



ORGANIC COMPOUNDS CONTAINING OXYGEN-II



Objectives

- **Preparation of methanol and its properties**
- **Preparation of ethanol and its properties**
- **Preparation of ethylene glycol and its properties**
- **Preparation of glycerol and its properties**
- **Preparation of phenol**

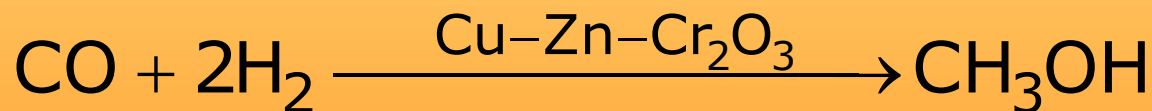
Methanol

Preparation

1. From destructive distillation of wood

Pyroligneous acid obtained from destructive distillation of wood consists of 5% methyl alcohol

2. By catalytic hydrogenation of carbon monoxide.



3. From natural gas





Properties of methanol

Colourless liquid.

Highly poisonous in nature; as little as 30 ml can cause death.

Uses

As a solvents in paints, varnishes.

Chiefly for making formaldehyde.

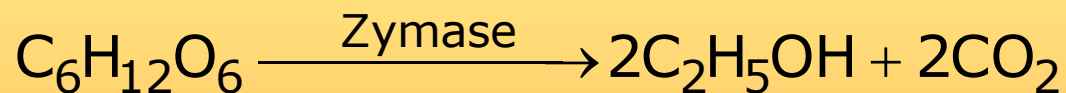
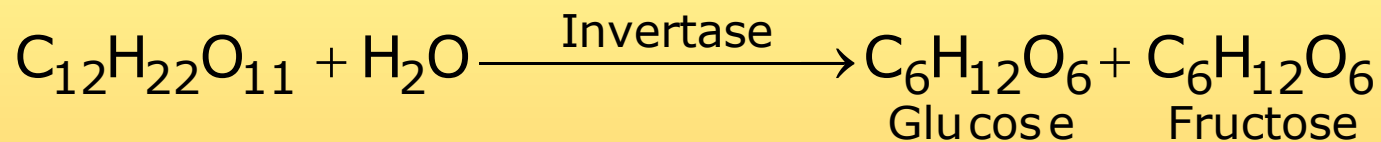
As an antifreeze for automobile radiators.

To denature ethyl alcohol.

20% mixture of methyl alcohol and gasoline makes a good motor fuel.

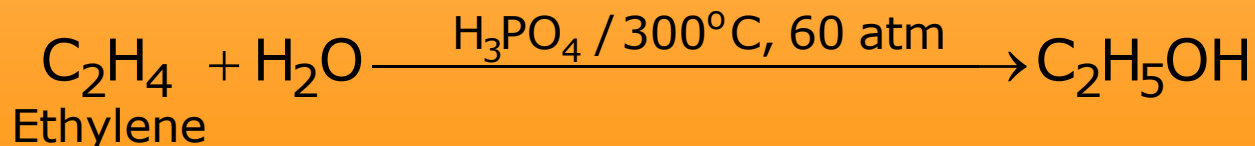
Ethanol

Fermentation of sugar



Fermentation stops when alcohol formed is more than 14 percent due to the acidic nature of the alcohol.

Synthesis of alcohol



Important reactions

Reaction with sulphuric acid:

(i) At room temperature



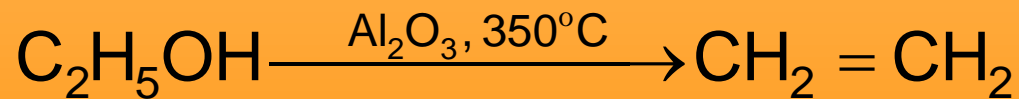
(ii) At 140°C



(iii) At 170°C

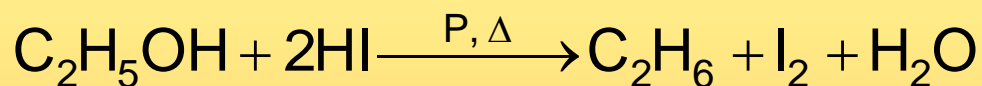


Reaction with alumina:



Specific reactions

Reduction



oxidation



Formation of iodoform





Uses of ethyl alcohol

- **Manufacturing of alcoholic beverages.**
- **As an industrial solvent.**
- **Manufacturing drugs, flavouring extracts, and perfumes.**
- **As an antiseptic in hospitals.**
- **In manufacturing of synthetic rubber.**



Absolute alcohol

100% pure ethyl alcohol

Commercial alcohol is 95% ethyl alcohol.

Because at this composition water and alcohol formed azeotropic mixture, it cannot be separated by further distillation.

Method to obtain absolute alcohol

Laboratory method:

Quicklime is added to the commercial alcohol. The mixture is refluxed for 8 hours. It is then distilled to give absolute ethyl alcohol.



Industrial method:

Commercial alcohol is extracted with benzene. Distillation of this gives absolute alcohol at 78°C.



Denatured alcohol

Mixture of commercial ethyl alcohol with small amount of very poisonous substances.

Alcoholic beverages.



Heavy
excise duty



Denatured

For industrial purposes, it is duty free.



Alcoholic beverages

Wine → 12% ethyl alcohol.

Beers → 4% ethyl alcohol.

Whiskey → 40-50% ethyl alcohol.

Brandy → 40-50% ethyl alcohol.

Content of ethyl alcohol in beverages is indicated by 'Proof Spirit'

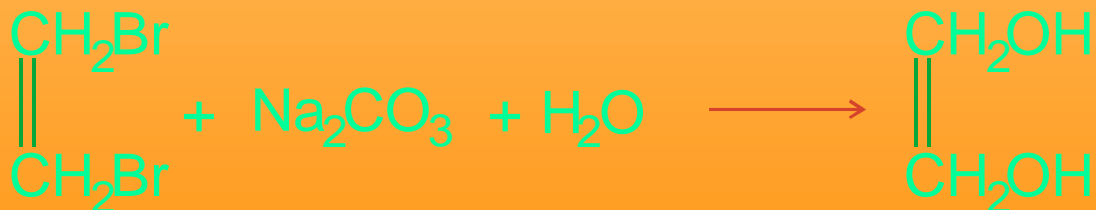
Proof is the double of volume of ethyl alcohol in beverages.

Preparation of ethylene glycol

1. By oxidation of ethylene with cold dilute potassium permanganate solution.

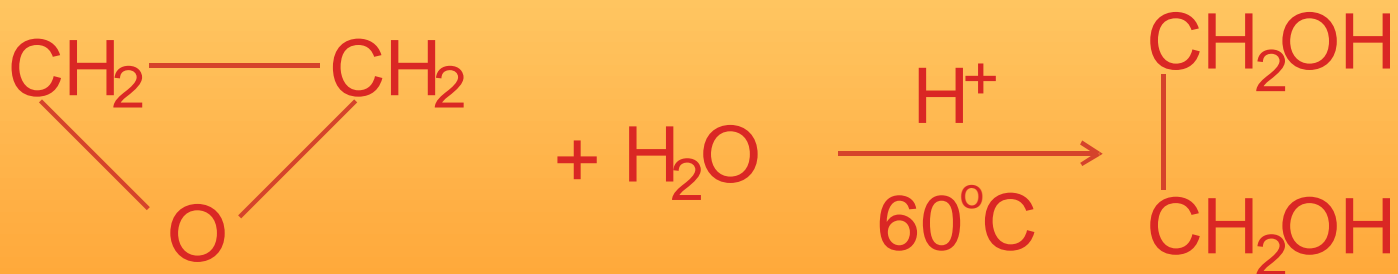


2. By hydrolysis of 1,2-dibromoethane with aqueous sodium carbonate solution.



Preparation of glycol

3. By hydrolysis of ethylene oxide with H_2O at 200°C under pressure or with dilute H_2SO_4 at 60°C .





Properties of glycol

It's a colourless viscous liquid, b.p 197°C.

It has a sweet taste.

It is hygroscopic.

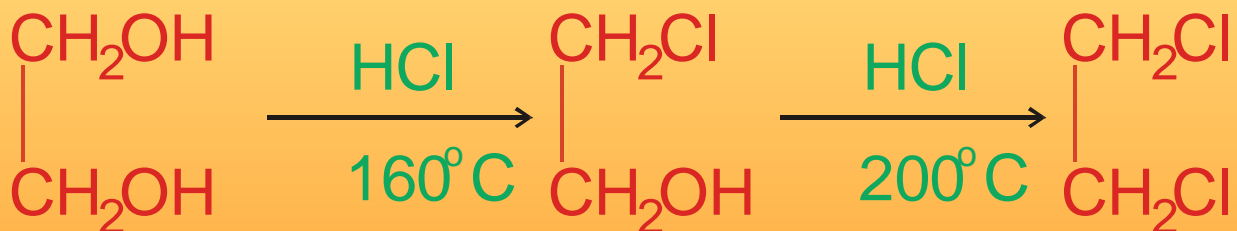
Soluble in ethanol and water.

Toxic as methyl alcohol when taken orally.

Reactions with sodium

It shows all the reactions of $-OH$ group. Due to two $-OH$ group it consumes more reactants. Sometimes more drastic conditions are required to react with second $-OH$ group of ethylene glycol.

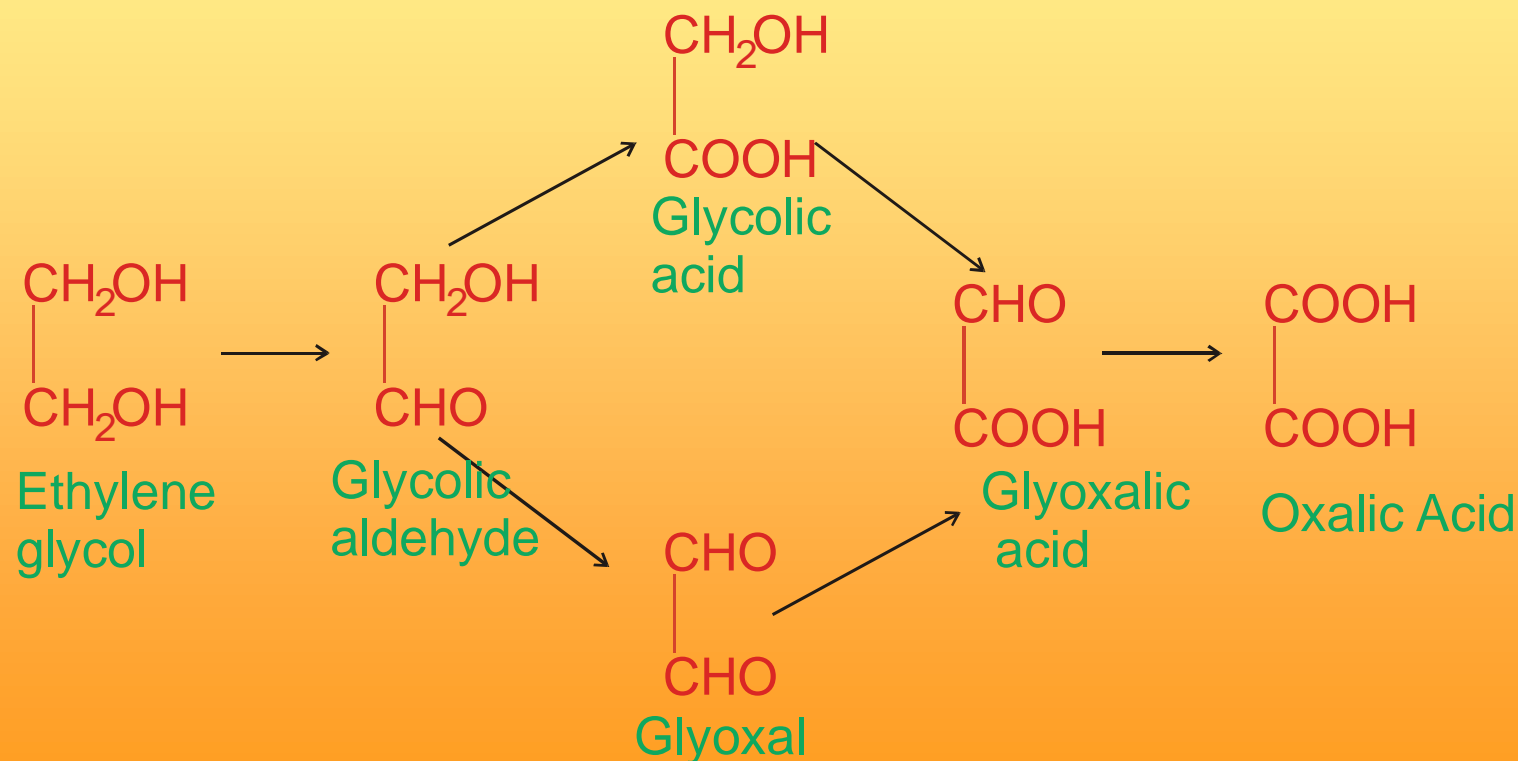
For example



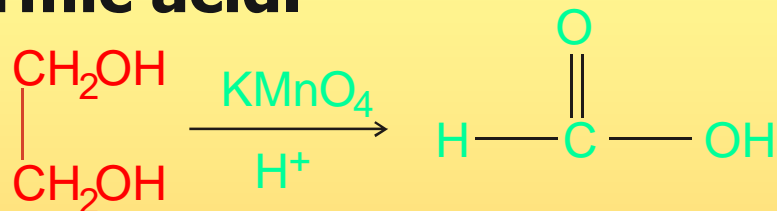
It is used as coolant in automobiles and synthetic fibres like dacron, polyester used for making wrinkle free clothes.

Oxidation of glycol

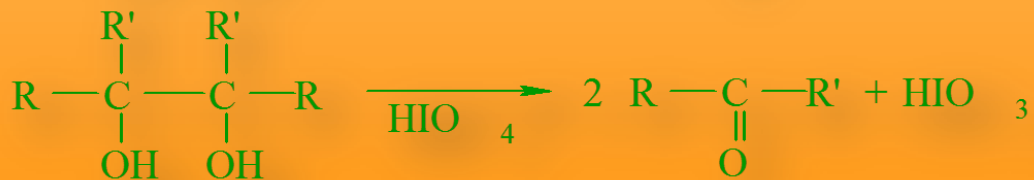
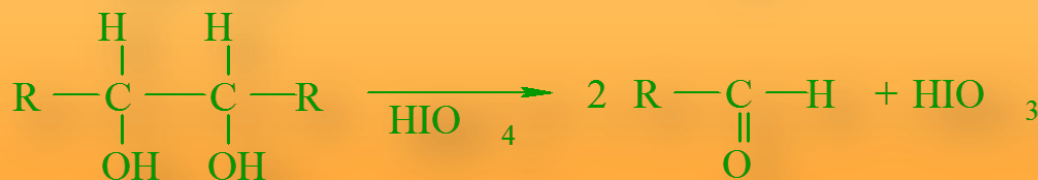
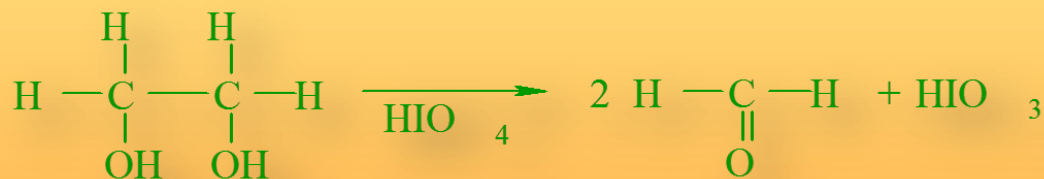
(i). Nitric acid yields a number of substances.



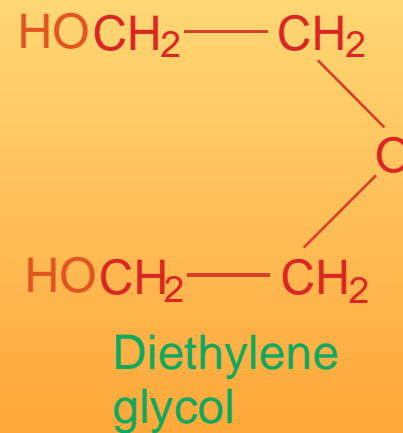
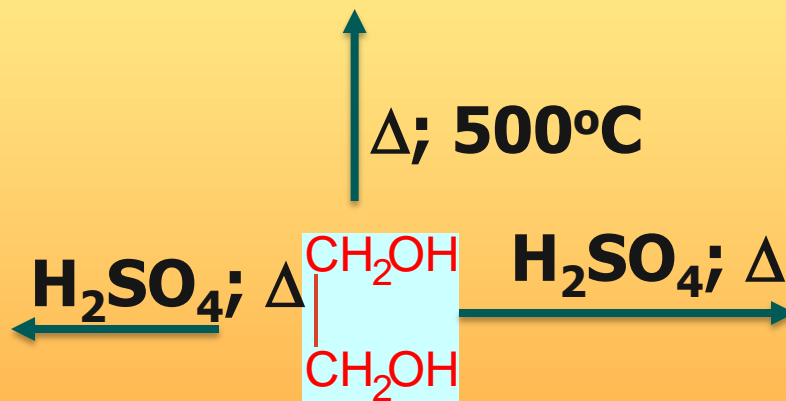
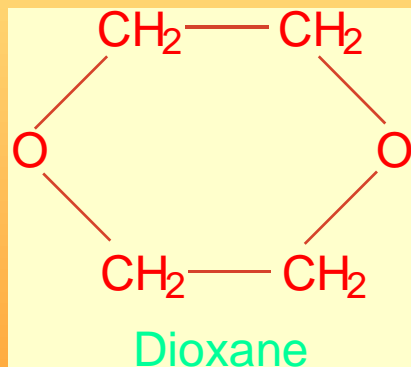
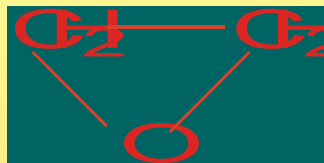
(ii) With acidic potassium permanganate or potassium dichromate gives formic acid.



(iii). Periodic Acid Cleavage of Glycols



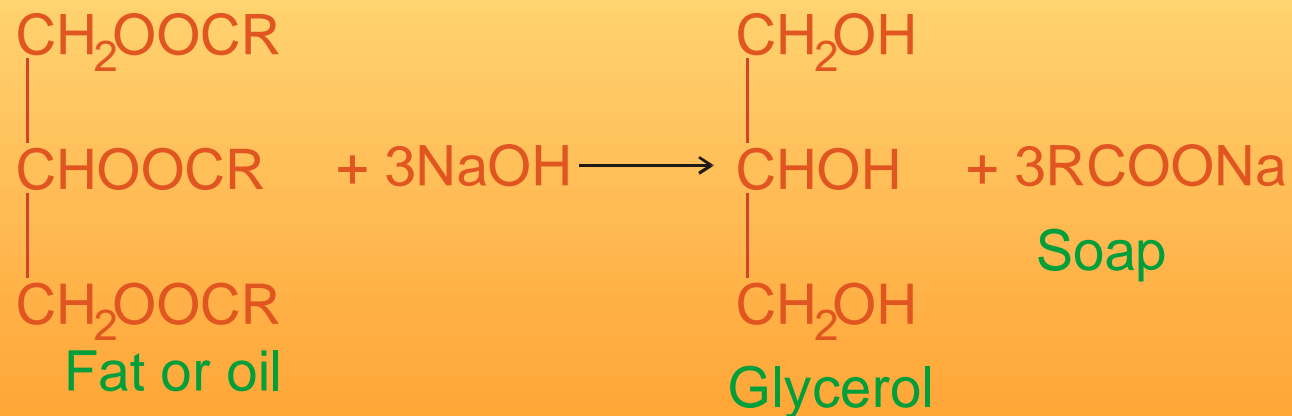
Dehydration of ethylene glycol



Propane-1,2,3-triol(Glycerol)

Preparation

1. From fats and oils: by product of soap industry.



This reaction is called saponification.



Properties

Colourless, odourless sweet tasting and syrup liquid, b.p. 290°C.

It is nontoxic.

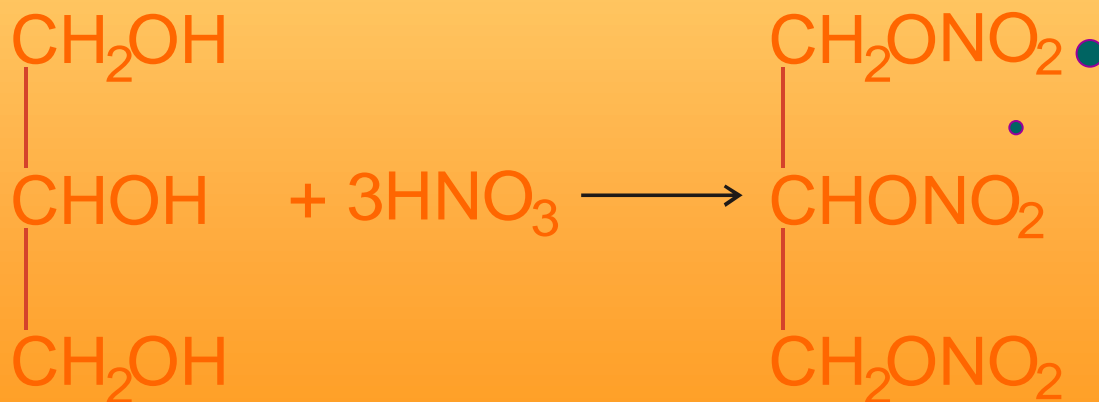
Soluble in water and ethanol.

It is hygroscopic, i.e., absorbs moisture from air.

Reaction with nitric acid

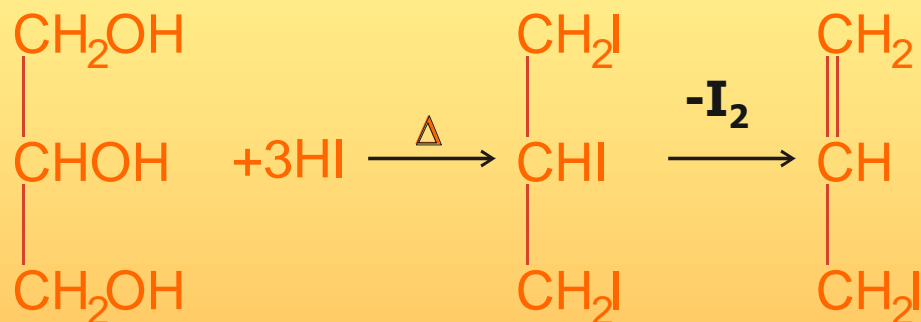
Gives nitroglycerine; pale yellow oily liquid;

a powerful
explosive.

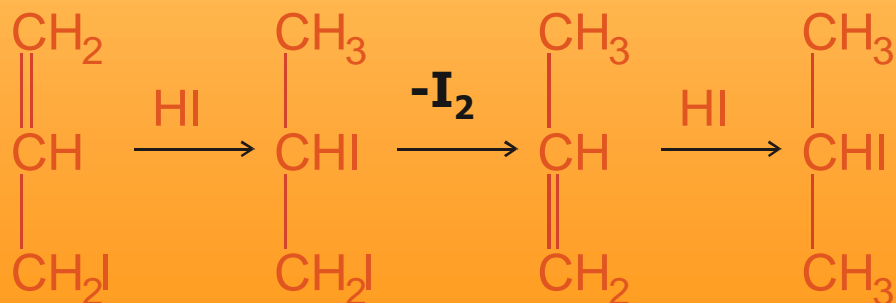


Reaction with hydrogen iodide

With small amount of HI

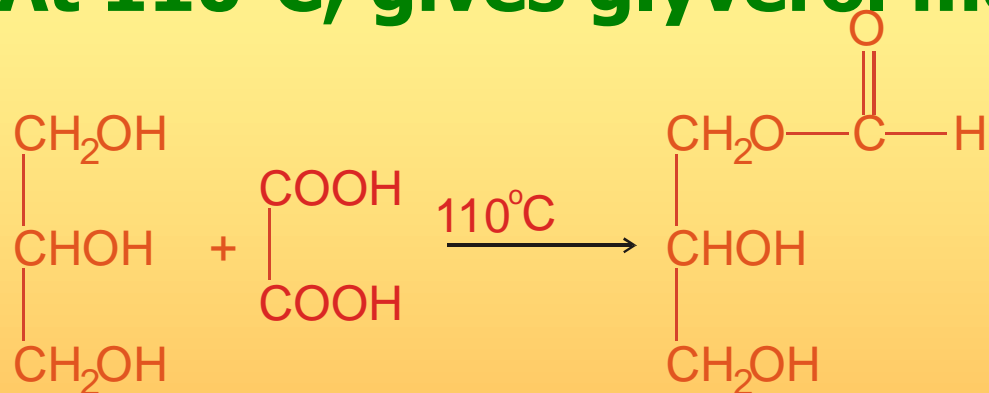


With large amount of hydrogen iodide.

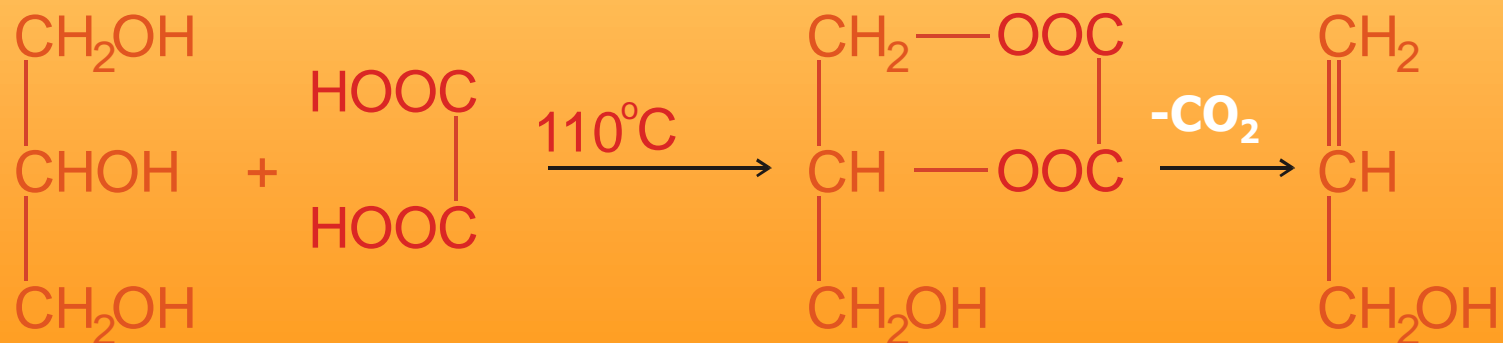


Reaction with oxalic acid

At 110°C, gives glyverol monoformate.



At 260°C, gives allyl alcohol.



Oxidation

Two primary alcohol groups in glycerol are capable of being oxidized to the aldehydes and then the carboxyl group. The secondary alcohol group can be oxidized to the carbonyl group.

Variety of oxidation products obtained depending on the nature of the Oxidising agent.

- With dilute HNO_3 gives glyceric acid and tartaric acid.
- With concentrated HNO_3 gives mainly glyceric acid.
- With bismuth nitrate gives mainly mesoxalic acid.
- With bromine water, sodium hypobromite, or Fenton's reagent ($\text{FeSO}_4 + \text{H}_2\text{O}_2$), gives a mixture of glyceraldehyde and dihydroxyacetone.
- With periodic acid gives formaldehyde and formic acid.



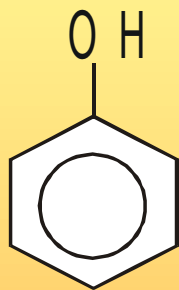
Dehydration

When heated alone or with KHSO_4 two molecules of water eliminates.

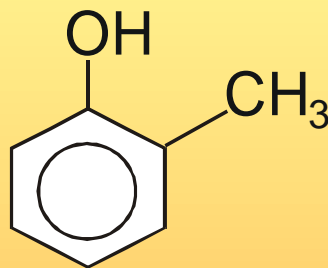


Phenol

Containing —OH group attached directly to an aromatic ring.



Phenol

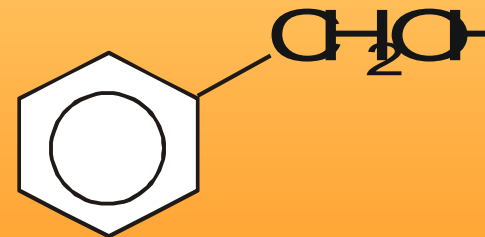


o-Cresol



Quinol

Compounds which contain an —OH group in a side chain attached to an aromatic ring are not phenols. They are called aromatic alcohol. For example

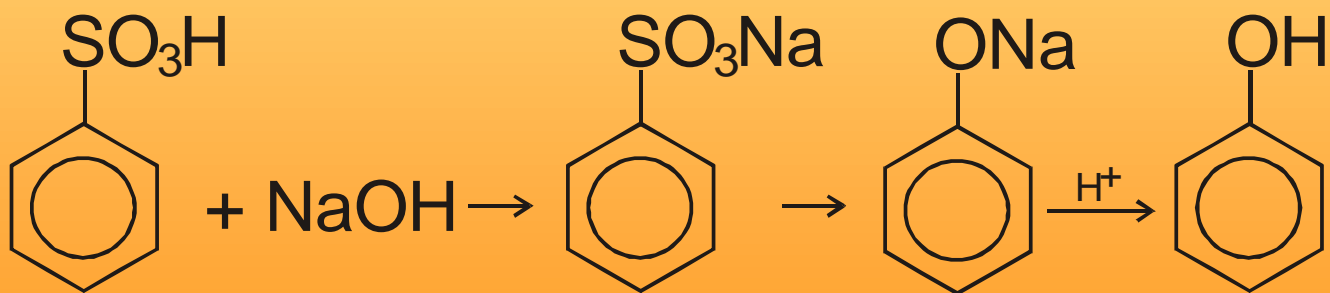


Benzyl alcohol

Preparation of phenol

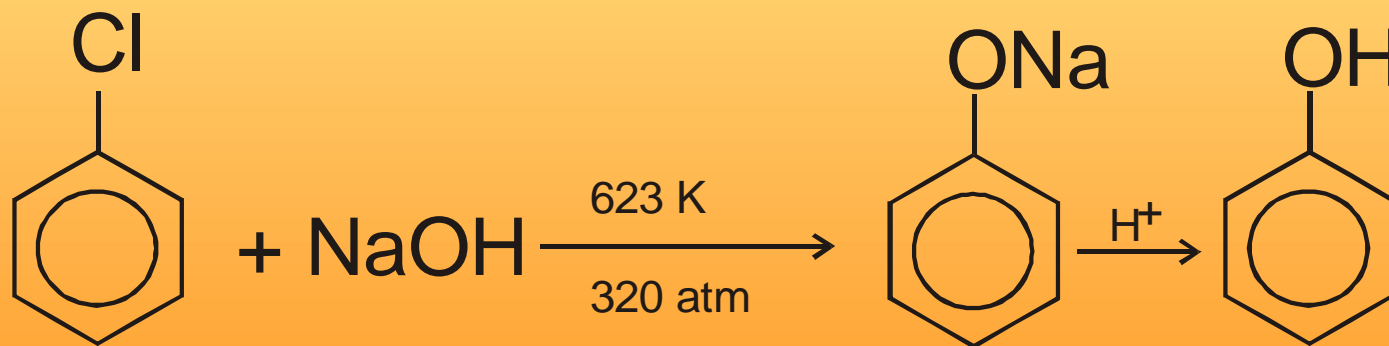
From aryl sulphonic acids

Aryl sulphonic acid gives corresponding phenol on heating with molten sodium hydroxide at 570-620 K.



Preparation of phenol

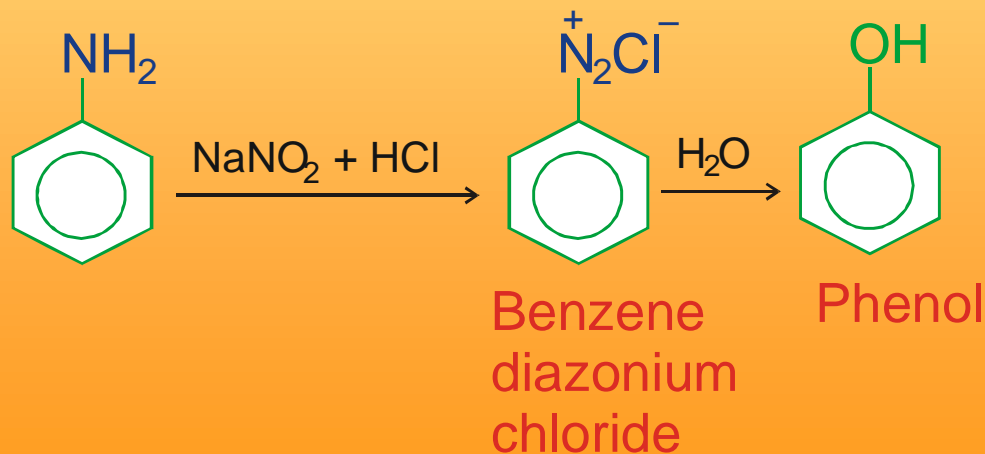
Chlorobenzene is hydrolysed by treating it with NaOH at 623 K and 320 atm.



Preparation of phenol

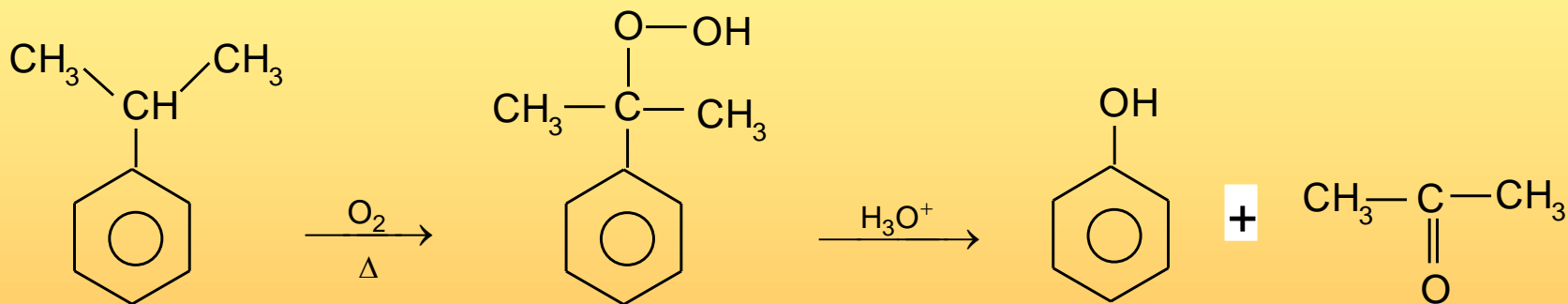
From hydrolysis of diazonium salt

Diazonium salts are prepared by treating an aromatic primary amine with nitrous acid ($\text{NaNO}_2 + \text{HCl}$) at low temperature.

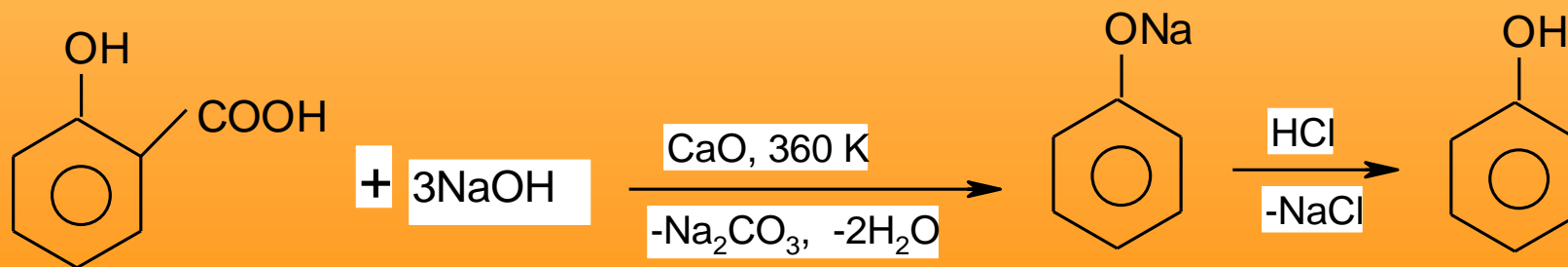


Preparation methods

Synthesis from cumene



By decarboxylation of salicylic acid with soda lime





Thanks...