

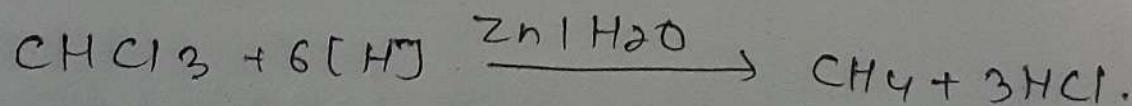
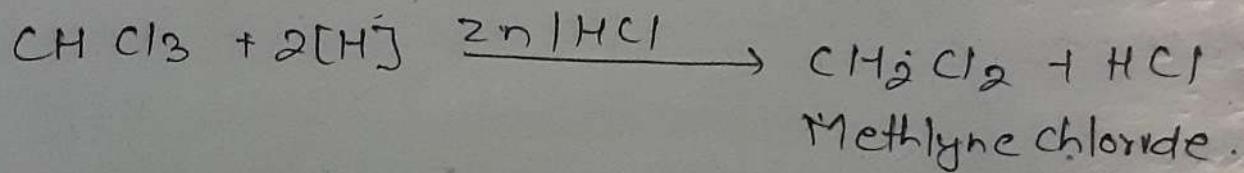


(v) Reaction with Nitric Acid.



Trichloronitromethane.
Chloropicrin or nitrochloroform

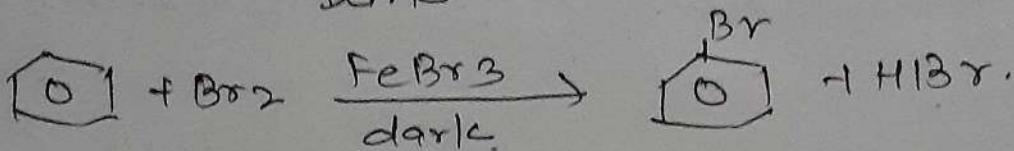
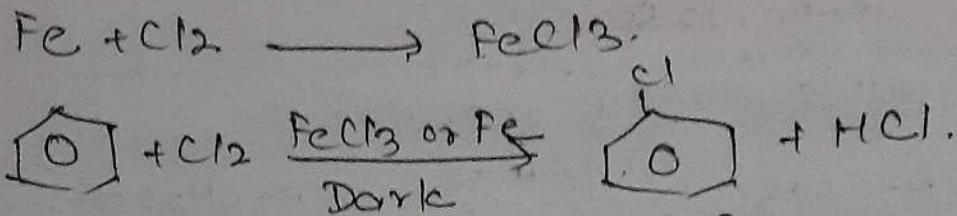
(vi) Reduction:



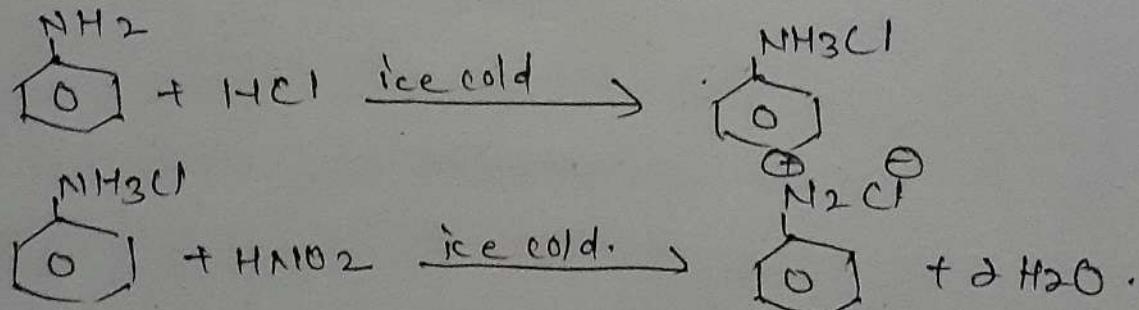
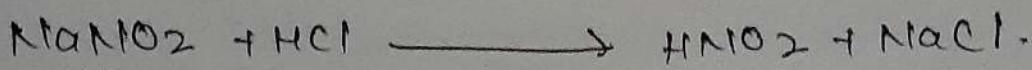
Halo Aromes.

Methods of Preparation:

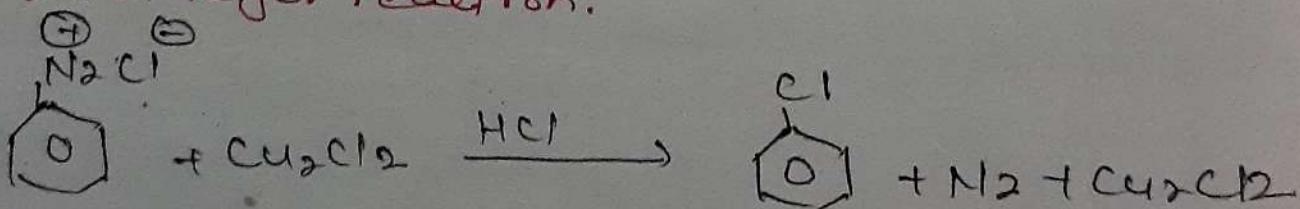
① From Benzene.



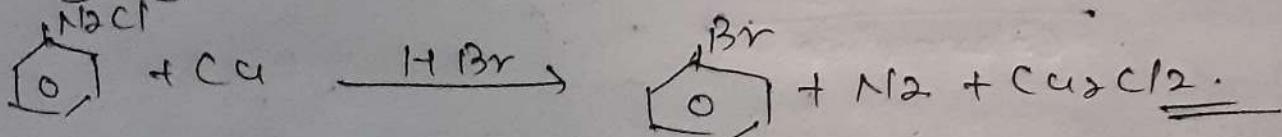
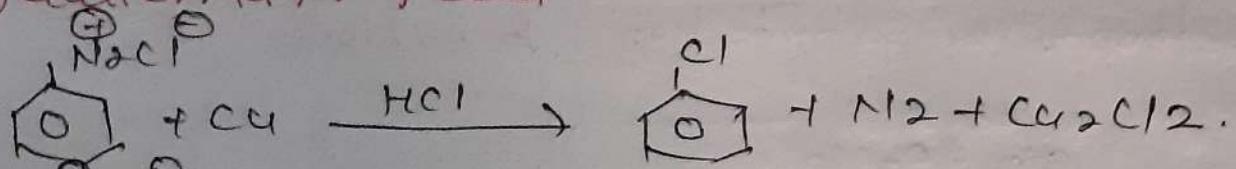
② Benzene Diazonium Chloride.



① Sandmeyer reaction.

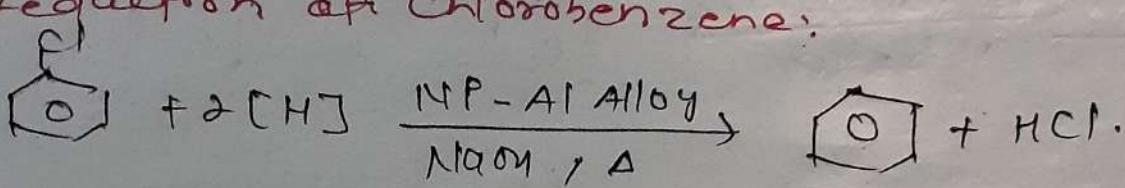


② Criebermann Reaction.

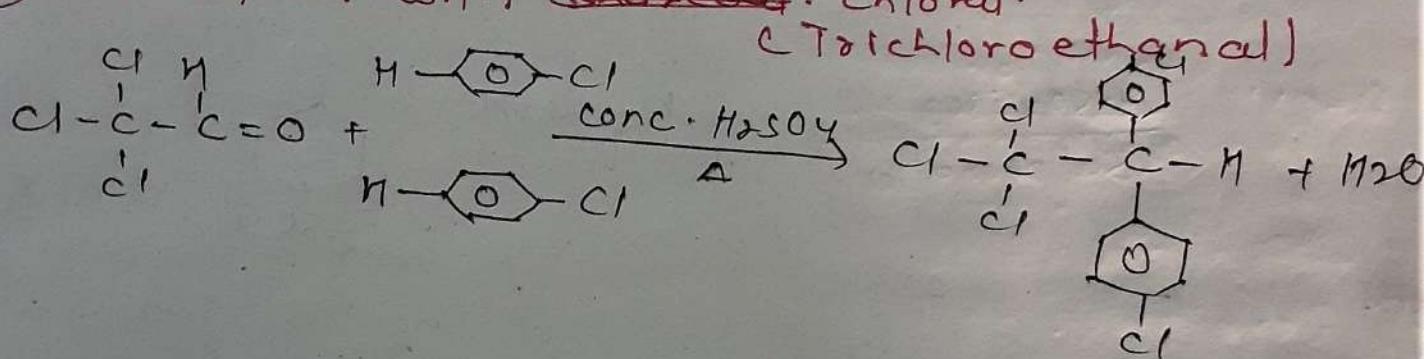


Chemical Reactions of HaloArenes.

① Reduction of Chlorobenzene.



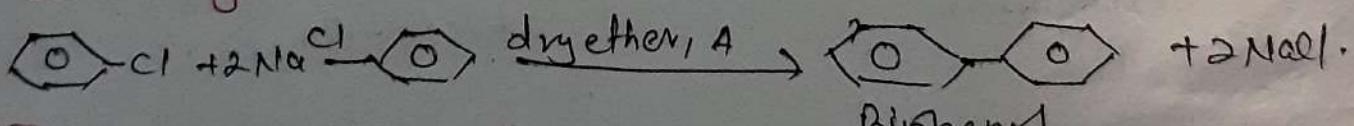
② Reaction with ~~Chloroal.~~ chloral.



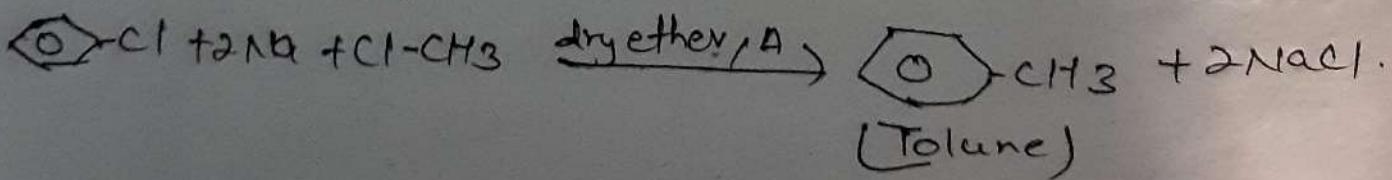
DDT.
(Dichlorodiphenyl
Trichloro ethane).

③ Action with Na.

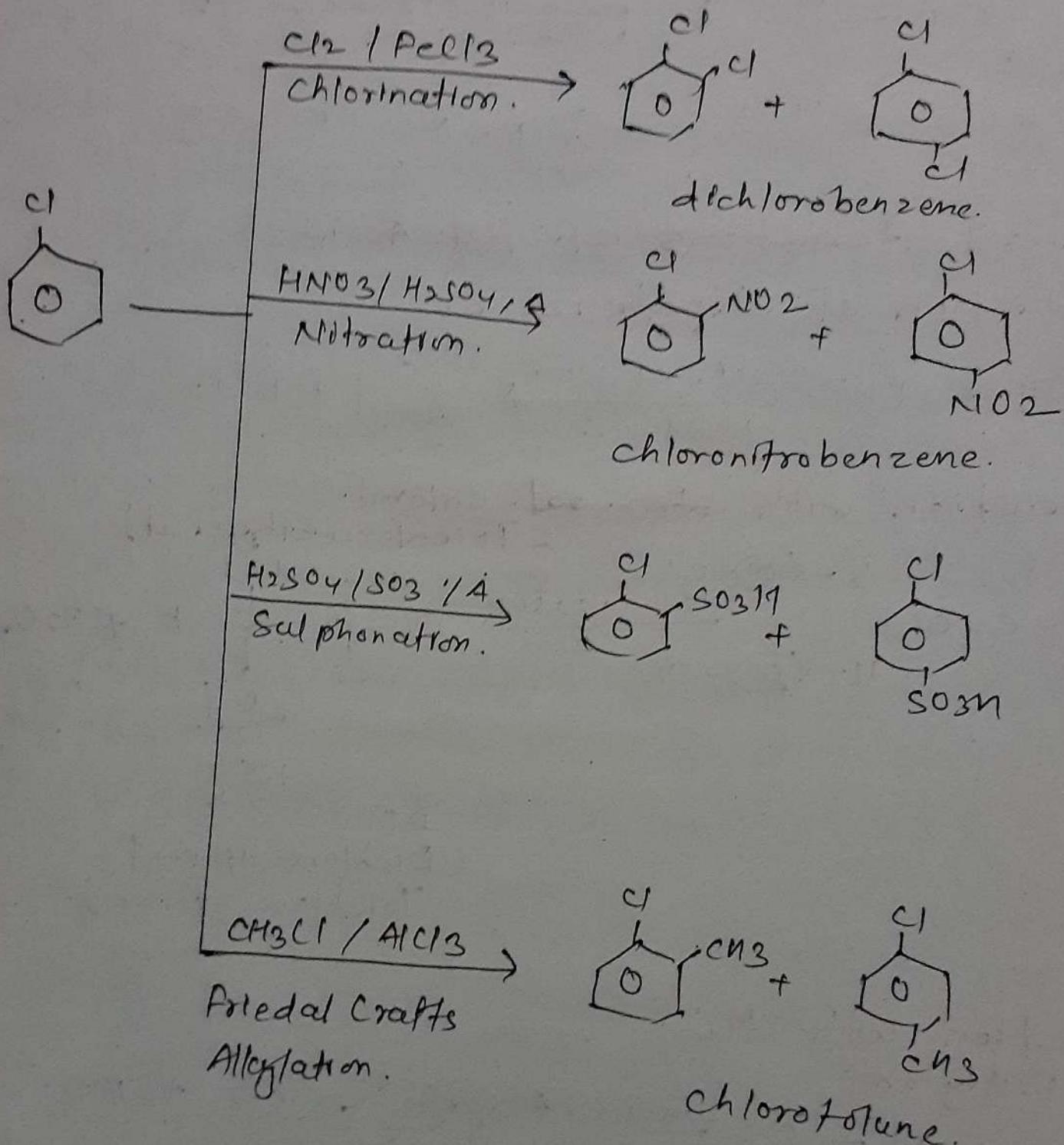
① Fittig Rx^2



② Wurtz-Fittig Rx^2



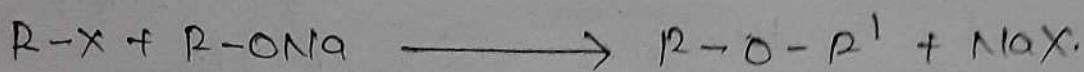
④ Electrophilic Substitution Reactions.



Ethers.

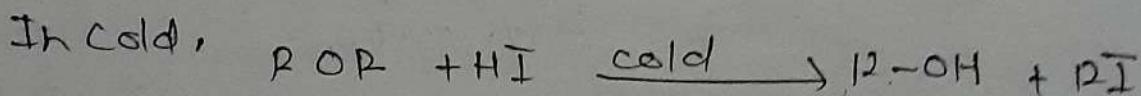
Methods of Preparation of Ethers:

- ① By Williamson's Synthesis.

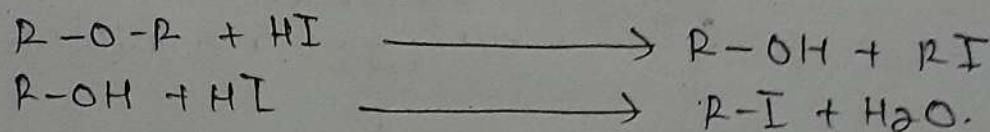


Chemical Properties of Ethoxy Ethane.

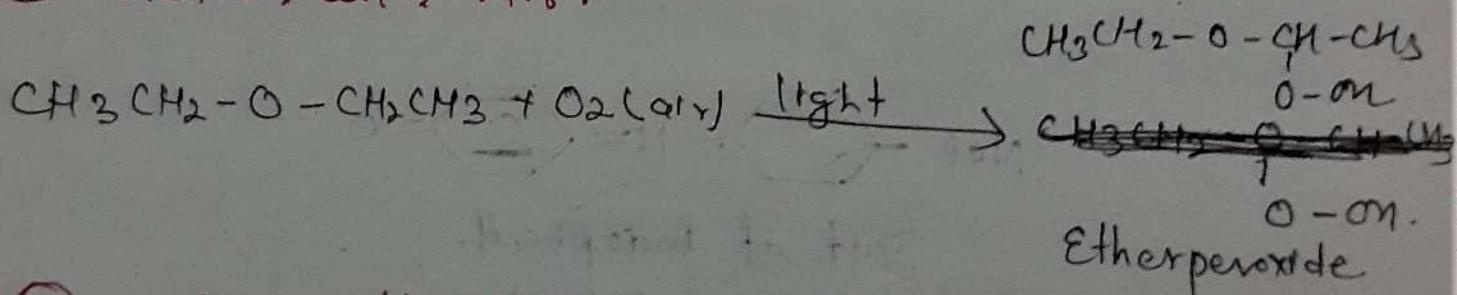
- ① Action with HI



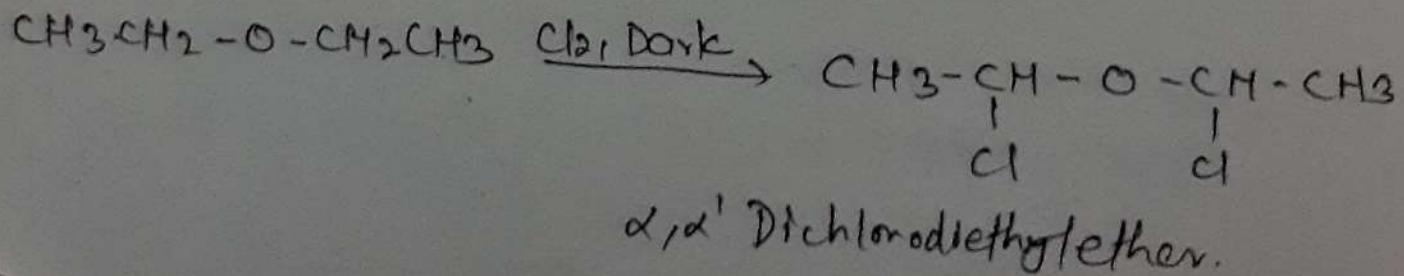
In hot and excess HI

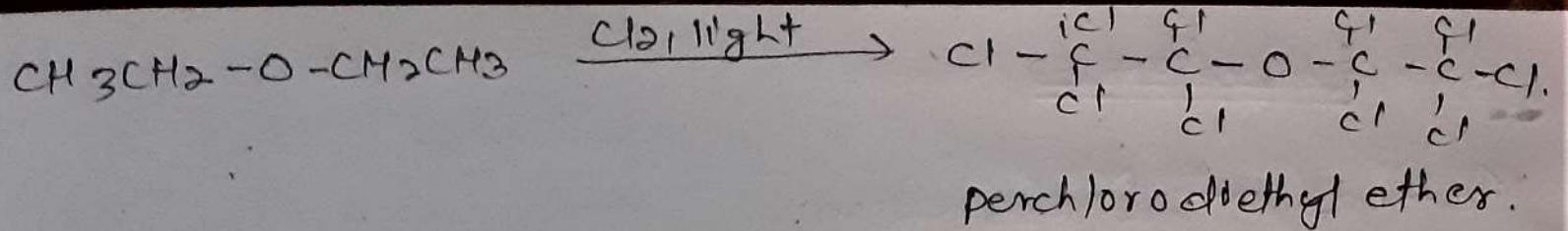


- ② Action with Air.

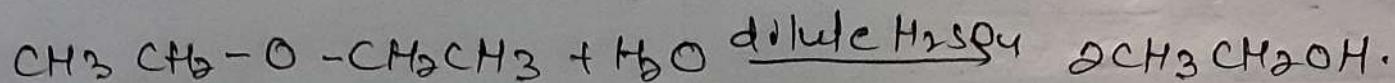
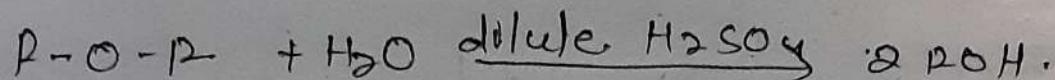


- ③ Action with Cl₂.





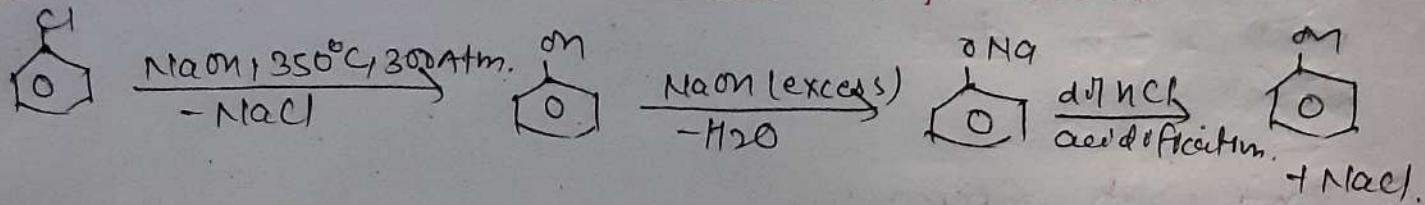
⑩ Action with conc H_2SO_4 .



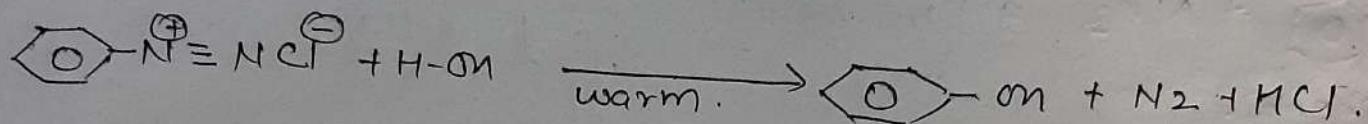
Phenols

Preparation of Phenols:

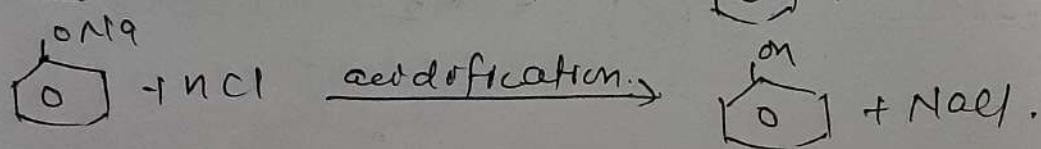
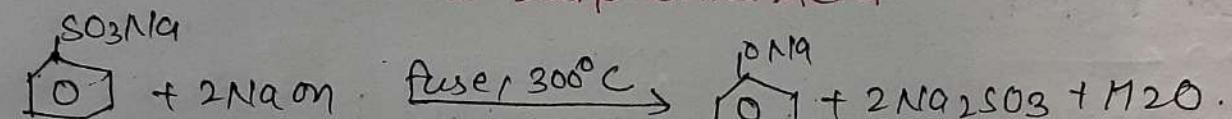
① From chloro Benzene: (Dow's process)



② From Diazonium salt

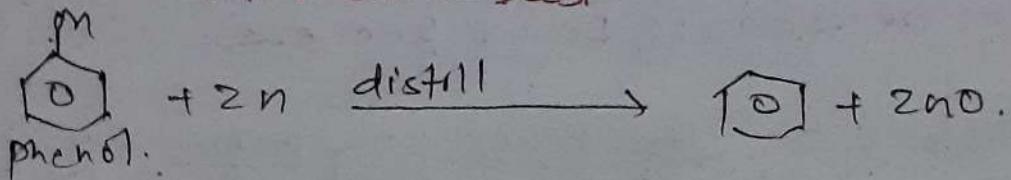


③ From Benzene Sulphonic Acid.

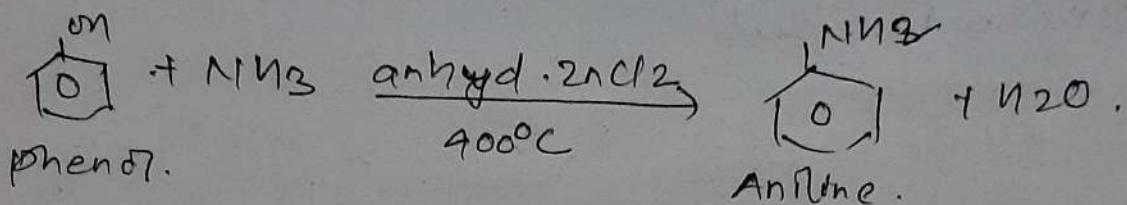


Chemical Reactions of Phenol.

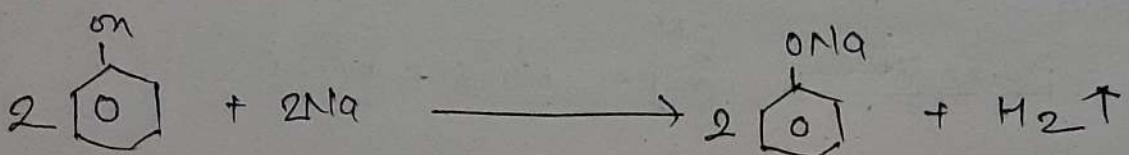
① Rx² with Zinc Dust.



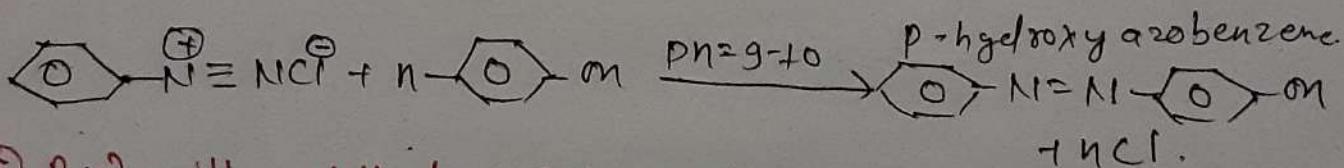
② Rx² with Ammonia.



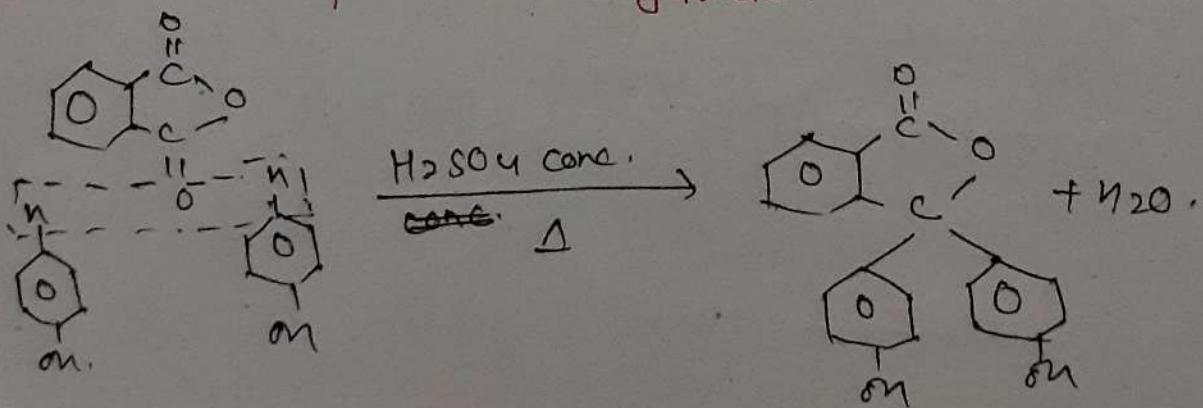
③ Rx² with Na.



④ Rx² with Benzene Diazonium Chloride.

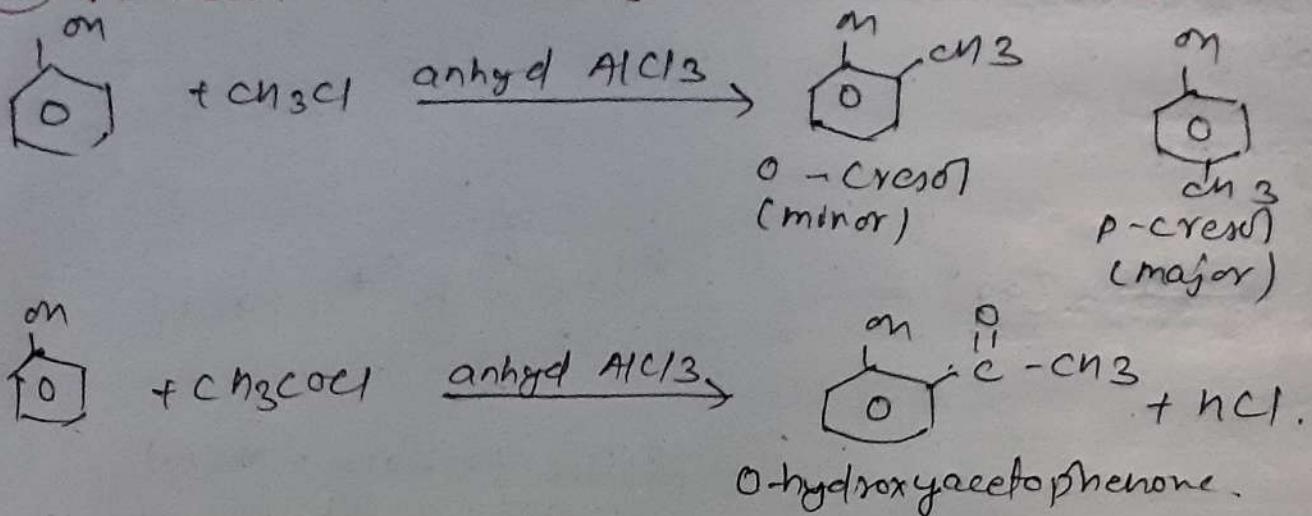


⑤ Rx² with phthalic Anhydride.

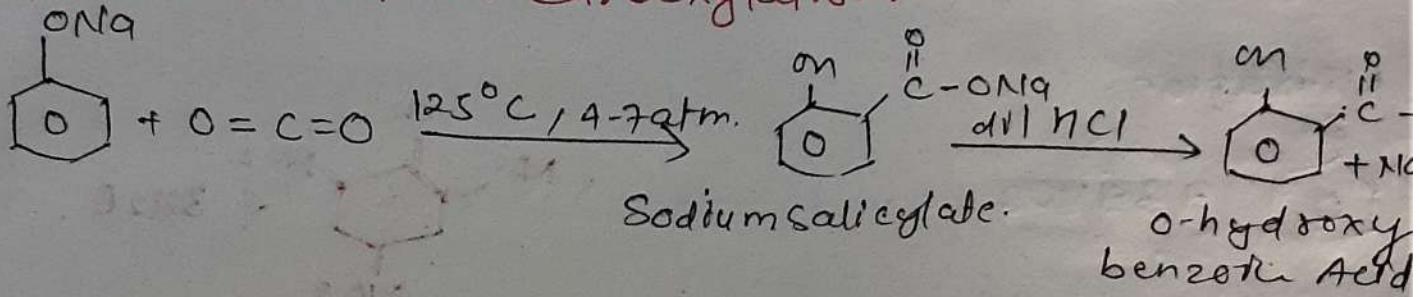


Phenolphthalein
Acid-base indicator.

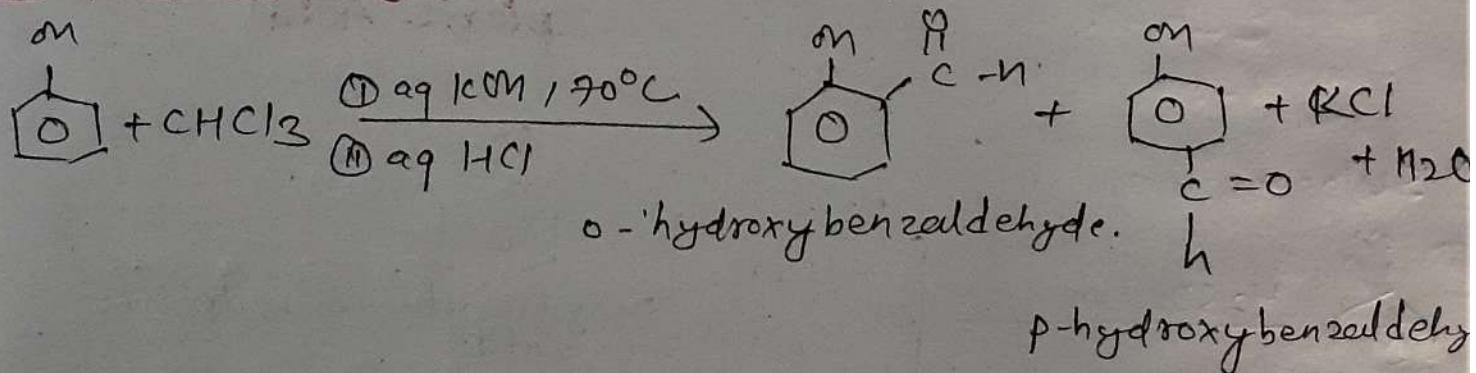
⑥ Friedel-Crafts Alkylation and Acylation



⑦ Kolbe's Reaction: Carboxylation.

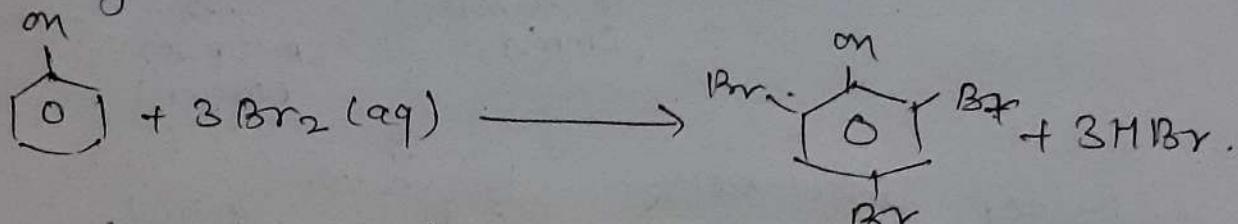


⑧ Piemeyer-Tiemann's Reaction.



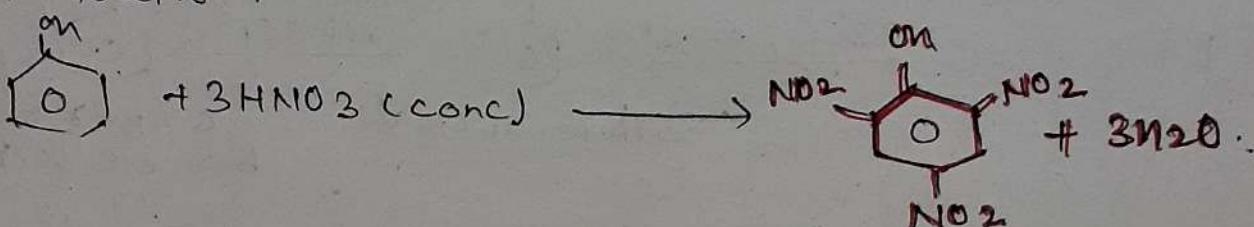
Electrophilic Substitution Reactions of Phenols:

① Halogenation.



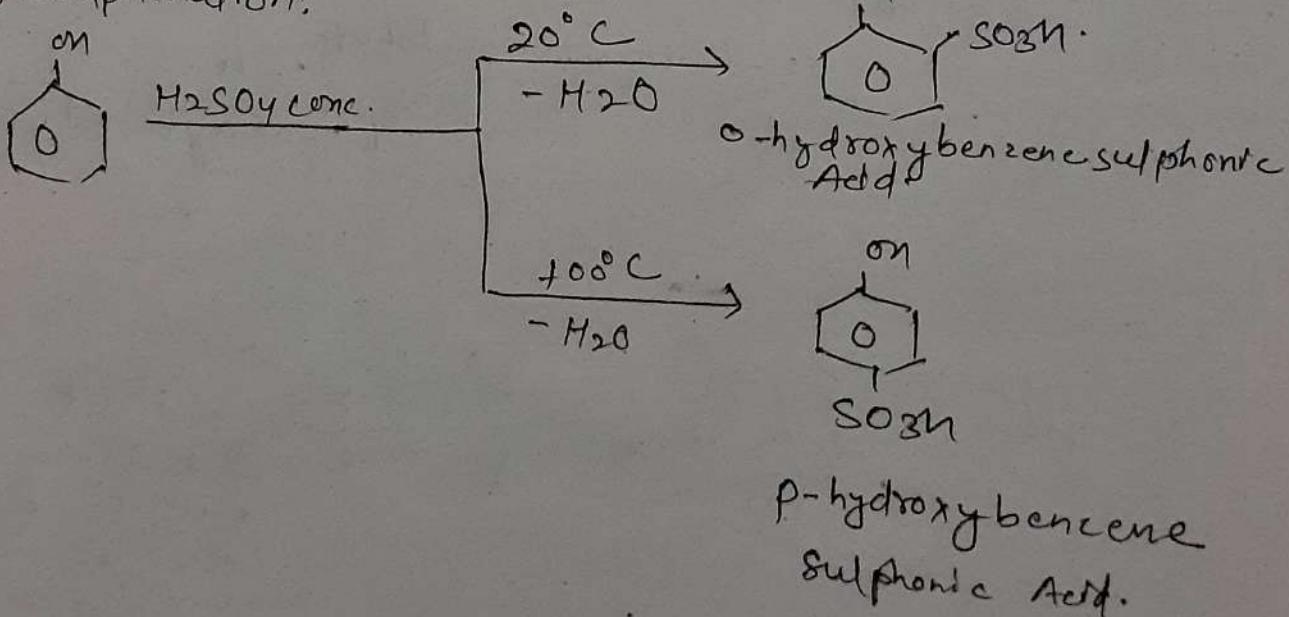
2,4,6-Tribromo phenol.
(white ppt)

② Nitration.



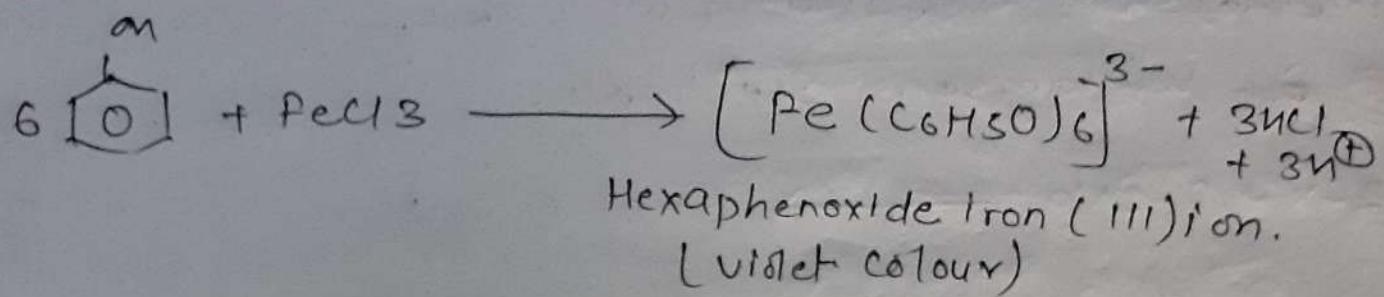
2,4,6-Tonitrophenol.
(Picric Acid)

③ Sulphonation.

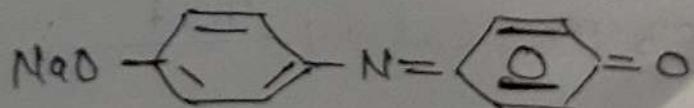
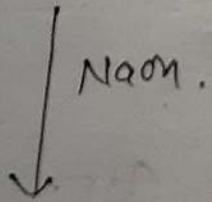
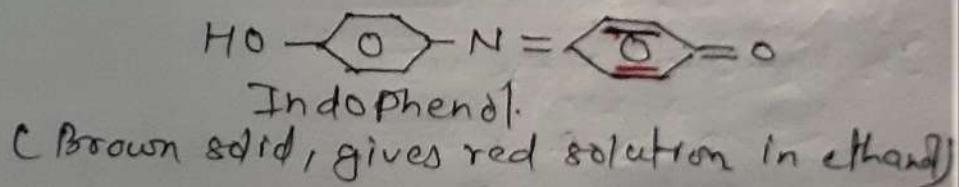
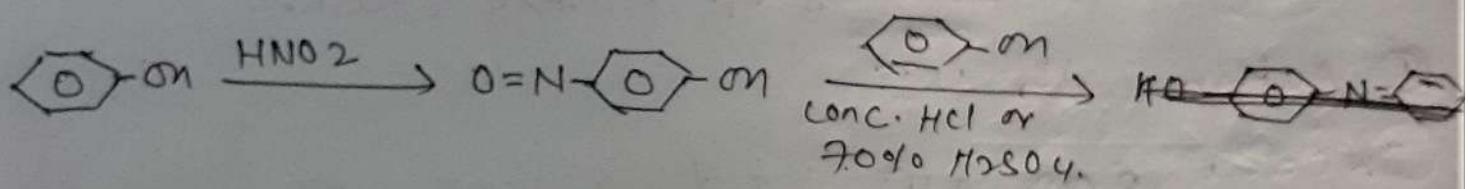


Test of Phenols:

① Fehl's Test:



② Übermann's Test:

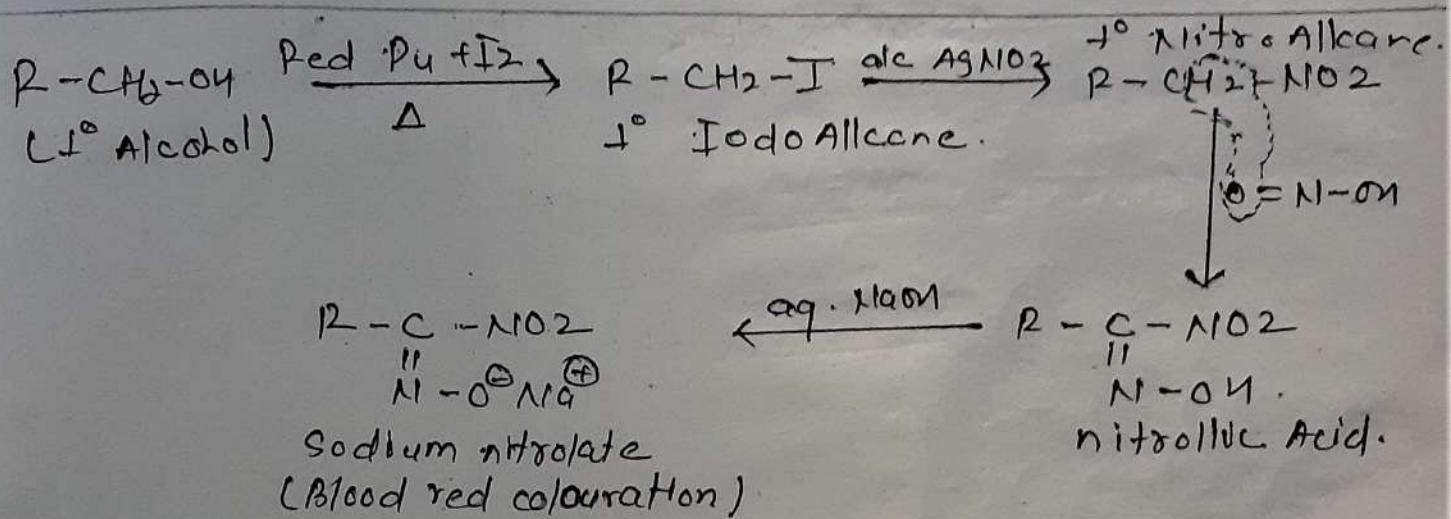


Salt of Indophenol.
(Blue solution)

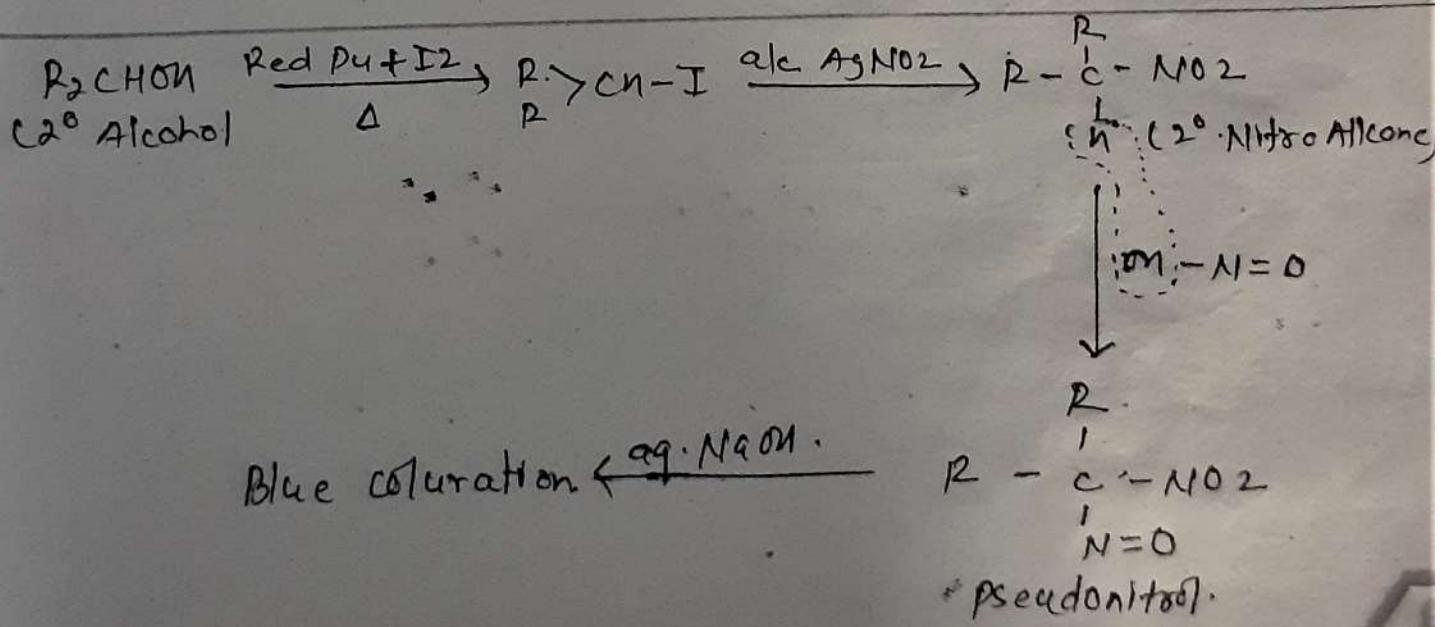
Distinction of Primary, Secondary and Tertiary Alcohols.

① Victor Mayer's Test:

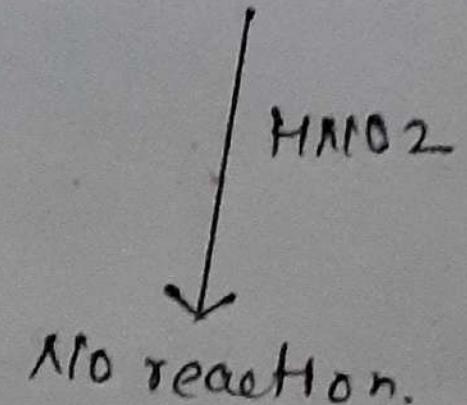
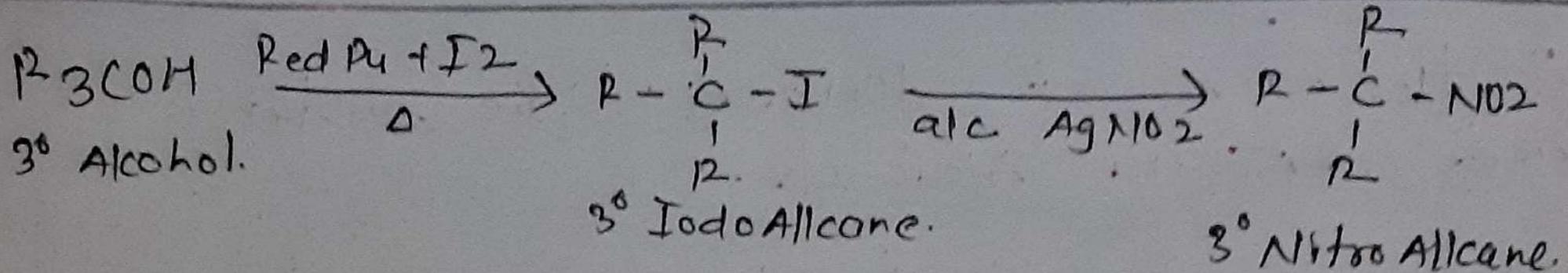
For 1° Alcohol.



For 2° Alcohol.



3° Alcohol

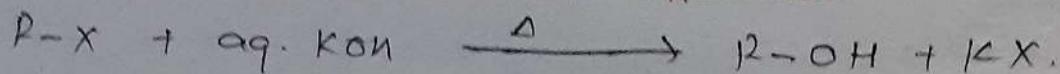


Colourless solution $\xleftarrow{\text{aq. NaOH}}$

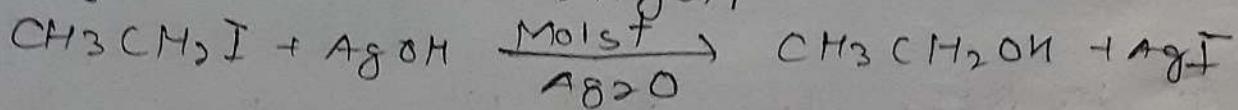
Preparation of ~~Alk~~ Monohydric Alcohols:

① From Haloalkanes.

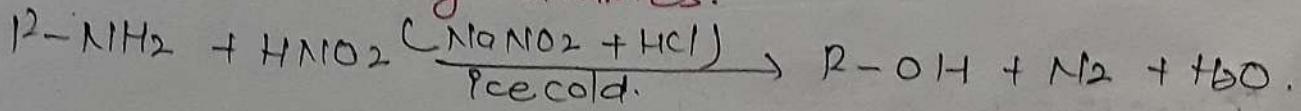
② By hydrolysis of Haloalkanes.



③ By the action of moist silver oxide on haloalkanes:

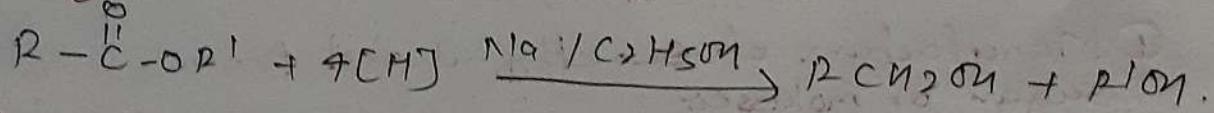


④ From Primary Amines:

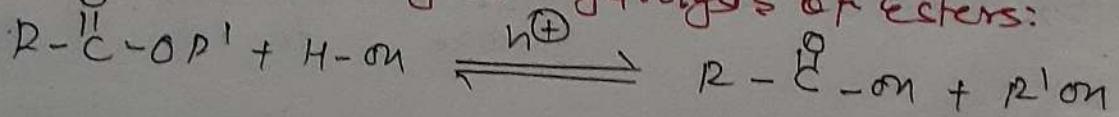


⑤ From Esters

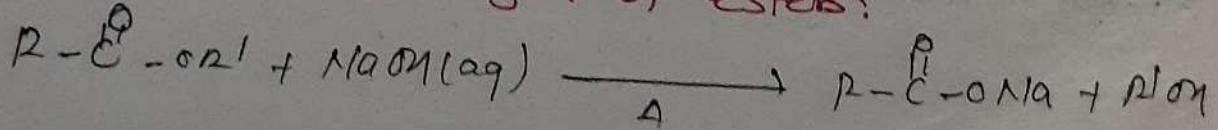
⑥ By Reduction of Esters:



⑦ By Acid catalyzed hydrolysis of Esters:

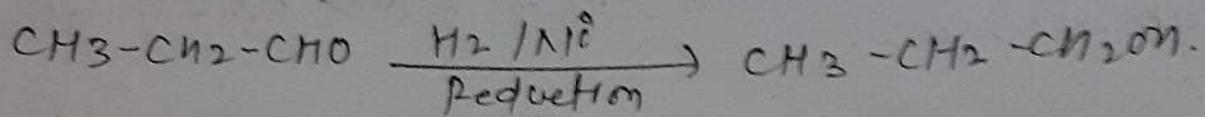
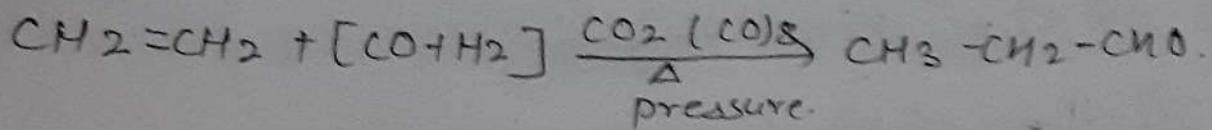


⑧ By Alkaline hydrolysis of Esters:

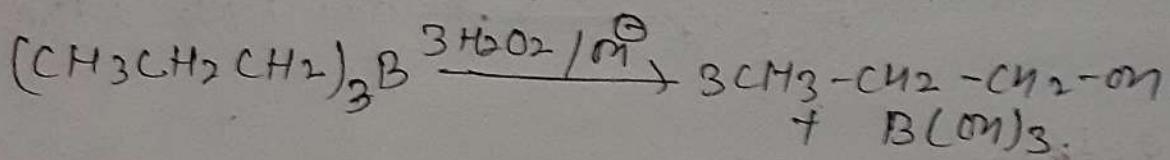
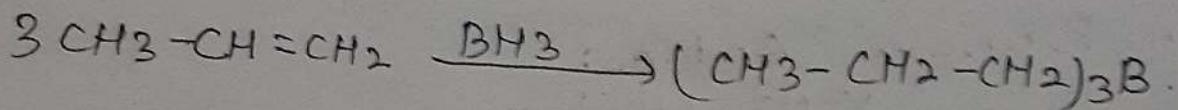


Industrial Preparation of Alcohols:

① Oxo Process: Hydroformylation of Alkene.

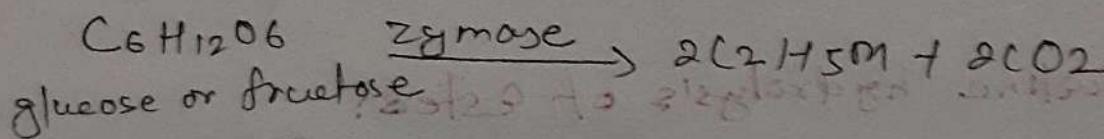
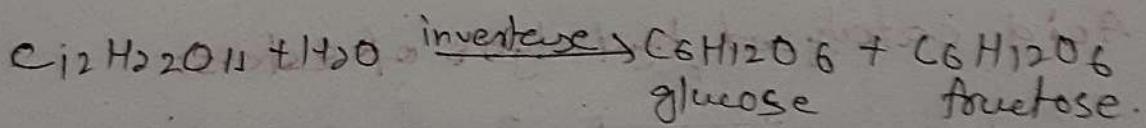


② Hydroboration Oxidation of Ethene.

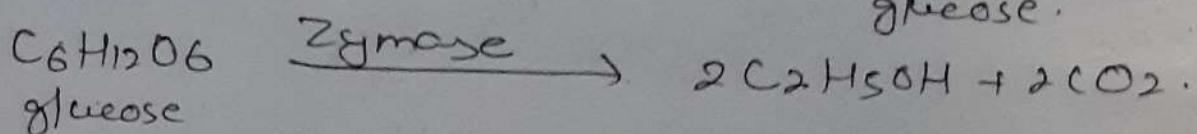
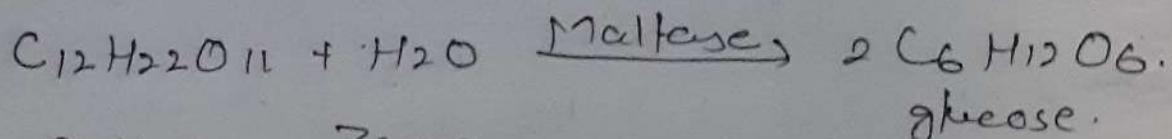
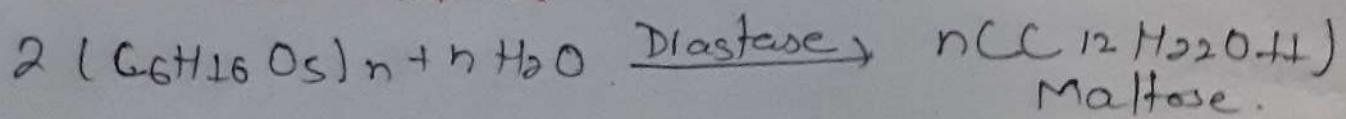


③ Fermentation of Sugar:

① Manufacture of ~~sug~~ethyl alcohol from sugar or molasses.



⑪ Manufacture of ethyl alcohol from starch.
(Wetzmann method)

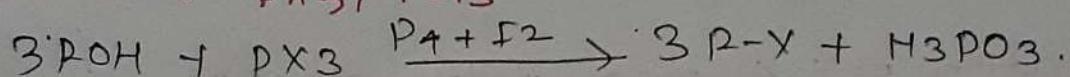


Chemical Reactions of Monoalcoholic Alcohol.

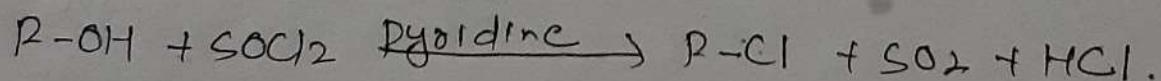
① Rx² with HX.



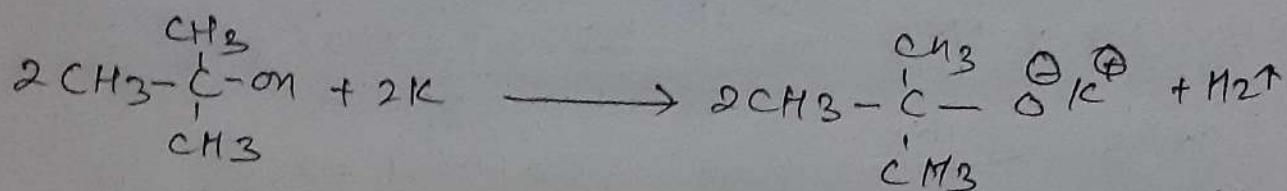
② Rx² with PX₃, PCl₅



③ Rx² with SOCl₂

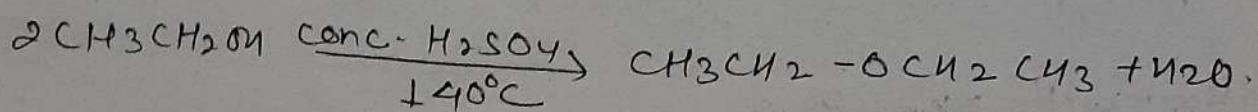
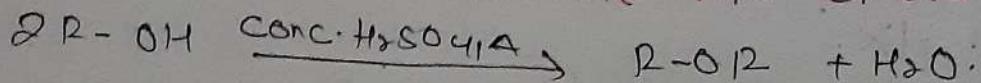


④ Action with Reactive Metals.

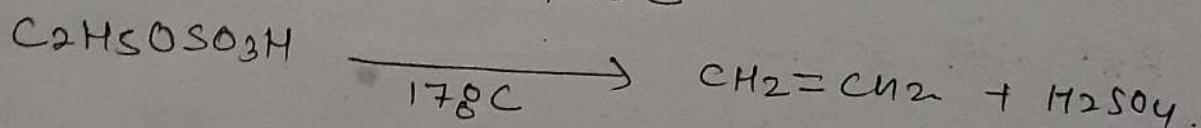
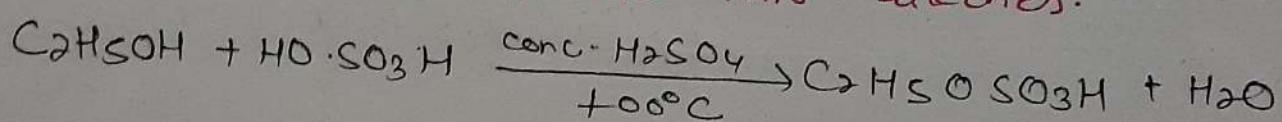


⑤ Dehydration of Alcohols.

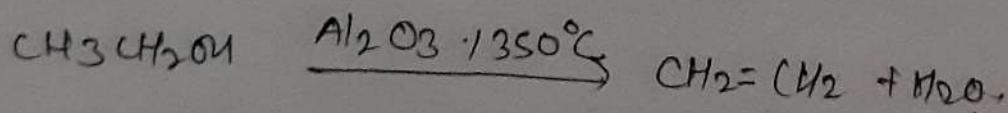
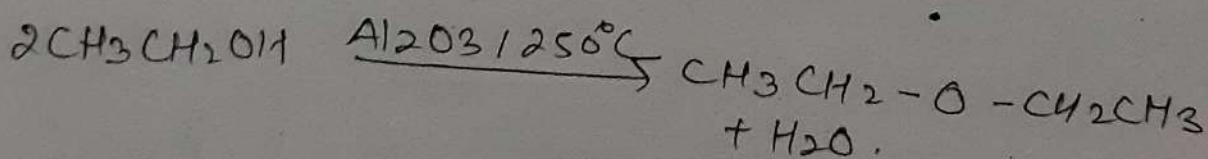
① Dehydration of Alcohols into Ethers



② Dehydration of Alcohols into alkenes.



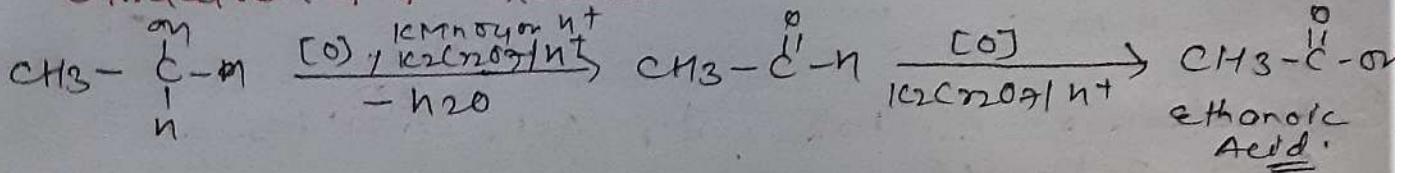
③ Catalytic Dehydration of Alcohols with Alumina.



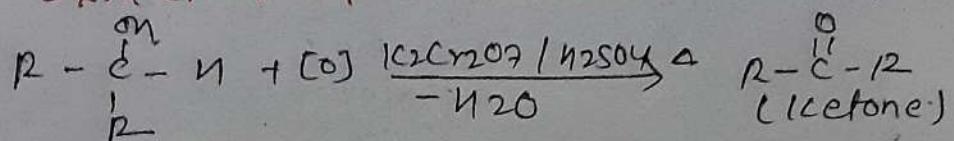
⑥ Oxidation of Alcohols:

① Oxidation using $\text{KMnO}_4 / \text{H}^+$ or $\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}^+$

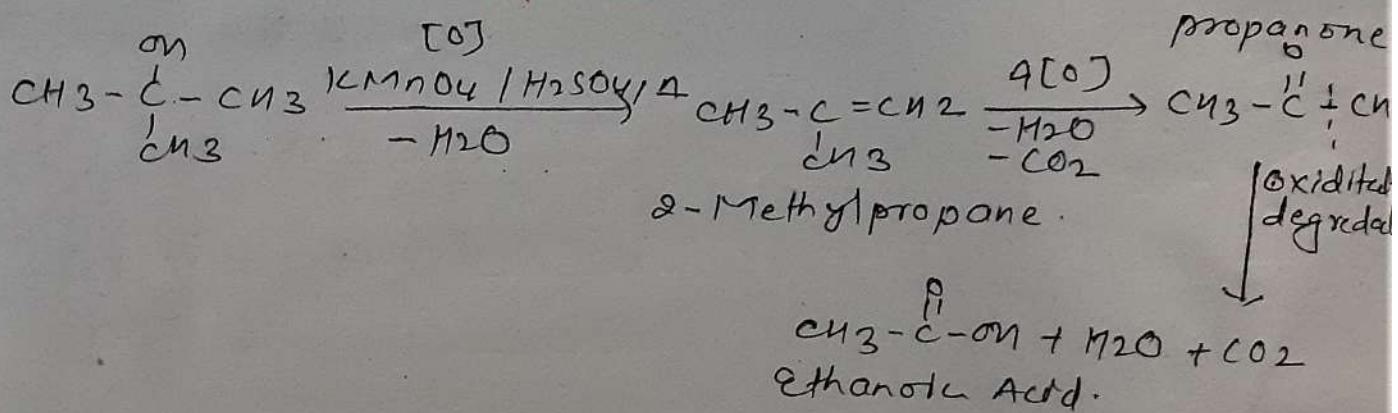
Oxidation of 1° Alcohols.



Oxidation of 2° Alcohols.

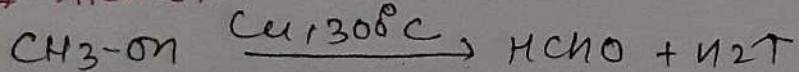


Oxidation of 3° Alcohols.

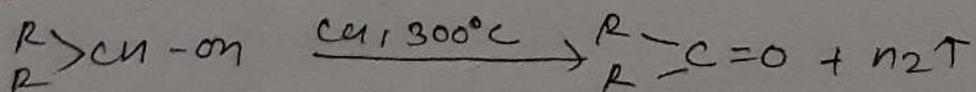


② Catalytic Dehydrogenation of Alcohols (Oxidation).

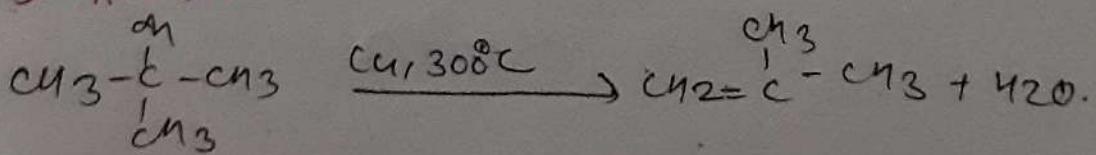
1° Alcohol.



2° Alcohol

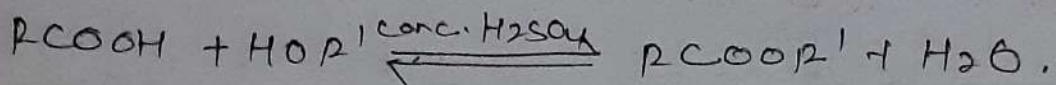


3° Alcohol.

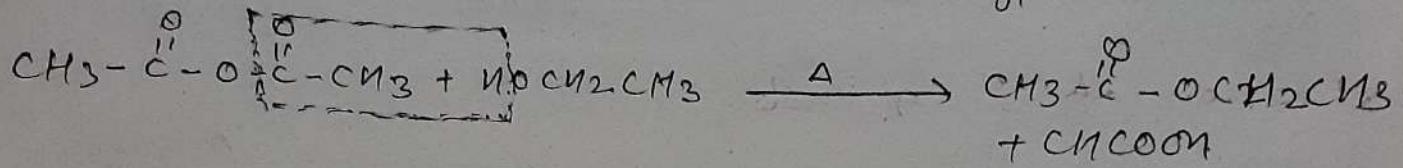
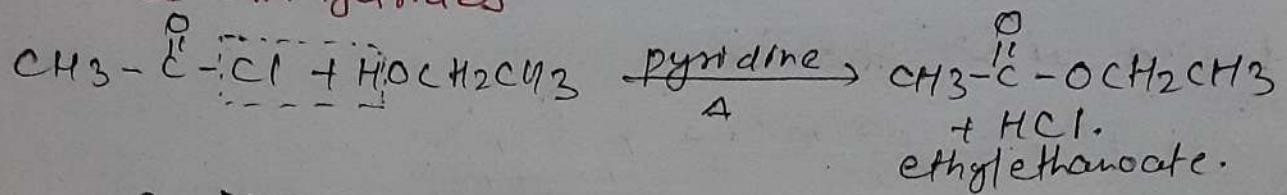


⑦ Esterification reaction:

⑧ Rxn of Alcohols with carboxylic acids:

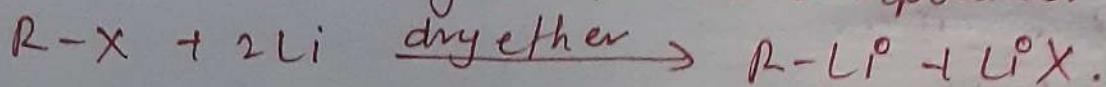


⑨ Reaction of Alcohols with Acid chlorides and Acid Anhydrides

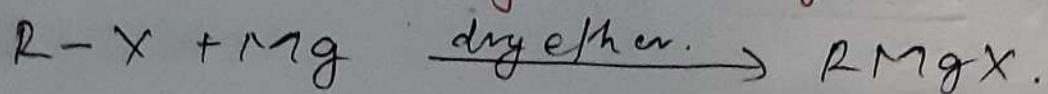


ORGANO Metallic compound.

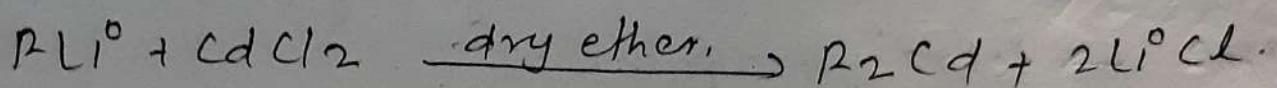
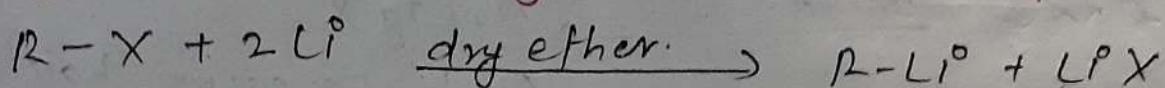
① Preparation of organolithium compounds.



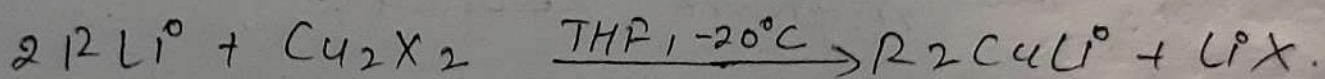
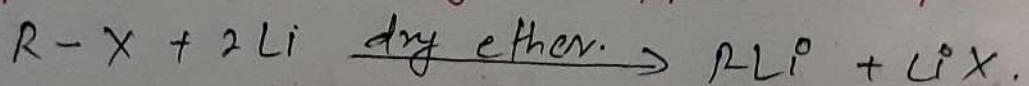
② Preparation of Grignard reagent.



③ Preparation of organocadmium compounds.



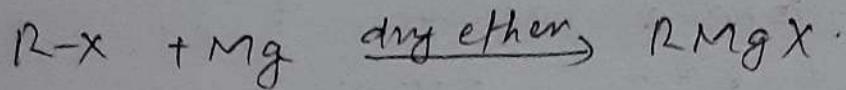
④ Preparation of organocopper compound.



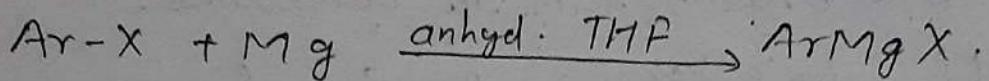
Grignard Reagent ($R\text{MgX}$).

Preparation ~~from~~

① From haloalkanes.



② Preparation from haloarenes.

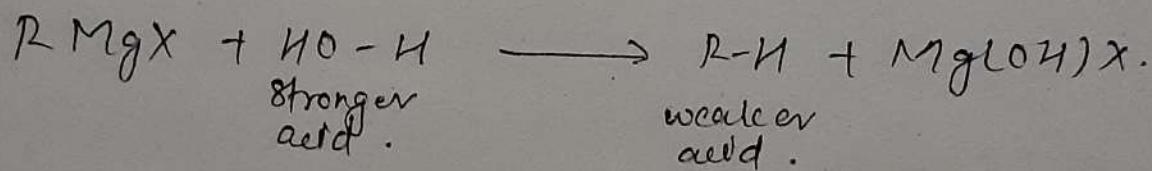


Aryl magnesium halide

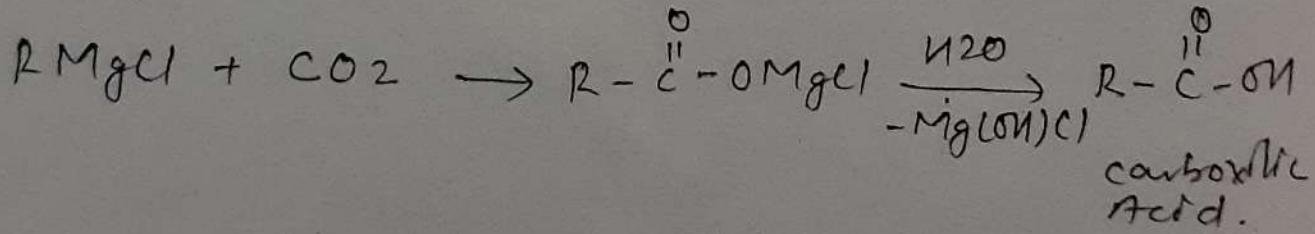
THF \rightarrow tetrahydrofuran.

Reactions of Grignard Reagent.

① Reaction with H_2O .

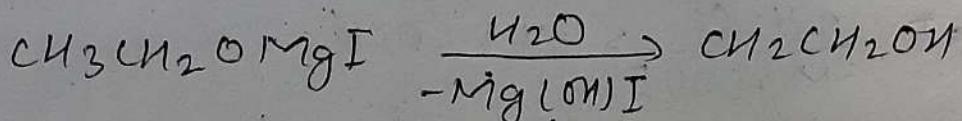
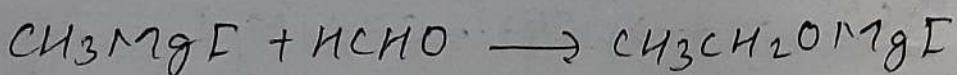
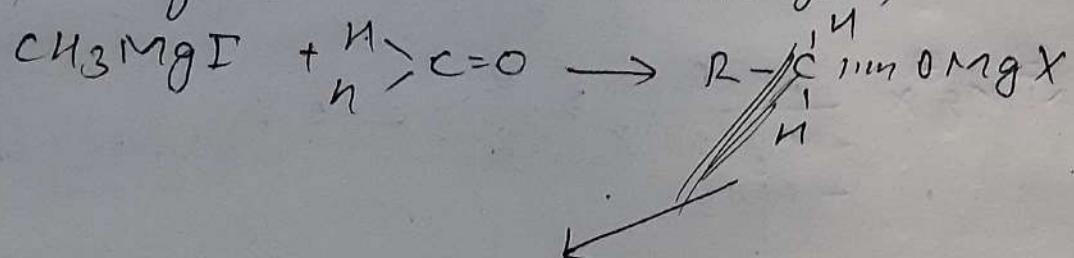


② $R\text{X}_2$ with CO_2 .

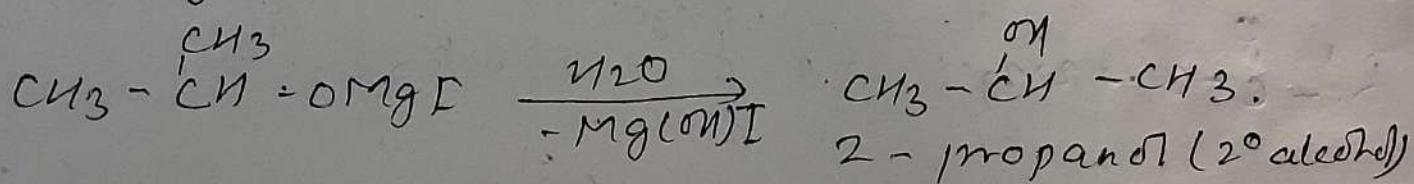
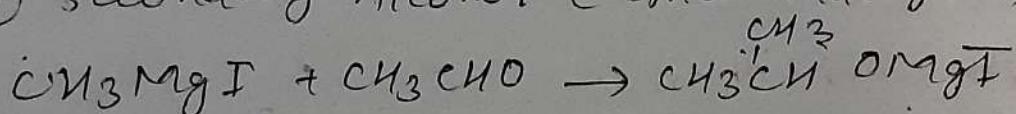


(III) Reaction with aldehydes and ketones:
Grignards synthesis of alcohols.

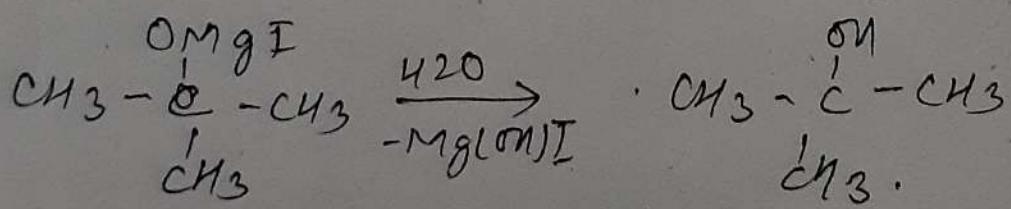
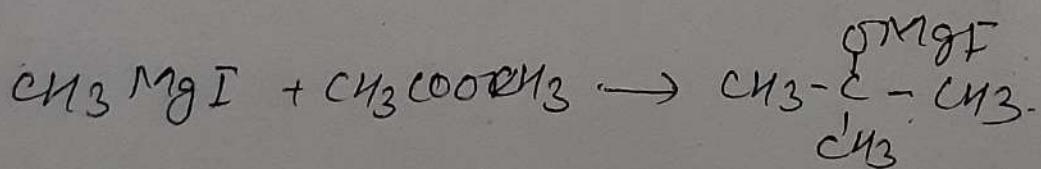
(I) Primary Alcohol (≠ formaldehyde)



(II) Secondary Alcohol (other aldehydes)

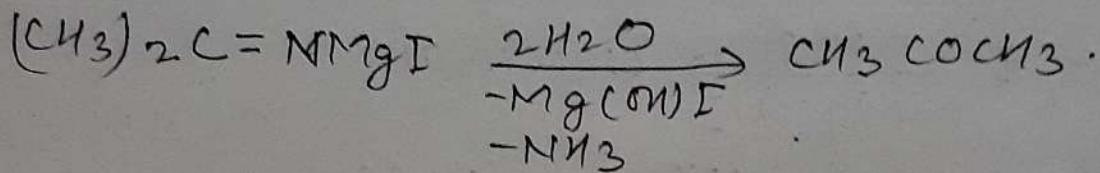
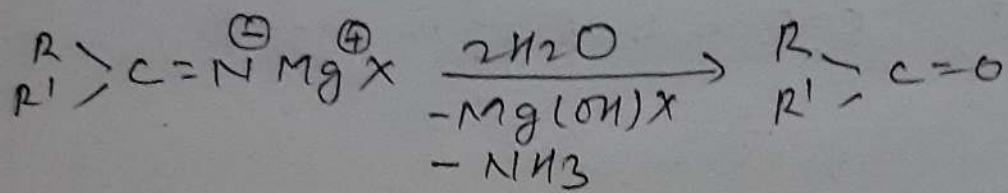
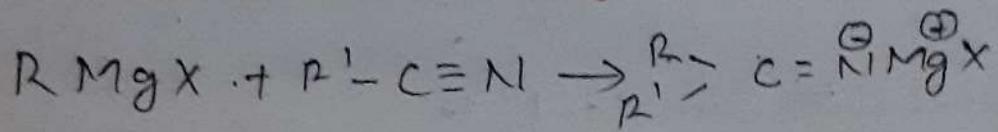


(III) Ketones yields 3° alcohols.

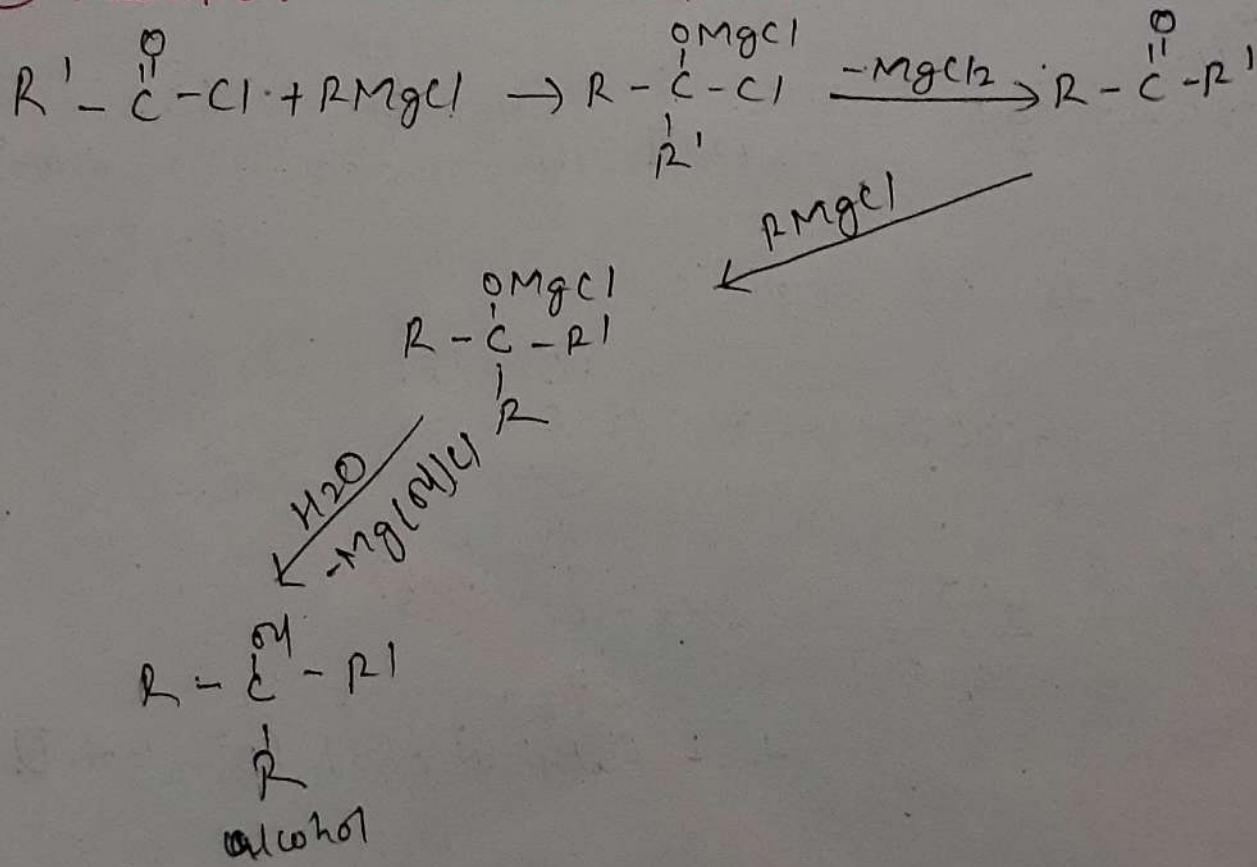


tert Butyl alcohol (3° alcohol)

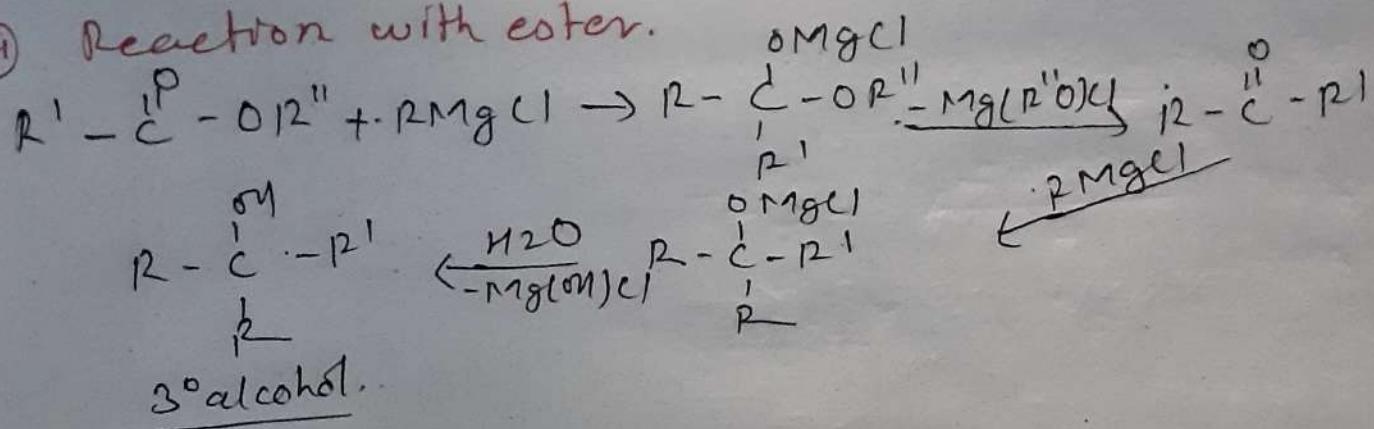
④ Reaction with alkyl cyanide.



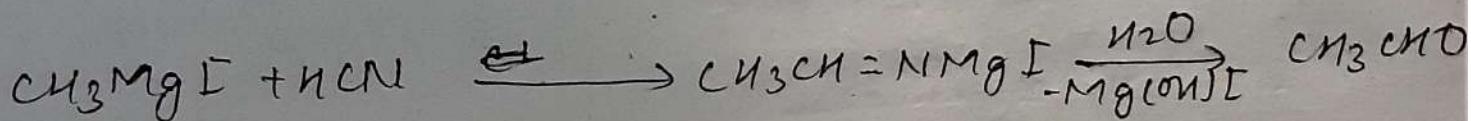
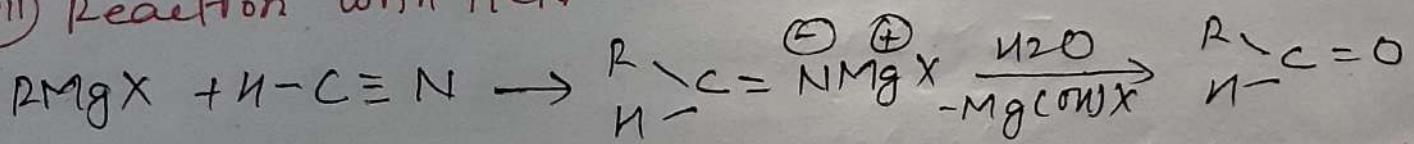
⑤ Reaction with Acid chloride.



(vi) Reaction with ester.



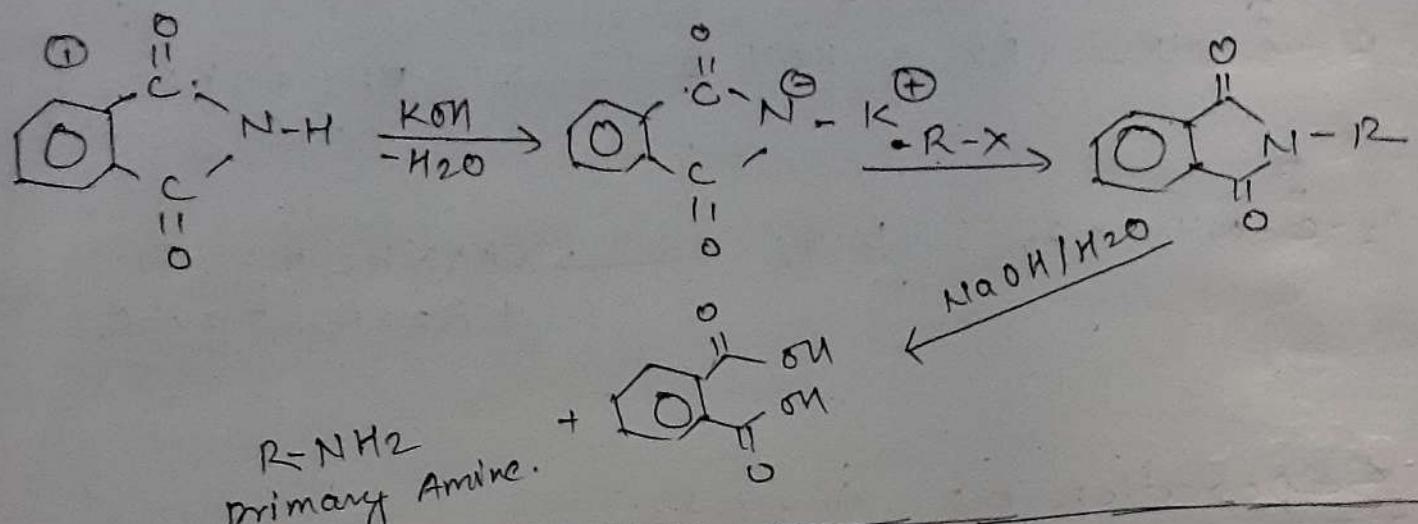
(vii) Reaction with HCN



Amines

General Methods of Preparation of
Primary Amines:

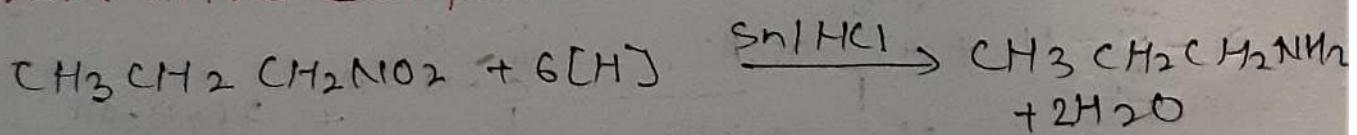
(I) From Haloalkane: (Gabriel phthalimide synthesis).



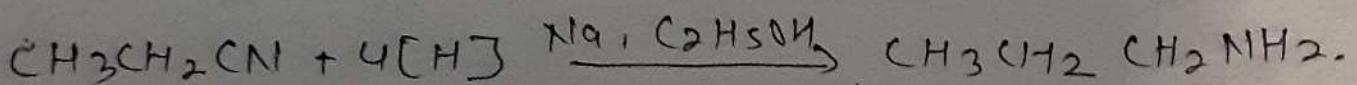
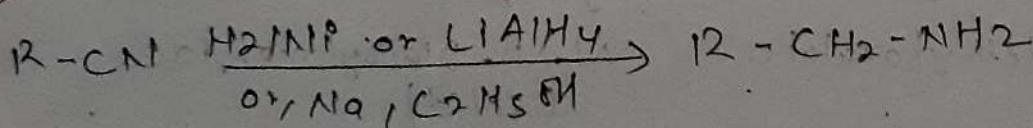
(II)



(III) From nitro compounds

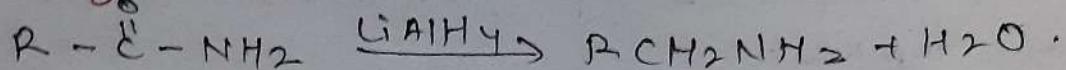


(IV) From nitriles (Cyanides)

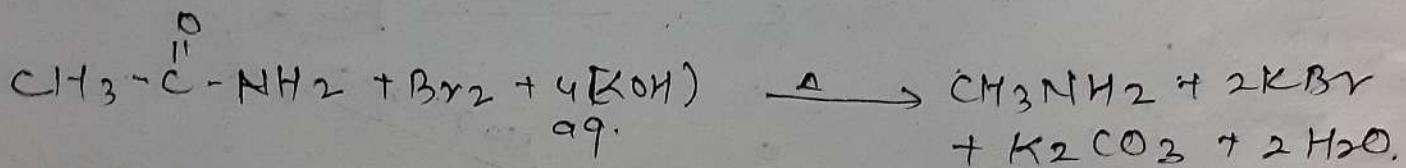
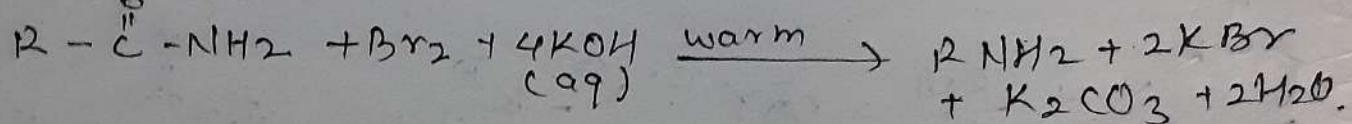


(iv) From amides.

(a) By Reduction.



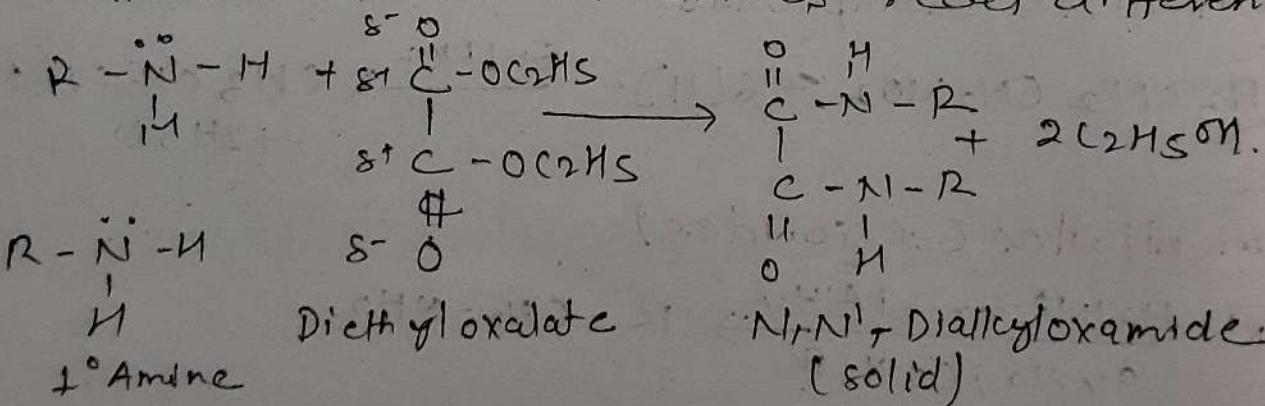
(b) By Hofmann hypobromite rearrangement.
/ Hofmann reaction.



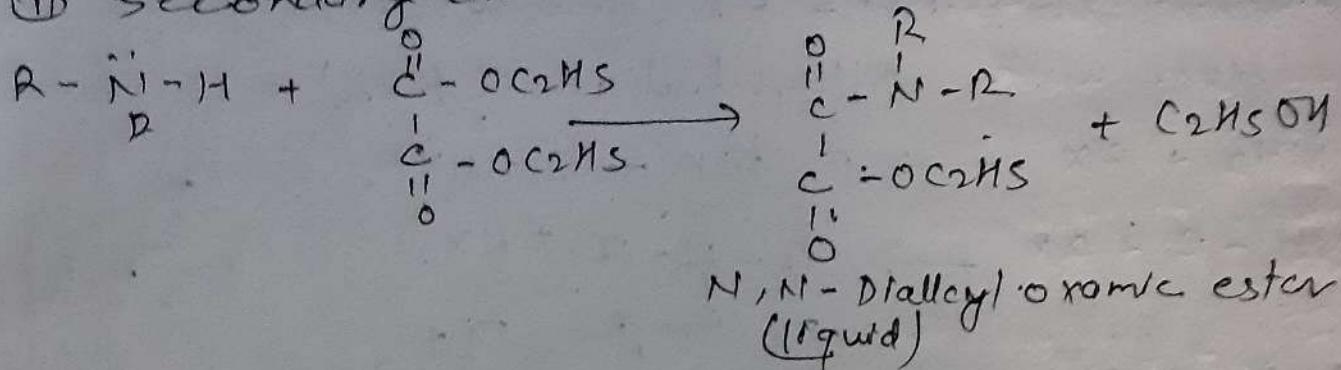
Separation of Amines.

(i) Hoffmann Method.

STEP 1: Mixing with Diethyl Oxalate.
In this method, the mixture of amines is treated with diethyl oxalate where different classes of amines react differently.

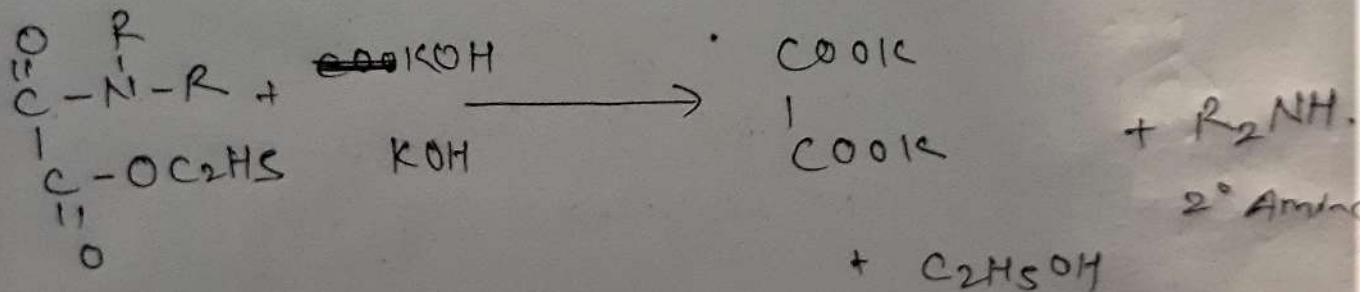
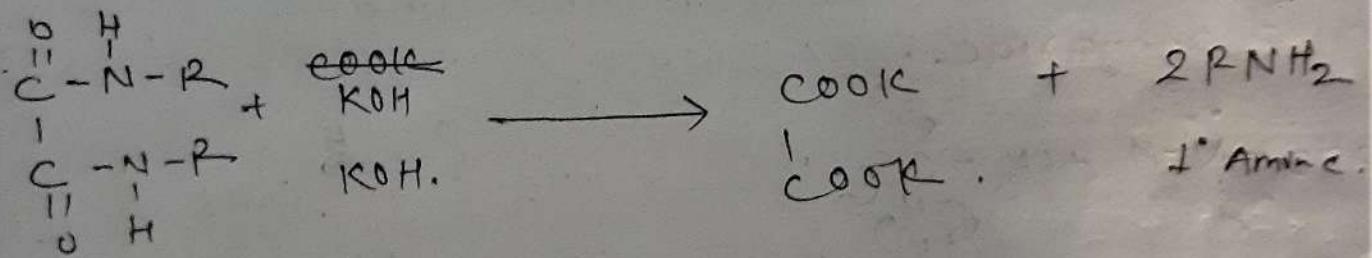


① Secondary amine



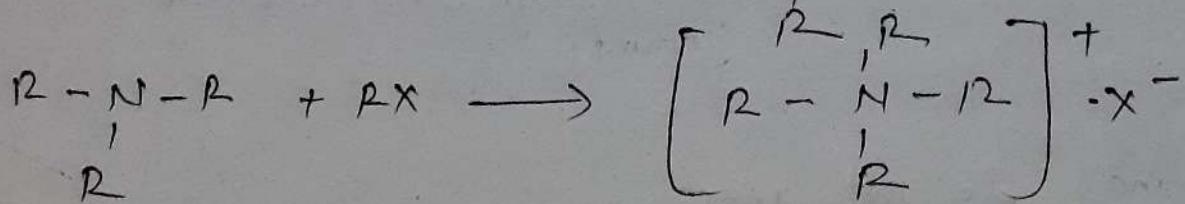
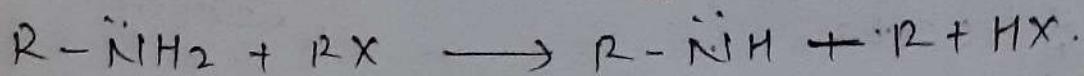
② Tertiary amine. do not react.

③ Separation of amines. with ~~COOK~~ KOH .



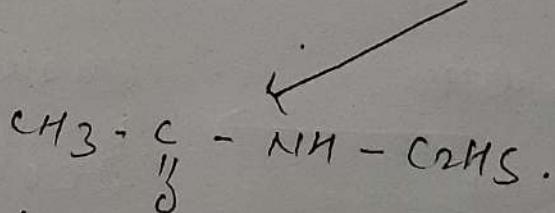
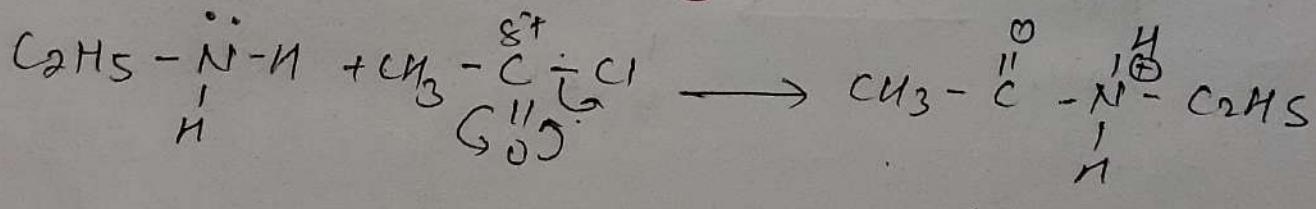
Chemical Reactions of Amines:

① Reaction with Alkyl halides ($R-X$)



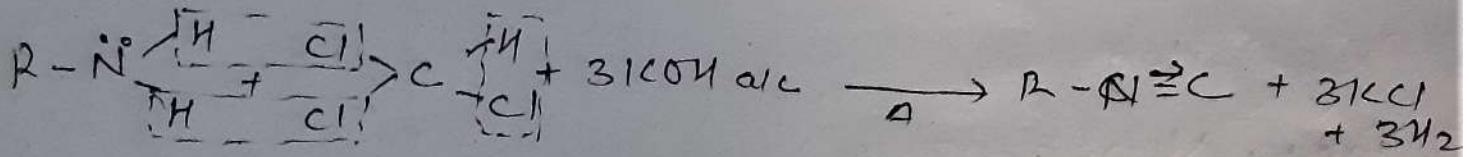
Quaternary Ammonium salt.

② Reaction with acid chloride and acid anhydride - (Acylation)



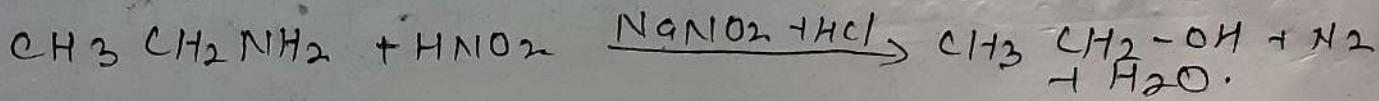
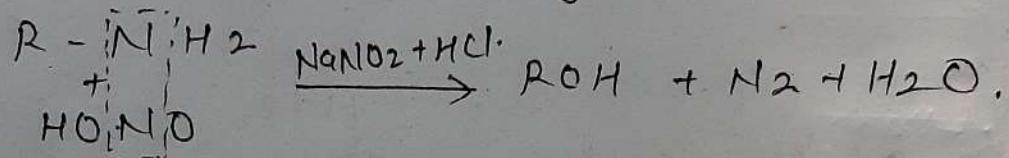
(N -methyl ethanamide)

③ Reaction with Chloroform: Carbylamine test.



④ Reaction with Nitrous Acid.

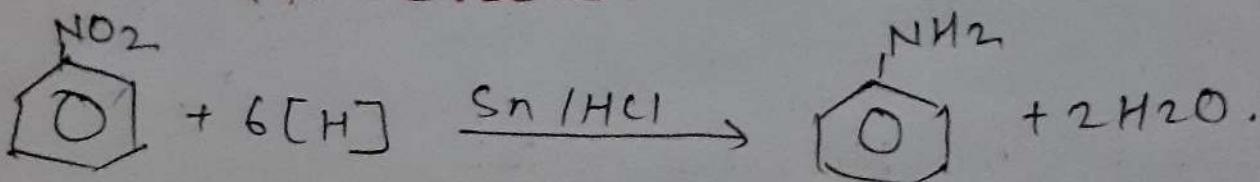
① Reaction of primary amines.



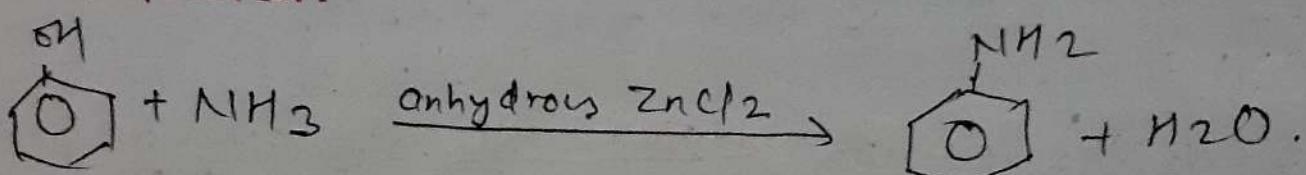
Aromatic Amines.

Preparation:

① From Nitrobenzene:

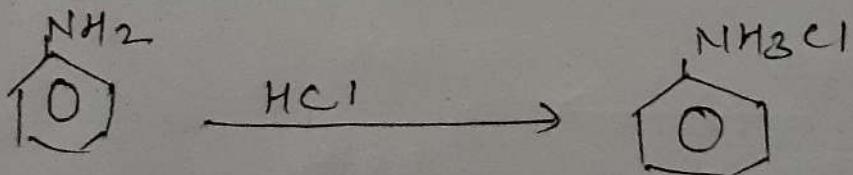


② From Phenol.



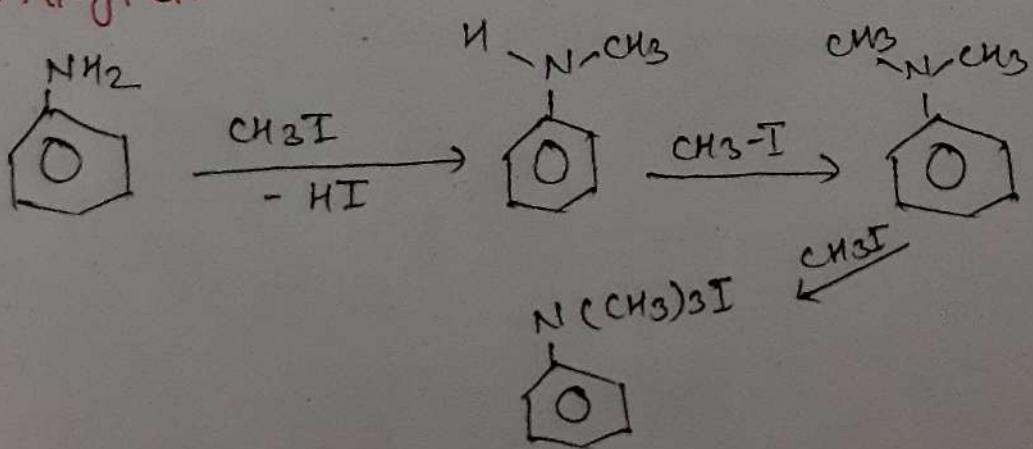
Chemical Properties of Aniline.

① Basic Nature.

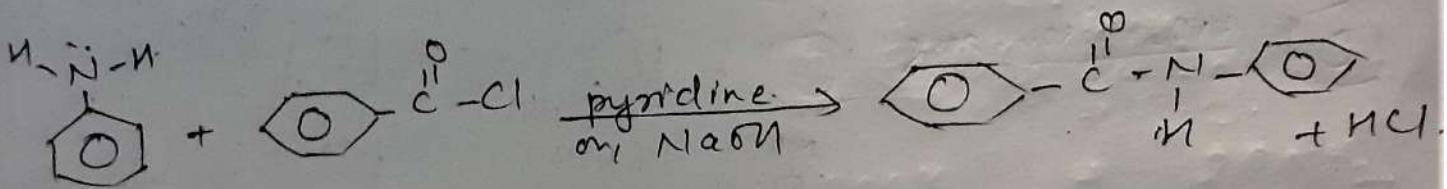
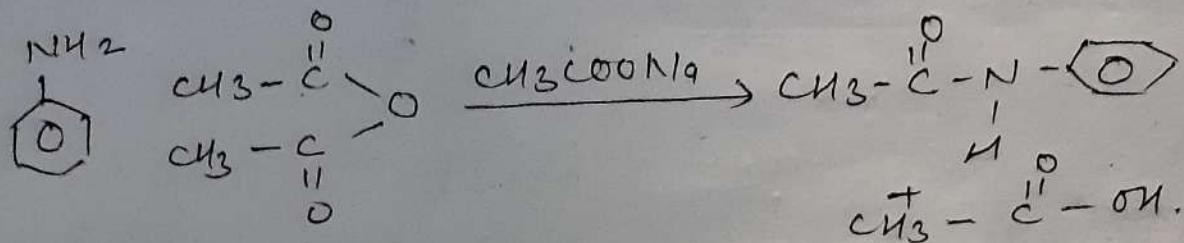
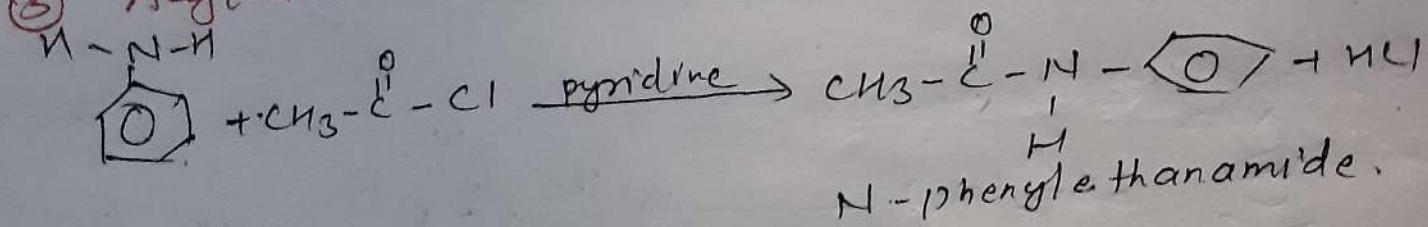


Anilinium chloride.
(Aniline hydrochloride)

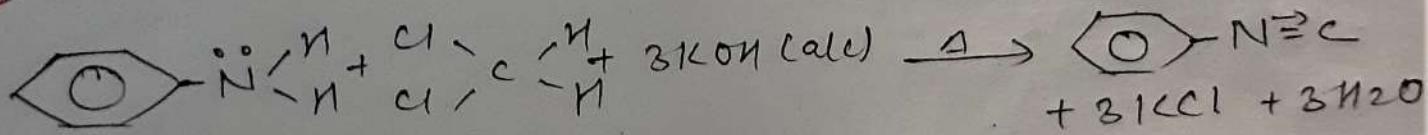
② Alkylation.



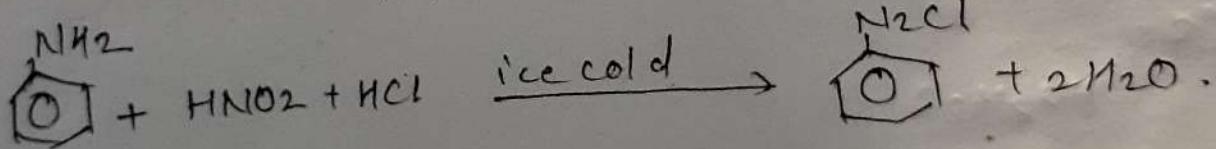
③ Acylation:



④ Carbamino Reaction:

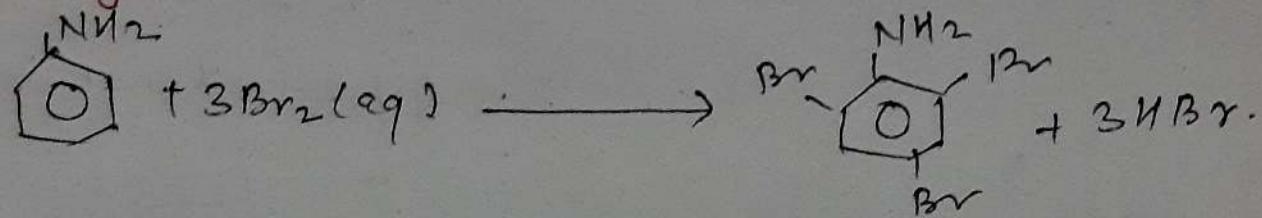


⑤ Diazotization:

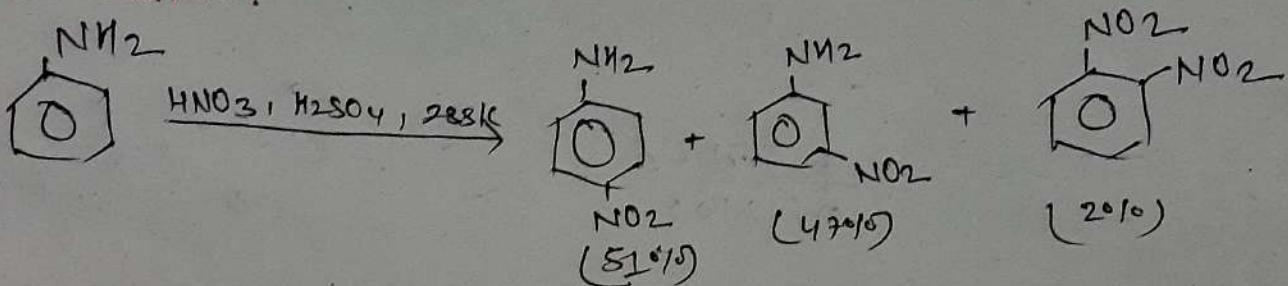


Electrophilic substitution Reactions.

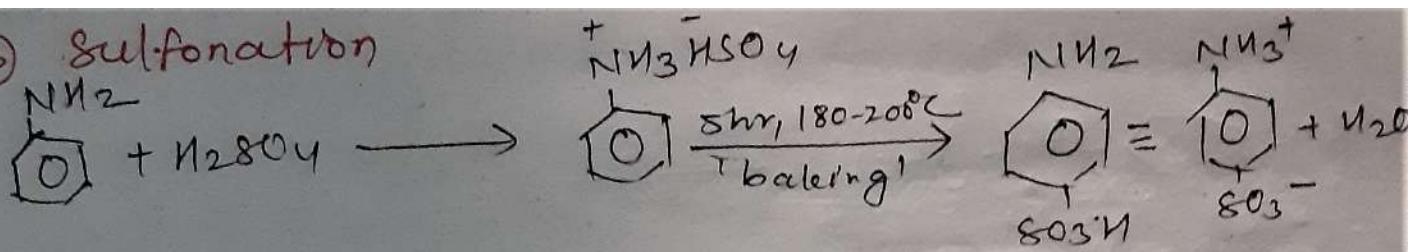
① Halogenation.



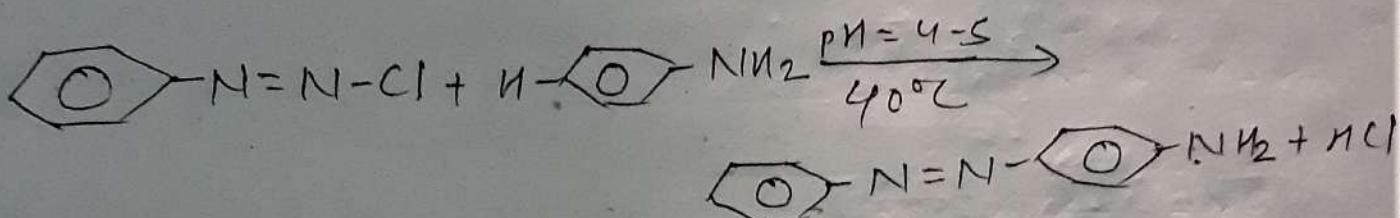
② Nitration.



③ Sulfonation



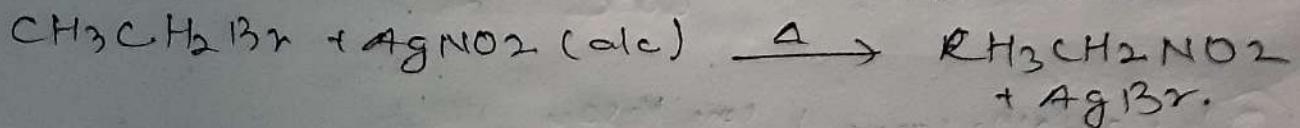
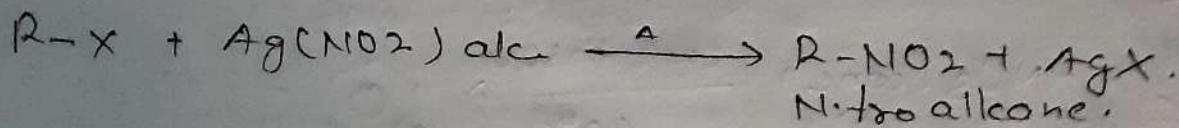
④ Reaction with diazonium salt : Coupling Reaction:



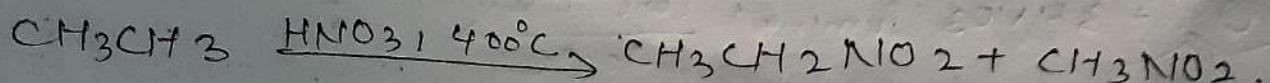
Nitro Compounds

Methods of Preparation:

① From Halo Alkanes.



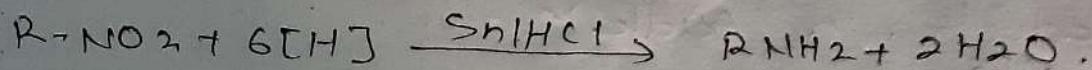
② From Alkenes : Nitration.



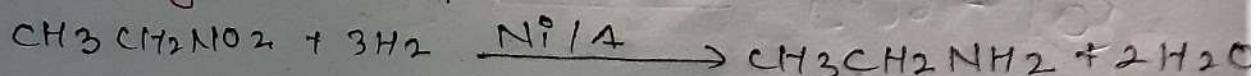
Chemical Reactions

① Reduction

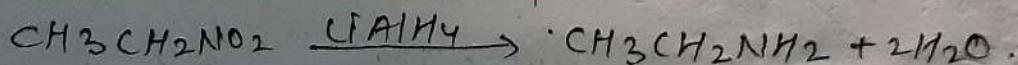
① Reduction in acidic medium:



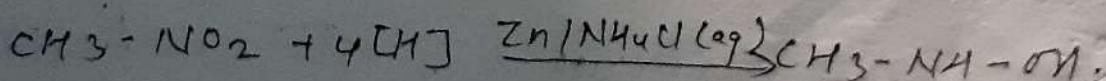
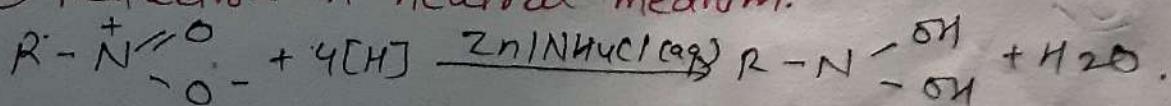
② catalytic reduction:



③ Reduction with LiAlH₄



④ Reduction in neutral medium.

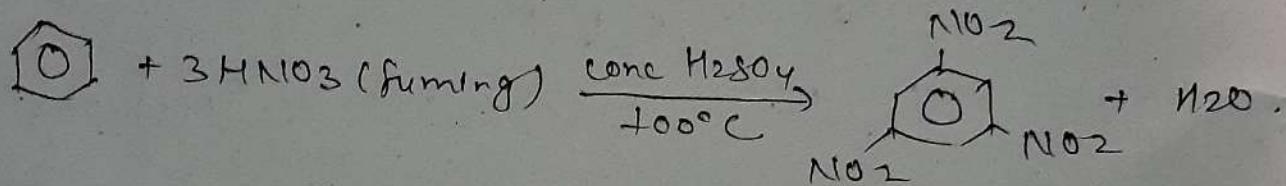
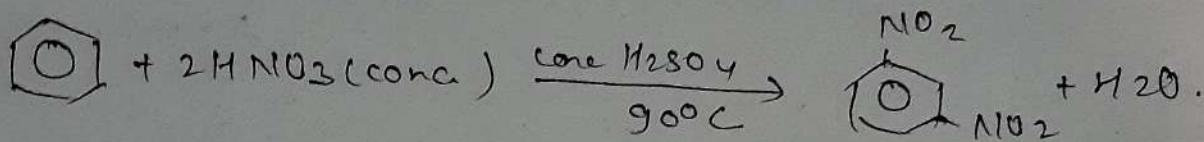
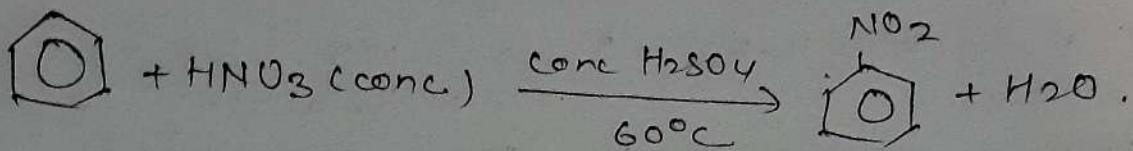


(Baller-Mulliken's Test)

Nitrobenzene.

Method of Preparation.

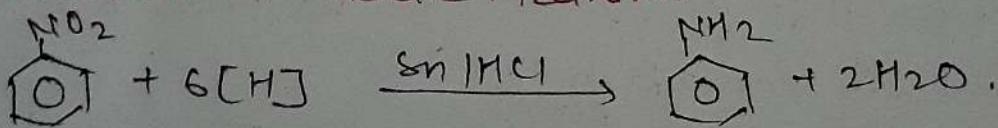
① From Benzene:



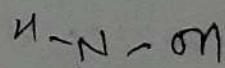
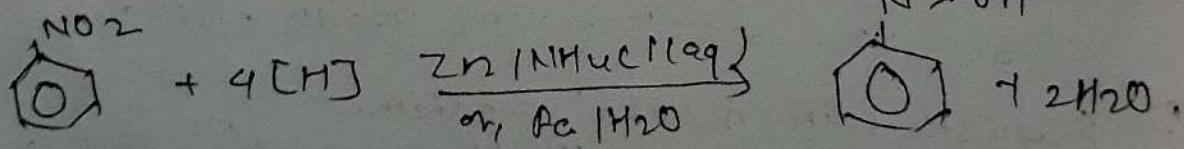
Chemical Properties.

→ Reduction in Different Mediums:

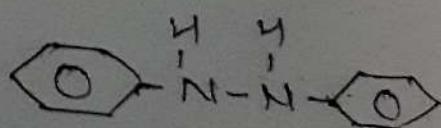
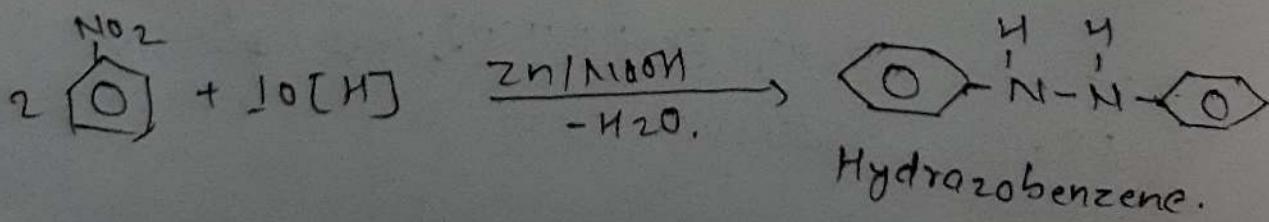
① Reduction in Acidic Medium.



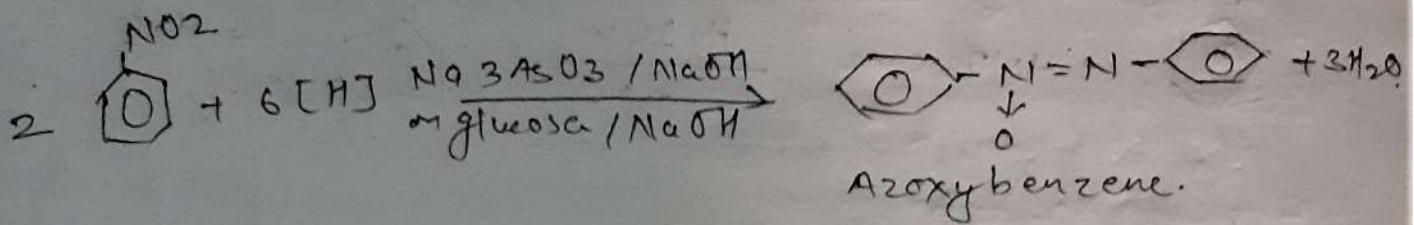
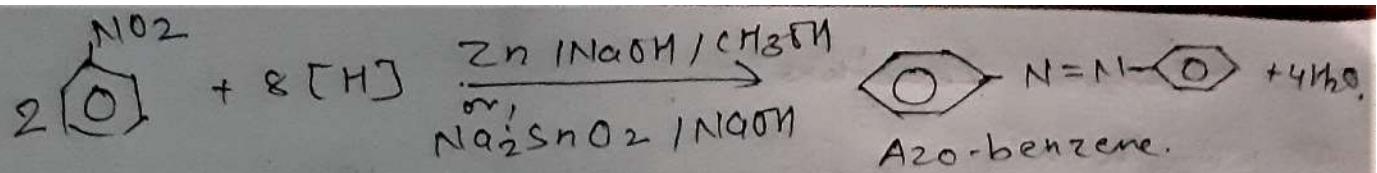
② Reduction in Neutral Medium:



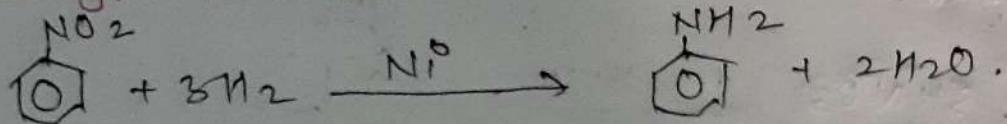
③ Reduction in alkaline medium.



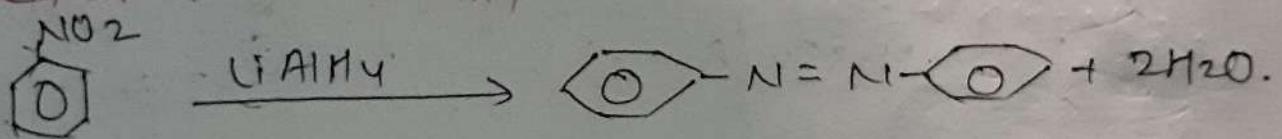
Hydrazobenzene.



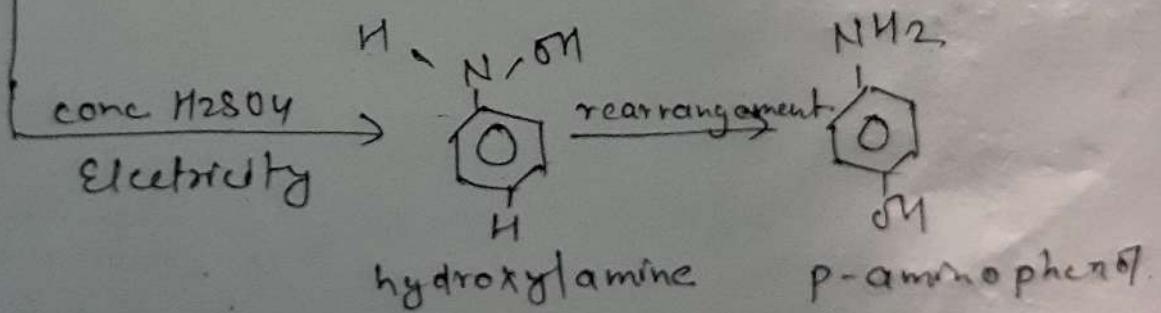
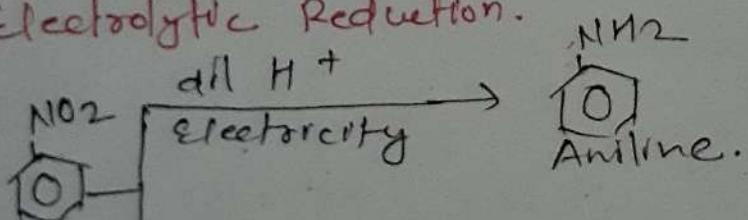
④ Catalytic Reduction:



⑤ Reduction with LiAlH₄

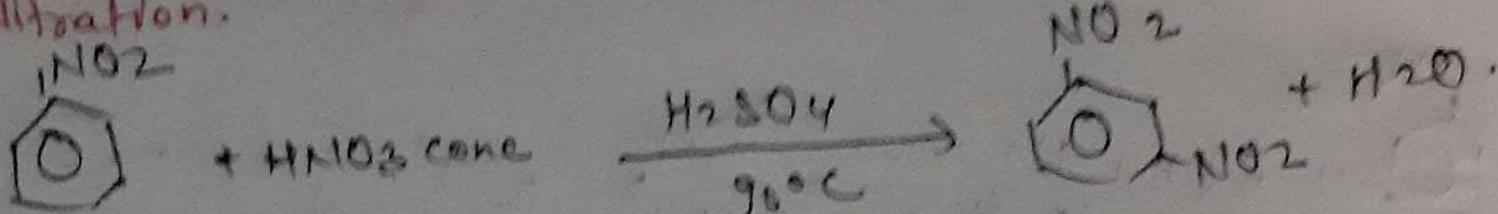


⑥ Electrolytic Reduction.

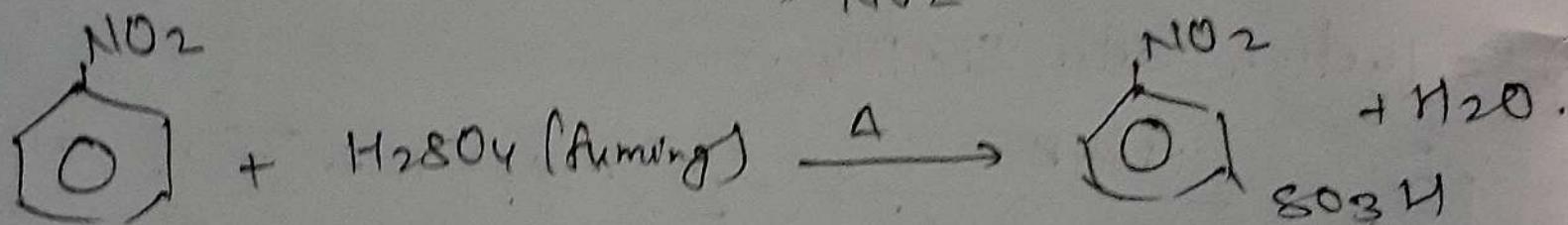
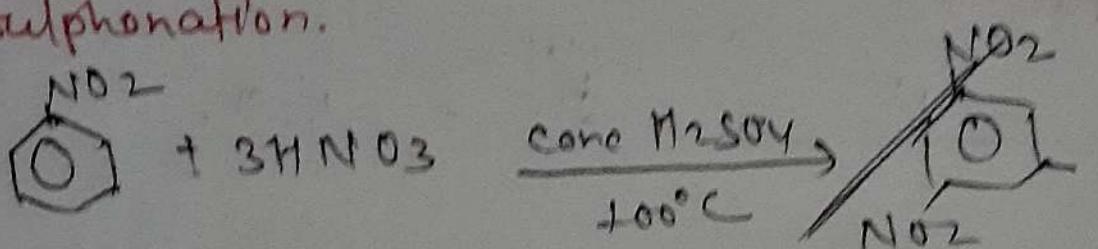


Other Reactions:

① Nitration.



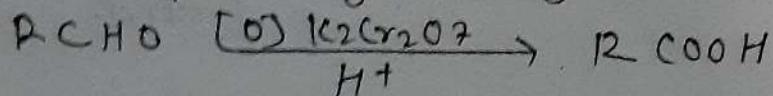
② Sulphonation.



Carboxylic Acid and Their Derivatives.

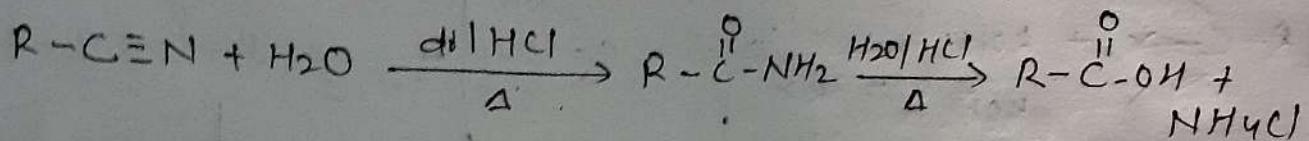
Methods of Preparation of Monocarboxylic Acids.

① From primary Aldehydes:

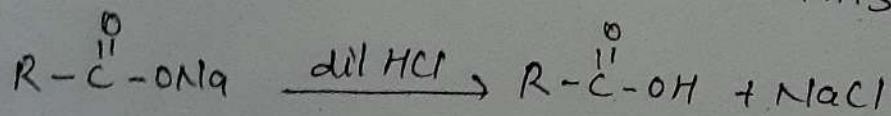
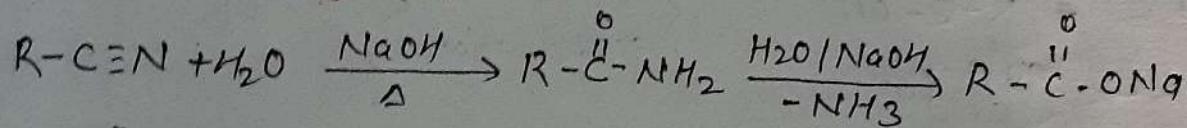


② From Nitriles,

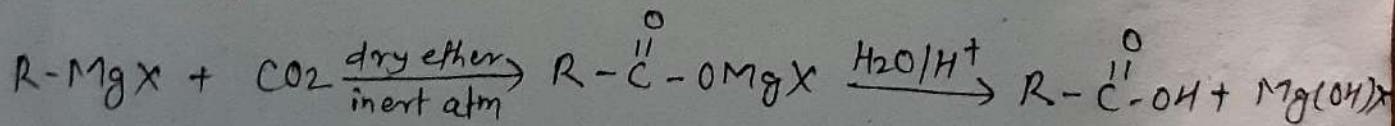
① Acidic hydrolysis of nitrile:



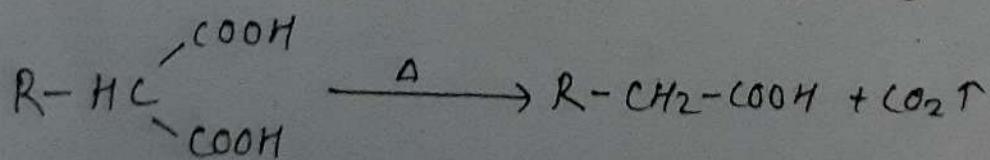
② Alkaline hydrolysis of nitrile:



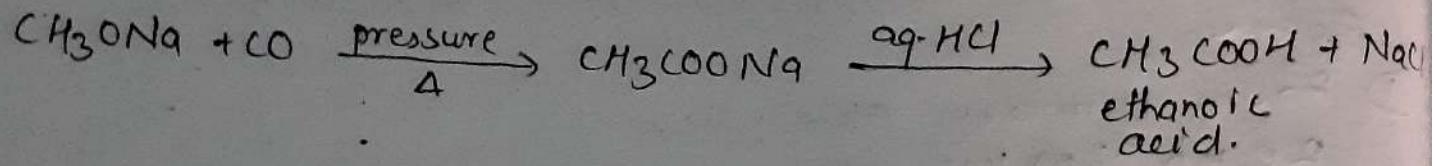
③ From Grignard Reagent.



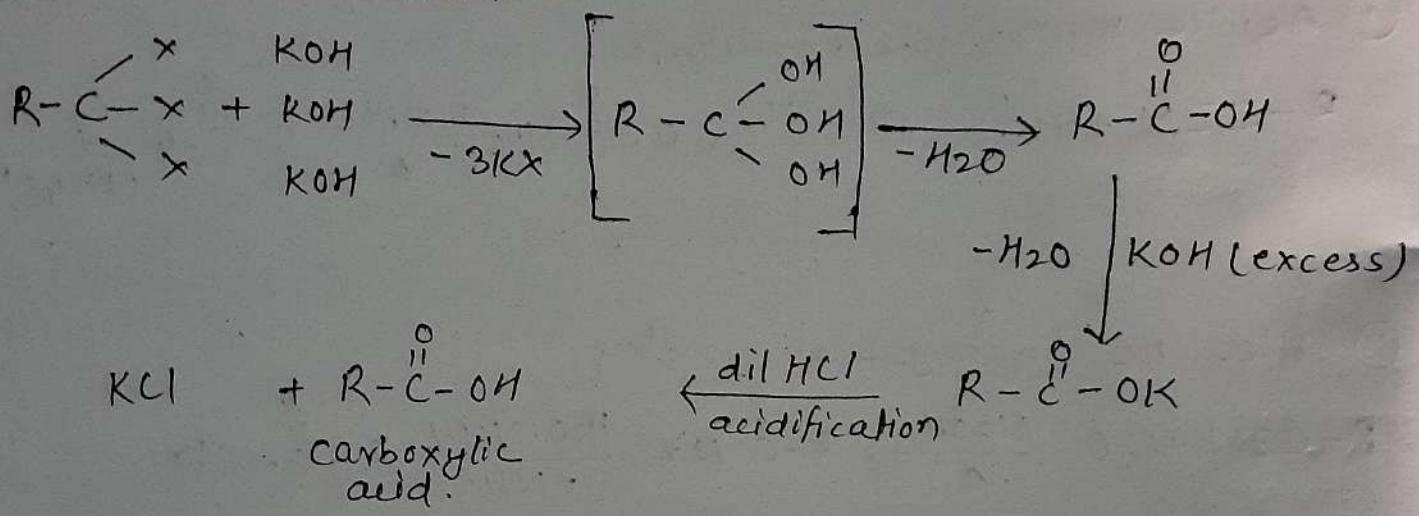
④ From Dicarboxylic Acids (Decarboxylation)



5. From sodium alkoxide

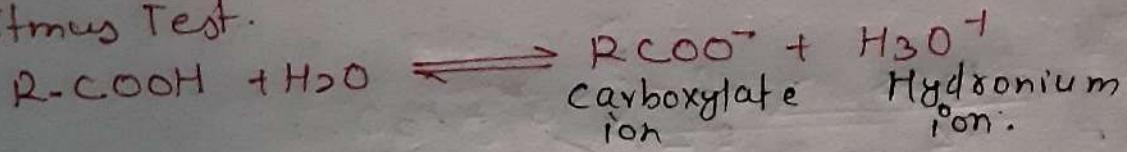


⑥ From Trihaloalkanes:

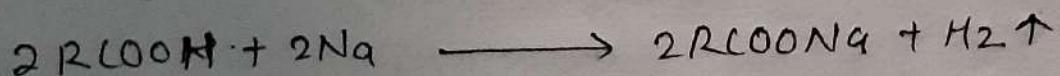


Chemical Reactions :-

① Litmus Test.



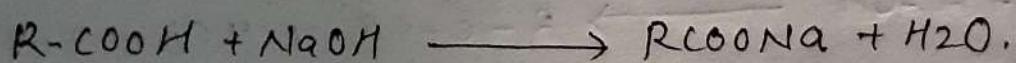
⑪ Reaction with Active metals:



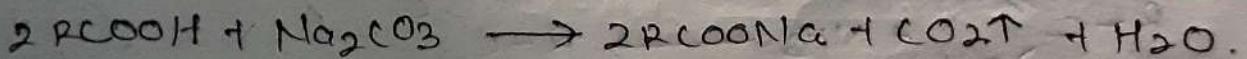
(iii) Reaction with Metal oxides:



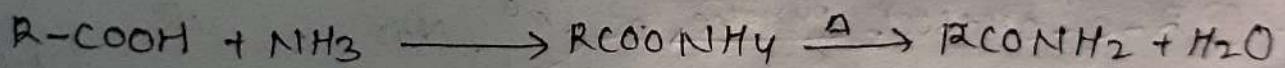
Reaction with caustic alkali



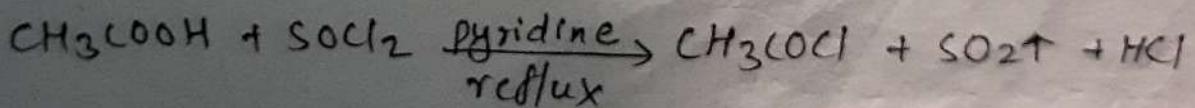
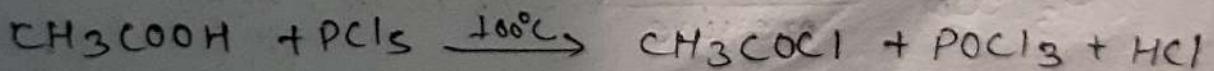
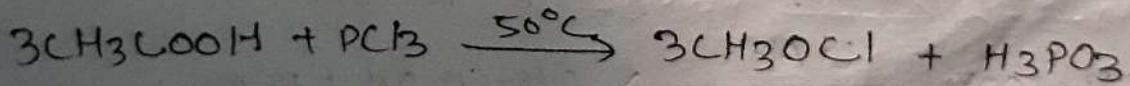
⑤ Reaction with metal Carbonates and bicarbonate



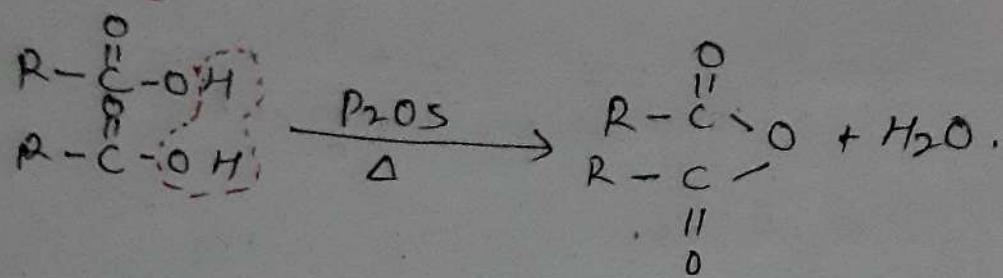
⑥ Reaction with Ammonia.



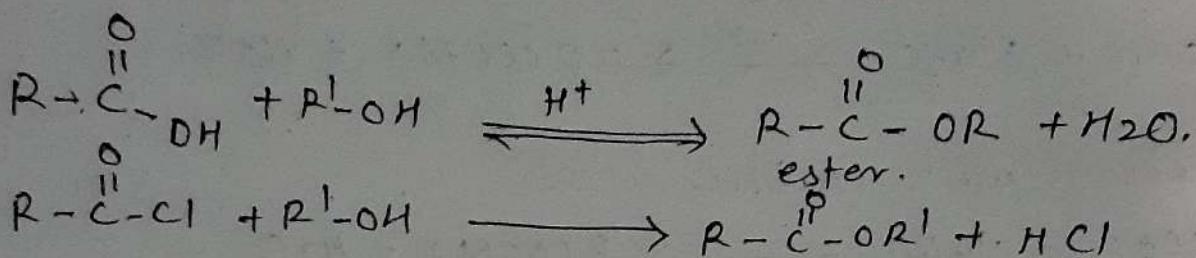
Q11 Formation of Acid chloride.



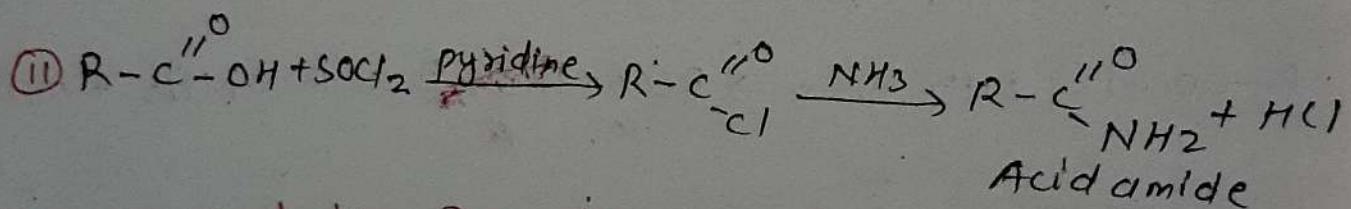
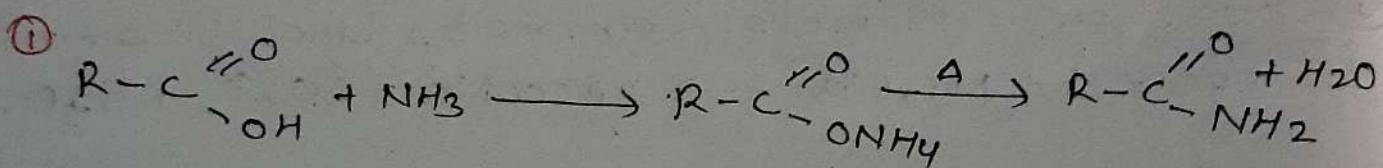
(viii) Dehydration of Carboxilic Acid



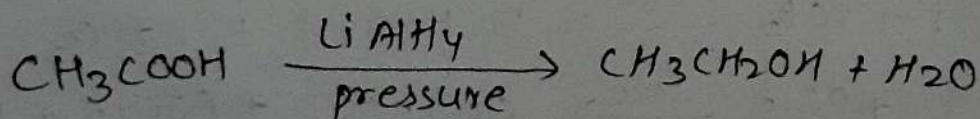
(ix) Formation of Ester: Esterification.



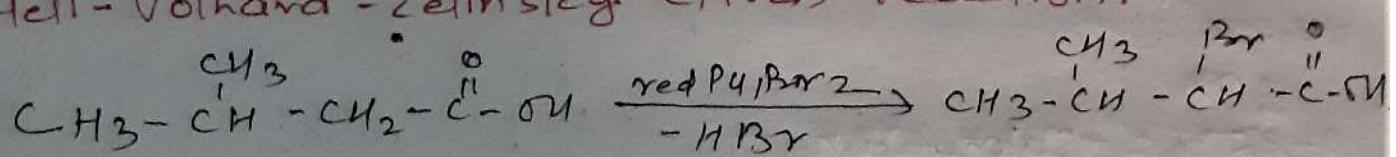
(x) Formation of Amide



(xi) Partial Reduction: Formation of Alcohol

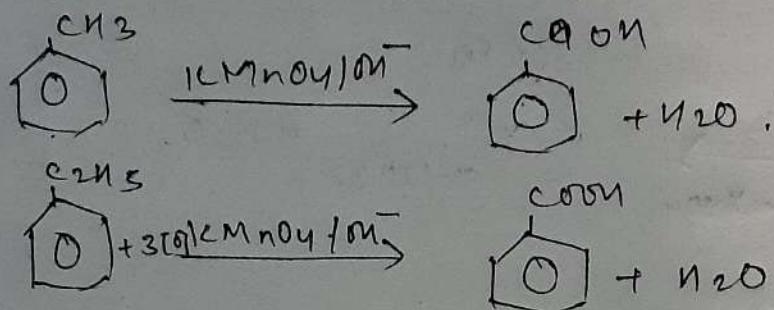


Hell-Volhard-Zelinsky (HVZ) reaction.

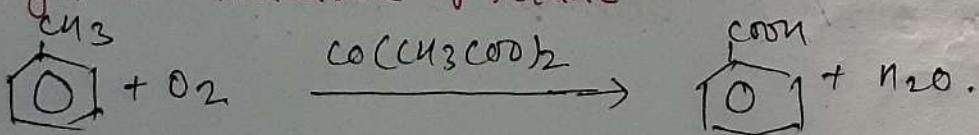


Preparation of Benzoic Acid.

① By Oxidation of Alkyl Benzene.

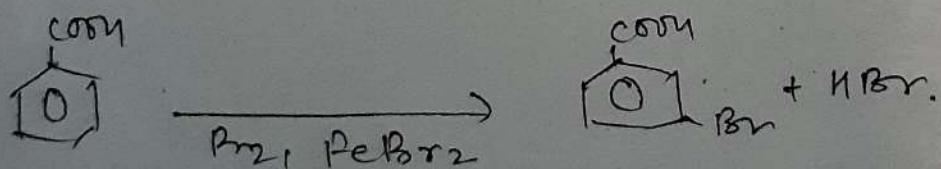


② By the oxidation of Toluene

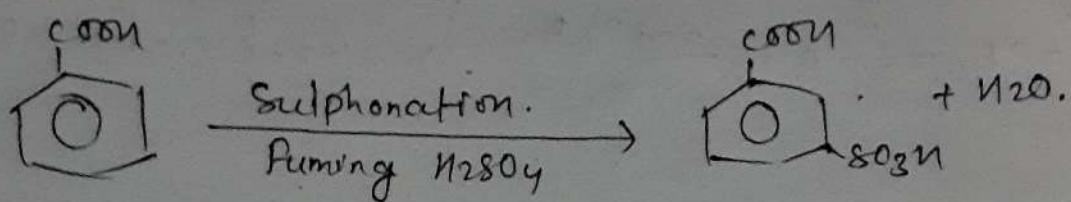


Electrophilic Substitution Reaction of Benzoic Acid.

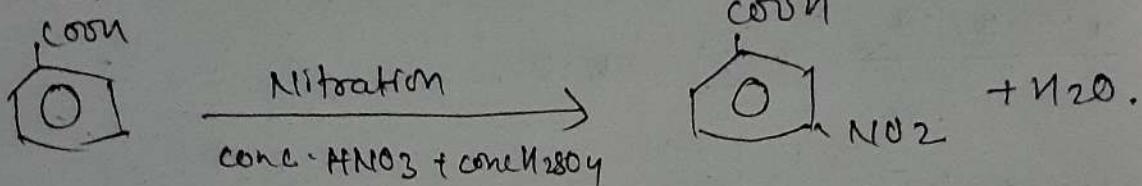
① Bromination



Sulphonation:

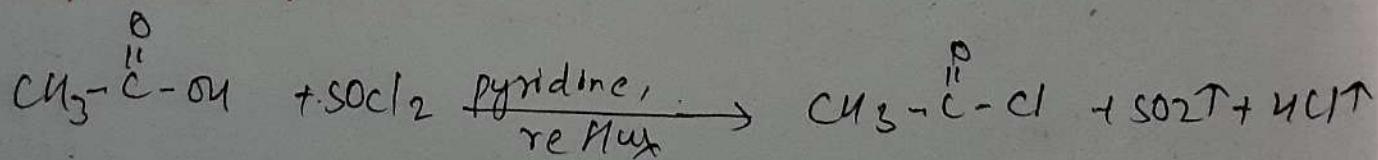


Nitration:

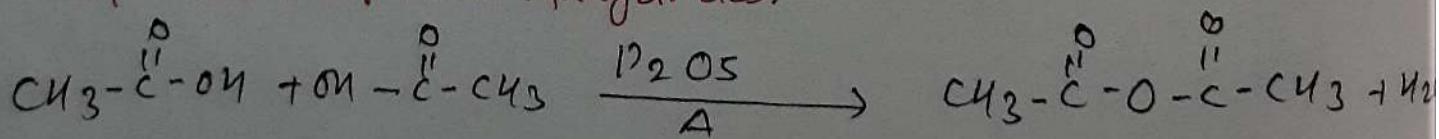


Preparation of Acid Derivatives from Carboxylic Acids.

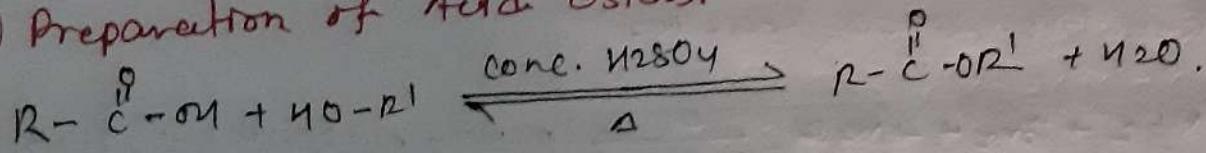
① Preparation of Acid Chlorides



② Preparation of Acid Anhydrides.

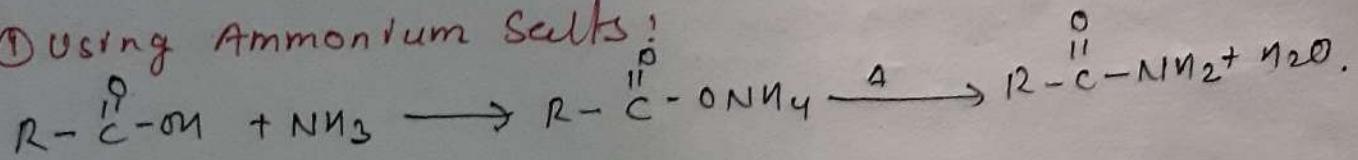


(ii) Preparation of Acid Esters:

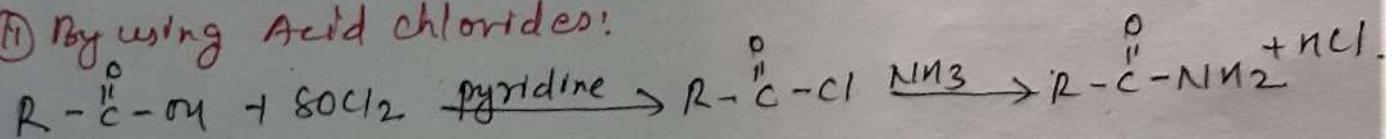


(iv) Preparation of Acid Amides:

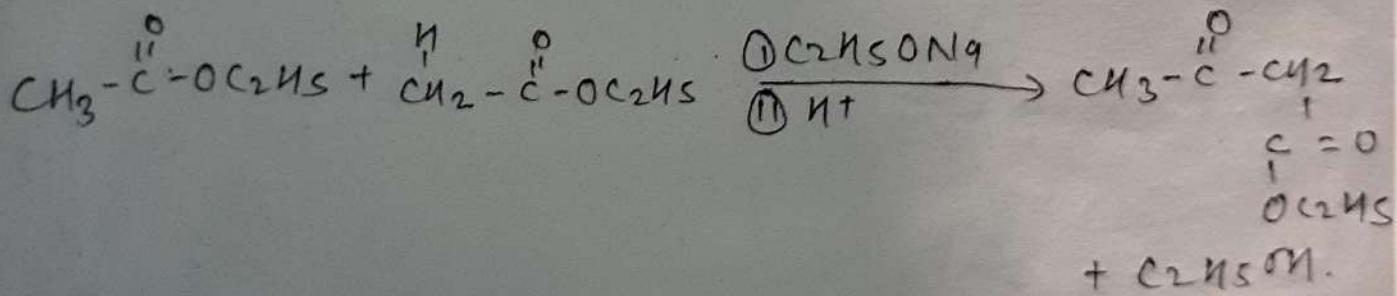
① Using Ammonium Salts:



② By using Acid chlorides:



Claisen condensation.

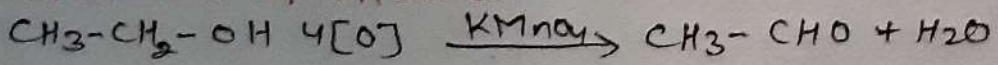


Aldehydes and Ketones

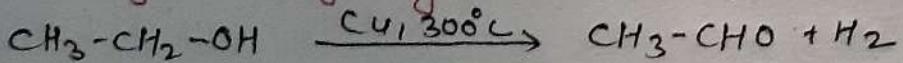
Methods of Preparation of Aldehydes & Ketones.

(I) From Alcohols.

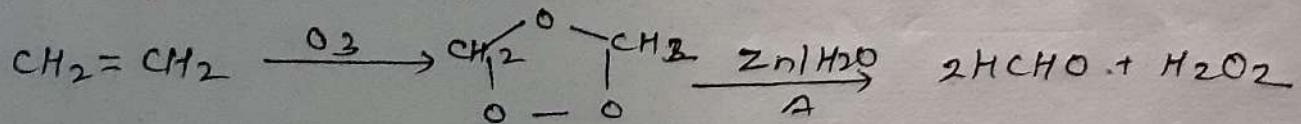
(i) Oxidation of Alcohols



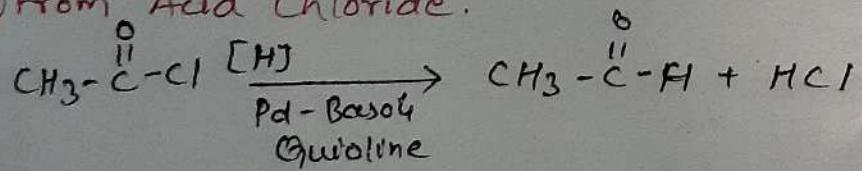
(ii) Catalytic dehydrogenation of Alcohols



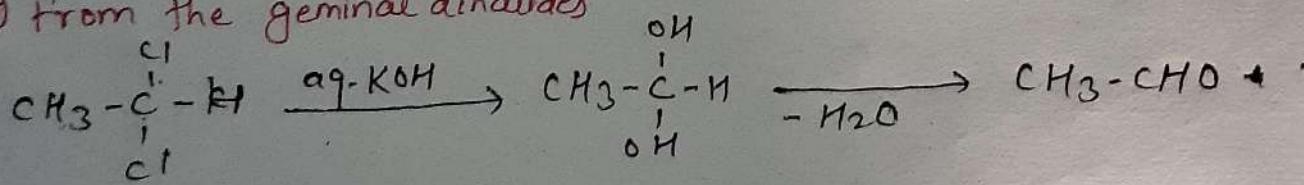
(III) Ozonolysis of Alkenes.



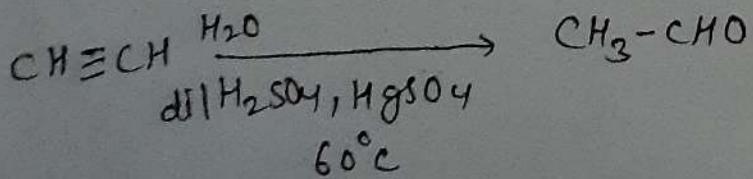
(IV) From Acid Chloride.



(V) From the geminal dihalides

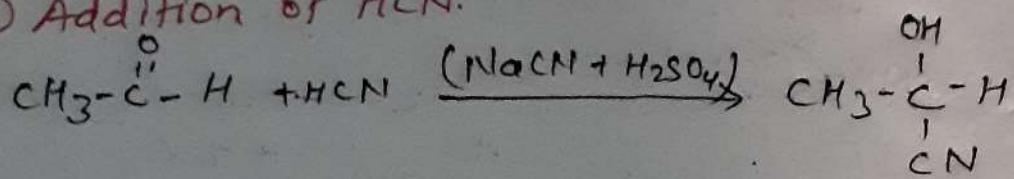


(VI) From the catalytic hydration of Alkynes.

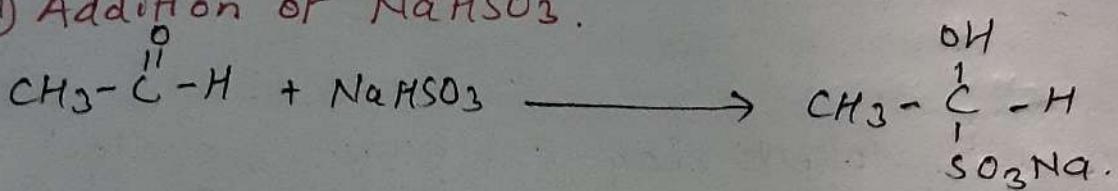


Chemical Reactions of Aldehydes and Ketones.

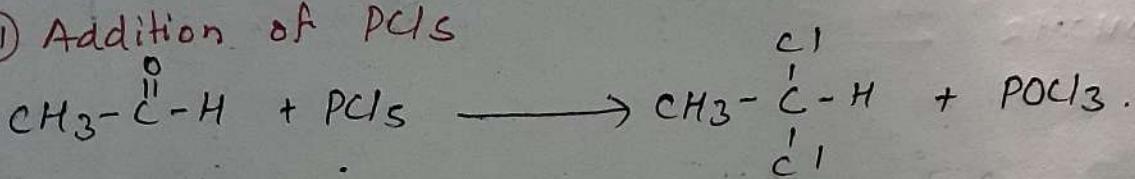
① Addition of HCN.



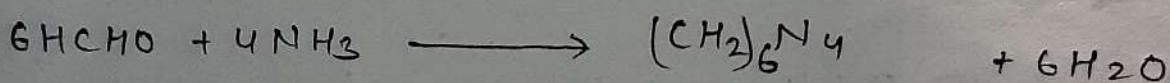
② Addition of NaHSO₃.



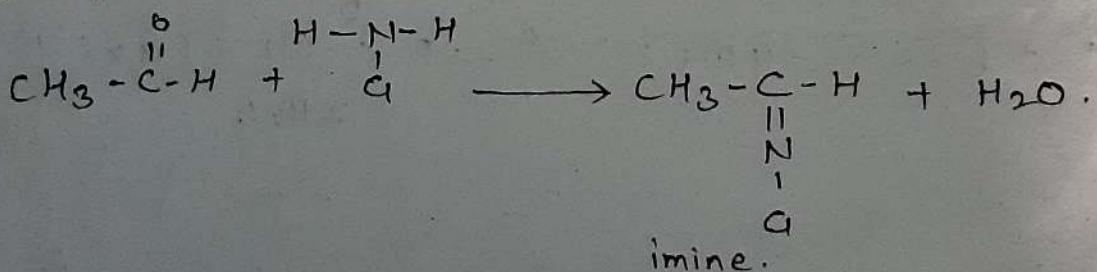
③ Addition of PCls



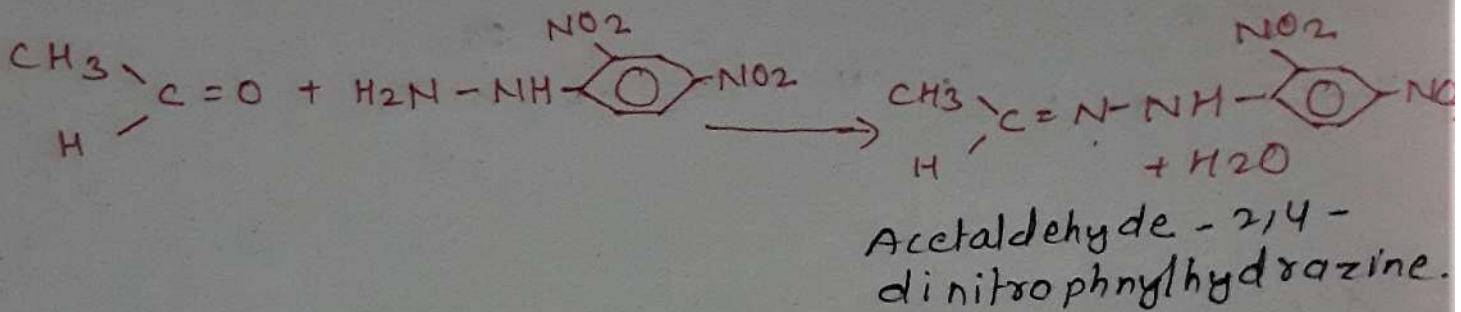
④ Addition of NH₃.



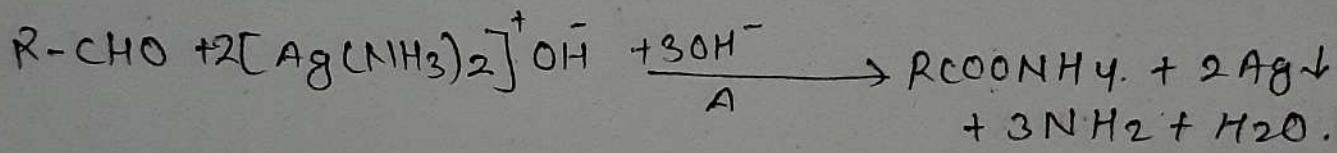
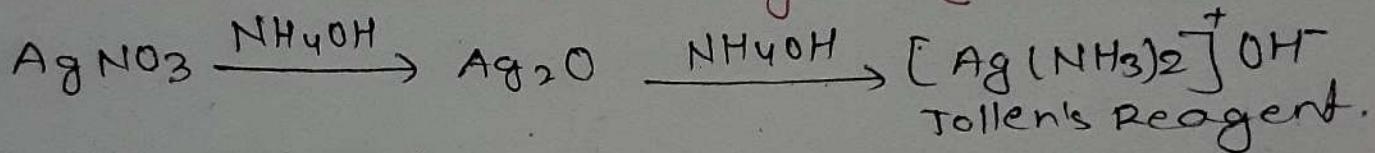
⑤ Addition of derivatives of NH₃.



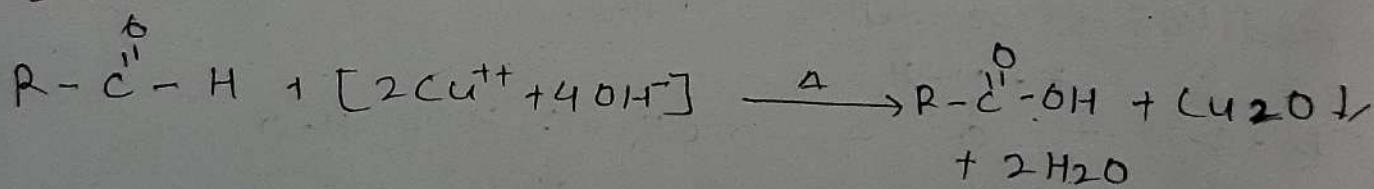
⑥ Reaction with 2,4 DNP :



⑦ Oxidation with tollen's reagent : (Silver mirror or test)



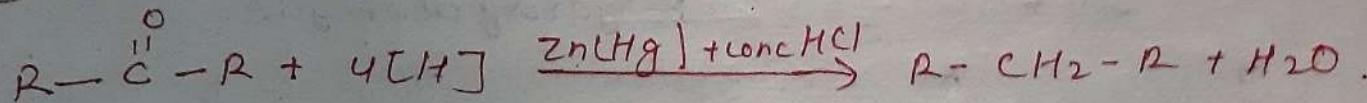
Oxidation with Fehling's solution and Benedict's solution.



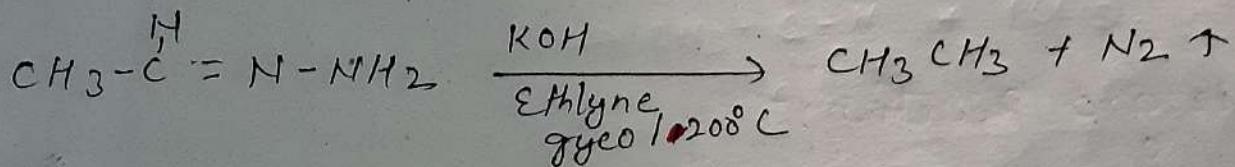
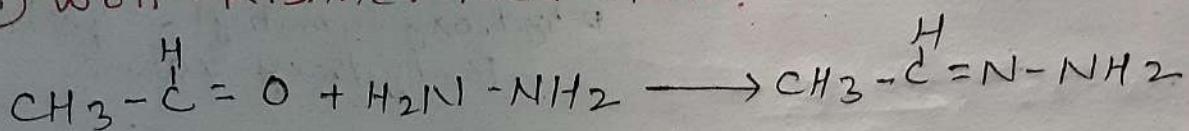
Reduction of Aldehydes and Ketones.

① Reduction to ~~Alcohols~~: Alkanes.
(Wolf-Kishner reduction and Clemensen Reduction)

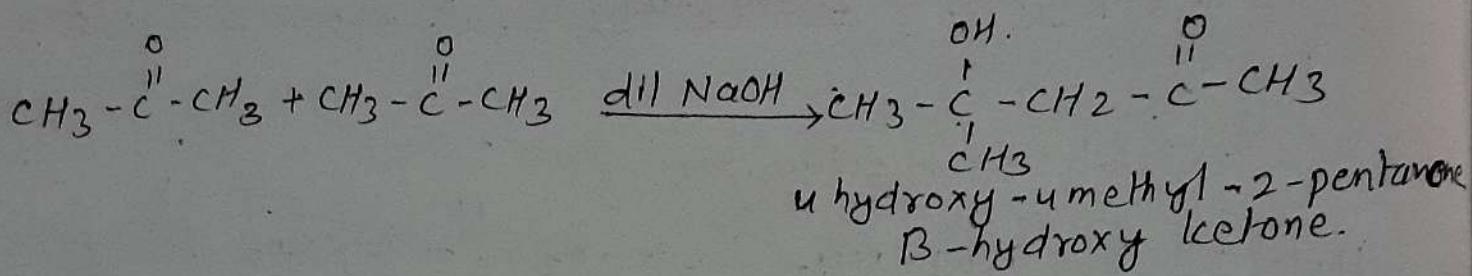
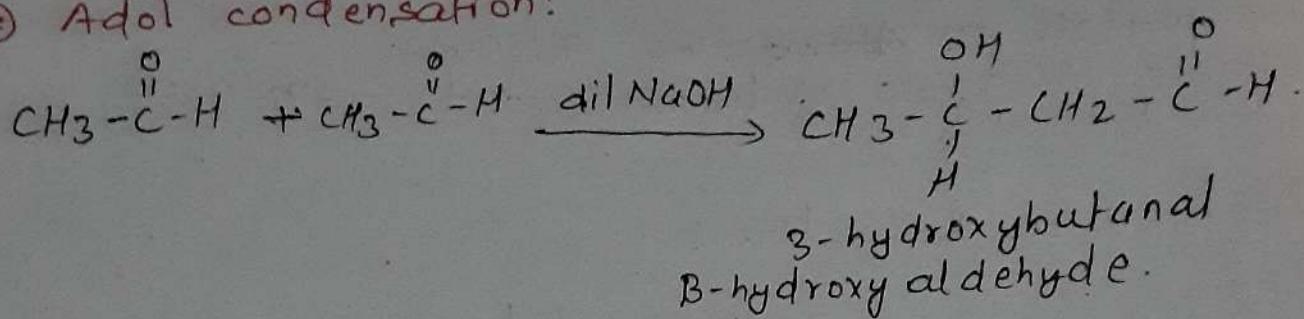
① Clemensen Reduction:



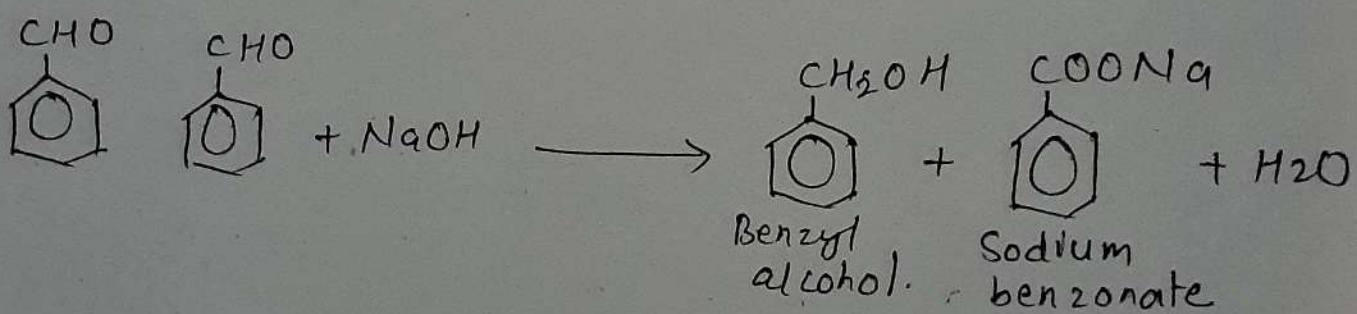
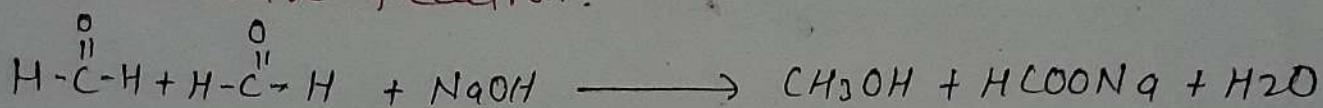
② Wolf-Kishner Reduction:



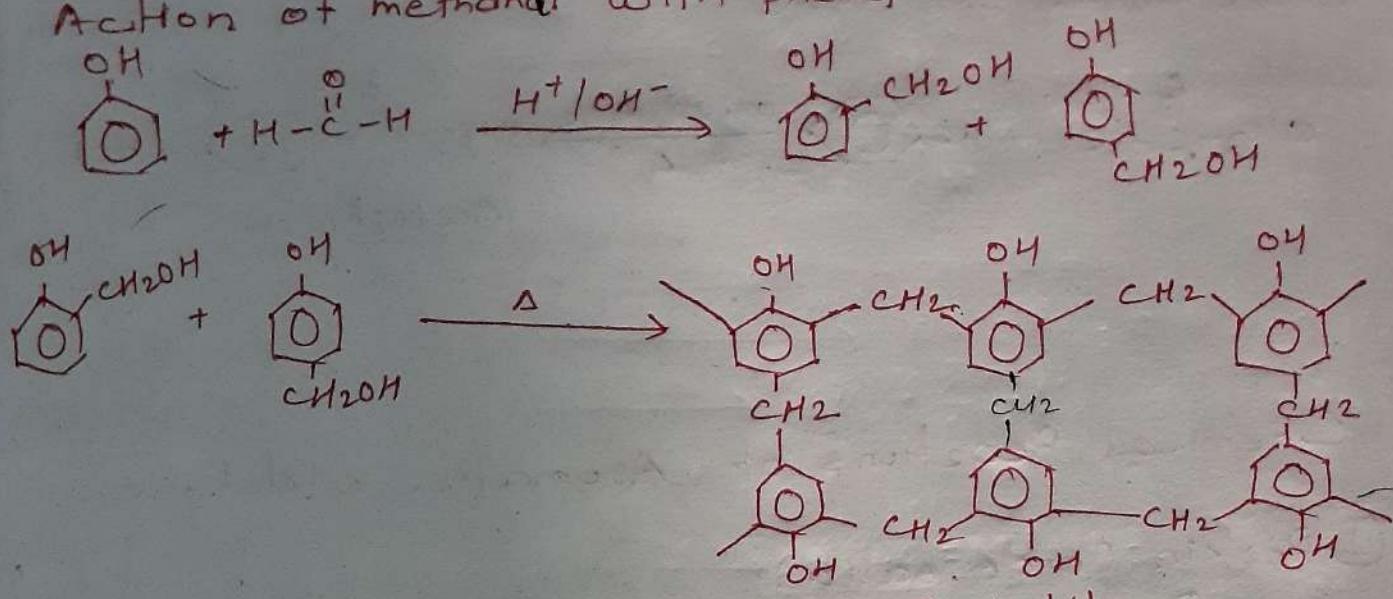
④ Adol condensation:



Cannizzaro Reaction:



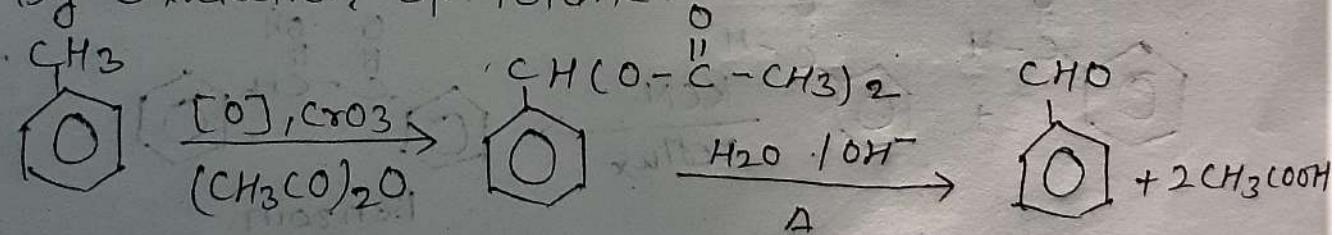
Action of methanol with phenol



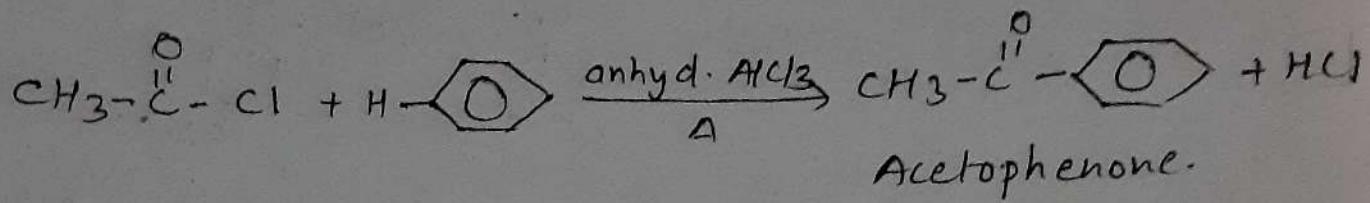
Bakelite.
(Thermosetting plastic)
(Bakelite)

Preparation of Benzaldehyde.

① By Oxidation of Toluene.

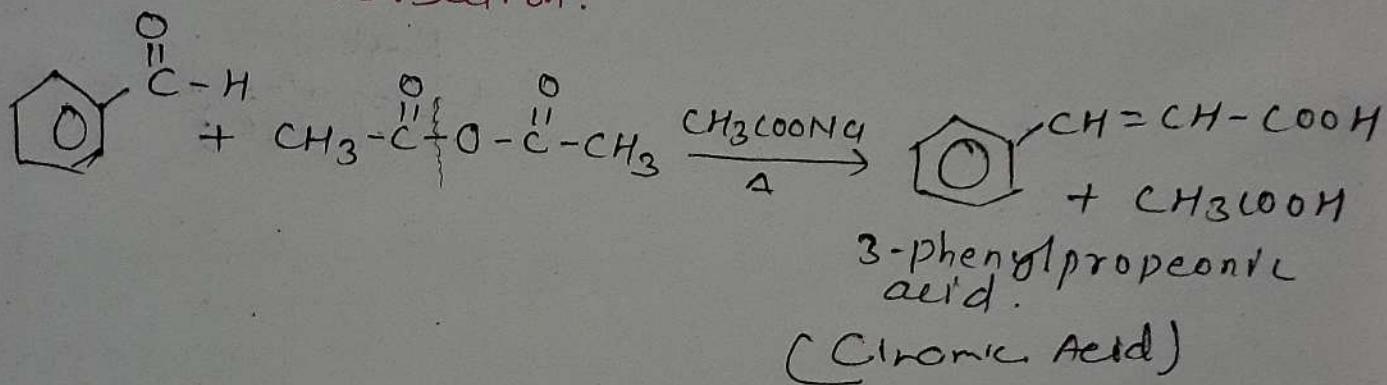


Preparation of Acetophenone.

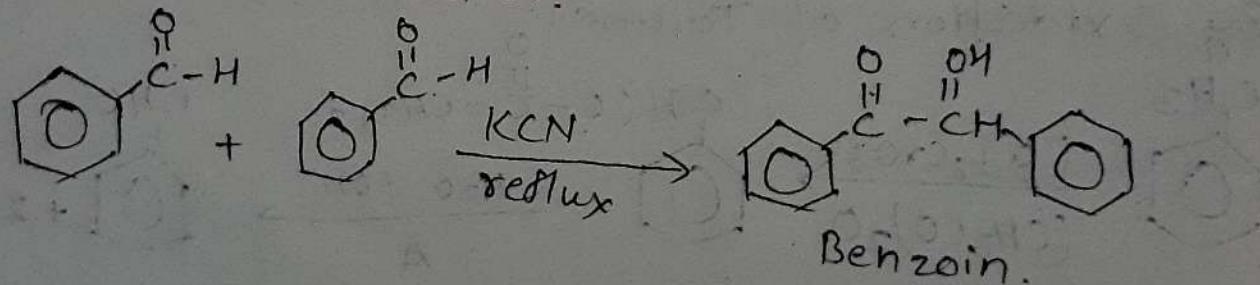


Chemical Reactions of Aromatic aldehyde.

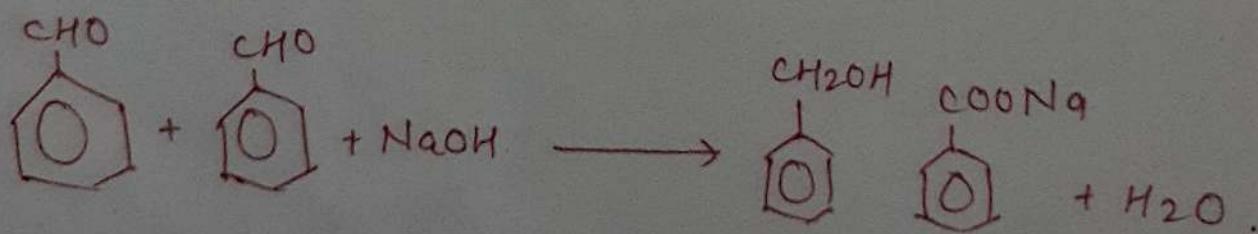
① Perkin condensation:



② Benzoin condensation:



③ Cannizzaro Reaction:



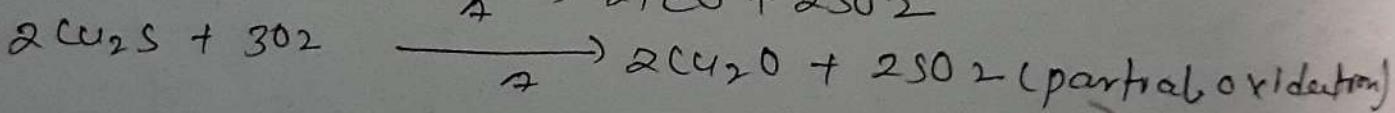
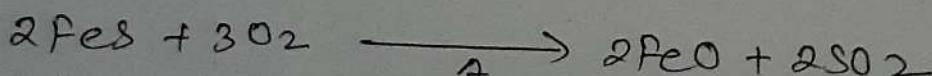
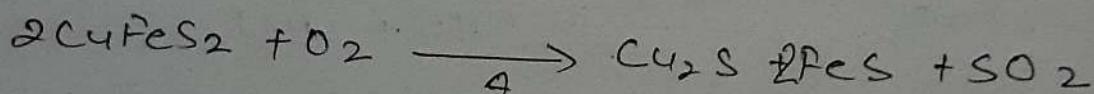
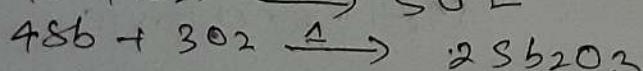
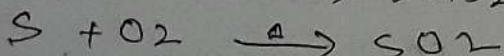
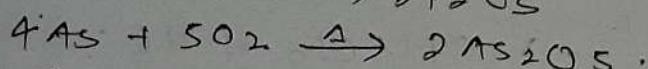
Copper.

Occurrence:

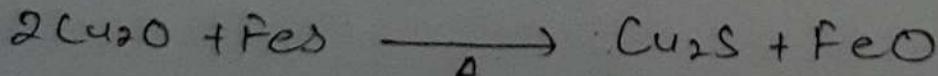
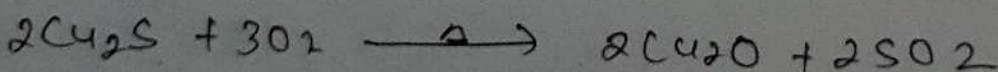
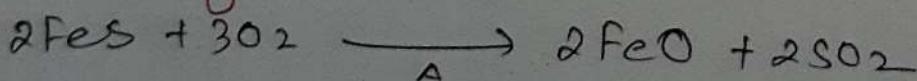
- ① Copper pyrites on chalcopyrites $\text{Cu}_2\text{S}\text{FeS}_3$ or CuFeS_2 .
- ② Copper glance or chalcocite Cu_2S .
- ③ Malachite $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$.
- ④ Azurite $2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$.
- ⑤ Cuprite Cu_2O .
- ⑥ Bornite Cu_3FeS_3 .

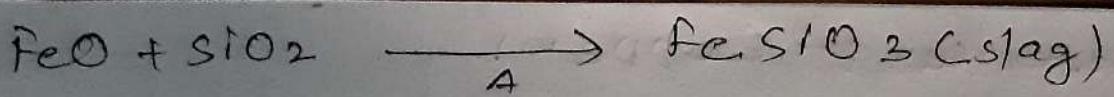
Extraction of Copper.

③ Roasting:

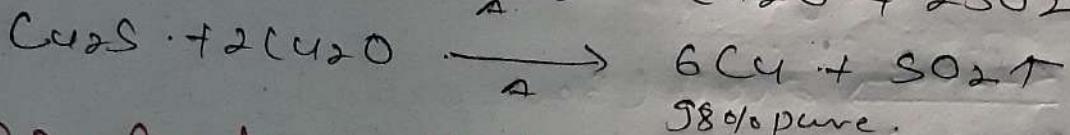


④ Smelting



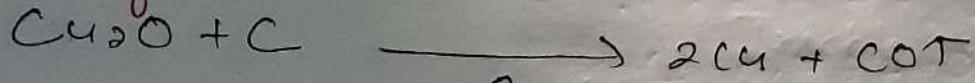


④ Bessemerisation:



⑤ Purification or Refining.

a) Smelting

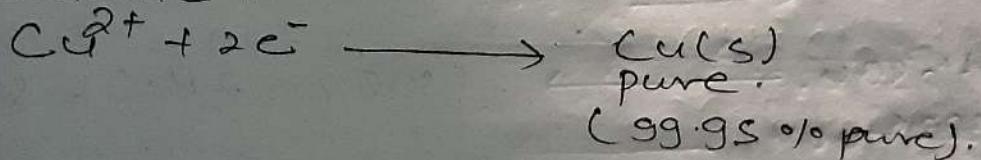


b) Electro-refining.

At Anode:

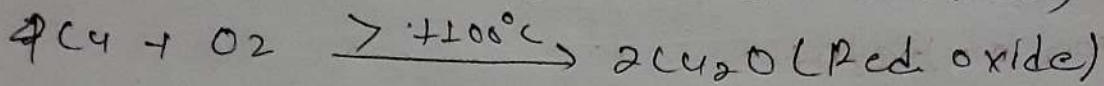
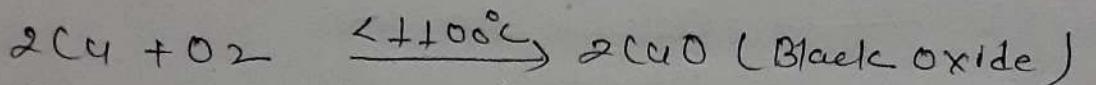
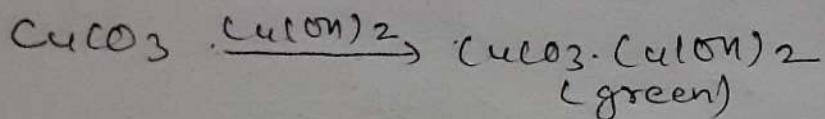
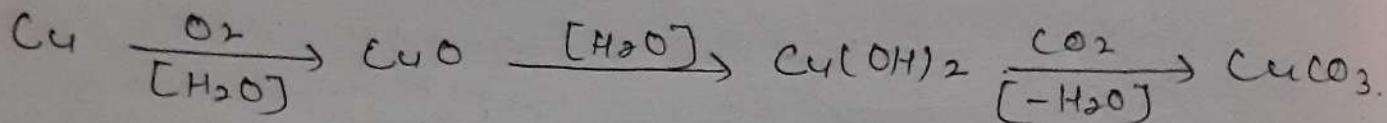


At Cathode:

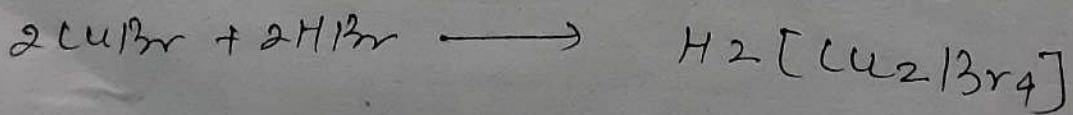
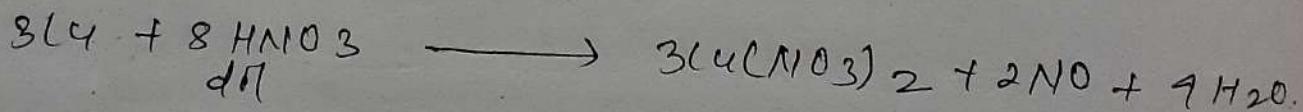
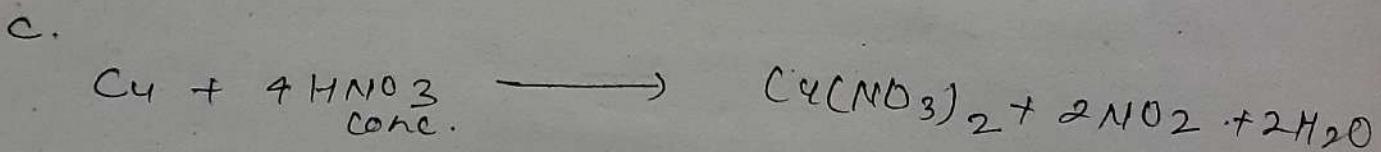
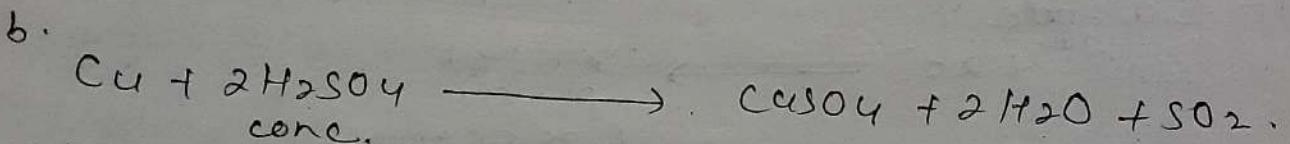
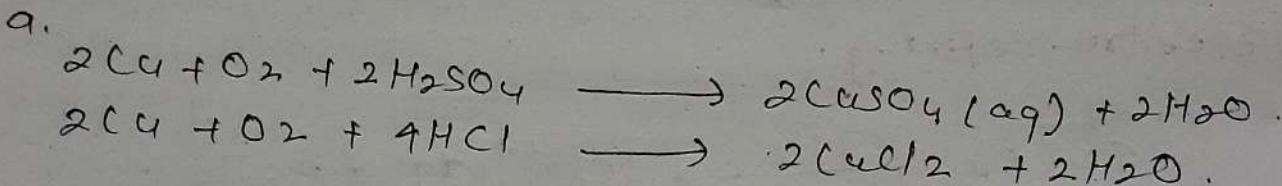


Chemical Properties of Copper:

① with Air:



② with Acids:



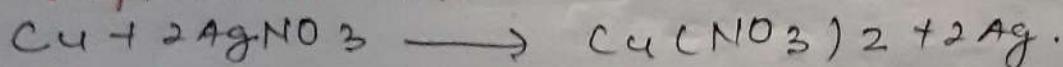
(iii) with Aqueous Ammonia:



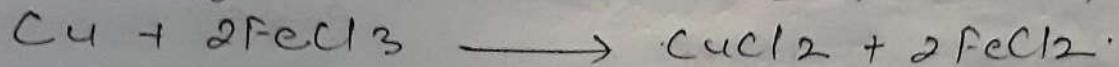
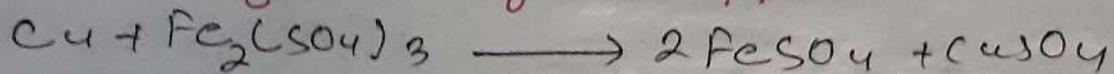
(iv) with Metal Ions:



a. Displacement Rx²⁺:



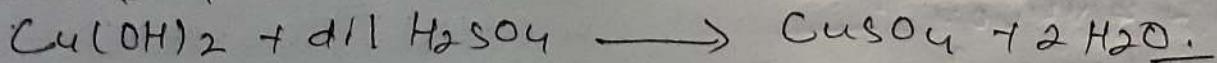
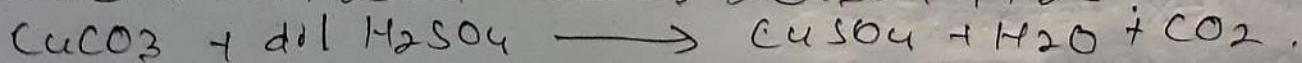
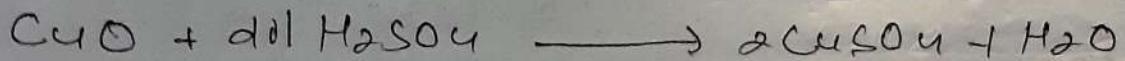
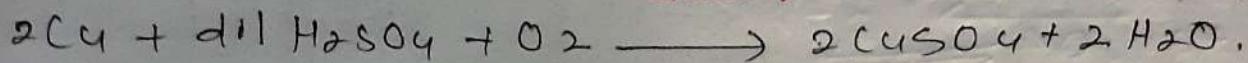
b. Reducing property of Copper.



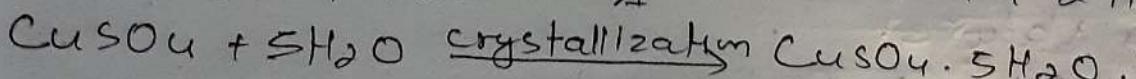
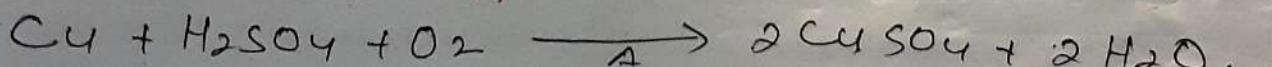
Blue Vitrol:

Preparation of Blue Vitrol:

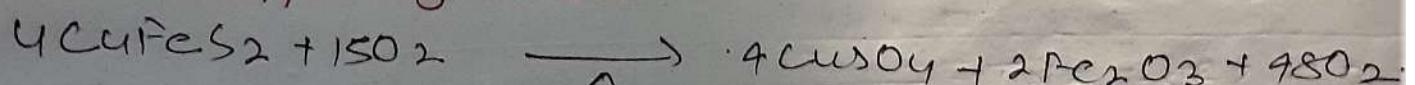
① From Cu or CuO or CuCO₃ or Cu(OH)₂ etc:



② From Scrap Copper:



③ From Copper Pyrites:



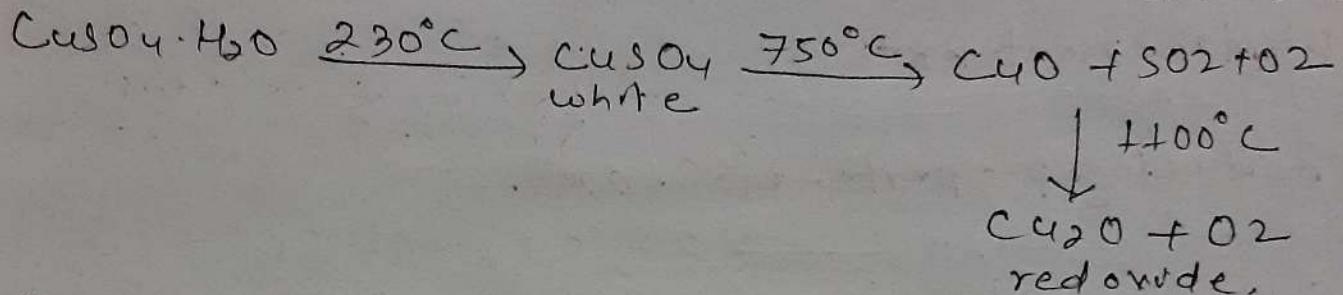
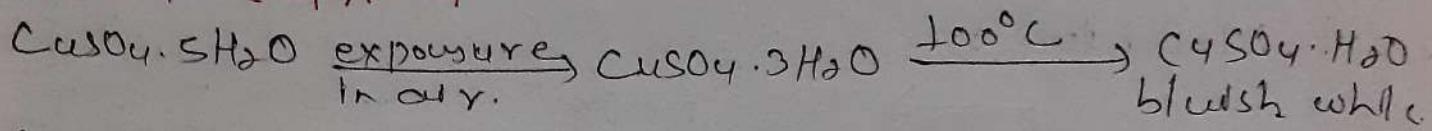
Physical Properties:

① CuSO₄.5H₂O is blue in colour.

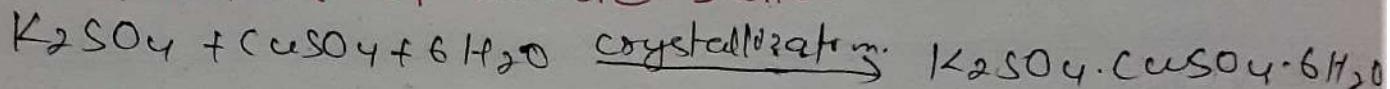
② Anhydrous CuSO₄ is white,

Chemical Properties :

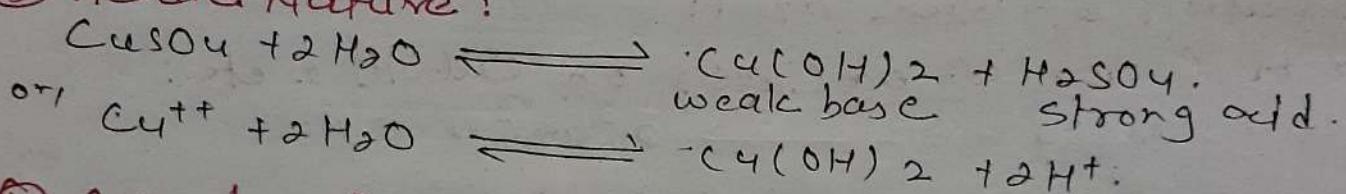
① Action of Heat:



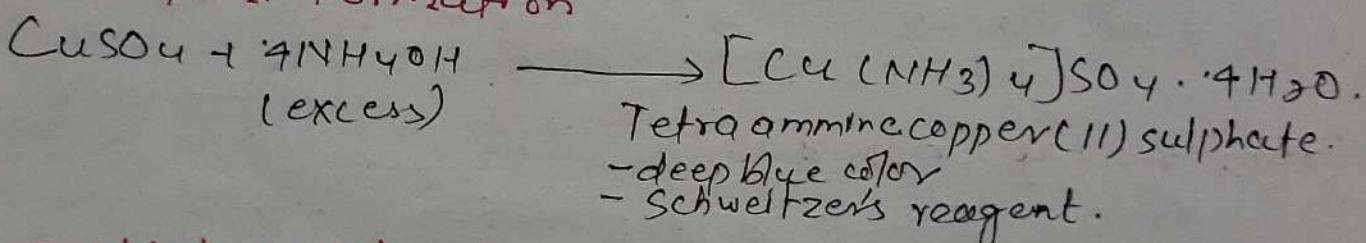
② Formation of double salts:



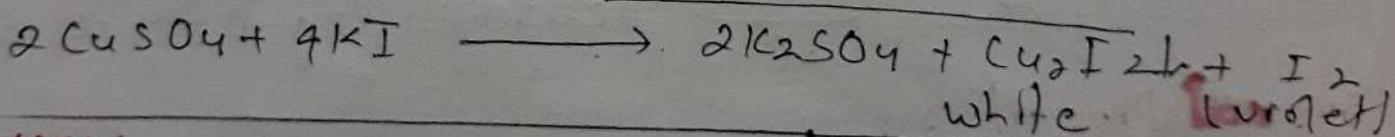
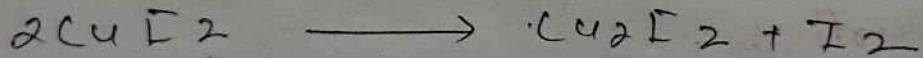
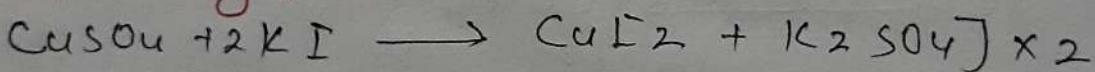
③ Acidic Nature:



④ Complex Formation



⑤ Oxidizing Nature:



Uses:

- i) Electropatting and electrolyt. plating.
- ii) Used as mordant during dyeing.
- iii) Used as fungicide and germicide.
- iv) Used as preservative of wood, gum, etc.
- v) Anhydrous CuSO_4 is used to detect presence of H_2O .

Cuprous Oxide or Red Oxide of Copper. (Cu_2O)

Chemical formula : Cu_2O

Uses of Cuprous oxide :

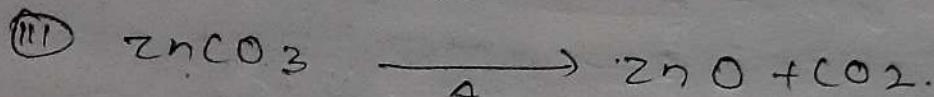
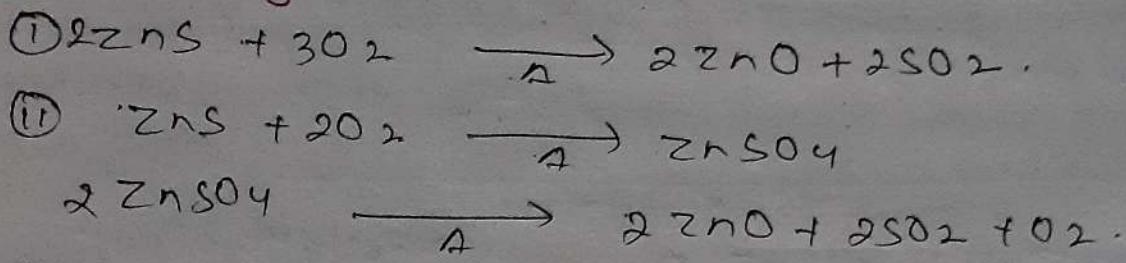
- ① Cuprous oxide is used for coloring glass in blue or black colour.
- ② It is used for the estimation of C and H percentage in organic compounds. (Quantitative Analysis of Organic Compound).

Occurrence of Zinc:

- ① Zinc Blende (ZnS)
- ② Calamine ($ZnCO_3$)
- ③ Zincite or red zinc oxide (ZnO)
- ④ Franklinite ($ZnO \cdot Fe_2O_3$)
- ⑤ Wallerite (Zn_2SiO_4).

Extraction of Zinc from (ZnS)

(iii) Roasting:



(iv) Reduction:

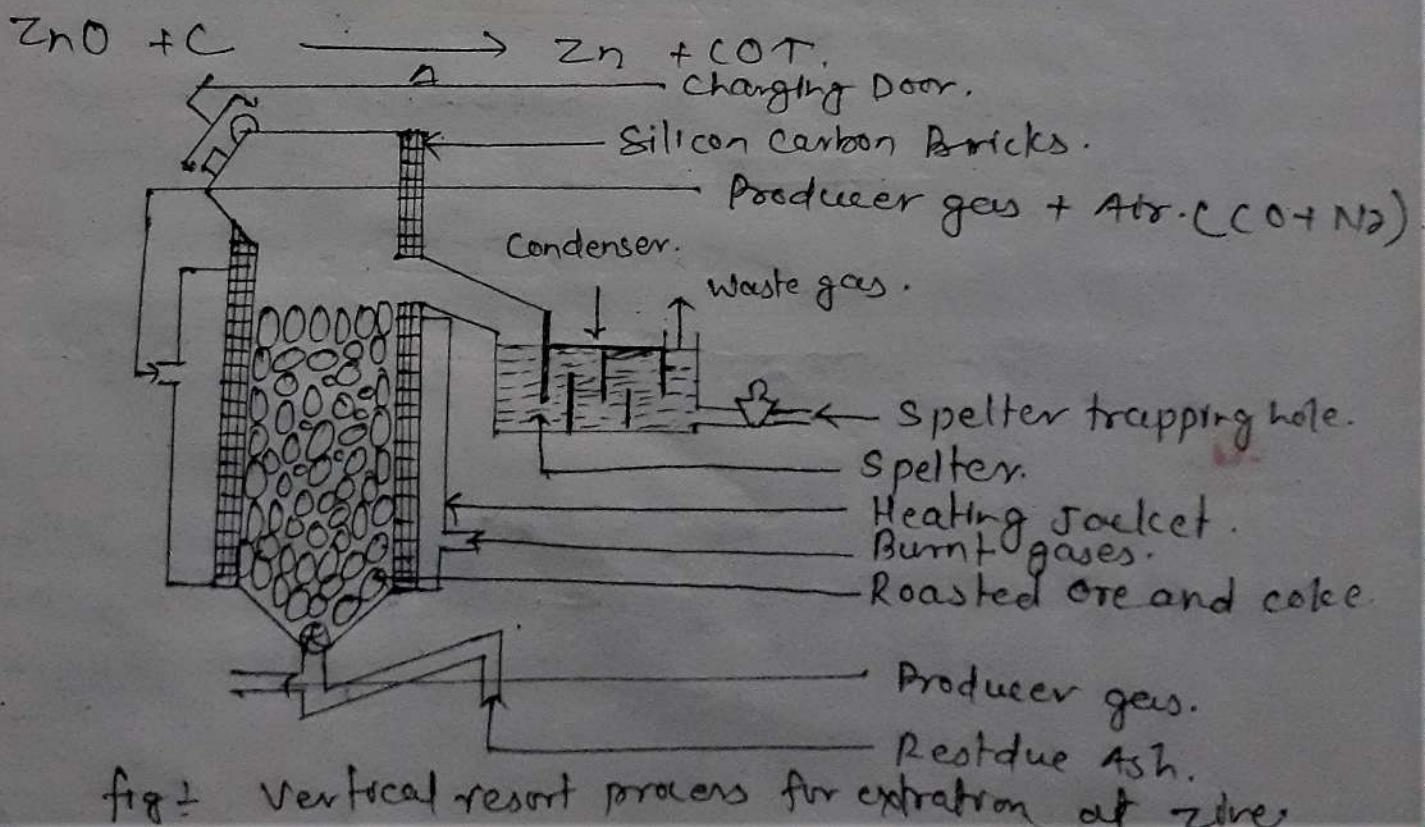
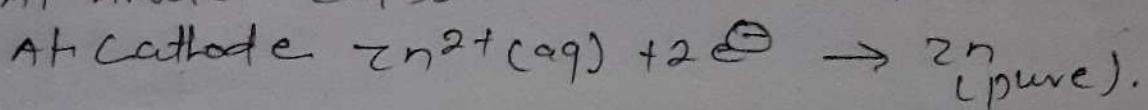


fig: Vertical reverberatory process for extraction of zinc.

(iv) Purification or Refining of zinc:

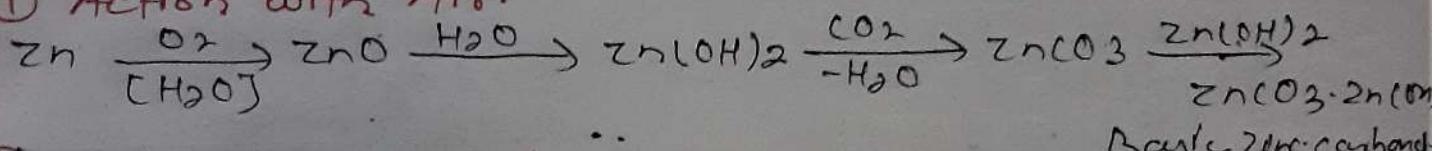
① Distillation:

② Electrolysis.

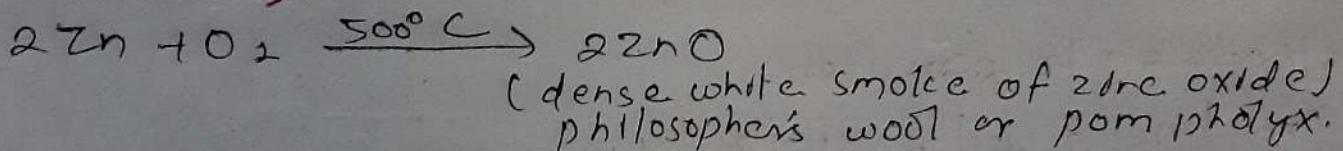


Chemical Properties of Zinc.

① Action with Air:

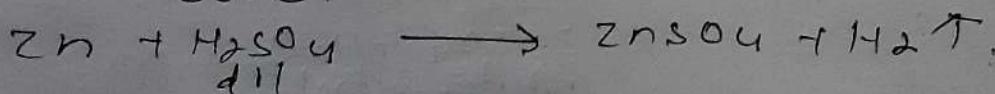
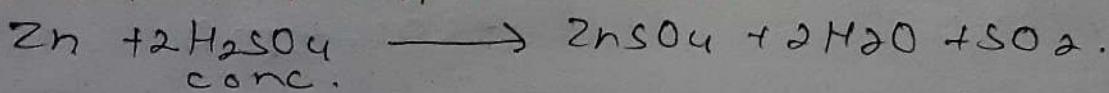


② Action with Acid.



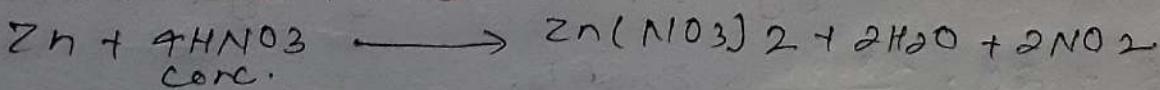
③ Action of Acids.

④ Action of Sulphuric Acid:

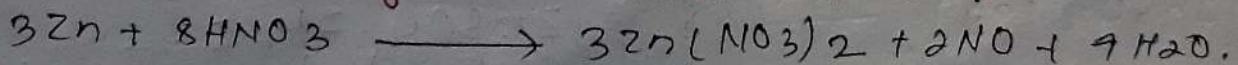


⑤ Action of Nitric Acid (HNO_3).

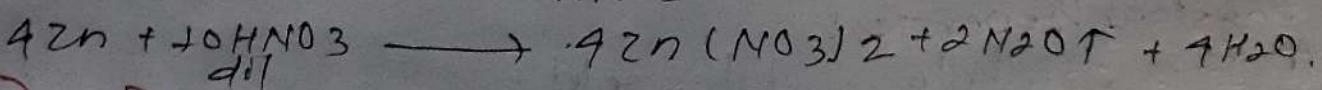
① with conc. HNO_3 .



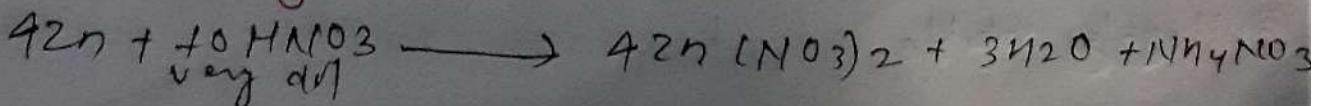
② with moderately concentrated 1:1 HNO_3 .



③ Action with dilute HNO_3 .



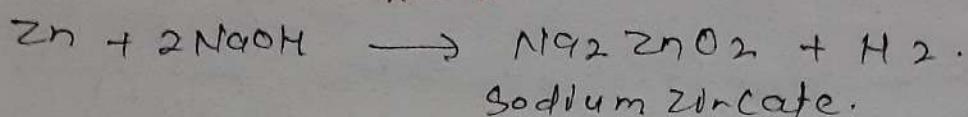
④ with very dilute HNO_3 :



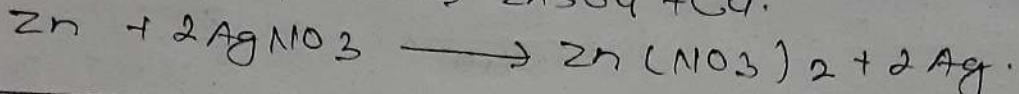
③ Action of HCl:



④ Action with Alkali:



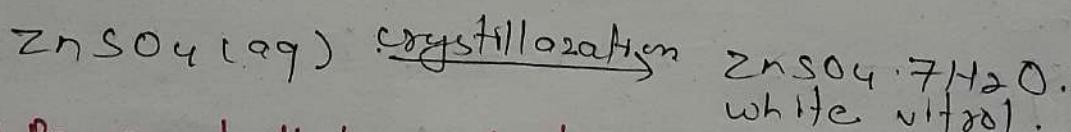
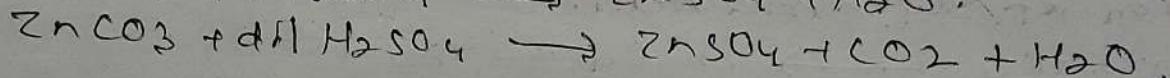
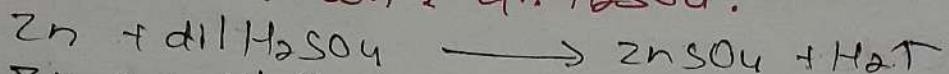
⑤ Displacement Reaction:



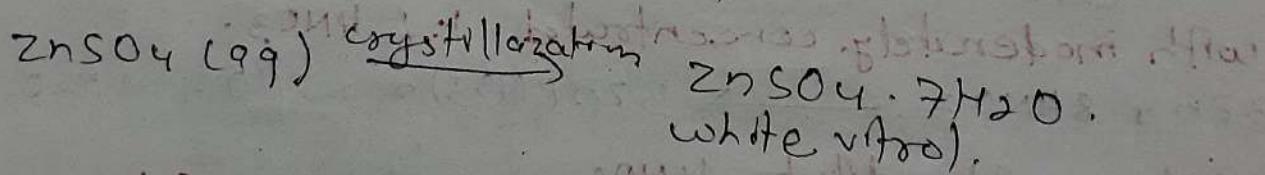
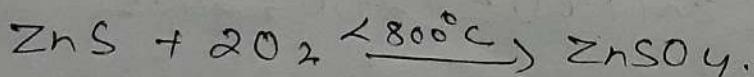
white vitrol $[ZnSO_4 \cdot 7H_2O]$

Methods of Preparation:

① Treatment with dil H₂SO₄:



② By controlled oxidation between zinc blende (ZnS) and oxygen, followed by crystallization.

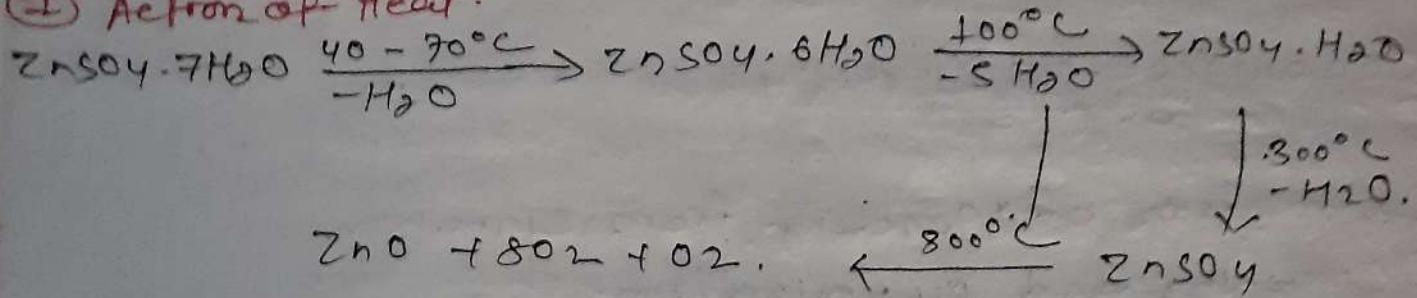


Physical Properties:

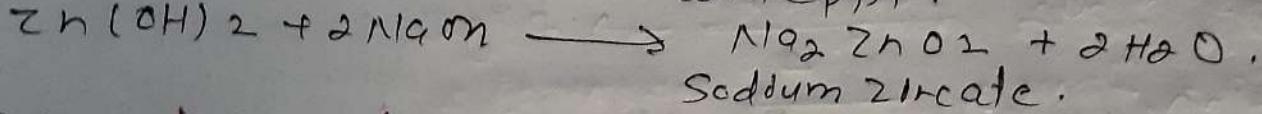
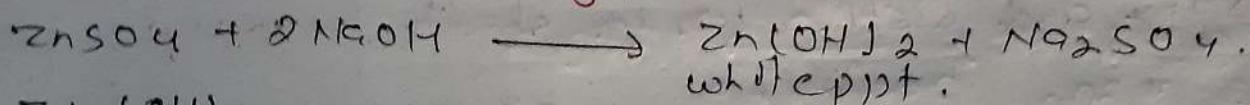
- ① It is crystalline white solid.
- ② It is efflorescent solid loses water of crystallization when exposed to air.
- ③ Highly soluble in water.

Chemical Properties:

① Action of Heat:



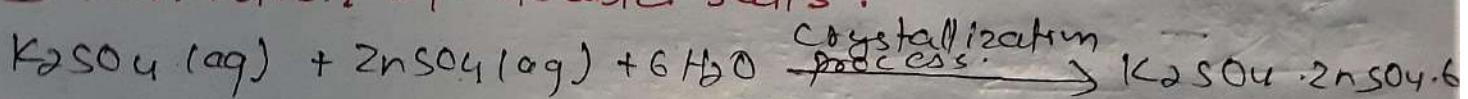
② Action of Sodium Hydroxide:



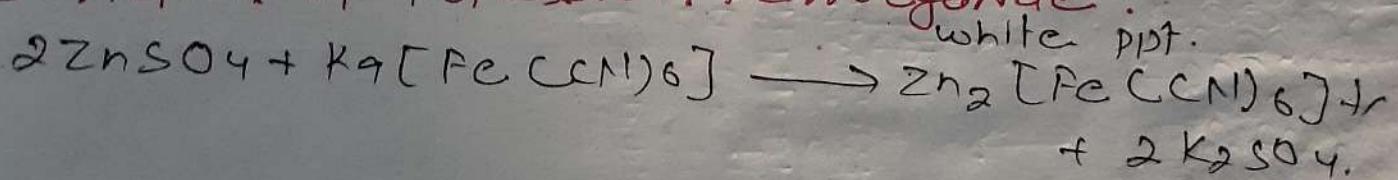
③ Reaction with Barium sulphide:



④ Formation of double salts:



⑤ Action of Potassium ferrocyanide:



Uses:

- ① It is used as electrolyte during electro-galvanic ion.
- ② Its solution is used as eye lotion.
- ③ It is used as媒染剂 for dyeing.
- ④ It is used for the preparation of lithopone, which is white pigment.

Mercury

Occurrence of Mercury:

- ① Cinnabar (HgS).

Extraction of Mercury from Cinnabar.

- ① Crushing and pulverization.
- ② Concentration of ore by froth floatation process.
- ③ Roasting and distillation in shaft furnace.

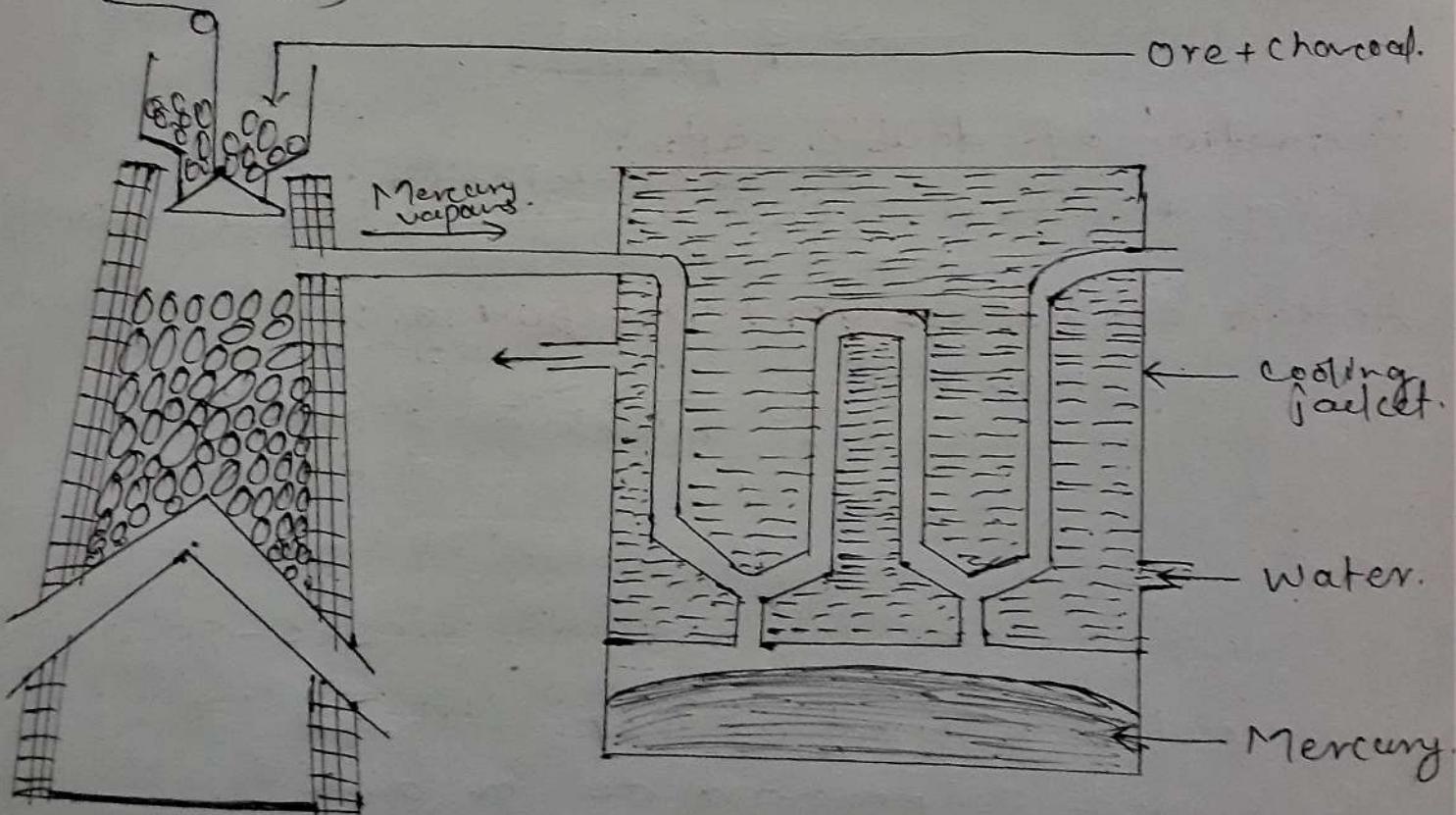
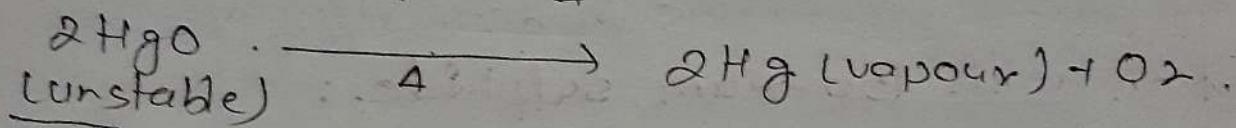
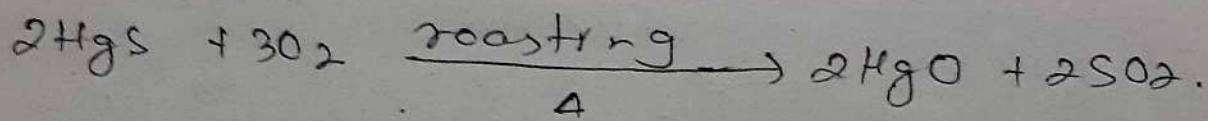
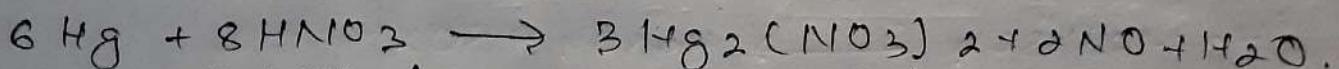
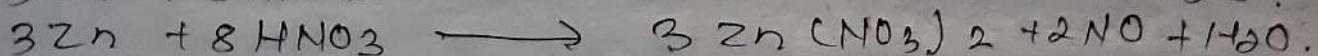
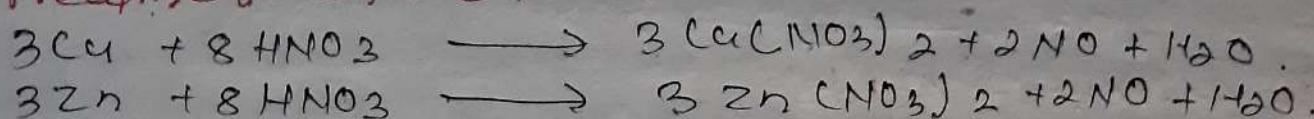


fig : Shaft furnace for the extraction of mercury.

(i) Purification of Mercury:

(i) Filtration:

(ii) Treatment with 5% nitric acid solution:



(iii) Vacuum distillation:

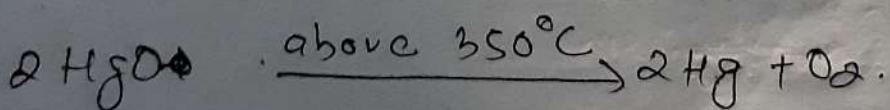
Mercury obtained from the above process still contains some impurities like Ag_2 , Ag , etc. So mercury thus obtained is subjected to distillation under reduced pressure, where mercury gets distilled off leaving behind the impurities.

Physical Properties:

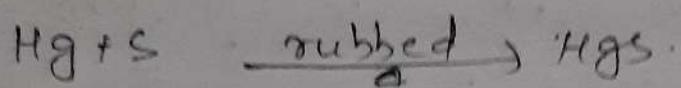
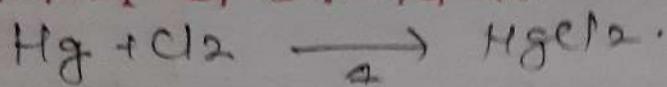
- (i) Mercury is a liquid metal at room temperature.
- (ii) It is a silvery white in colour.
- (iii) It solidifies at -38.85°C and boils at 357°C .
- (iv) Mercury vapours are deadly poisonous.
- (v) It is a poor conductor of heat and good conductor of electricity.

Chemical Properties of Mercury.

(i) Action with Air.

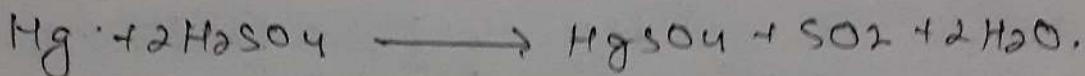


(ii) Action of non-metals:

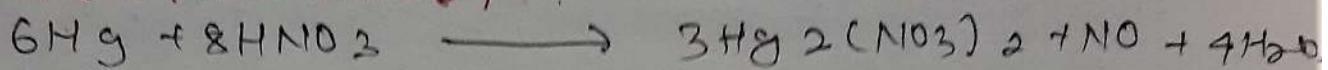


(iii) Action of Acids:

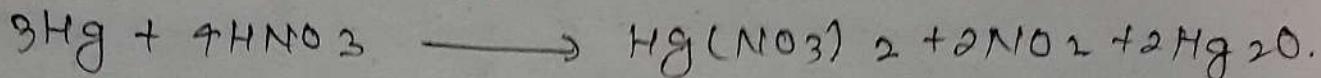
i) with Hot conc. H_2SO_4 .



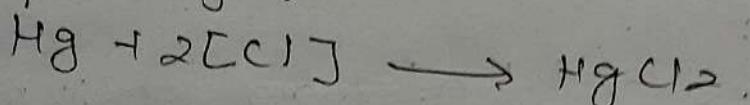
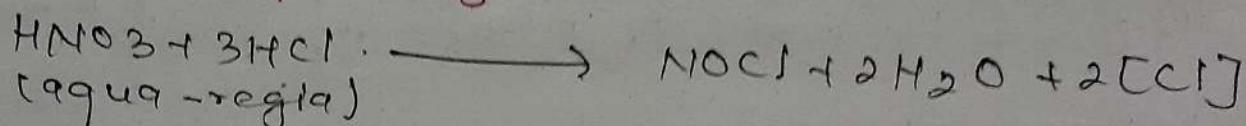
ii) with dilute HNO_3 ,



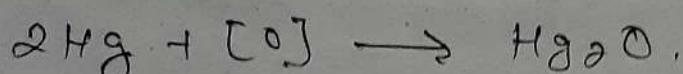
iii) with conc. HNO_3 ,



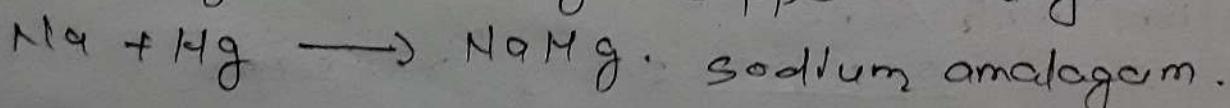
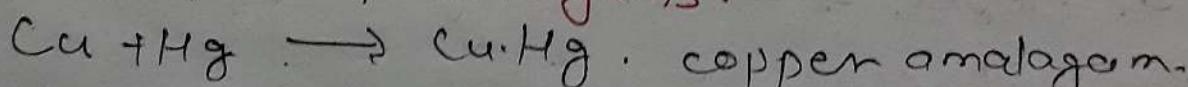
iv) with Aqua-regia.



(iv) Action of O_3 .



(v) Formation of amalgams:



Calomel.

Preparation:

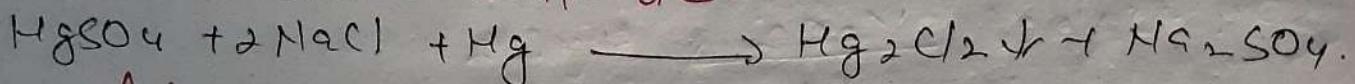
① From Mercurous Nitrate.



② From mercuric chloride:



③ From mercuric sulphate.



Physical Prop:

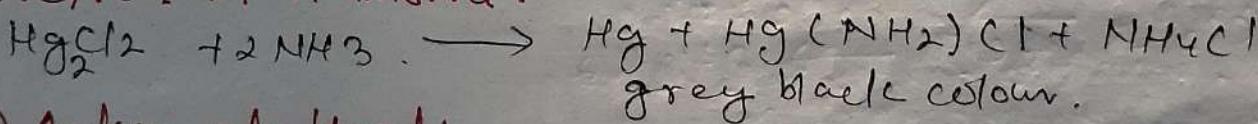
i) White powder, insoluble in H_2O .

ii) Sublimates at more than 350°C .

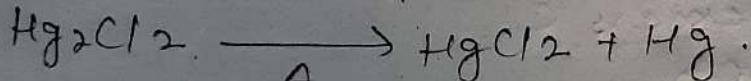
iii) Non-poisonous.

Chemical Prop:

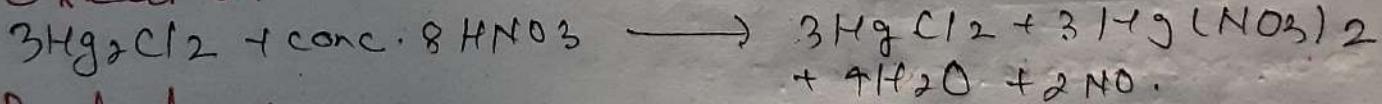
① Action of Ammonia:



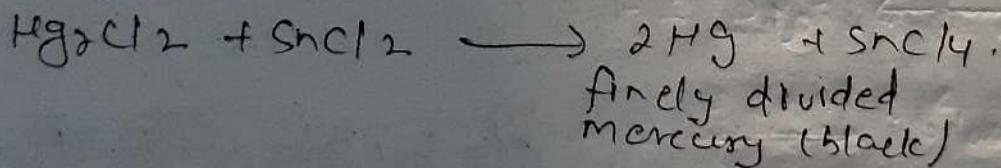
② Action of Heat:



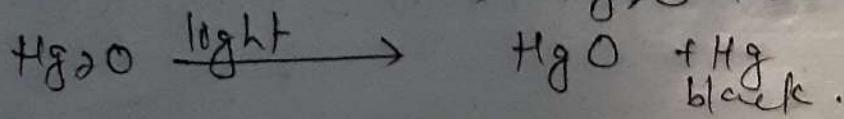
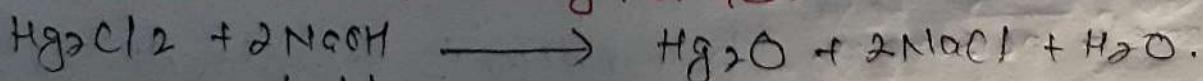
③ Oxidation:



④ Reduction:



⑤ Action of sodium hydroxide:



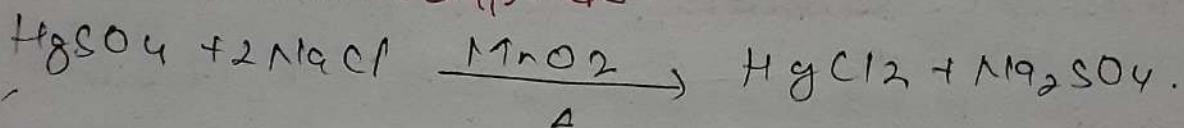
Uses of Calomel:

- ① Used as purgative drug.
- ② Used as an antiseptic drug.
- ③ Used as a bed pill along with Na_2CO_3 .
- ④ It is used to make calomel electrode which is a secondary reference electrode.

Corrosive Sublimate.

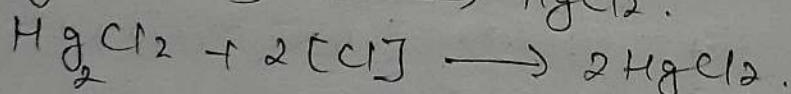
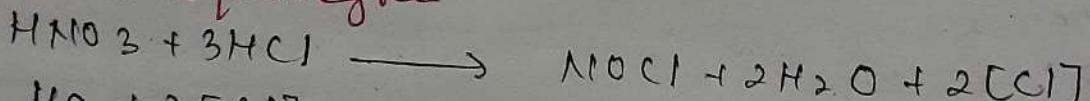
Preparation :

- ① From Mercuric Sulfate:



- ② From Mercuric chloride.

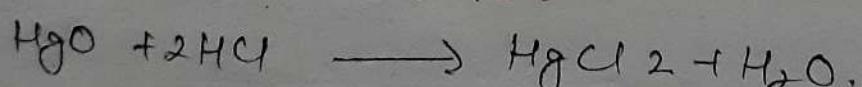
a. From aqua regia



b. Treatment of Hg with excess Cl.



- ③ From mercuric oxide.



Physical Prop:

- ① white crystalline solid, ~~mostly~~ sparingly soluble in cold H_2O .
- ② Soluble in hot H_2O .
- ③ It is extremely poisonous. Its antidote is "white of egg".

Chemical Properties.

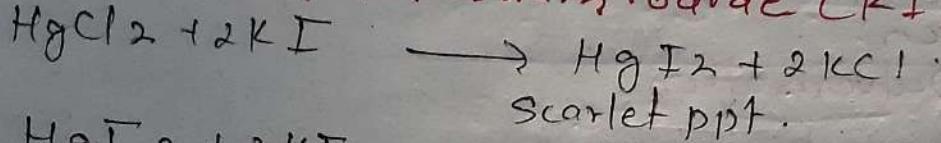
① Reduction:



② Action of Alkali:



③ Action of Potassium Iodide (KI):

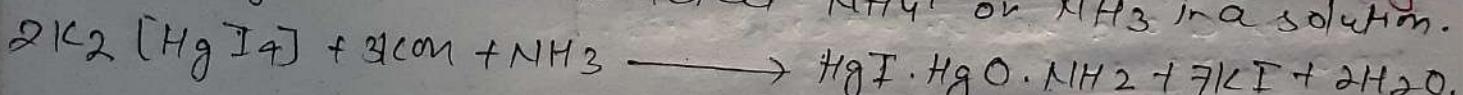


Scarlet ppt.



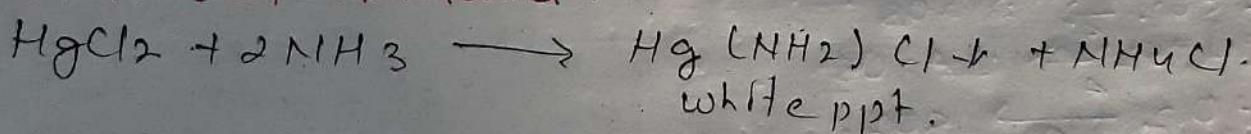
Potassium tetrailodo mercurate(II)

Alkaline soln of $\text{K}_2[\text{HgI}_4]$ is called **Nessler's reagent**.
This reagent is used to detect NH_4^+ or NH_3 in a solution.



Iodine of Millions base.
(Brown ppt).

④ Action of Ammonia:



white ppt.

⑤ Action of Heat:



Uses:

- ① Used for preparation of Nessler's reagent and calomel.
- ② Used as preservative of timber and leather.
- ③ Used as fungicide in agricultural fields.
- ④ Used in preparation of dry cells.
- ⑤ Its very dilute sol is used to sterilize the surgical instruments.

Iron

Occurrence:

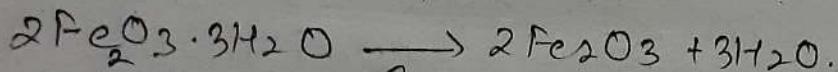
- ① Haemite (Fe_2O_3)
- ② Limonite or brown Haemite ($2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$)
- ③ Magnetite (Fe_3O_4)
- ④ Iron pyrite (FeS_2)
- ⑤ Copper pyrite (CuFeS_2)
- ⑥ Siderite or Spatitic ore (FeCO_3)

Extraction of Iron:

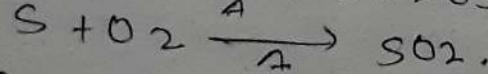
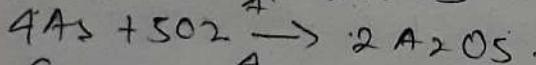
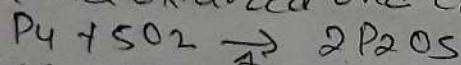
- ① Crushing and Pulverisation
- ② Dressing and Concentration:

③ Calculations:

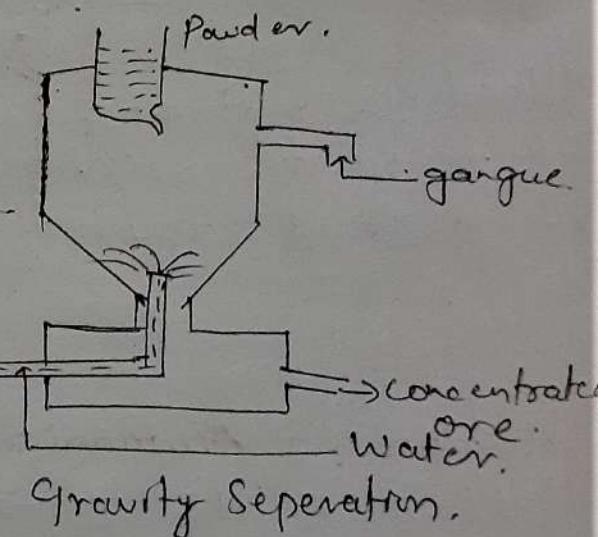
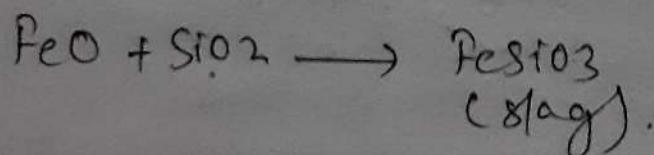
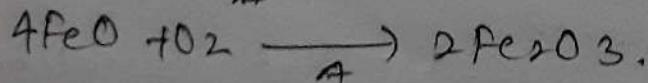
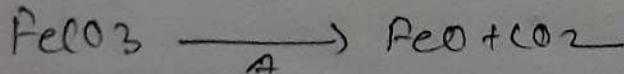
• Moisture and water of crystallization are removed.



• Volatile impurities such as $\text{P}, \text{As}, \text{S}$, etc. are oxidized and expelled.

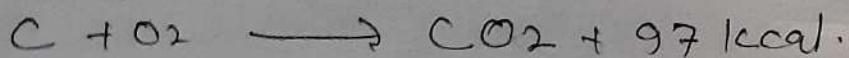
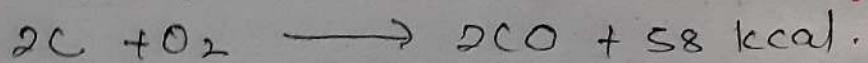


• If iron carbonate is present, it will be decomposed to form ferrous oxide.

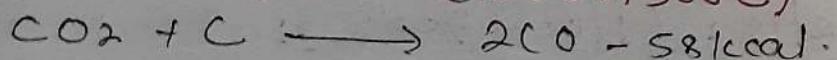


④ Extraction of Crude Iron.

⑤ Zone of Combustion: ($1300 - 1500^{\circ}\text{C}$):



⑥ Zone of fusion ($1200 - 1300^{\circ}\text{C}$)



If ferric oxide is present,

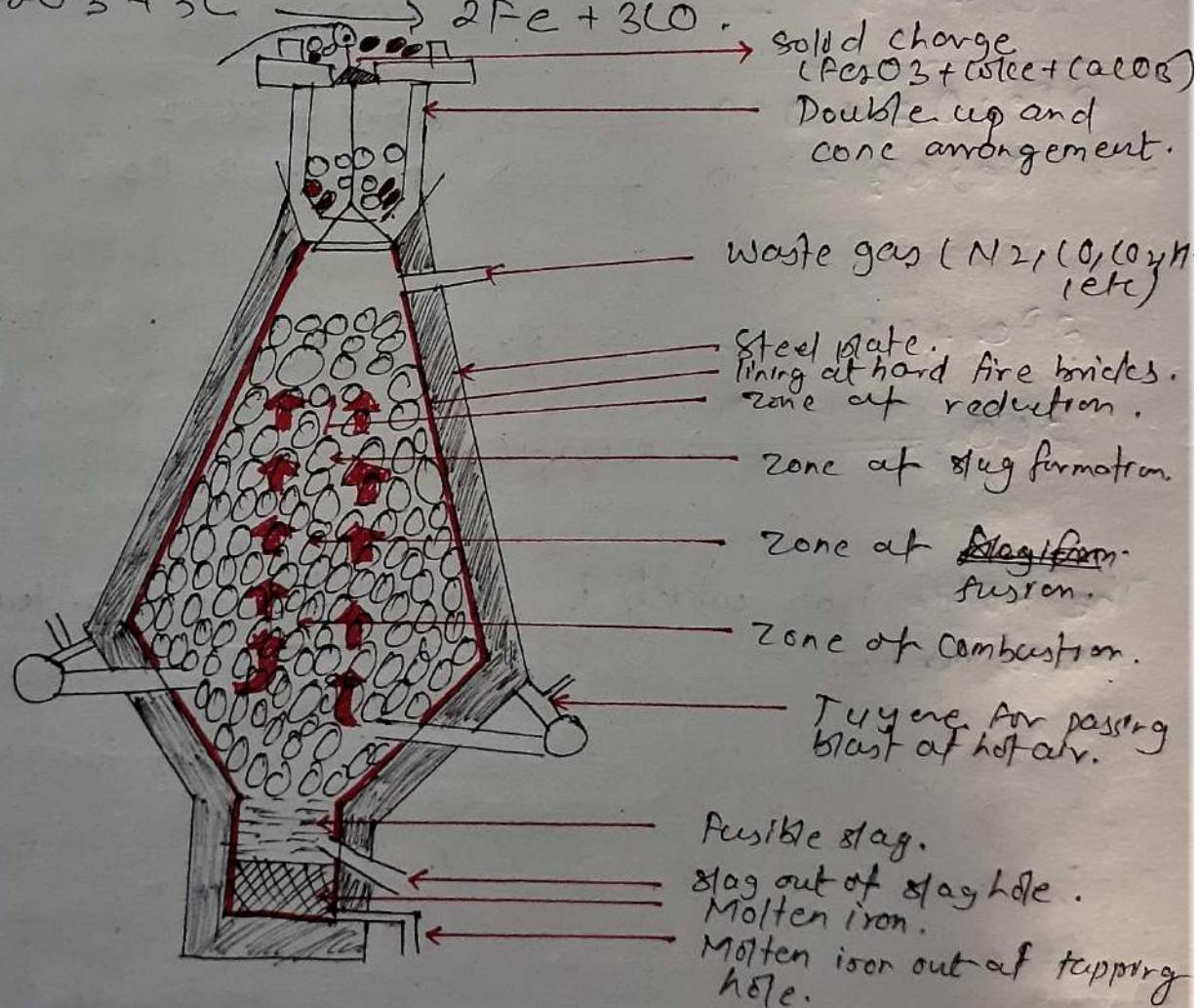
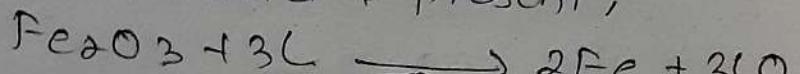
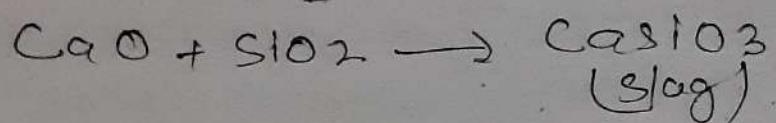
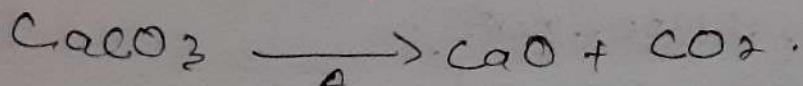
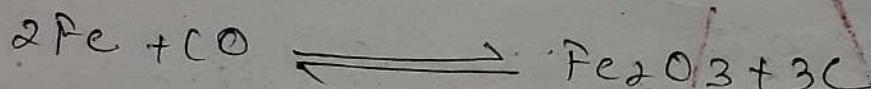
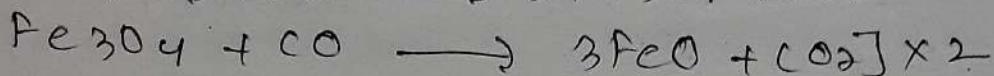
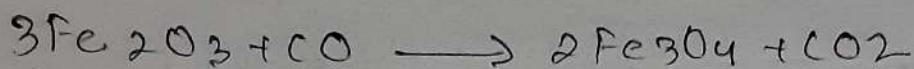


fig: Extraction of iron in blast furnace.

③ Zone of Slag formation: ($700 - 1000^{\circ}\text{C}$):



④ Zone of Reduction ($400 - 700^{\circ}\text{C}$):



The molten iron which is solidified to a big lump is called pig iron.

Physical Properties:

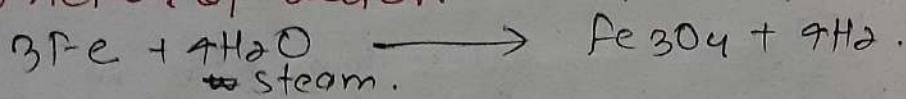
- ① Pure form of iron is soft and white solid. Presence of carbon makes iron hard.
- ② Specific gravity of iron is 7.86.
- ③ Its melting point is 1530°C and boiling point is 2750°C .
- ④ Magnetic, loses at 760°C .
- ⑤ Conductor of heat & electricity.
- ⑥ Malleable and ductile.

Chemical Properties of Iron:

① Action with Air:

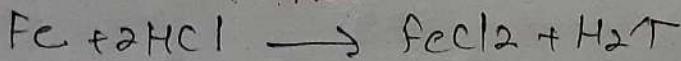


② Action of water.



③ Action of Acid.

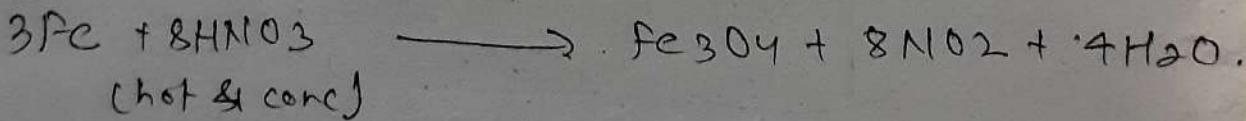
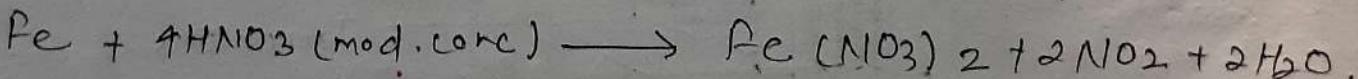
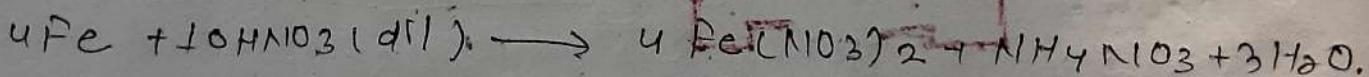
① Action with HCl



② H₂SO₄.

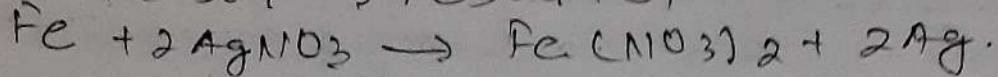
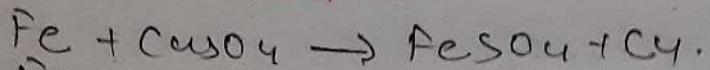


③ HNO₃.

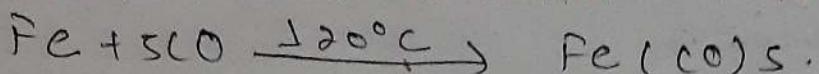


(iv) Reaction with alkali: Not rxn.

(v) Displacement rxn



(vi) Reaction with carbon monoxide:



Iron-pentacarbonyl

Manufacture of Steel:

a. Bessemer Process

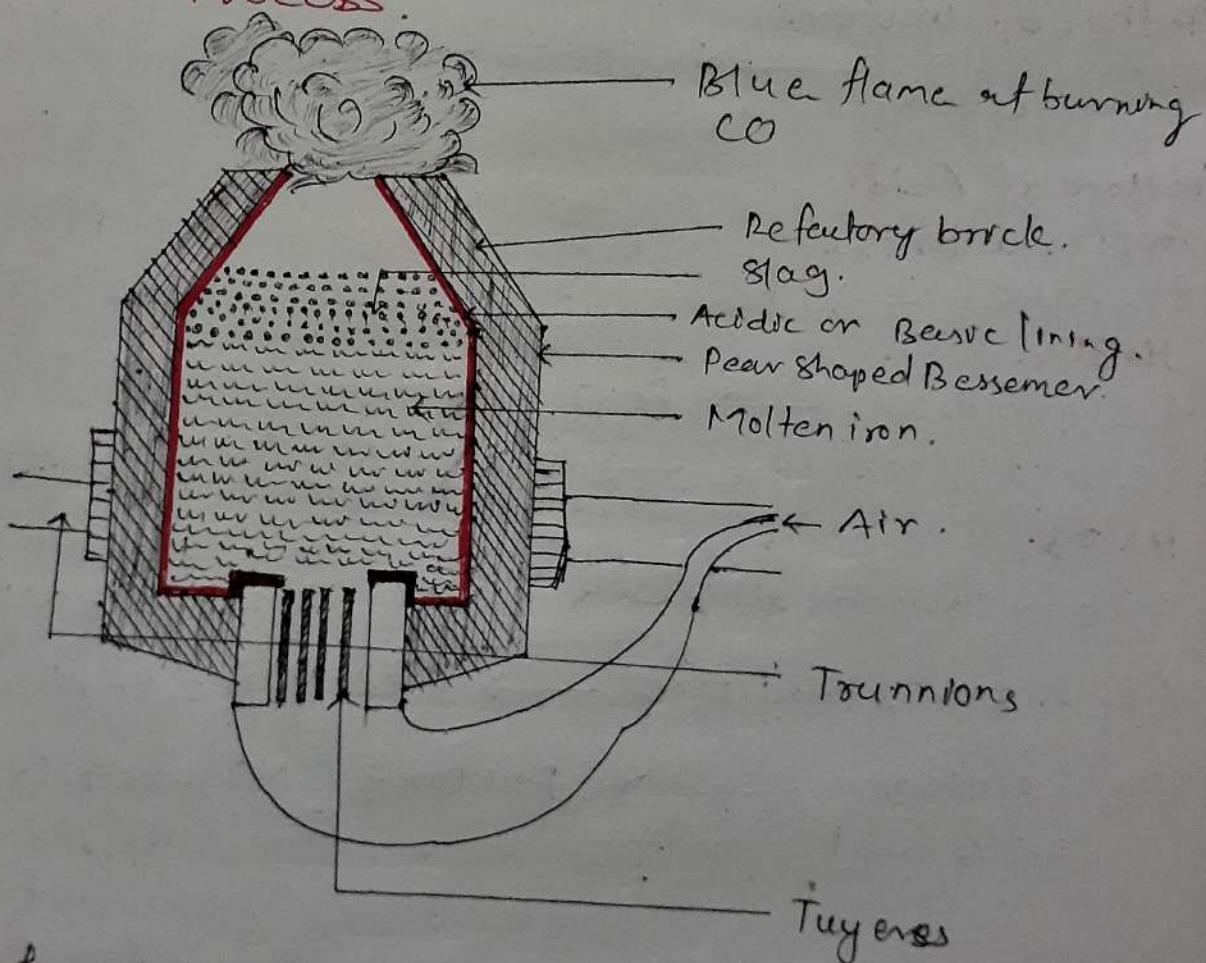
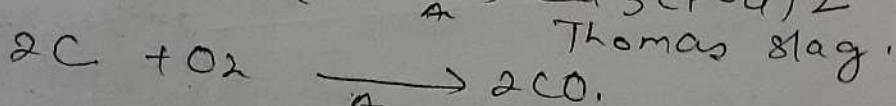
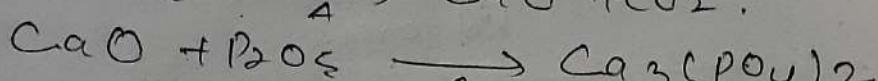
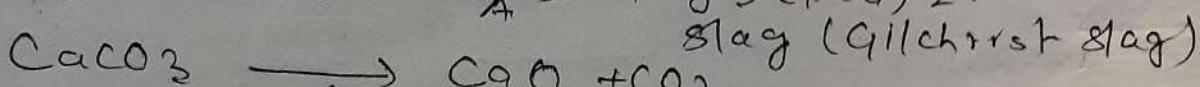
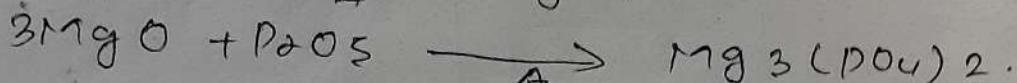
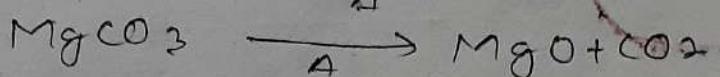


fig - Schematic Diagram of Bessemer converter used for the manufacture of ~~iron~~ steel from cast iron.

① Adolphe Bessemer Process



② Basic Bessemer Process



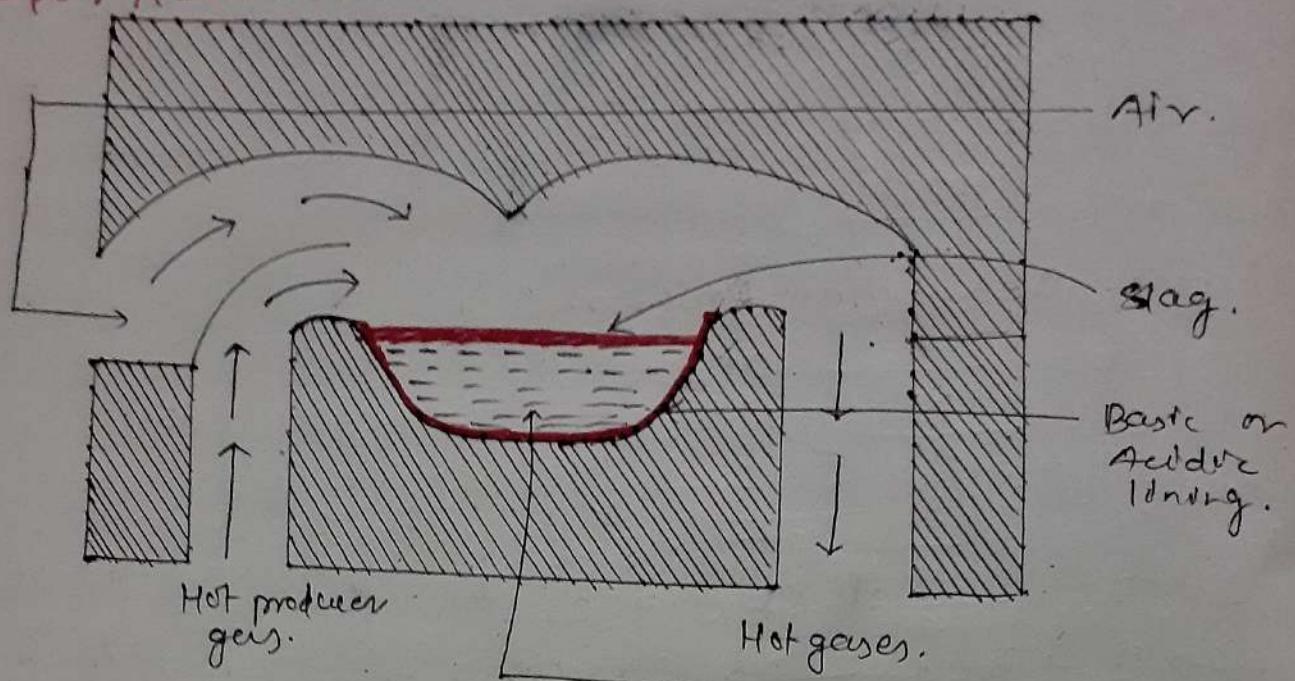
Advantages of Bessemer Process:

- ① Quick to run and is completed within 15 to 20 minutes.
- ② It is relatively inexpensive.

Disadvantages of Bessemer Process:

- ① Quality of steel obtained by this process varies from batch to batch.
- ② It can't remove the impurities completely. Thus produced steel rusts easily.
- ③ The process is too rapid to carry out ~~any~~ analytical test of the product from time to time.

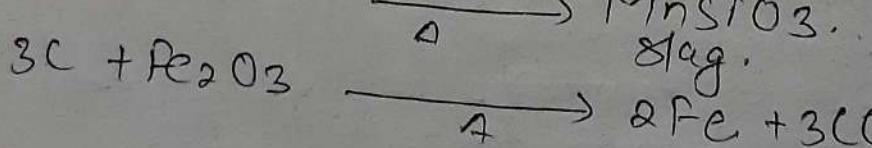
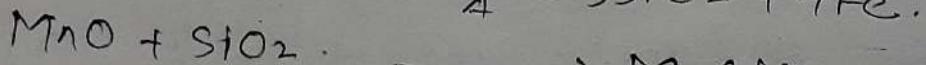
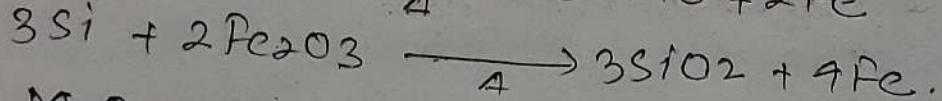
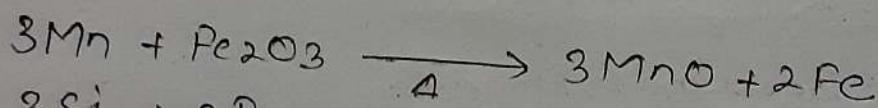
⑥ Open Hearth Process



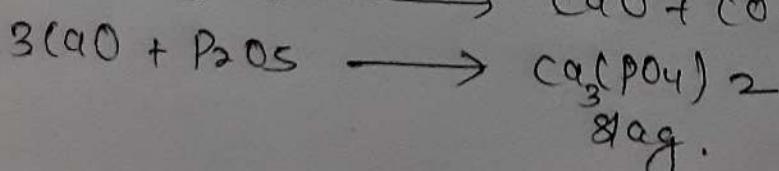
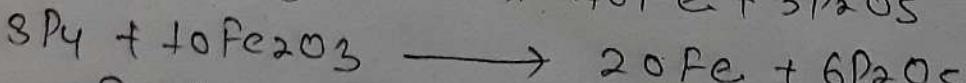
Molten pig iron,
low grade wrought
iron + scrap iron
+ haematite.

Agt - An open hearth furnace used for the manufacture of steel.

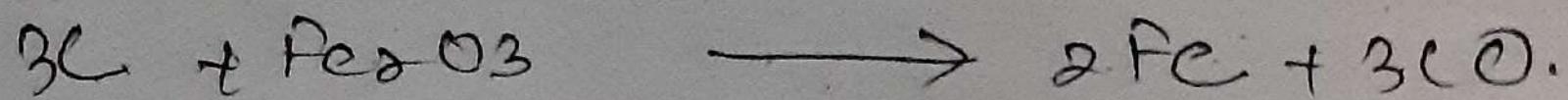
Acidic Process:



Basic Process :



Slag.



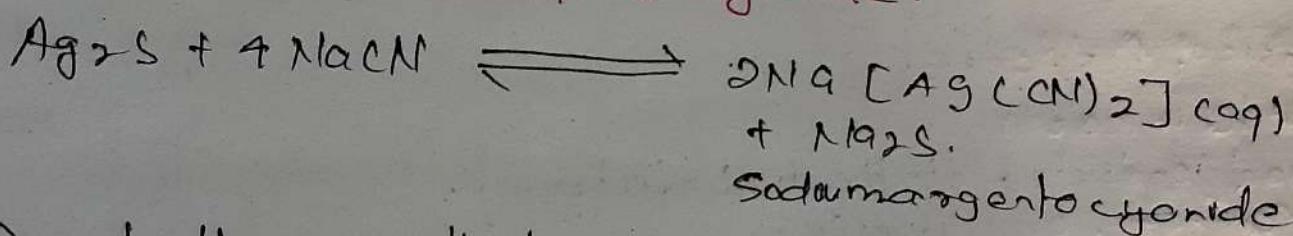
Silver

① Occurrence:

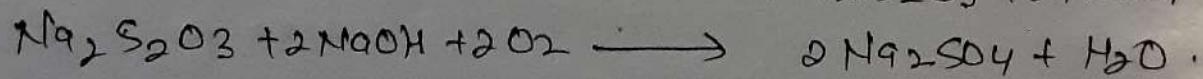
- ① Argentite on silver glorce (Ag_2S)
- ② Horn silver (AgI)
- ③ Silver copper glorce ($(\text{Cu Ag})_2\text{S}_2$)
- ④ Argentiferous galena ($\text{Pb S} \cdot \text{Ag}_2\text{S}$)
- ⑤ Pyrargyrite or ruby silver ($3\text{Ag}_2\text{S} \cdot \text{Sb}_2\text{S}_3$).

Extraction of silver from argentite ore using Cyanide process. (Mae-Arthur-Forrest process).

- ① Crushing and Pulverization.
- ② Concentration of ore by Froath Flotation Process.
- ③ Formation of Complex Cyanide.

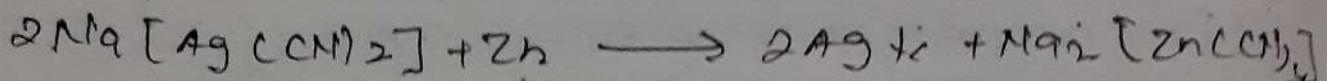


Due to the case that reaction is reversible, air is blown, which removes Na_2S from equilibrium mixture as Na_2SO_4 . So reaction proceeds in forward direction.



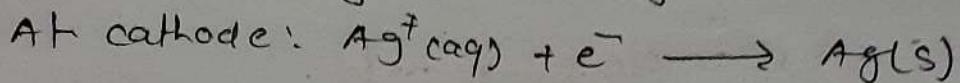
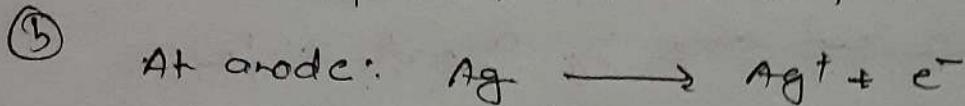
④ Reduction by precipitation method

The solution obtained from the above method is filtered off and treated with finely divided Zn where Ag gets precipitated in the form of dark amorphous powder.



⑤ Purification of silver.

⑥ Dried silver is heated with KNO_3 solid in crucible to get a compact mass. The impurities are oxidised on the surface. liquid silver forms compact mass on cooling.

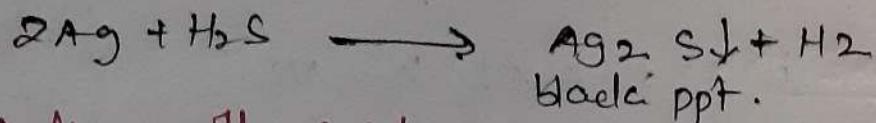


Physical Properties:

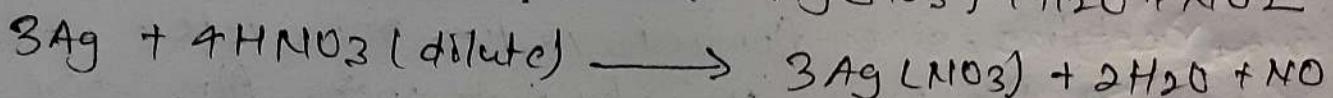
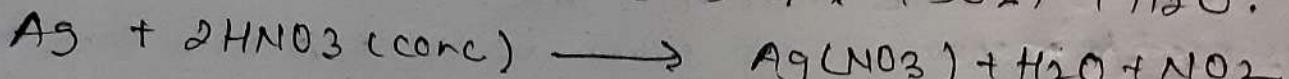
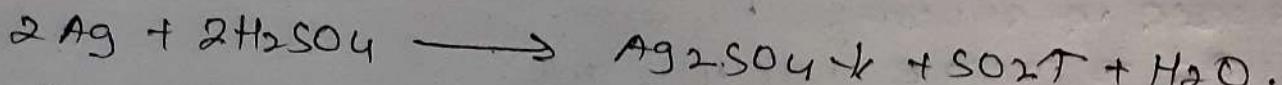
- ① White in colour.
- ② Good conductor of Heat & Electricity.
- ③ Malleable and ductile.
- ④ The density of silver is 10.52 g/cm^3 .
- ⑤ M.P = 956°C , B.P = 1955°C

Chemical Properties:

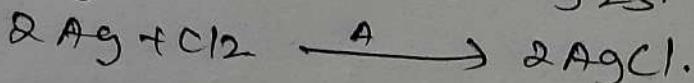
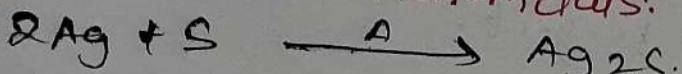
① Action with Am:



② Action with Acids:

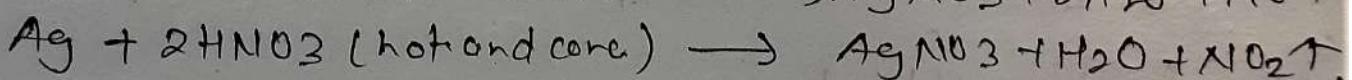


③ Action with non-metals:



Silver Nitrate (AgNO_3)

Preparation:

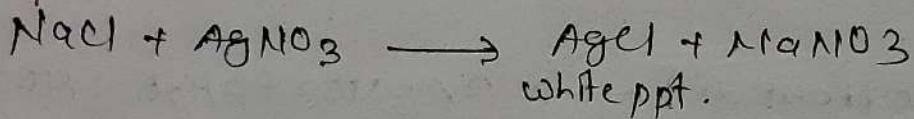


Uses of AgNO_3

- ① It is used as laboratory reagent. For example, it is used for halide test.
$$\text{Cl}^- + \text{Ag}(\text{NO}_3)_2 \xrightarrow{\text{cone HNO}_3} \text{AgCl} \downarrow + \text{NO}_3^-$$
- ② It is used in silvering of mirror.
- ③ It is used to prepare indelible ink.
- ④ It is used to prepare some silver based explosives such as silver acetylide, silver fulminate, silver azide, etc.
- ⑤ It is used in the preparation of photographic film where silver nitrate is reacted with sodium or potassium salts.
- ⑥ It is used to prepare Tollen's reagent.

Silver Chloride (AgCl)

Preparation :



Uses of silver chloride:

- ① AgCl is used in silver/silver chloride electrode which is a common reference electrode.
- ② It is used in pottery glaze to produce "inglaze luster". The use of AgCl in pottery glaze is due to its low solubility.
- ③ It is used to prepare photographic paper.
- ④ It can be used as antidote of mercury poisoning.
- ⑤ It can act as antimicrobial agent.