



**CLASSROOM STUDY
PACKAGE**

CHEMISTRY

ALCOHOL PHENOL AND ETHER

JEE EXPERT

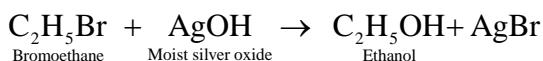
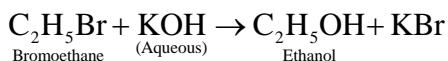
ALCOHOL PHENOL AND ETHER

Hydroxy compounds are those compounds in which the hydroxy group, – OH is directly linked with the aliphatic or aromatic carbon.

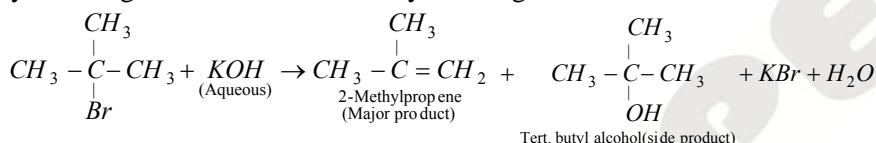
Monohydric alcohols

These are compound containing one hydroxyl group. Their general formula is $C_nH_{2n+2}O$

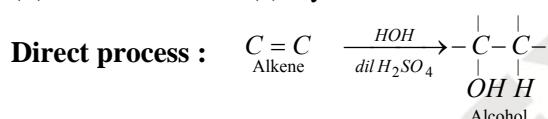
(1) Preparation : (i) From alkyl halide



- 1° alkyl halide gives good yield of alcohols.
 - 2° alkyl halide gives mixture of alcohol and alkene.
 - 3° alkyl halide gives alkenes due to dehydrohalogenation.



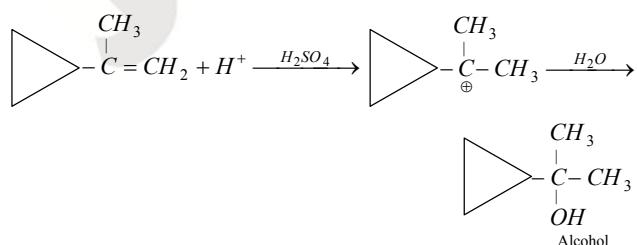
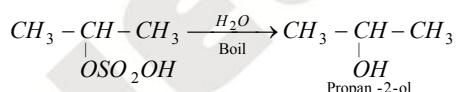
(ii) **From alkenes** : (a) Hydration



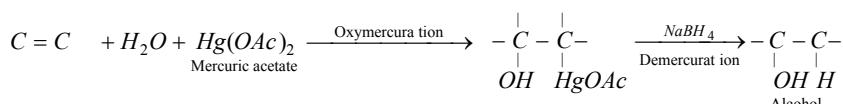
Indirect process :



In case of unsymmetrical alkenes

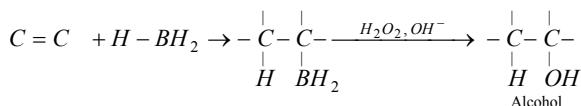


(b) Oxymercuration-demercuration

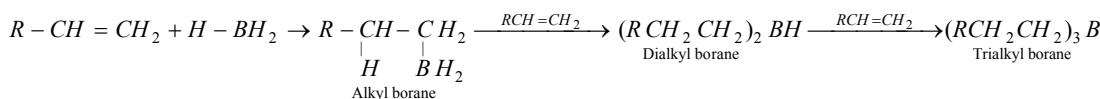


This reaction is very fast and produces the alcohol in high yield. The alcohol obtained corresponds to Markownikoff's addition of water to alkene.

(c) Hydroboration oxidation (HBO) : (Antimarkownikoff's orientation)

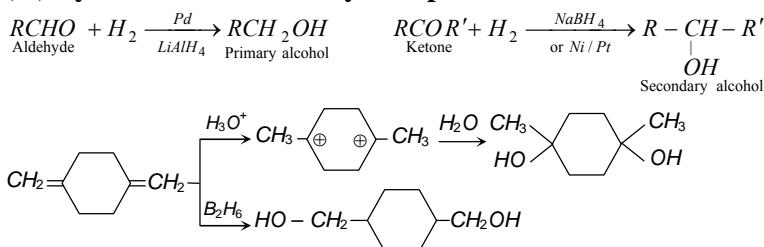


Diborane is an electron deficient molecule. It acts as an electrophile reacting with alkenes to form alkyl boranes R_3B .

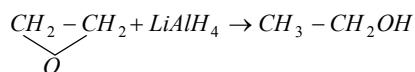


□ Carbocation are not the intermediate in HBO hence no rearrangement take place.

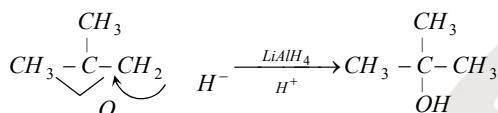
(iii) By reduction of carbonyl compounds



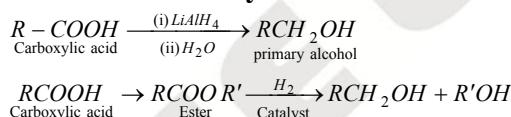
$LiAlH_4$ also reduces epoxides into alcohol :



Hydride selectively attacks the less alkylated carbon of the epoxide.

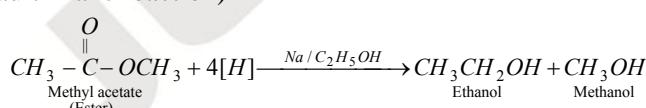


(iv) By reduction of carboxylic acids and their derivatives

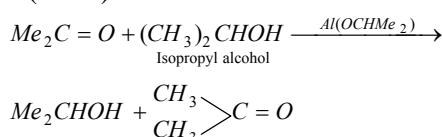


Esters are also reduced to alcohols

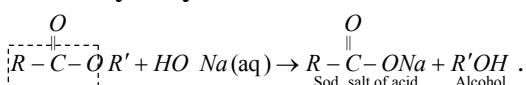
(Bouveault Blanc reaction)



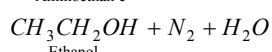
□ Reduction with aluminium isopropoxide is known as Meerwein-Ponndorff verley reduction (MPV) reduction.



(v) By alkaline hydrolysis of ester



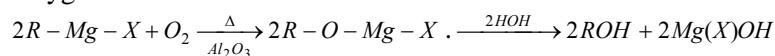
(vi) From primary amines



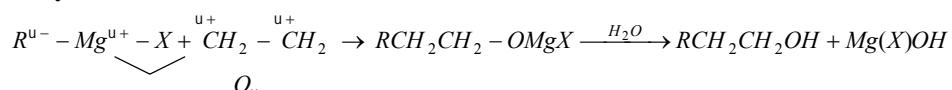
It is not a good method of preparation of alcohols because number of by product are formed like alkyl chloride alkenes and ethers.

(vii) From Grignard reagent

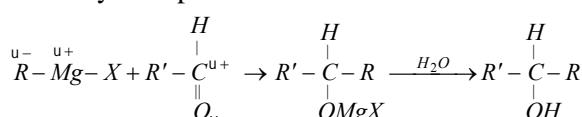
(a) With oxygen :



(b) With ethylene oxide :



(c) With carbonyl compounds :



□ If R' \equiv H, product will be 1°alcohol.

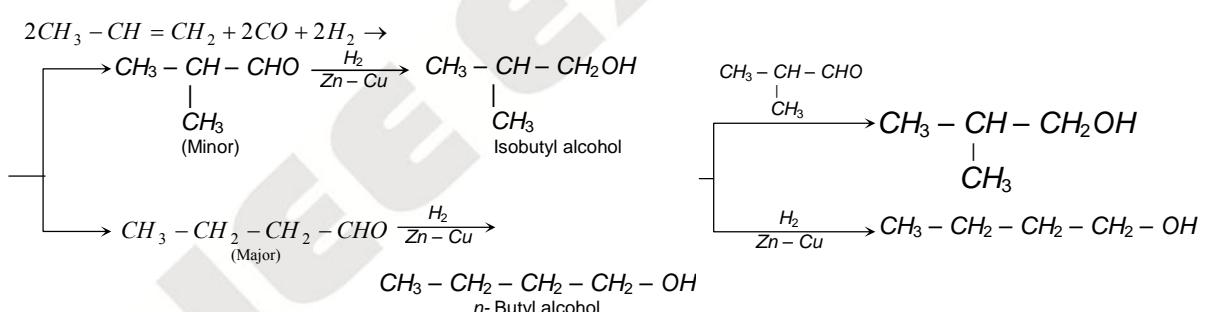
□ If $R' \equiv R$, product will be 1°alcohol.

If carbonyl compound is a ketone, product will be 3° alcohol.

- If carboxylic compound is a ketone, product will be 3° alcohol.
- It is the best method for preparation of alcohol because we can prepare every type of alcohols

(viii) **The oxo process** : It is also called carbonylation or hydroformylation reaction. A mixture of alkene carbon monoxides and hydrogen. Under pressure and elevated temperature in the presence of catalyst forms aldehyde.

Catalyst is cobalt carbonyl hydride [$CoH(CO)_4$] product is a mixture of isomeric straight chain (major) and branched chain (minor) aldehydes. Aldehydes are reduced catalytically to the corresponding alcohols.

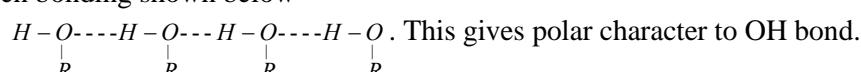


(2) Physical properties of monohydric alcohols

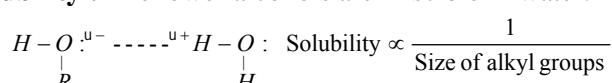
(i) **Character** : Alcohols are neutral substances. These have no effect on litmus paper. This is analytical test for alcohols.

(ii) **Physical state** : The lower alcohols (upto C₁₂) are colourless alcohol with characteristic smell and burning taste. The higher members with more than 12-carbon atoms are colourless and odourless solids.

(iii) **Polar character** : Oxygen atom of the – OH group is more electronegative than both carbon and hydrogen. Thus the electron density near oxygen atom is slightly higher. Hydrogen bonding shown below



(iv) **Solubility** : The lower alcohols are miscible in water.



Increase in carbon-chain increases organic part hence solubility in water decreases.

Isomeric 1°, 2°, 3° alcohols have solubility in order 1° > 2° > 3°.

(v) **Boiling points** : Due to intermolecular hydrogen bonding boiling points of alcohols are higher than hydrocarbon and ethers.

B.P. $\propto \frac{1}{\text{No. of branches}}$; B.P. follows the trends:

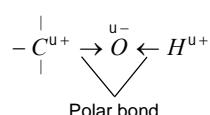
1° alcohol > 2° alcohol > 3° alcohol

(vi) **Density** : Alcohols are lighter than water.

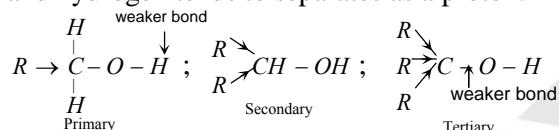
Density \propto Molecular masses.

(vii) **In toxicating effects :** Methanol is poisonous and is not good for drinking purposes. It may cause blindness and even death. Ethanol is used for drinking purposes.

(3) **Chemical properties :** Characteristic reaction of alcohol are the reaction of the – OH group. The reactions of the hydroxyl group consists of either cleavage of C – O bond or the cleavage of O – H bond.



C – O bond is weaker in the case of tertiary alcohols due to +I effect of alkyl groups while – OH bond is weaker in primary alcohols as electron density increase between O – H bond and hydrogen tends to separates as a proton.

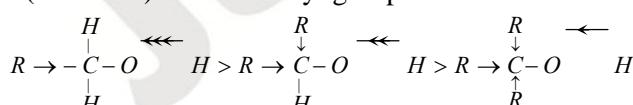


Thus primary alcohols give the most of reaction by cleavage of O – H bond while tertiary alcohols are most reactive because of cleavage of C – O bond. Hence – O – H cleavage reactivity order : Primary > Secondary > Tertiary and C – O – cleavage reactivity order : Tertiary > Secondary > Primary alcohol

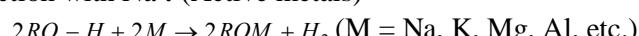
(i) Reaction involving cleavage of with removal of 'H' as proton

Alcohols are stronger acids than terminal acetylene but are not acidic enough to react with aqueous NaOH or KOH. Acidic nature is in the order $\text{HOH} > \text{ROH} > \text{CH} \equiv \text{CH} > \text{NH}_3 > \text{RH}_3$.

Acidic nature of alcohol decrease with increase of alkyl groups on – OH bonded carbon due to +I (inductive) effect of alkyl group.

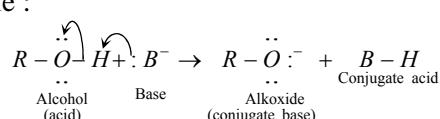


(a) Reaction with Na : (Active metals)

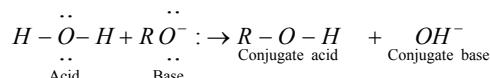


Evolution of H_2 shows the presence of –OH and reaction show that alcohols are acidic in nature. Alcohols acts as Bronsted acids because they donate a proton to a strong base ($:B^-$).

Example :

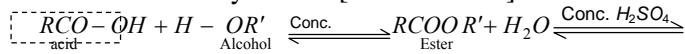


On reaction of alkoxide with water, starting alcohol is obtained.



This is the analytical test for alcohols.

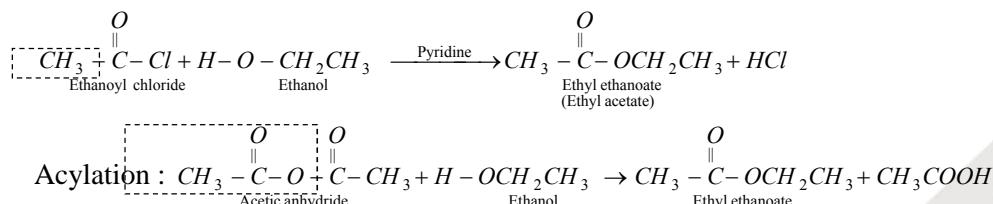
(b) Reaction with carboxylic acid [Esterification] :



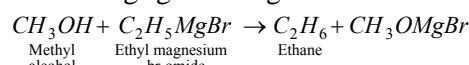
When HCl gas is used as catalyst, the reaction is called fischer-speier esterification.

Presence of bulky group in alcohol or in acid decreases the rate of esterification. This is due to steric hindrance of bulky group. Reactivity of alcohol in this reaction is $1^\circ > 2^\circ > 3^\circ$.

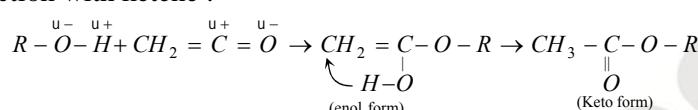
(c) Reaction with acid derivatives : (Analytical test of alcohol)



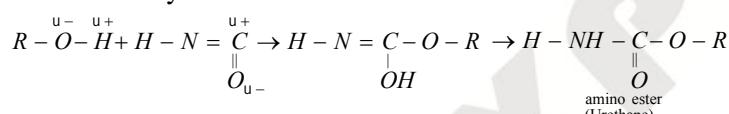
(d) Reaction with grignard reagents :



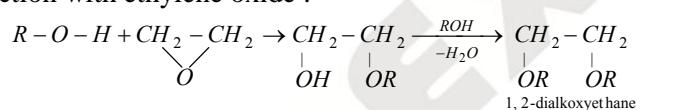
(e) Reaction with ketene :



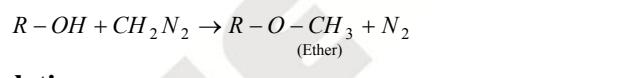
(f) Reaction with isocyanic acid :



(g) Reaction with ethylene oxide :



(h) Reaction with diazomethane :

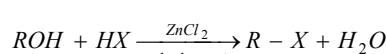


(ii) **Alkylation** : $ROH + R_2'SO_4 \rightarrow$

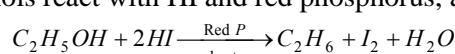
(iii) Reaction involving cleavage of $\text{C}_2\text{O}_4^{2-}$

(iii) Reaction involving cleavage of $-C-OH$ with removal of substituent of $-OH$ group

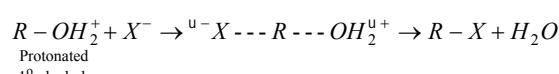
(a) Reaction with
order of $\text{HI} > \text{HB}$
 1° . The reaction
follows Grignard's pro-



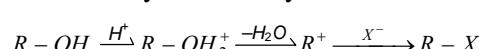
If alcohols react with HJ and red phosphorus, alkane will be formed



Primary alcohols follow S_{E2} mechanism.

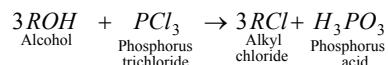


In secondary and tertiary alcohols, the S_N2 mechanism operates.

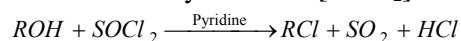


(b) Reaction with PCl_5 : $\text{ROH} + \text{PX}_3 \rightarrow \text{RX} + \text{POX}_2 + \text{HX}$; X = Cl (Analytical test for alcohols)

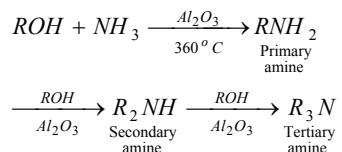
(c) Reaction with PCl_3 :



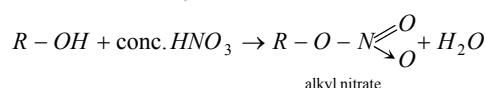
(d) Reaction with thionyl chloride $[SOCl_2]$:



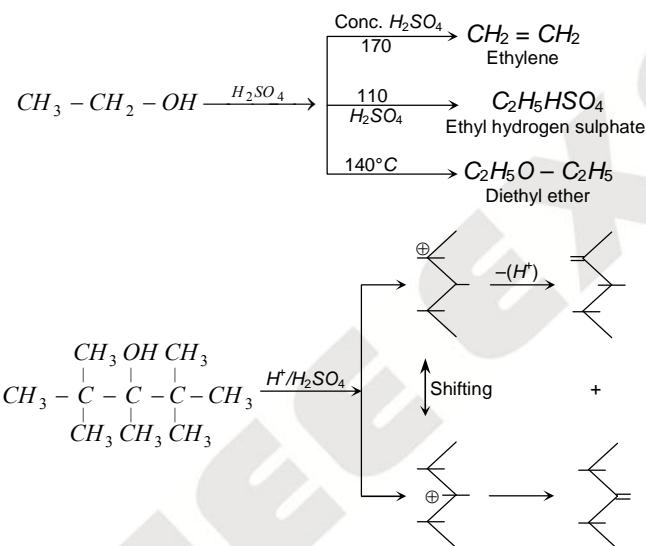
(e) Reaction with ammonia :



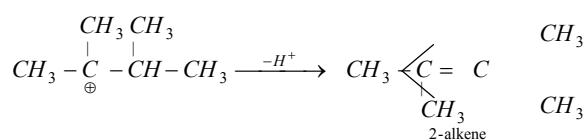
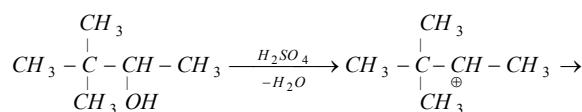
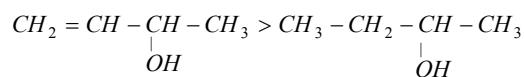
(f) Reaction with HNO_3 :

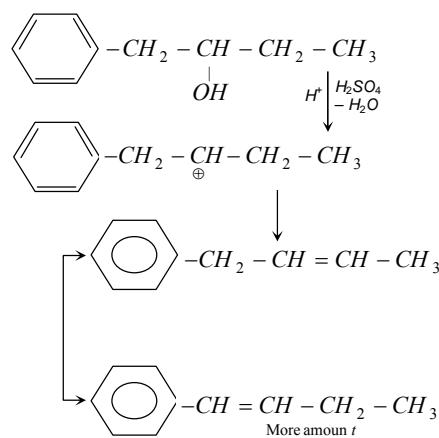


(g) Reaction with H_2SO_4 [Dehydration of alcohol] : The elimination of water from a compound is known as dehydration. The order of ease dehydration is Tertiary > Secondary > primary alcohol. The products of dehydration of alcohols are depend upon the nature of dehydrating agents and temperature.



Alcohol leading to conjugated alkene are dehydrated to a greater extent than those of alcohols leading to nonconjugated alkene. Thus dehydration is in order

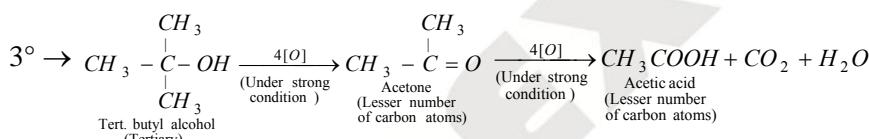
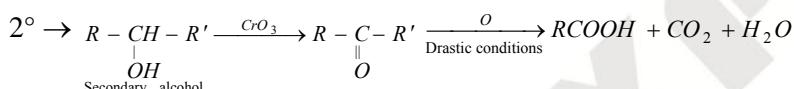
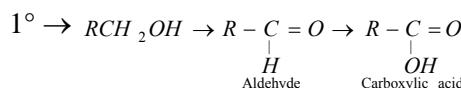




(iv) General reaction of alcohols

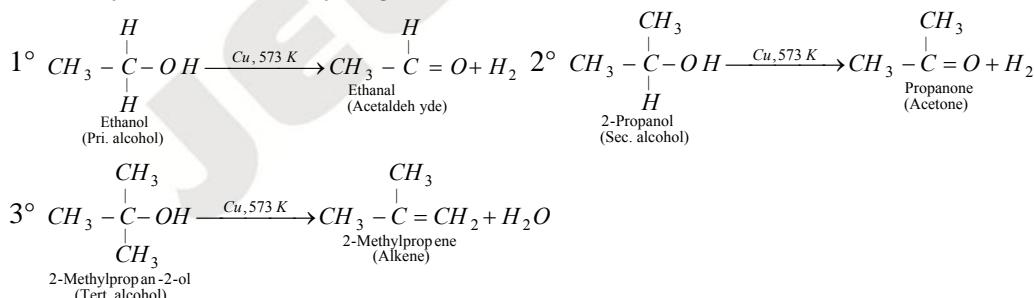
(a) Reduction : $R-OH + 2HI \xrightarrow{\Delta} R-H + H_2O + I_2$

(b) Oxidation : Difference between 1° , 2° and 3° alcohols.



- 3° alcohols are resistant to oxidation, but on taking stronger oxidising agent they form ketone.

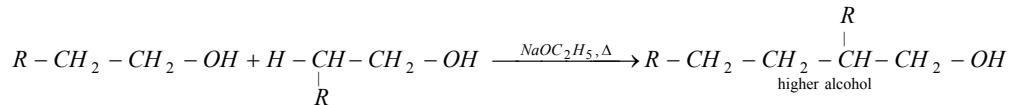
(c) Catalytic oxidation/dehydrogenation



Important reagents used for oxidation of alcohols

- PCC [Pyridinium chloro chromate ($C_6H_5NH^+Cl^-CrO_3^-$)] to oxidise 1° alcohols to aldehydes and 2° alcohols to ketones.
 - PDC [Pyridinium di chromate ($C_5H_5.NH_2^+Cr_2O_7^-$)] to oxidise 1° alcohols to aldehyde and 2° alcohol to ketones.
 - H_2CrO_4 (chromic acid) to oxidise 1° alcohol to carboxylic acid.
 - $CrO_3 \cdot H_2SO_4$ / Acetone to oxidise 2° alcohol to ketones.
 - Jones reagents (chromic acid in aqueous acetone solution) oxidise 1° alcohol to aldehyde and 2° alcohol to ketone without affecting (C = C) double bond.

- MnO_2 selectively oxidises the – OH group of allylic and benzylic 1° and 2° alcohols to give aldehyde and ketone respectively.
- N_2O_4 in $CHCl_3$ oxidises primary and secondary benzyl alcohol.

(d) Self condensation : **Guerbet's reaction**

(e) Reaction with ceric ammonium nitrate : Ceric ammonium nitrate + ROH $\xrightarrow[\text{Yellow colour}]{}$ Red colour solution of complex. This is analytical test for alcohols.

(f) Iodoform test : When a few drops of alcohol are warmed with iodine and NaOH yellow precipitate of iodoform with characteristic smell is obtained. Any alcohol consists CH_3CHOH group give iodoform test.

Since reaction takes place with alkali solution as one of the reagents hence alkyl halide like $CH_3 - CH_2Cl$ and $CH_3 - \underset{Cl}{\underset{|}{|}} CH - R$ will also give this test.

(4) **Uses of monohydric alcohol:**(i) **Uses of ethanol :** It is used

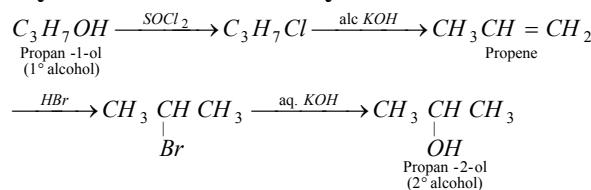
(a) In alcoholic beverages, (b) As a solvent in paints, varnishes, oils, perfumes etc., (c) In the preparation of chemical like chloroform, ether etc., (d) As a fuel in spirit lamps, (e) As an antifreeze for automobile radiators, (f) In the scientific apparatus like spirit levels, (g) As power alcohol.

(ii) **Uses of methanol :**

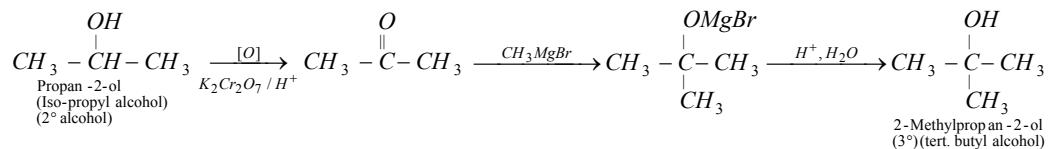
- (a) Methanol is an important industrial starting material for preparing formaldehyde, acetic acid and other chemicals.
- (b) As a fuel (a petrol substitute). A 20% mixture of methyl alcohol and gasoline is a good motor fuel.
- (c) As an antifreeze or automobile radiators.
- (d) To denature ethyl alcohol. The mixture is called methylated spirit.
- (e) In the preparation of dyes, medicines and perfumes. Methyl salicylate and methyl anthra anilate are used in perfumery.

Table : 26.1 Difference between methanol and ethanol

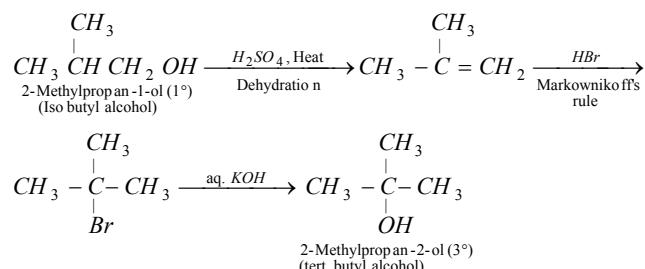
Methanol	Ethanol
(i) When CH_3OH is heated on Cu coil it gives formalin like smell.	(i) It does not give formalin like smell.
(ii) When CH_3OH is heated with salicylic acid in H_2SO_4 (conc.) then methyl salicylate is formed which has odour like winter green oil.	(ii) No such odour is given.
(iii) It does not give haloform or iodoform test.	(iii) It gives haloform test

Interconversion of monohydric alcohols(i) **Primary alcohol into secondary alcohols**

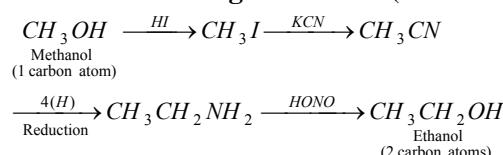
(ii) Secondary alcohol into tertiary alcohol



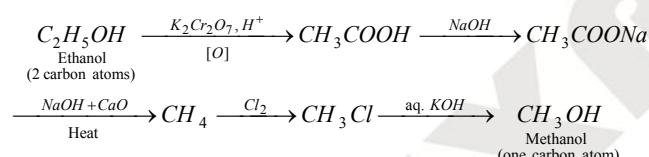
(iii) Primary alcohol into tertiary alcohol



(iv) Lower alcohol into higher alcohol (ascent of series)



(v) Higher alcohol into lower alcohol [Descent series]



Distinguish between primary, secondary and tertiary monohydric alcohols

(i) **Lucas test** : A mixture of anhydrous $ZnCl_2$ + conc. HCl is called as Lucas reagent.

Primary	$R - CH_2 - OH \xrightarrow[-H_2O]{\text{conc. } HCl / ZnCl}_2 \text{ anhy.} R - CH_2 - Cl \rightarrow$ ppt. appears after heating
Secondary	$R_2CH - OH \xrightarrow[-H_2O]{\text{conc. } HCl / ZnCl}_2 \text{ anhy.} R_2 - CH - Cl \rightarrow$ ppt. appears with in 5 minutes
Tertiary	$R_3C - OH \xrightarrow{\text{ZnCl}_2 / HCl} R_3C - Cl \rightarrow$ ppt. appears immediately

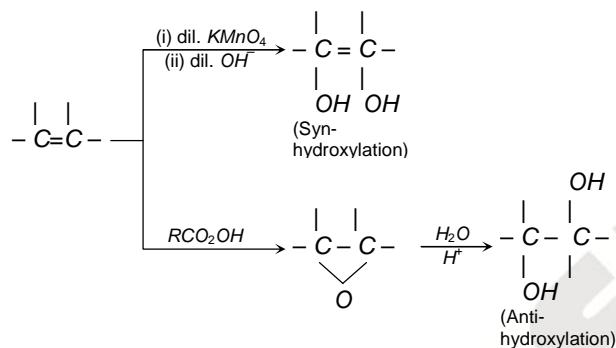
(ii) **Victor mayer test** : Also known as RBW test. RBW → Red, Blue, White test.

Dihydric alcohols

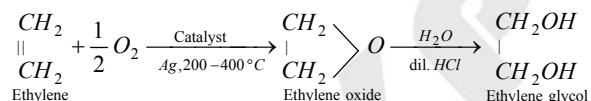
These are compound containing two hydroxyl groups. These are dihydroxy derivatives of alkanes. Their general formula is $C_nH_{2n+2}O_2$. The simplest and most important dihydric alcohol is ethylene glycol. They are classified as α , β , γ glycols, according to the relative position of two hydroxyl groups. α is 1, 2 glycol, β is 1, 3 glycol.

(1) Preparation

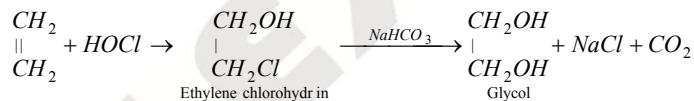
(i) **From ethylene :** (a) Through cold dilute alkaline solution of Bayer's reagent



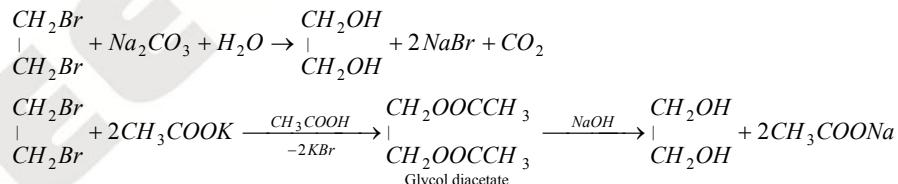
(b) With O_2 in presence of Ag :



(c) With HOCl followed by hydrolysis : (Industrial method)

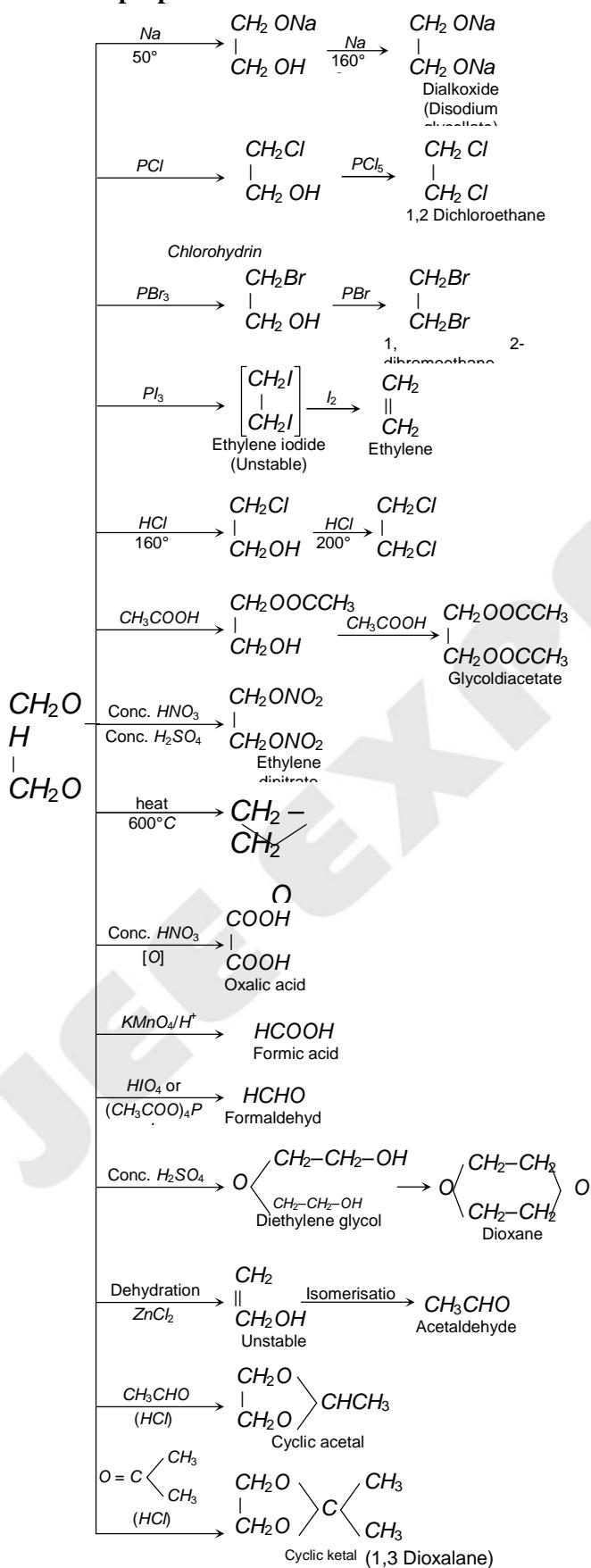


(ii) **From 1, 2 dibromo ethane [Lab method]:**

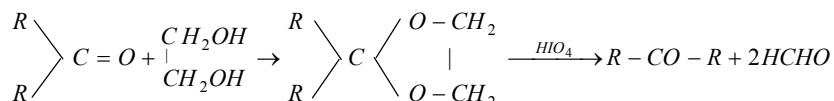
**(2) Physical properties**

- (i) It is a colourless, syrupy liquid and sweet in taste. Its boiling point is $197^\circ C$.
- (ii) It is miscible in water and ethanol in all proportions but is insoluble in ether.
- (iii) It is toxic as methanol when taken orally.
- (iv) It is widely used as a solvent and as an antifreeze agent.

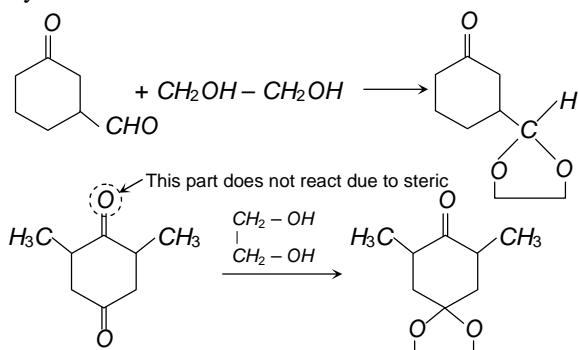
(3) Chemical properties



Dioxalane formation provides a path of protecting a carbonyl group in reaction studied in basic medium in which acetals are not affected. The carbonyl compound may be regenerated by the addition of periodic acid to aqueous solution of the dioxalane or by acidic hydrolysis.



Aldehyde is more reactive than ketone in dioxalane formation.



(4) **Uses**

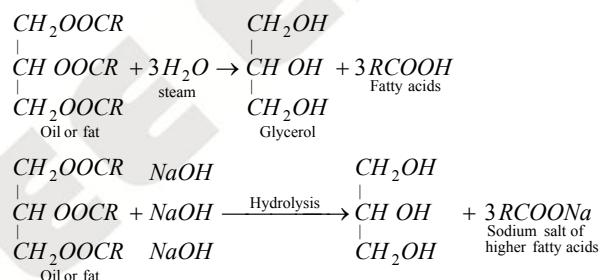
- (i) Used as an antifreeze in car radiators.
 - (ii) Used in the manufacture of dacron, dioxane etc.
 - (iii) As a solvent and as a preservatives.
 - (iv) As a cooling agent in aeroplanes.
 - (v) As an explosives in the form of dinitrate.

Trihydric alcohols.

The only important trihydric alcohol is glycerol (propane-1, 2, 3-triol). It occurs as glycosides in almost all animal and vegetable oils and fats.

(1) Preparation

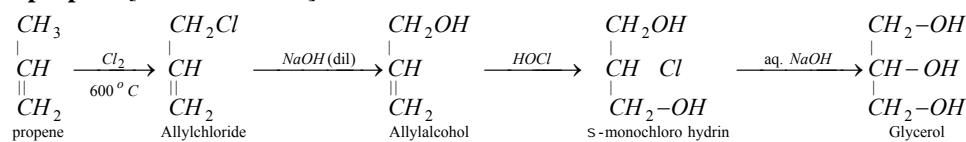
(i) From oils and fats



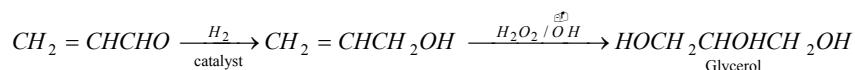
(ii) By fermentation of sugar



(iii) From propene [Modern method]



(iv) From propenal :



(2) Physical properties

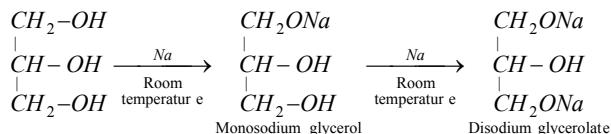
- (i) It is a colourless, odourless, viscous and hygroscopic liquid.
 - (ii) It has high boiling point i.e., 290°C. The high viscosity and high boiling point of glycerol are due to association through hydrogen bonding.

(iii) It is soluble in water and ethyl alcohol but insoluble in ether.

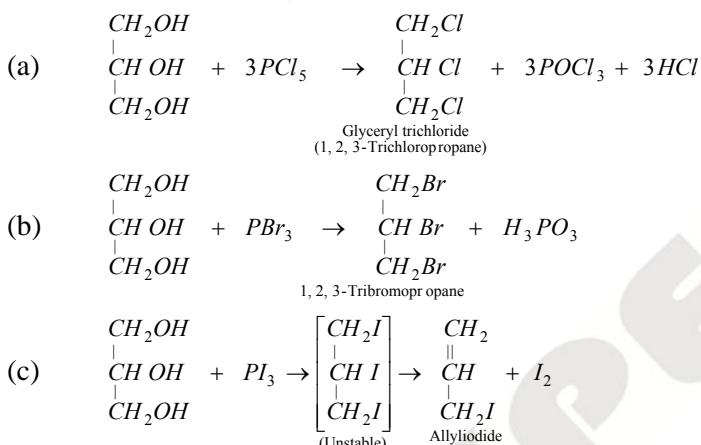
(iv) It is sweet in taste and non toxic in nature.

(3) Chemical properties

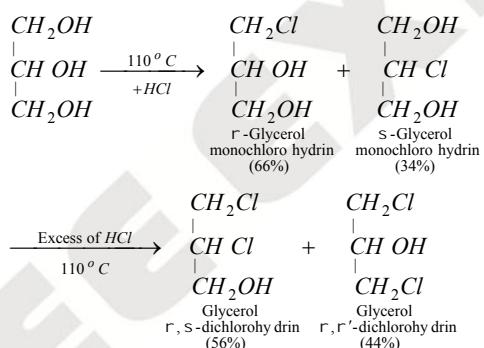
(i) Reaction with sodium



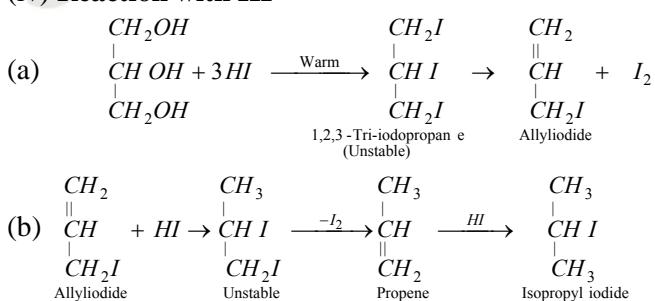
(ii) Reaction with PCl_5 , PBr_3 and PI_3



(iii) Reaction with HCl or HBr

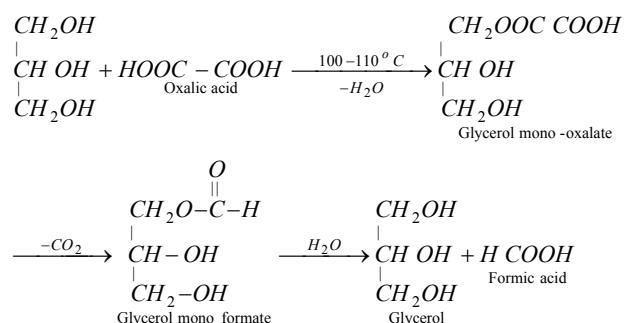


(iv) Reaction with HI

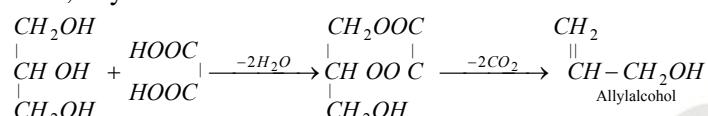


(v) Reaction with oxalic acid

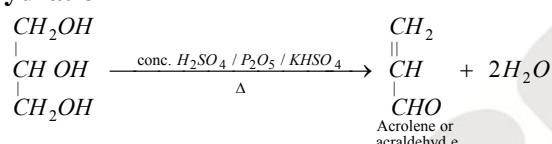
(a) At 110°C Glycerol is formed



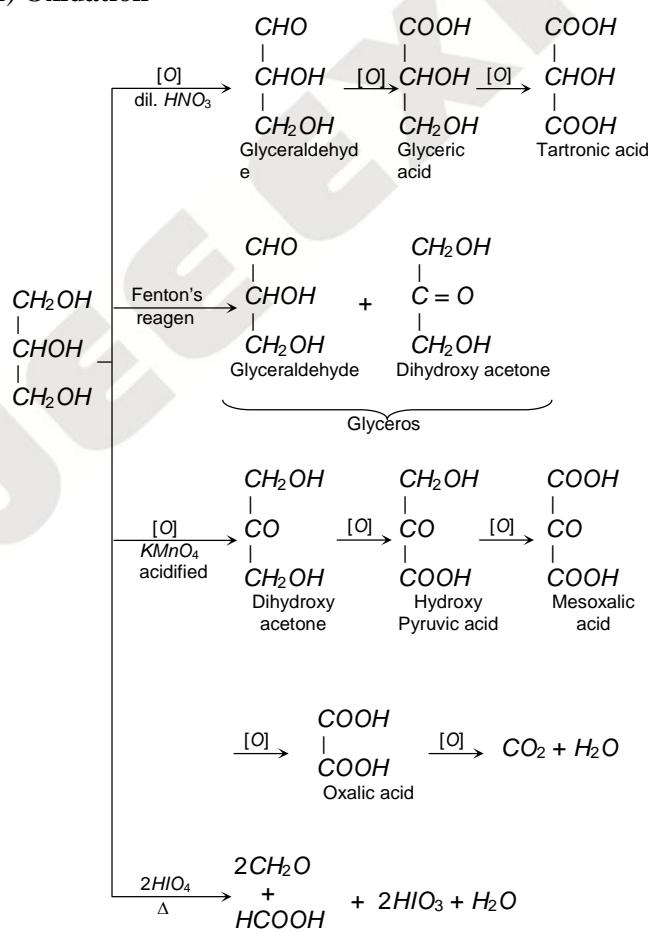
(b) At 260°C, allyl alcohol is formed



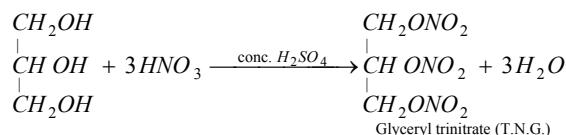
(vi) Dehydration



(vii) Oxidation



(viii) Reaction with nitric acid



Dynamite is prepared from T.N.G.

Dynamite : A mixture of T.N.G. and glyceryl dinitrate absorbed in kieselguhr is called dynamite. It was discovered by Alfred. Nobel in 1867. It releases large volume of gases and occupy 10,900 times the volume of nitroglycerine.



Blasting gelatin : A mixture of glyceryl trinitrate and cellulose nitrate (gun cotton).

Cordite : It is obtained by mixing glyceryl trinitrate with gun cotton and vaseline it is smokeless explosive.

(4) Uses

- (a) As antifreeze in automobile radiator.
- (b) In the preparation of good quality of soap-hand lotions shaving creams and tooth pastes.
- (c) As a lubricant in watches.
- (d) As a preservatives.
- (e) As a sweetening agent in confectionary, beverages and medicines being non toxic in nature.
- (f) In manufacture of explosives such as dynamite.

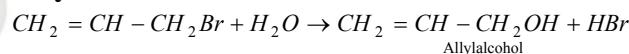
(5) Analytical tests of glycerol

- (i) **Acrolein test** : When glycerol is heated with $KHSO_4$ a very offensive smell is produced due to formation of acrolein. Its aqueous solution restores the colour of schiff's reagent and reduces Fehling solution and Tollen's reagent.
- (ii) **Dunstan's test** : A drop of phenolphthalein is added approximately 5 ml of borax solution. The pink colour appears on adding 2-3 drops of glycerol, pink colour disappears. The pink colour appears on heating and disappears on cooling again.

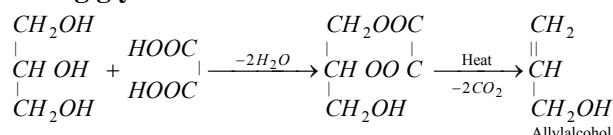
Unsaturated alcohols (Allyl alcohol)

(1) Preparation

(i) From allyl halide



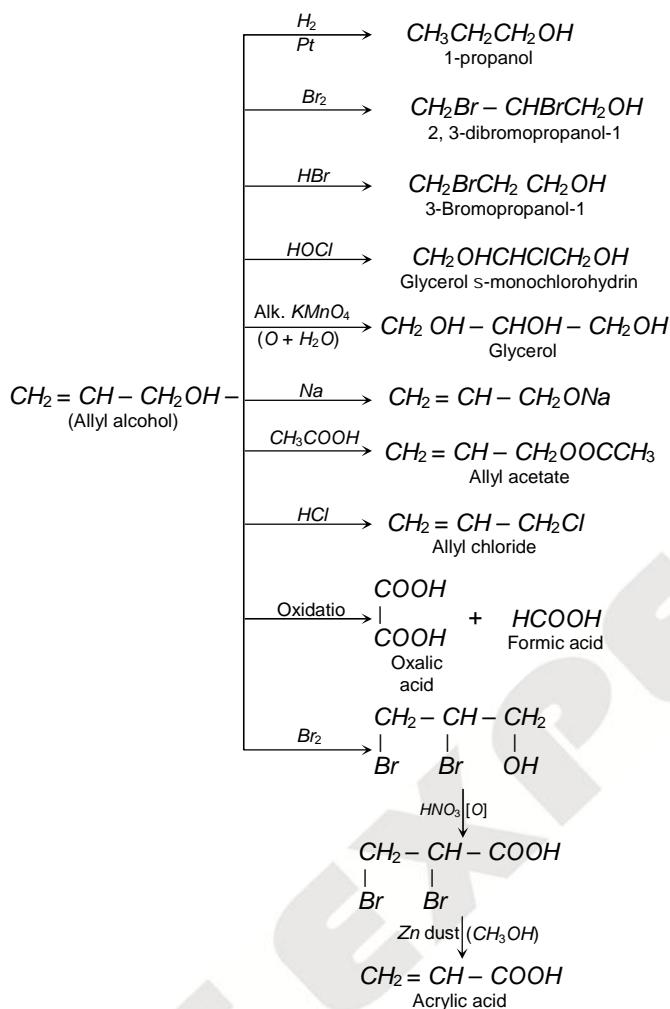
(ii) By heating glycerol with oxalic acid :



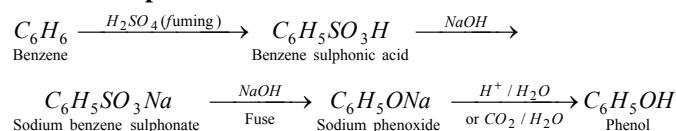
(2) Physical properties

- (a) It is colourless, pungent smelling liquid.
- (b) It is soluble in water, alcohol and ether in all proportion.

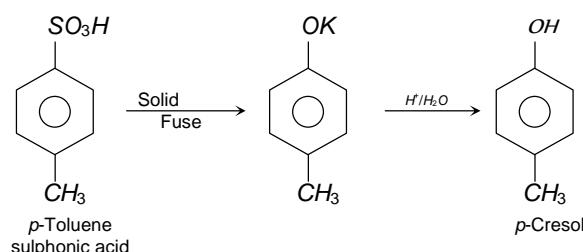
(3) Chemical properties

**Phenol****Phenol (Carbolic acid), $\text{C}_6\text{H}_5\text{OH}$ or Hydroxy benzene :**

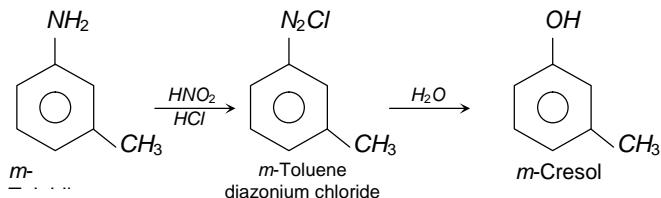
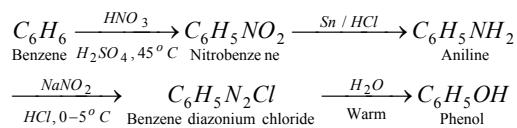
It was discovered by Runge in the middle oil fraction of coal-tar distillation and named it ‘carbolic acid’ (carbo = coal, oleum = oil) or phenol containing 5% water is liquid at room temperature and is termed as carbolic acid. It is also present in traces in human urine.

(1) **Preparation**(i) **From benzene sulphonic acid**

This is one of the laboratory methods for the preparation of phenol. Similarly methyl phenols (cresols) can be prepared.

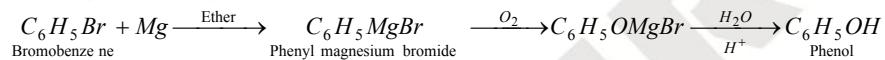


(ii) From benzene diazonium chloride

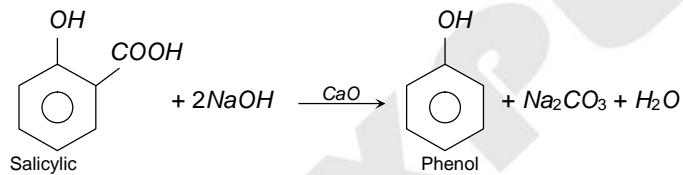


□ Diazonium salts are obtained from aniline and its derivatives by a process called **diazotisation**.

(iii) From Grignard reagent



(iv) From salicylic acid :



(v) **Middle oil of coal tar distillation** : Middle oil of coal-tar distillation has naphthalene and phenolic compounds. Phenolic compounds are isolated in following steps.

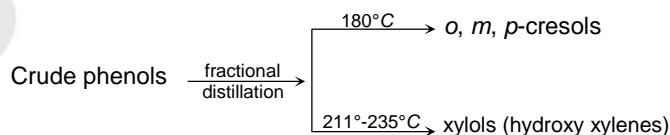
Step I : Middle oil is washed with H_2SO_4 . It dissolves basic impurities like pyridine (base).

Step II : Excessive cooling separates naphthalene (a low melting solid)

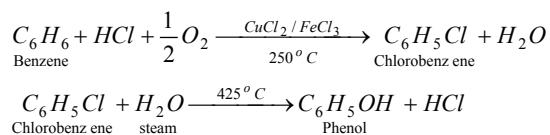
Step III : Filtrate of step II is treated with aqueous NaOH when phenols dissolve as phenoxides. Carbon dioxide is then blown through the solution to liberate phenols.



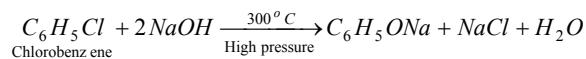
Step IV : Crude phenol (of step III) is subjected to fractional distillation.



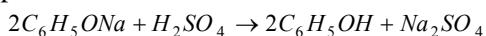
(vi) Raschig's process



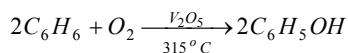
(vii) Dow process



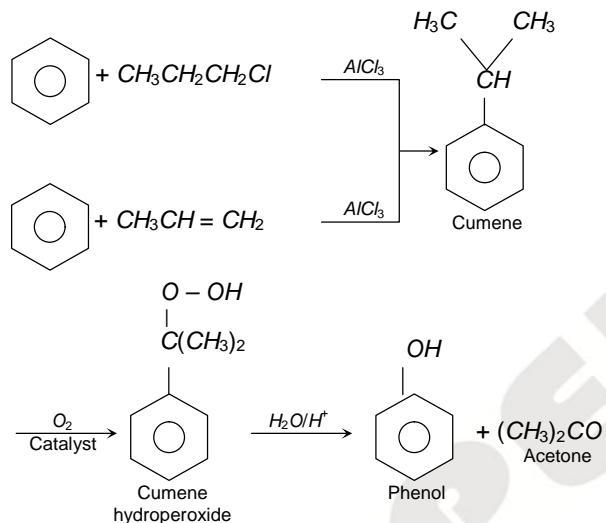
sodium phenoxide on treatment with mineral acid yields phenol.



(viii) Oxidation of benzene

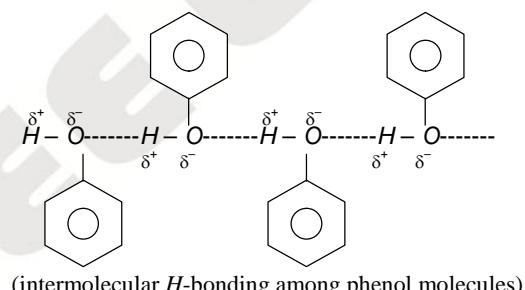


(ix) Oxidation of isopropyl benzene [Cumene]

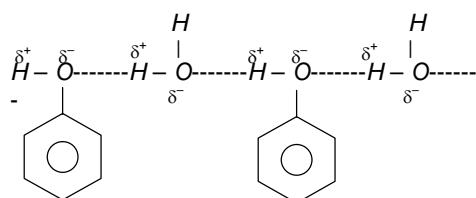


(2) Physical properties

- (i) Phenol is a colourless crystalline, deliquescent solid. It attains pink colour on exposure to air and light.
- (ii) They are capable of forming intermolecular H-bonding among themselves and with water. Thus, they have high boiling points and they are soluble in water.



(intermolecular H-bonding among phenol molecules)



(crossed intermolecular H-bonding between water and phenol molecules)

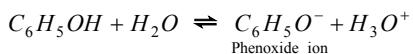
Due to intermolecular H-bonding and high dipole moment, melting points and boiling points of phenol are much higher than that of hydrocarbon of comparable molecular weights.

- (iii) It has a peculiar characteristic smell and a strong corrosive action on skin.
- (iv) It is sparingly soluble in water but readily soluble in organic solvents such as alcohol, benzene and ether.

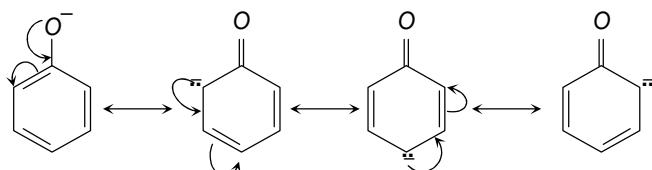
(v) It is poisonous in nature but acts as antiseptic and disinfectant.

(3) **Chemical properties**

(i) **Acidic nature :** Phenol is a weak acid. The acidic nature of phenol is due to the formation of stable phenoxide ion in solution.

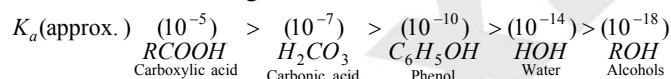


The phenoxide ion is stable due to resonance.



The negative charge is spread throughout the benzene ring. This charge delocalisation is a stabilising factor in the phenoxide ion and increase acidity of phenol. [No resonance is possible in alkoxide ions (RO^-) derived from alcohols. The negative charge is localised on oxygen atom. Thus alcohols are not acidic].

□ Phenols are much more acidic than alcohols but less so than carboxylic acids or even carbonic acid. This is indicated by the values of ionisation constants. The relative acidity follows the following order



Effects of substituents on the acidity of phenols : Presence of electron attracting group, (e.g., $-NO_2$, $-X$, $-NR_3^+$, $-CN$, $-CHO$, $-COOH$) on the benzene ring increases the acidity of phenol as it enables the ring to draw more electrons from the phenoxy oxygen and thus releasing easily the proton. Further, the particular effect is more when the substituent is present on o- or p-position than in m-position to the phenolic group.

The relative strengths of some phenols (as acids) are as follows :

p-Nitrophenol > o-Nitrophenol > m- Nitrophenol > Phenol

Presence of electron releasing group, (e.g., $-CH_3$, $-C_2H_5$, $-OCH_3$, $-NR_2$) on the benzene ring decreases the acidity of phenol as it strengthens the negative charge on phenoxy oxygen and thus proton release becomes difficult. Thus, cresols are less acidic than phenol.

However, m-methoxy and m-aminophenols are stronger acids than phenol because of $-I$ effect and absence of $+R$ effect.

m-methoxy phenol > m-amino phenol > phenol > o-methoxy phenol > p-methoxy phenol

Chloro phenols : o- > m- > p-

Cresols : m- > p- > o-

Dihydric phenol : m- > p- > o-

The acidic nature of phenol is observed in the following :

(a) Phenol changes blue litmus to red.

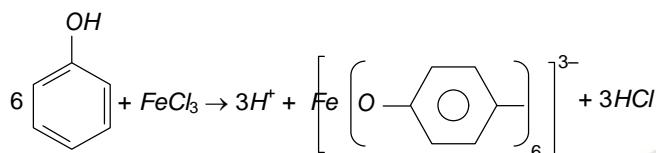
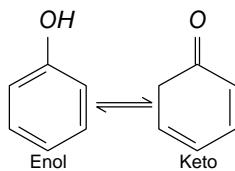
(b) Highly electropositive metals react with phenol. $2C_6H_5OH + 2Na \rightarrow 2C_6H_5ONa + H_2$

(c) Phenol reacts with strong alkalies to form phenoxides. $C_6H_5OH + NaOH \rightarrow C_6H_5ONa + H_2O$

However, phenol does not decompose sodium carbonate or sodium bicarbonate, i.e., CO_2 is not evolved because phenol is weaker than carbonic acid.

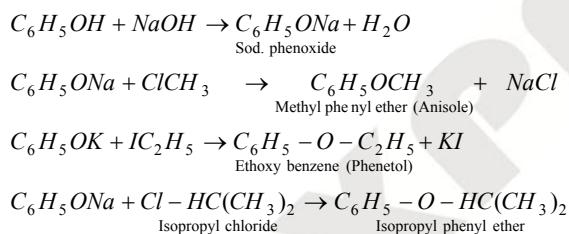
(ii) Reactions of -OH group

(a) Reaction with FeCl_3 : Phenol gives violet colouration with ferric chloride solution (neutral) due to the formation of a coloured iron complex, which is a characteristic to the existence of keto-enol tautomerism in phenols (predominantly enolic form).



This is the test of phenol.

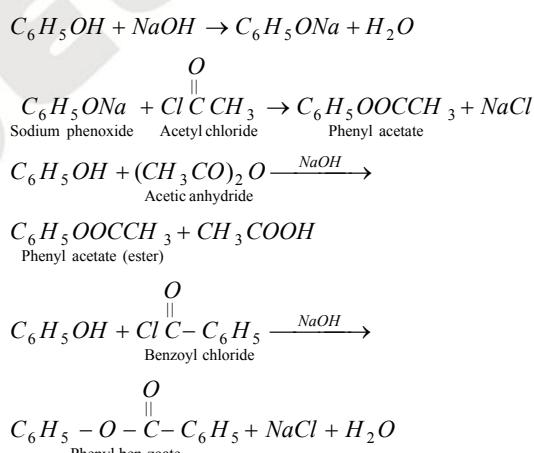
(b) Ether formation : Phenol reacts with alkyl halides in alkali solution to form phenyl ethers (Williamson's synthesis). The phenoxide ion is a nucleophile and will replace halogenation of alkyl halide.



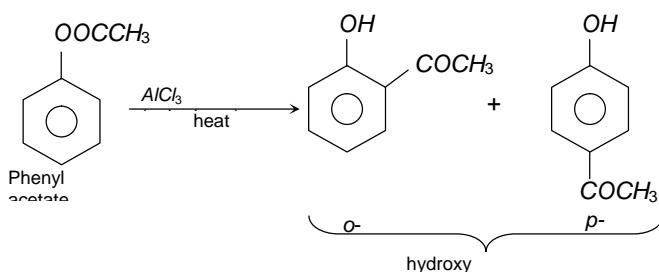
Ethers are also formed when vapours of phenol and an alcohol are heated over thoria (ThO_2) or Al_2O_3 .



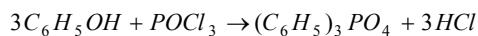
(c) Ester formation : Phenol reacts with acid chlorides (or acid anhydrides) in alkali solution to form phenylesters (Acylation). This reaction (Benzoylation) is called **Schotten-Baumann** reaction.



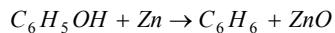
The phenyl esters on treatment with anhydrous AlCl_3 undergoes **Fries rearrangement** to give o- and p-hydroxy ketones.



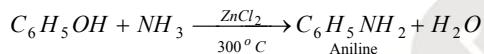
(d) Reaction with PCl_5 : Phenol reacts with PCl_5 to form chlorobenzene. The yield of chlorobenzene is poor and mainly triphenyl phosphate is formed.



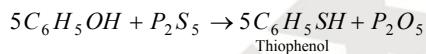
(e) Reaction with zinc dust : When phenol is distilled with zinc dust, benzene is obtained.



(f) Reaction with ammonia : Phenol reacts with ammonia in presence of anhydrous zinc chloride at $300^{\circ}C$ or $(NH_4)_2SO_3 / NH_3$ at $150^{\circ}C$ to form aniline. This conversion of phenol into aniline is called **Bucherer reaction**.

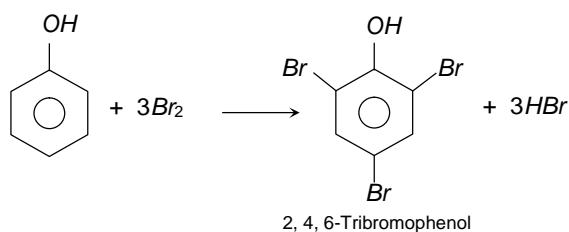
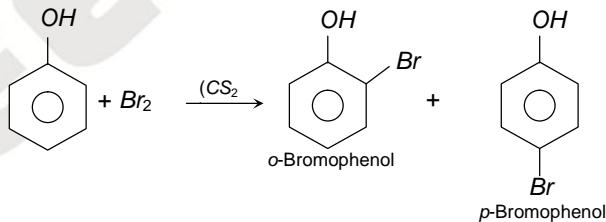


(g) Action of P_2S_5 : By heating phenol with phosphorus penta sulphide, thiophenols are formed.



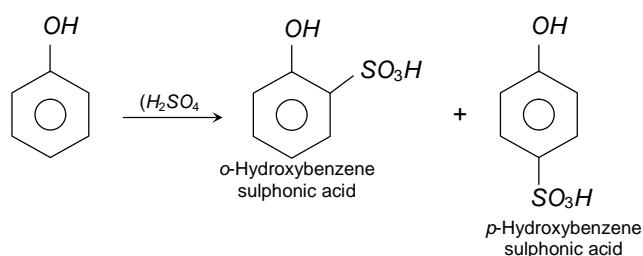
(iii) **Reactions of benzene nucleus** : The $-OH$ group is ortho and para directing. It activates the benzene nucleus.

(a) Halogenation : Phenol reacts with bromine in carbon disulphide (or $CHCl_3$) at low temperature to form mixture of ortho and para bromophenol.



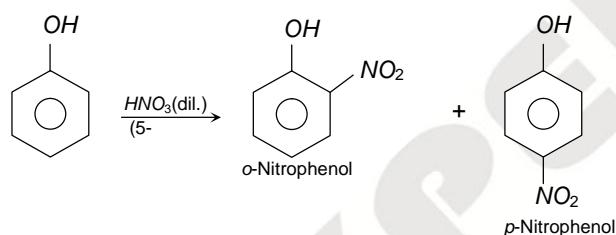
Phenol forms a white precipitate with excess of bromine water yielding 2, 4, 6-tribromophenol.

(b) Sulphonation : Phenol reacts with conc. H_2SO_4 readily to form mixture of ortho and para hydroxy benzene sulphonic acids.

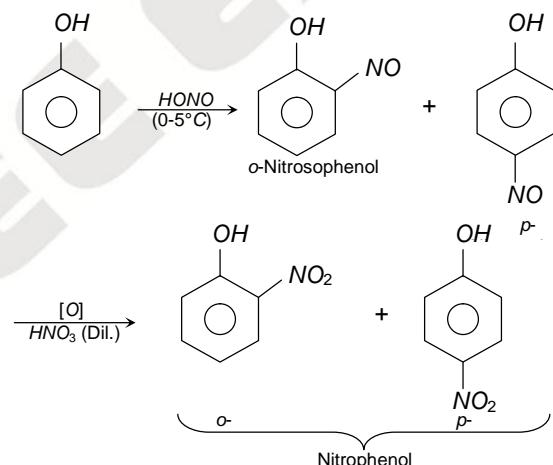


At low temperature (25°C), the ortho-isomer is the major product, whereas at 100°C , it gives mainly the para-isomer.

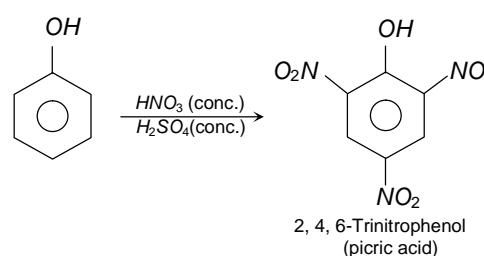
(c) Nitration : Phenol reacts with dilute nitric acid at $5\text{-}10^\circ\text{C}$ to form ortho and para nitrophenols, but the yield is poor due to oxidation of phenolic group. The $-\text{OH}$ group is activating group, hence nitration is possible with dilute nitric acid.



It is believed that the mechanism of the above reaction involves the formation of *o*- and *p*-nitroso phenol with nitrous acid, $\text{HNO}_2(\text{NaNO}_2 + \text{HCl})$ at $0\text{-}5^\circ\text{C}$, which gets oxidised to *o*- and *p*-nitrophenol with dilute nitric acid.

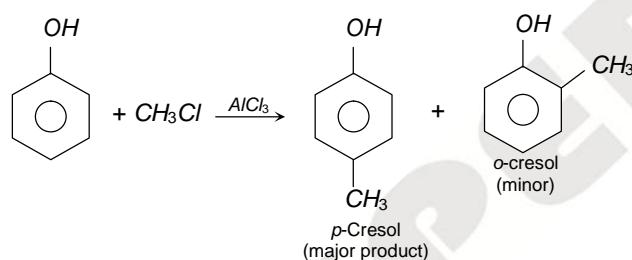


However, when phenol is treated with concentrated HNO_3 in presence of concentrated H_2SO_4 , 2,4,6-trinitrophenol (Picric acid) is formed.

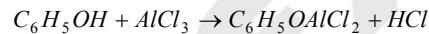


To get better yield of picric acid, first sulphonation of phenol is made and then nitrated. Presence of $-SO_3H$ group prevents oxidation of phenol.

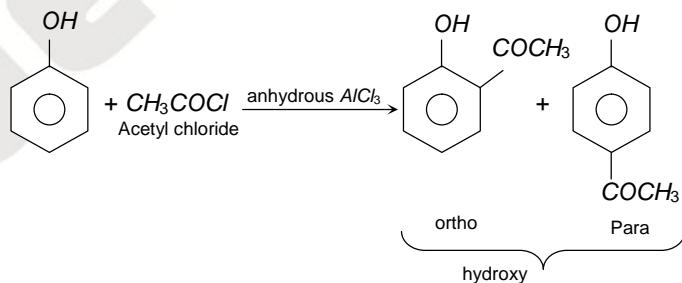
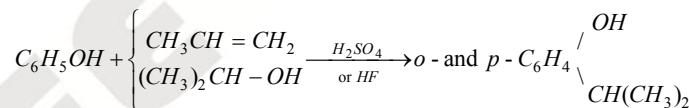
(d) Friedel-Craft's reaction : Phenol when treated with methyl chloride in presence of anhydrous aluminium chloride, p-cresol is the main product. A very small amount of o-cresol is also formed.



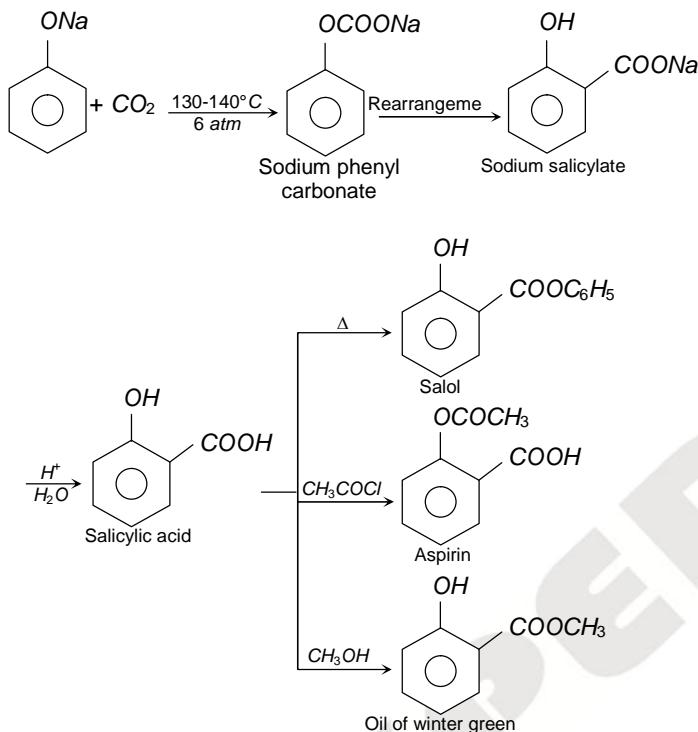
RX and $AlCl_3$ give poor yields because $AlCl_3$ coordinates with O. So Ring alkylation takes place as follows,



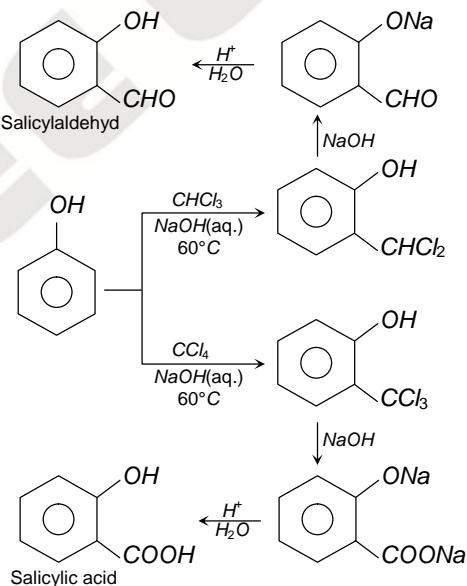
Thus to carry out successful Friedel-Craft's reaction with phenol it is necessary to use a large amount of $AlCl_3$. The **Ring alkylation** takes place as follows :



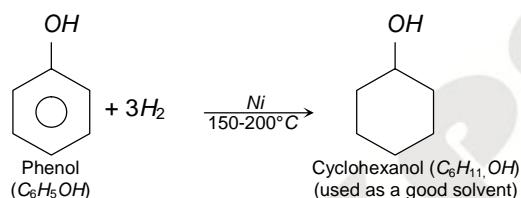
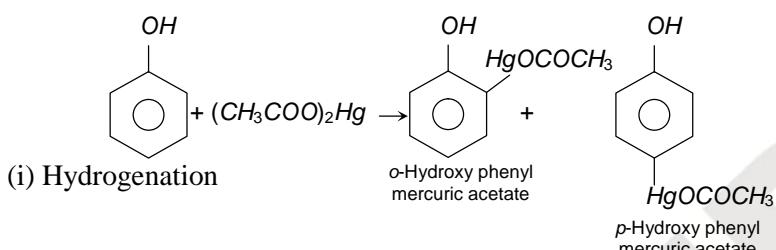
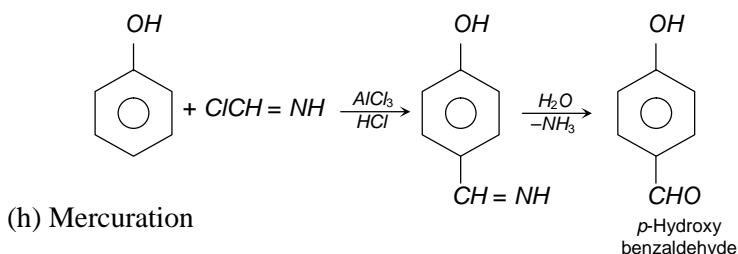
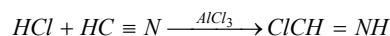
(e) Kolbe-Schmidt reaction (Carbonation) :



(f) Reimer-Tiemann reaction : Phenol, on refluxing with chloroform and sodium hydroxide (aq.) followed by acid hydrolysis yields salicylaldehyde (o-hydroxy benzaldehyde) and a very small amount of p-hydroxy benzaldehyde. However, when carbon tetrachloride is used, salicylic acid (predominating product) is formed.

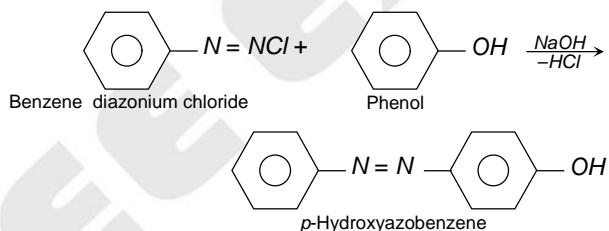


(g) Gattermann's reaction : Phenol, when treated with liquid hydrogen cyanide and hydrochloric acid gas in presence of anhydrous aluminium chloride yields mainly p-hydroxy benzaldehyde (Formylation).

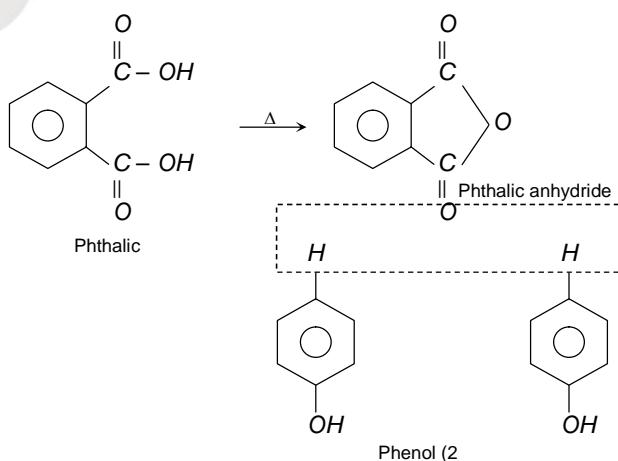


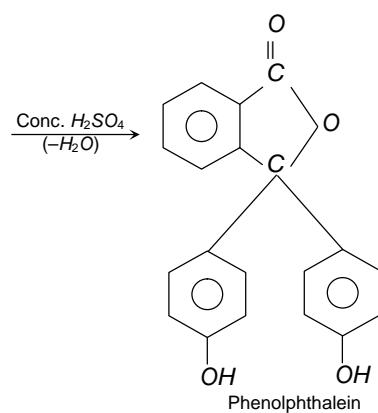
(iv) Miscellaneous reactions

(a) Coupling reactions : Phenol couples with benzene diazonium chloride in presence of an alkaline solution to form a red dye (*p*-hydroxy azobenzene).

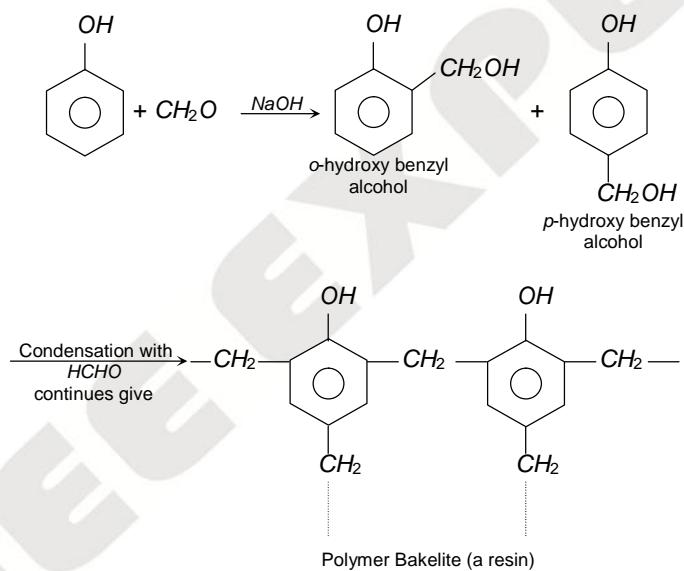


Phenol couples with phthalic anhydride in presence of concentrated H_2SO_4 to form a dye, (phenolphthalein) used as an indicator.

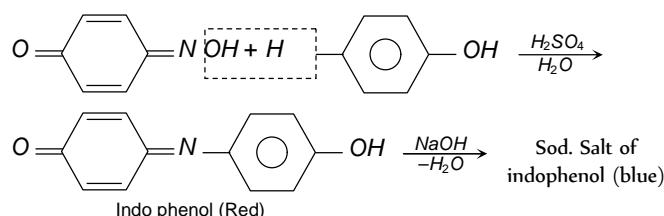
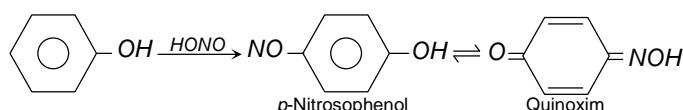




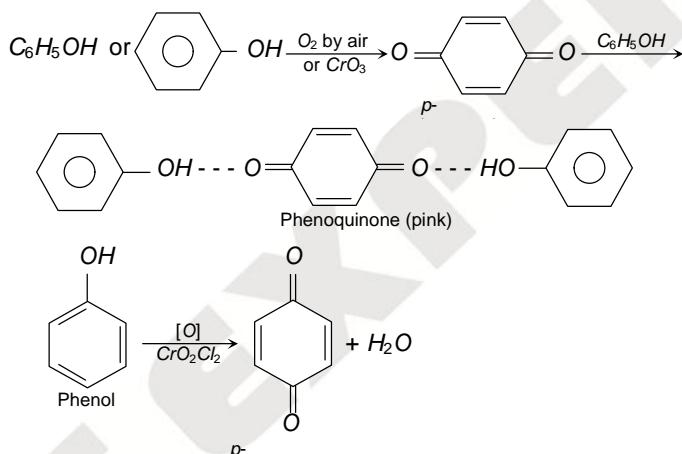
(b) Condensation with formaldehyde : Phenol condenses with formaldehyde (excess) in presence of sodium hydroxide or acid (H^+) for about a week to form a polymer known as bakelite (a resin).



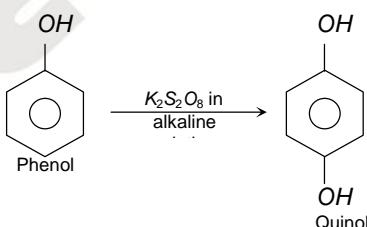
(c) Liebermann's nitroso reaction : When phenol is reacted with $NaNO_2$ and concentrated H_2SO_4 , it gives a deep green or blue colour which changes to red on dilution with water. When made alkaline with NaOH original green or blue colour is restored. This reaction is known as Liebermann's nitroso reaction and is used as a test of phenol.



(d) Oxidation : Phenol turns pink or red or brown on exposure to air and light due to slow oxidation. The colour is probably due to the formation of quinone and phenoquinone.



But on oxidation with potassium persulphate in alkaline solution, phenol forms 1, 4-dihydroxy benzene (Quinol). This is known as Elbs persulphate oxidation.

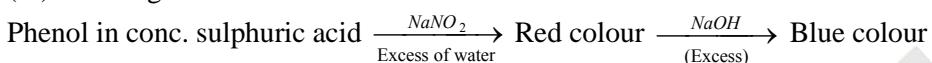


- (4) **Uses :** Phenol is extensively used in industry. The important applications of phenol are
- As an antiseptic in soaps, lotions and ointments. A powerful antiseptic is “Dettol” which is a phenol derivative (2, 4-dichloro-3, 5-dimethyl phenol).
 - In the manufacture of azo dyes, phenolphthalein, etc.
 - In the preparation of picric acid used as an explosive and for dyeing silk and wool.
 - In the manufacture of cyclohexanol required for the production of nylon and used as a solvent for rubber and lacquers.
 - As a preservative for ink.
 - In the manufacture of phenol-formaldehyde plastics such as bakelite.
 - In the manufacture of drugs like aspirin, salol, phenacetin, etc.

- (viii) For cauterising wounds caused by the bite of mad dogs.
- (ix) As a starting material for the manufacture of nylon and artificial tannins.
- (x) In the preparation of disinfectants, fungicides and bactericides.

(5) Tests of phenol

- (i) Aqueous solution of phenol gives a violet colouration with a drop of ferric chloride.
- (ii) Aqueous solution of phenol gives a white precipitate of 2, 4, 6-tribromophenol with bromine water.
- (iii) Phenol gives **Liebermann's nitroso reaction.**



- (iv) Phenol combines with phthalic anhydride in presence of conc. H_2SO_4 to form phenolphthalein which gives pink colour with alkali, and used as an indicator.
- (v) With ammonia and sodium hypochlorite, phenol gives blue colour.

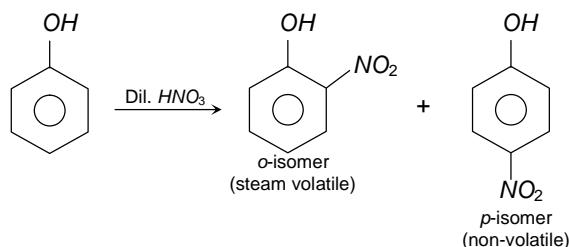
Table : 26.2 Difference between phenol and alcohol

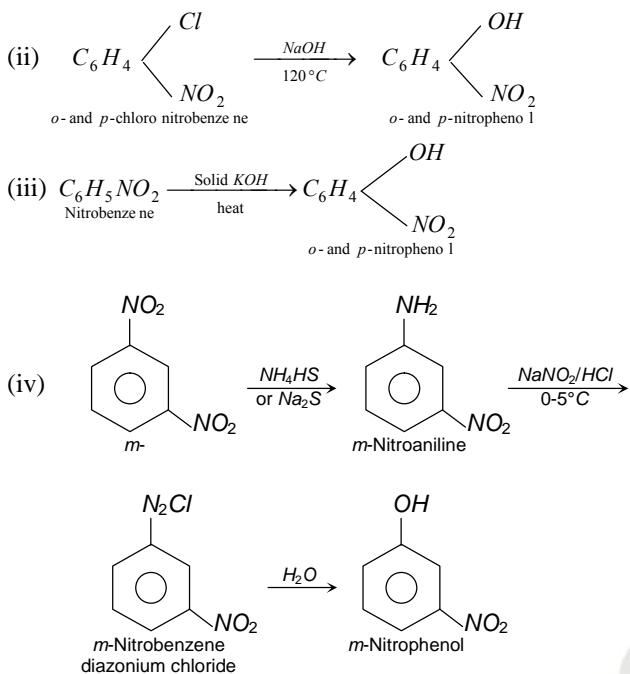
Property	Phenol ($\text{C}_6\text{H}_5\text{OH}$)	Alcohol ($\text{C}_2\text{H}_5\text{OH}$)
Odour	Typical phenolic odour	Pleasant alcoholic odour
Nature, reaction with alkali	Acidic, dissolves in sodium hydroxide forming sodium phenoxide.	Neutral, no reaction with alkalies.
Reaction with neutral FeCl_3	Gives violet colouration due to formation of complex compound.	No reaction.
Reaction with halogen acids	No reaction with halogen acids.	Forms ethyl halides.
Oxidation	Pink or brown colour due to formation of quinone and phenoquinone.	Undergoes oxidation to give acetaldehyde and acetic acid.
Reaction with HCHO	Forms polymer (bakelite).	No reaction.
Liebermann's nitroso reaction	Positive.	Does not show.
Coupling with benzene diazonium chloride	Forms azo dye.	Does not form any dye.
Reaction with PCl_5	Mainly forms triphenyl phosphate.	Forms ethyl chloride
Iodoform test	Does not show.	Positive.

Derivatives of phenol :

NITROPHENOLS

(1) Preparation





- (2) **Properties :** *o*-Nitrophenol is a yellow coloured crystalline compound, while *m*- and *p*-isomers are colourless crystalline compounds.

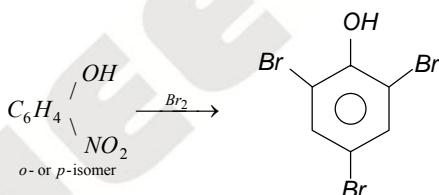
Isomer	<i>ortho</i>	<i>meta</i>	<i>para</i>
m.pt. (°C)	45	97	114

The lowest melting point of *o*-isomer is due to **intramolecular hydrogen bonding** whereas *meta* and *para* isomers possess **intermolecular hydrogen bonding** and thus, they have higher melting points.

They are stronger acids than phenol. The order is :

p-isomer > *o*-isomer > *m*-isomer > phenol

When reduced, they form corresponding aminophenols. *o*- and *p*-Nitrophenols react with bromine water to form 2, 4, 6-tribromophenol by replacement of nitro group.

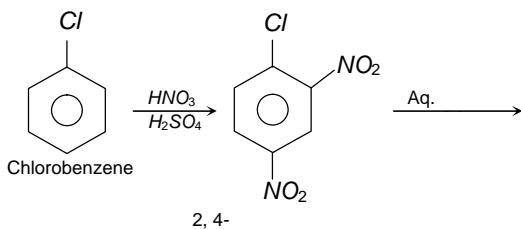


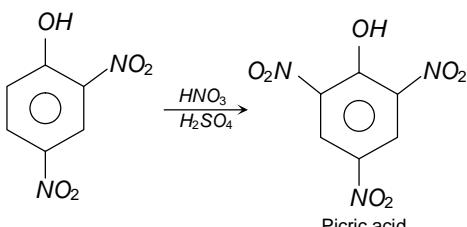
Picric acid (*2, 4, 6*-trinitrophenol) 2,4,6 Tribromophenol

- (1) **Preparation :** It is obtained when phenol is treated with conc. HNO_3 . However, the yield is very poor.

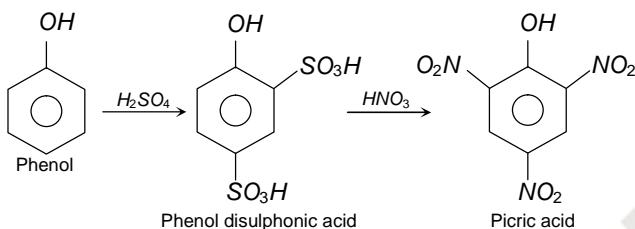
It is prepared on an industrial scale :

(i) From chlorobenzene

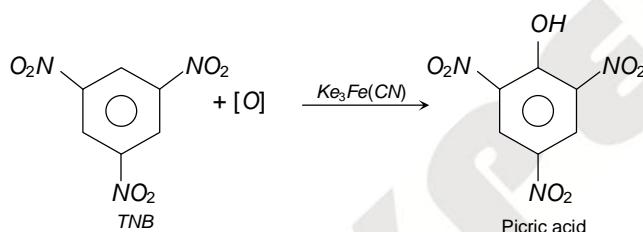




(ii) From phenol through disulphonic acid



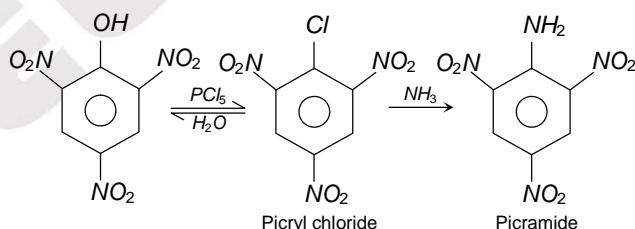
(iii)



(2)

Properties : It is a yellow crystalline solid, melting points 122°C. it is insoluble in cold water but soluble in hot water and in ether. It is bitter in taste. Due to the presence of three electronegative nitro groups, it is a stronger acid than phenol and its properties are comparable to the carboxylic acid. It neutralises alkalies and decomposes carbonates with evolution of carbon dioxide.

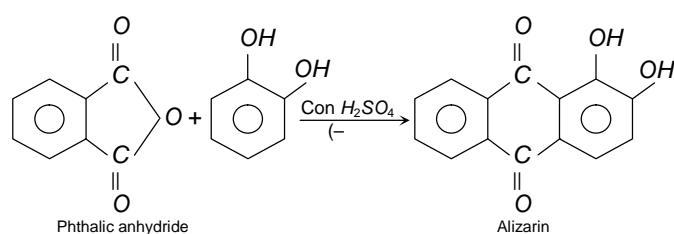
Dry picric acid as well as its potassium or ammonium salts explode violently when detonated. It reacts with PCl_5 to form picryl chloride which on shaking with NH_3 yields picramide.



When distilled with a paste of bleaching powder, it gets decomposed and yields chloropicrin, CCl_3NO_2 , as one of the products and is thus employed for the manufacture of tear gas.

It forms yellow, orange or red coloured molecular compounds called picrates with aromatic hydrocarbons, amines and phenols which are used for characterisation of these compounds.

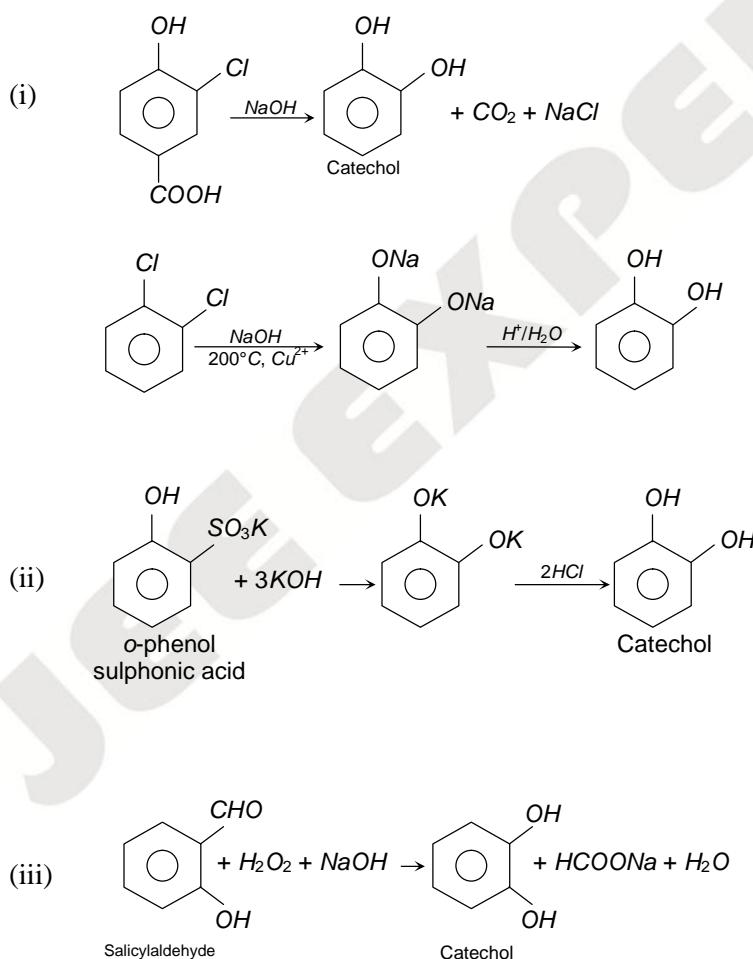
❑ Picrates are explosive in nature and explode violently when heated. These are prepared carefully.



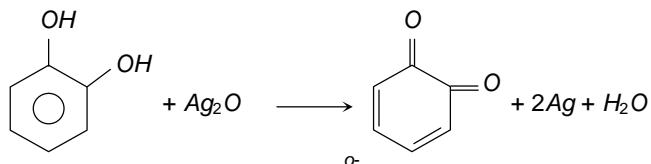
- (3) **Uses :** It is used as a yellow dye for silk and wool, as an explosive and as an antiseptic in treatment of burns.

Catechol (1, 2-Dihydroxy benzene)

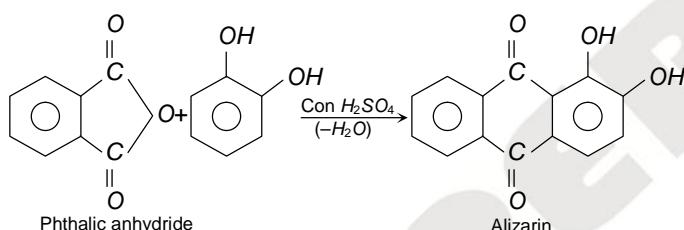
(1) Preparation



- (2) **Properties :** It is a colourless crystalline solid, melting points 105°C. it is soluble in water. It is affected on exposure to air and light. It acts as a reducing agent as it reduces Tollen's reagent in cold and Fehling's solution on heating. With silver oxide it is oxidised to o-benzoquinone.



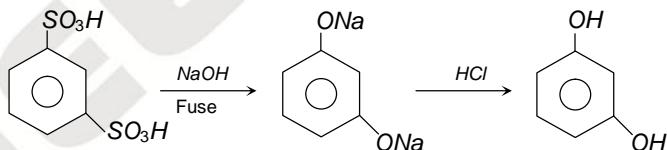
It forms insoluble lead salt (white ppt.) when treated with lead acetate solution and gives green colour with FeCl_3 which changes to red on adding Na_2CO_3 solution. It forms alizarin dye stuff when condensed with phthalic anhydride in the presence of sulphuric acid.



- (3) **Uses :** It finds use as photographic developer, in the manufacture of alizarin and adrenaline hormone and as an antioxidant (inhibitor in auto oxidation) for preserving gasoline.

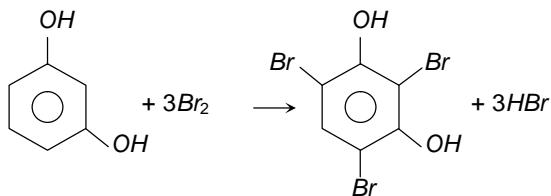
Resorcinol (1, 3-Dihydroxy benzene)

- (1) **Preparation :** It is prepared by alkali fusion of 1,3, benzene disulphonic acid (Industrial method).

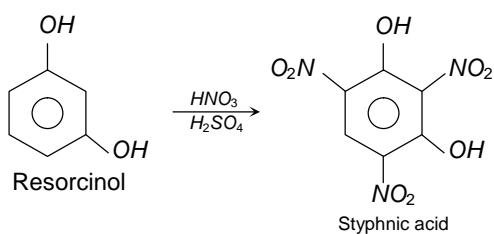


- (2) **Properties :** It is a colourless crystalline solid, melting points 110°C. it is affected on exposure by air and light. It is soluble in water, alcohol and ether. It shows tautomerism. Its aqueous solution gives violet colour with FeCl_3 . It reduces Fehling's solution and Tollen's reagent on warming.

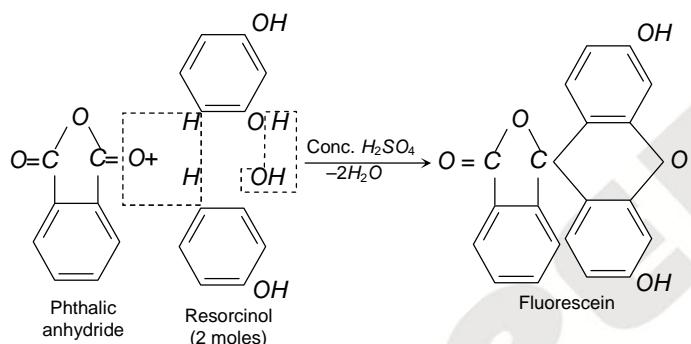
With bromine water, it gives a crystalline precipitate, 2, 4, 6-tribromoresorcinol.



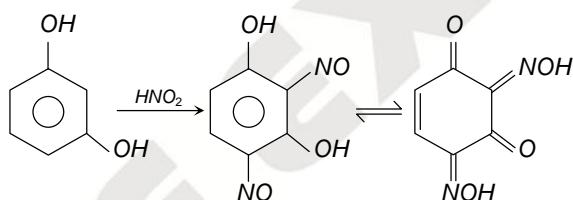
On nitration, it forms 2, 4, 6-trinitro-1, 3-dihydroxybenzene.



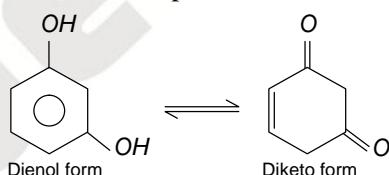
It condenses with phthalic anhydride and forms fluorescein.



With nitrous acid, it forms 2, 4-dinitrosoresorcinol



Resorcinol behaves as a tautomeric compound. This is shown by the fact that it forms a dioxime and a bisulphite derivative.

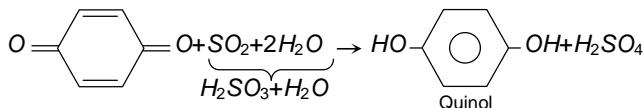


(3) **Uses**

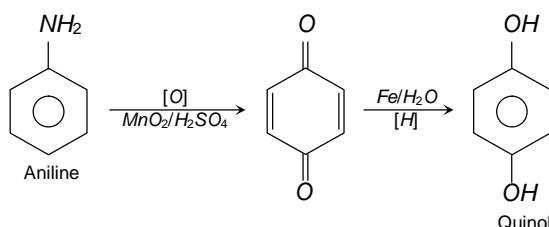
- (i) It is used as antiseptic and for making dyes.
 - (ii) It is also used in the treatment of eczema. 2, 4, 6-trinitroresorcinol is used as an explosive.

Hydroquinone or quinol (1, 4-Dihydroxy benzene)

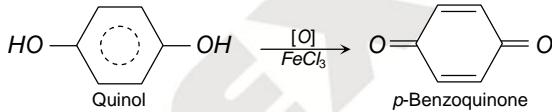
- (1) **Preparation :** It is formed by reduction of p-benzoquinone with sulphurous acid ($H_2SO_3 = H_2O + SO_2$).



(p-Benzoquinone is obtained by oxidation of aniline)



- (2) **Properties :** It is a colourless crystalline solid, melting points 170°C. it is soluble in water. It also shows tautomerism. It gives blue colour with $FeCl_3$ solution.
It acts as a powerful reducing agent as it is easily oxidised to p-benzoquinone. It reduces Tollen's reagent and Fehling's solution.

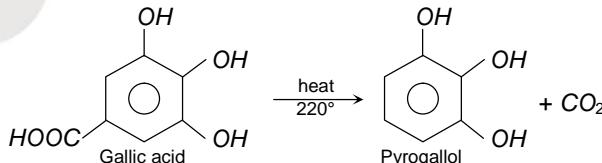


Due to this property, it is used as photographic developer.

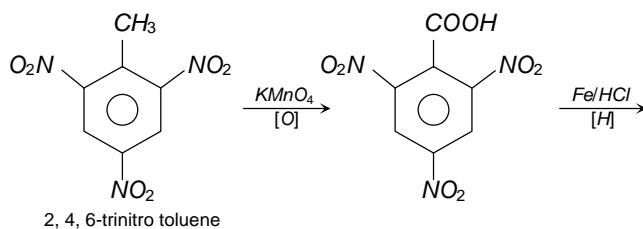
- (3) **Uses :** It is used as an antiseptic, developer in photography, in the preparation of quinhydrone electrode and as an antioxidant.

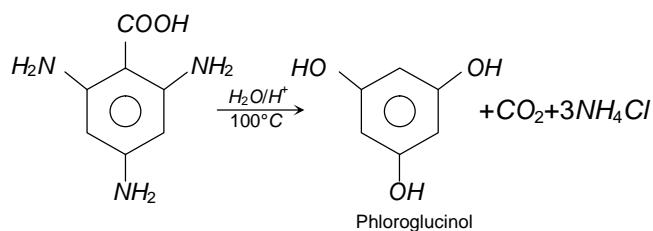
Trihydric Phenols : Three trihydroxy isomeric derivatives of benzene are **Pyrogallol** (1, 2, 3), hydroxy quinol (1, 2, 4) and phloroglucinol (1, 3, 5).

Pyrogallol is obtained by heating aqueous solution of gallic acid at 220°C.

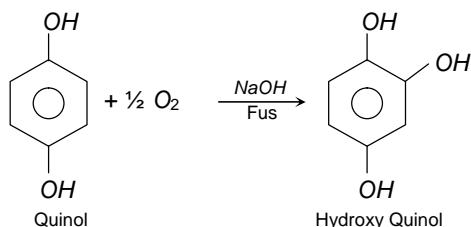


Phloroglucinol is obtained from trinitrotoluene (TNT) by following sequence of reactions.





Hydroxyquinol is prepared by the alkaline fusion of hydroquinone in air.



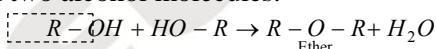
The three isomers are colourless crystalline compounds. All are soluble in water and their aqueous solutions give characteristic colour with $FeCl_3$ (Red, brown or bluish violet). Alkaline solutions absorb oxygen rapidly from air.

Uses of pyrogallol

- (i) As a developer in photography.
 - (ii) As a hair dye.
 - (iii) In treatment of skin diseases like eczema.
 - (iv) For absorbing unreacted oxygen in gas analysis.

Ether

Ethers are anhydride of alcohols, they may be obtained by elimination of a water molecule from two alcohol molecules.



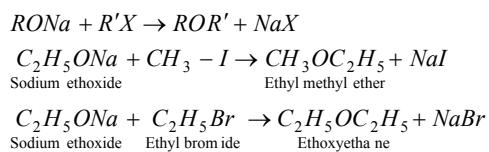
General formula is $C_nH_{2n+2}O$

General methods of preparation of ethers

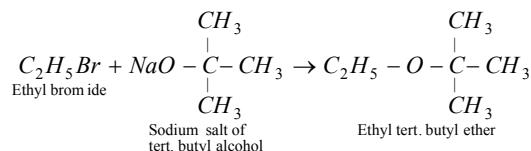
(1) From alkyl halides

(i) Williamson's synthesis

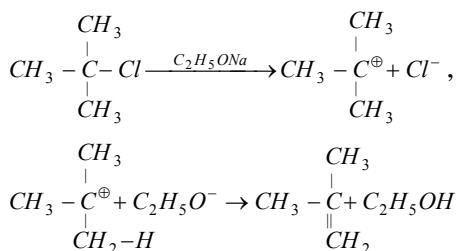
It is a nucleophilic substitution reaction and proceed through $S_{N}2$ mechanism.



- (a) Order of reactivity of primary halide is $CH_3X > CH_3CH_2X > CH_3CH_2CH_2X$.
 (b) Tendency of alkyl halide to undergo elimination is $3^\circ > 2^\circ > 1^\circ$.
 (c) For better yield alkyl halide should be primary and alkoxide should be secondary or tertiary.

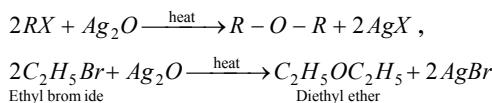


(d) Secondary and tertiary alkyl halides readily undergo E_2 elimination in the presence of a strong base to form alkenes.



Aryl halide and sodium alkoxide cannot be used for preparing phenolic ethers because aryl halide are less reactive toward nucleophilic substitution reaction than alkyl halides.

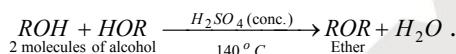
(ii) By heating alkyl halide with dry silver oxide



(2) From alcohols

(i) By dehydration of alcohols

(a) With conc. H_2SO_4 at $140^\circ C$

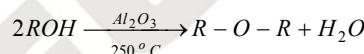


In this reaction alcohol must be present in excess.

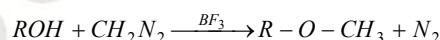
This reaction is mainly applicable for the dehydration of primary alcohols. Secondary and tertiary alcohols form alkenes mainly.

When this reaction is carried out between different alcohols then there is a mixture of different ethers is obtained.

(b) With Al_2O_3 at 250°C :



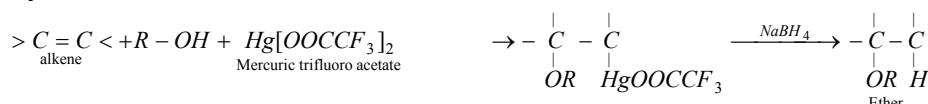
(ii) **By the action of diazomethane on alcohols :** This reaction is in presence of catalyst, boron trifluoride or HBF_4 .



(a) This method is very useful for preparing mixed ethers.

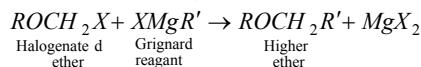
(b) In higher cases, there can be 1, 2-hydride or 1, 2-methyl shift to form more stable carbonium ion

(3) Alkoxy mercuration-demercuration



This is the best method for the preparation of t-ethers.

(4) Reaction of lower halogenated ether with grignard reagent



(i) Higher members can be prepared by the action of grignard reagent on lower halogenated ethers.

(ii) Ether form soluble coordinated complexes with grignard reagent.

Physical properties

(1) **Physical state :** Methoxy methane and methoxy ethane are gases while other members are volatile liquid with pleasant smell.

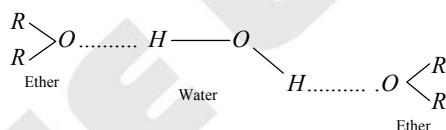
(2) **Dipole moment (D.M.) :** Bond angle of ether is due to sp^3 hybridisation of oxygen atom. Since C – O bond is a polar bond, hence ether possess a net dipole moment, even if they are symmetrical. Dipole moment of dimethyl ether is 1.3 D and dipole moment of di ethyl ether is 1.18 D.

□ The larger bond angle may be because of greater repulsive interaction between bulkier alkyl groups as compared to smaller H-atoms in water.

(3) **Boiling points :** Boiling points of ethers are much lower than those of isomeric alcohols, but closer to alkanes having comparable mass. This is due to the absence of hydrogen bonding in ethers.

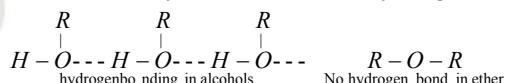
(4) **Solubility :** Solubilities of ethers in water are comparable with those of alcohols.

Example : Di ethyl ether and n-butyl alcohol have approximately the same solubility in water. This is because, ether form hydrogen bond with water much in the same way as alcohol do with water.



□ Solubility of ether in water decreases with the size of alkyl groups.

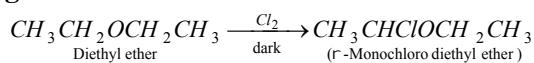
(5) **Hydrogen bonding :** There is no hydrogen directly attach (bonded) to oxygen in ethers, so ethers do not show any intermolecular hydrogen bonding.

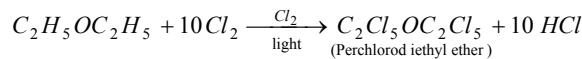
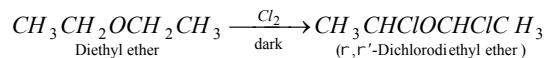


(6) **Density :** Ethers are lighter than water.

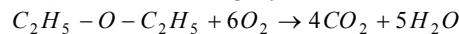
Chemical properties :

Ethers are quite stable compounds. These are not easily attacked by alkalies, dilute mineral acids, active metals, reducing agents or oxidising agents under ordinary conditions.

(1) **Reaction due to alkyl group**(i) **Halogenation :**

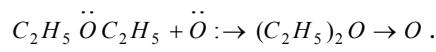


(ii) **Burning :** Ethers are highly inflammable. They burn like alkanes.



(2) Reaction due to ethernal oxygen

(i) **Peroxide formation :**

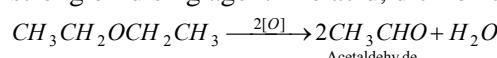


(a) The boiling point of peroxide is higher than that of ether. It is left as residue in the distillation of ether and may cause explosion. Therefore ether may never be evaporated to dryness.

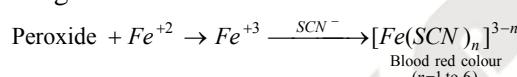
(b) Absolute ether can be prepared by distillation of ordinary ether from conc. H_2SO_4 and subsequent storing over metallic sodium.

Formation of peroxide can be prevented by adding small amount of Cu_2O to ether.

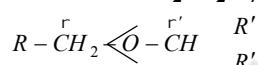
With strong oxidising agent like acid, dichromate ethers are oxidised to aldehydes.



The presence of peroxide can be indicated by the formation of blood red colour complex in the following reaction.

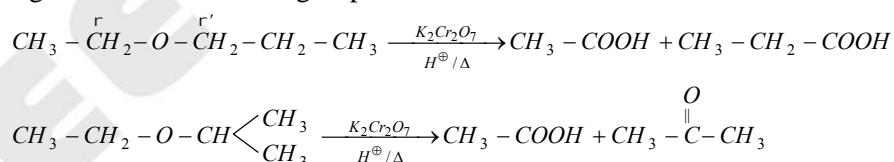


(ii) Oxidation with $K_2Cr_2O_7 / H^{\beta}$

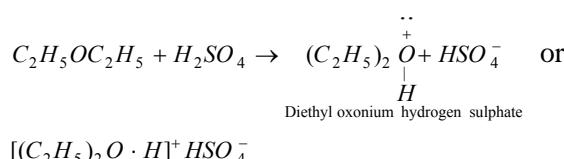
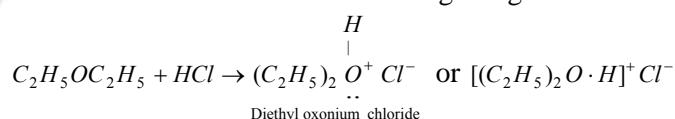


(a) Oxidation of ether can only be possible if any one of the alkyl groups of ether has hydrogen on α -carbon.

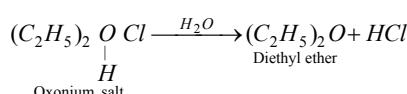
(b) α -carbon having two hydrogens converts in carboxylic group and α -carbon having only one hydrogen converts into keto group.



(iii) **Salt formation :** Due to lone pair of electrons on oxygen atom. Ether behaves as Lewis base and form stable oxonium salt with strong inorganic acids at low temperature.



The oxonium salts are soluble in acid solution and ethers can be recovered from the oxonium salts by treatment with water.

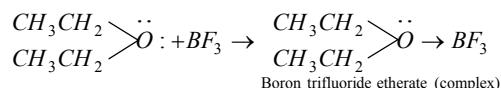


□ The formation of oxonium salt is similar to the formation of ammonium salts from ammonia and acids.

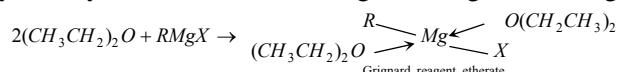
□ Ether is removed from alkyl halides by shaking with conc. H_2SO_4 .

□ Ethers can be distinguished from alkanes with the help of this reaction.

(iv) **Reaction with Lewis acids :** Being Lewis bases, ethers form complexes with Lewis acids such as BF_3 , $AlCl_3$, $FeCl_3$, etc. These complexes are called **etherates**.



Similarly, diethyl ether reacts with Grignard reagent forming Grignard reagent etherate.

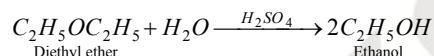


Due to the formation of the etherate, Grignard reagents dissolve in ether. That is why Grignard reagents are usually prepared in ethers. However, they cannot be prepared in benzene, because benzene has no lone pair of electrons and therefore, cannot form complexes with them.

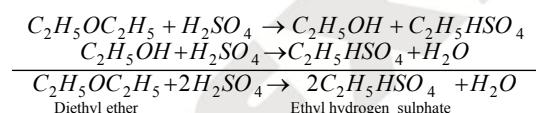
(3) Reaction involving cleavage of carbon-oxygen bond

(i) Hydrolysis

(a) With dil. H_2SO_4 : $ROR + H_2O \xrightarrow{H_2SO_4} 2ROH$

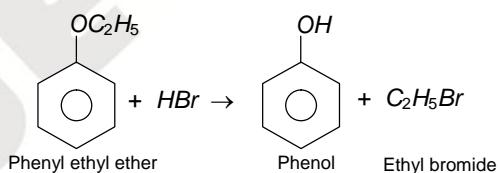
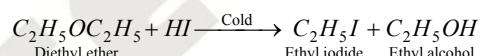


(b) With conc. H_2SO_4 :

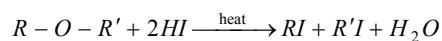


(ii) Action of hydroiodic acid

(a) With cold HI



(b) With hot HI



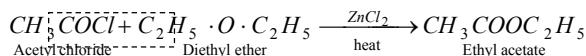
(iii) **Zeisel method :** $RI + AgNO_3 \text{ (alc.)} \rightarrow AgI \downarrow + RNO_3$

□ The silver iodide thus formed can be detected and estimated. This is the basis of Zeisel method for the detection and estimation of alkoxy group in a compound.

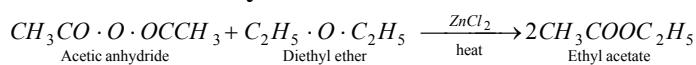
(iv) Action of PCl_5



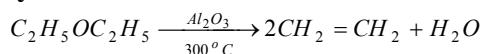
(v) Reaction with acetyl chloride



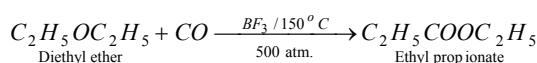
(vi) Reaction with acid anhydride



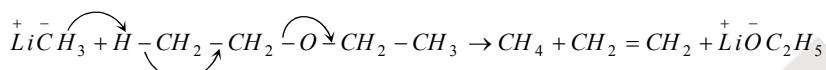
(vii) Dehydration



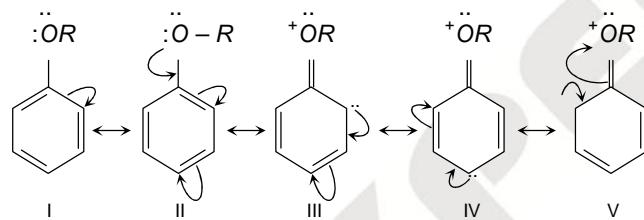
(viii) Reaction with carbon mono oxide



(ix) Action of bases

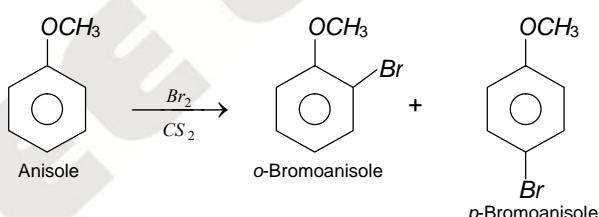


- (4) **Ring substitution in aromatic ethers :** Alkoxy group is ortho and para directing and it directs the incoming groups to ortho and para position. It activates the aromatic ring towards electrophilic substitution reaction.



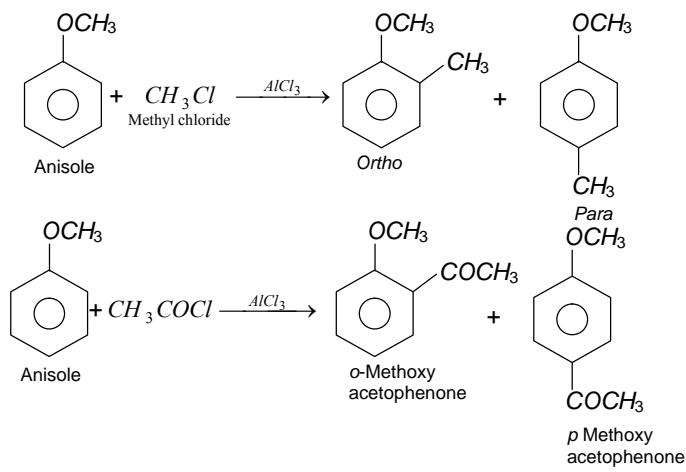
III, IV and V show high electron density at ortho and para position.

- (i) **Halogenation :** Phenyl alkyl ethers undergo usual halogenation in benzene ring.
For example, Bromination of anisole gives ortho and para bromo derivative even in the absence of iron (III) bromide catalyst.

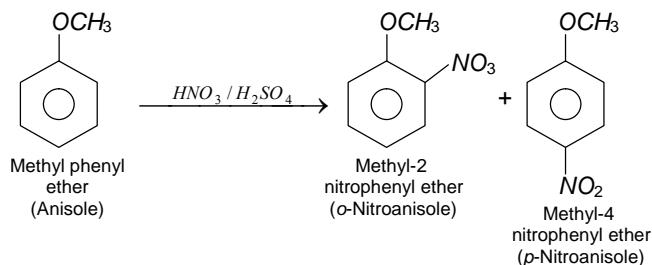


Para isomer is obtained in 90% yield.

(ii) Friedel craft reaction



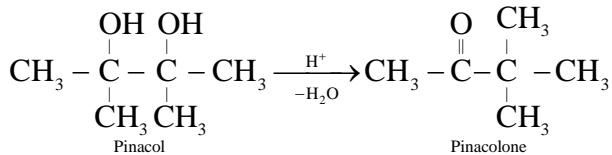
(iii) Nitration



□ Ethers are relatively less reactive than phenol towards electrophilic substitution reaction.

TIPS & TRICKS

- Methyl alcohol (CH_3OH) is called wood spirit. It is obtained by destructive distillation of wood. Drinking of methanol causes blindness.
- Ethyl alcohol (C_2H_5OH) is called grain alcohol. It is used in preparation of various beverages by using different percentages.
- An alcohol-water mixture containing 57.1% alcohol by volume or 49.3% by weight is called proof spirit.
- Ethyl alcohol containing 5 to 10% methyl alcohol is called methylated spirit. It is unfit for drinking purpose. Widespread deaths due to liquor poisoning occur mainly due to the presence of methyl alcohol. It is also called denatured spirit. Denaturing can also be done by adding 0.5% pyridine, petroleum naphtha, rubber distillate (caoutchoucine) or $CuSO_4$.
- Pyroligneous acid contains acetic acid (10%), methyl alcohol (2.5%) and acetone (0.5%).
- Fusel oil is a mixture of n-propyl alcohol, n-butyl alcohol, n-amyl alcohol and isoamyl alcohol.
- Tincture of iodine is 2-3% alcoholic solution of iodine.
- In the esterification reaction, the water formed is removed by Dean and Stark apparatus. It should be noted that bulkier the acid or alcohol, slower is the rate (due to steric hindrance). Decreasing order of rate of reaction of different alcohols and acids is $CH_3OH > C_2H_5OH > (CH_3)_2CHOH > (CH_3)_3C - OH$
 $HCOOH > CH_3COOH > (CH_3)_2CH - COOH > (CH_3)_3C - COOH$.
- Pinacol-pinacolone rearrangement :** The reaction involves dehydration of diols through the formation of carbocation intermediate which rearranges to more stable compound.



- In general, acid strength increases as Cresols << Phenol << p-chlorophenol << m-Nitrophenol << o-Nitrophenol < p-Nitrophenol << Picric acid.
- Glyceryl trinitrate is an inorganic ester.

- | |
|---|
| • Glyceryl trinitrate is colourless, oily liquid insoluble in water and is called Nobel's oil. Nobel's oil is also used in the treatment of angina pectoris and asthma. |
| • Ether peroxide formation is prevented by adding a little Cu ₂ O to it. |
| • Di-isopropyl ether is used in the petrol as an antiknock compound. |
| • The mixture of alcohol and ether is used as a substitute for petrol under the trade name natreelite. |
| • Ethers form soluble co-ordination complexes with Grignard's reagent i.e., why Grignard reagent is usually prepared in ether. |
| • Thio alcohols are known as mercaptans. |

JEE EXPERT

EXERCISE - I

OBJECTIVE QUESTION

General introduction of alcohol, Phenol & Ethers

1. Butane-2-ol is
 - (a) Primary alcohol
 - (b) Secondary alcohol
 - (c) Tertiary alcohol
 - (d) Aldehyde

2. Picric acid is
 - (a) Trinitroaniline
 - (b) Trinitrotoluene
 - (c) A volatile liquid
 - (d) 2, 4, 6 trinitrophenol

3. 3-pentanol is a
 - (a) Primary alcohol
 - (b) Secondary alcohol
 - (c) Tertiary alcohol
 - (d) None of these

4. Glycerol is a
 - (a) Primary alcohol
 - (b) Monohydric alcohol
 - (c) Secondary alcohol
 - (d) Trihydric alcohol

5. Cresols are
 - (a) Hydroxy toluenes
 - (b) Dihydric phenols
 - (c) Trihydric phenols
 - (d) Trihydric alcohols

6. Carbon percentage is maximum in
 - (a) Pyrene
 - (b) Gammexane
 - (c) Ethylene glycol
 - (d) PVC

7. Ortho-dihydroxy benzene is
 - (a) Carvacrol
 - (b) Resorcinol
 - (c) Catechol
 - (d) Orcinol

8. Glycerine has
 - (a) One primary and two secondary $-OH$ groups
 - (b) One secondary and two primary $-OH$ groups
 - (c) Three primary $-OH$ groups
 - (d) Three secondary $-OH$ groups

9. Which of the following is tertiary alcohol

- (a) $\begin{array}{c} CH_2 - OH \\ | \\ CH - OH \\ | \\ CH_2 - OH \end{array}$ (b) $\begin{array}{c} CH_2 \\ | \\ CH_3 - CH_2 - CH_2 OH \end{array}$ (c) $\begin{array}{c} CH_3 \\ | \\ CH_3 - C - OH \\ | \\ CH_3 \end{array}$ (d) $CH_3 - CH_2 - OH$

10. Which is primary alcohol

- (a) Butane-2-ol (b) Butane-1-ol (c) Propane-2-ol (d) Isopropyl alcohol

11. Carbinol is

- (a) C_2H_5OH (b) CH_3OH (c) $(CH_3)_2CHOH$ (d) $CH_3CH_2CH(OH)CH_3$

12. General formula of primary alcohol is

- (a) $>CHOH$ (b) $\geqslant C - OH$
 (c) $-CH_2OH$ (d) $=C \begin{array}{l} OH \\ \diagdown \\ OH \end{array}$

13. Which of following is phenolic

- (a) Phthalic acid (b) Phosphoric acid (c) Picric acid (d) Phenylacetic acid

14. 1, 2, 3-trihydroxybenzene is also known as

- (a) Pyrogallol (b) Phloroglucinol (c) Resorcinol (d) Quinol

15. Butanal is an example of

- (a) Primary alcohol (b) Secondary alcohol
 (c) Aliphatic aldehyde (d) Aliphatic ketone

16. Cyclohexanol is a

- (a) Primary alcohol (b) Secondary alcohol
 (c) Tertiary alcohol (d) Phenol

17. The characteristic grouping of secondary alcohols is

- (a) $-CH_2OH$ (b) $>CHOH$
 (c) $\begin{array}{c} | \\ -C - OH \end{array}$ (d) $c \begin{array}{l} OH \\ \diagup \\ OH \end{array}$

18. Which of the following are isomers

- (a) Methyl alcohol and dimethyl ether (b) Ethyl alcohol and dimethyl ether
 (c) Acetone and acetaldehyde (d) Propionic acid and propanone

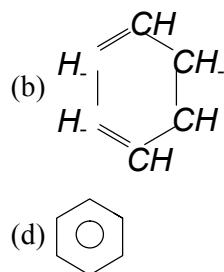
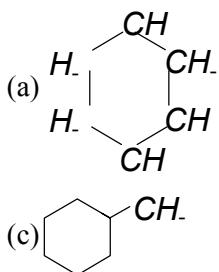
19. The compound $HOCH_2 - CH_2OH$ is

- (a) Ethane glycol (b) Ethylene glycol (c) Ethyldene alcohol (d) Dimethyl alcohol

20. Methylated spirit is

- (a) Methanol (b) Methanol + ethanol (c) Methanoic acid (d) Methanamide

21. The structural formula of cyclohexanol is



22. Molecular formula of amyl alcohol is

- (a) $C_7H_{14}O$ (b) $C_6H_{13}O$ (c) $C_5H_{12}O$ (d) $C_5H_{10}O$

23. Carbolic acid is

- (a) Phenol (b) Phenyl benzoate (c) Phenyl acetate (d) Salol

24. Absolute alcohol is

- (a) 100% pure ethanol (b) 95% alcohol + 5% H_2O
 (c) Ethanol + water + phenol (d) 95% ethanol + 5% methanol

25. Which of the following is dihydric alcohol

- (a) Glycerol (b) Ethylene glycol (c) Catechol (d) Resorcinol

26. Wood spirit is known as

- (a) Methanol (b) Ethanol (c) Acetone (d) Benzene

27. Oxygen atom in ether is

- (a) Very active (b) Replaceable (c) Comparatively inert (d) Active

28. Which of the following is a simple ether

- (a) CH_3OCH_3 (b) $C_2H_5OCH_3$ (c) $C_6H_5OCH_3$ (d) $C_6H_5OC_2H_5$

29. An example of a compound with the functional group ' $-O-$ ' is

- (a) Acetic acid (b) Methyl alcohol (c) Diethyl ether (d) Acetone

30. Which of the following do not contain an acyl group

- (a) Acid chloride (b) Amide (c) Ester (d) Ether

31. Name of $(CH_3)_2HC - O - CH_2 - CH_2 - CH_3$ is

- (a) Isopropyl propyl ether (b) Dipropyl ether
 (c) Di-isopropyl ether (d) Isopropyl propyl ketone

32. Acetals are

- (a) Ketones (b) Diethers (c) Aldehyde (d) Hydroxy aldehydes

33. In ethers, the $C - O - C$ bond angle is

- (a) 180° (b) 90° (c) 110° (d) 160°

34. According to Lewis concept of acids and bases, ether is
(a) Acidic (b) Basic (c) Neutral (d) Amphoteric
35. The compound which is not isomeric with diethyl ether is
(a) *n*-propylmethyl ether (b) Butan-1-*ol*
(c) 2-methylpropan-2-*ol* (d) Butanone
36. Structure of diethyl ether is confirmed by
(a) Kolbe's synthesis (b) Frankland's synthesis
(c) Wurtz's synthesis (d) Williamson's synthesis
37. Fermentation is an
(a) Endothermic reaction (b) Exothermic reaction
(c) Reversible reaction (d) None of these
38. Nitroglycerine is
(a) An ester (b) An alcohol
(c) A nitro compound (d) An acid
39. Which of the following are known as mercaptans
(a) Thio-alcohols (b) Thio-ethers
(c) Thio-acids (d) Thio-aldehydes

EXERCISE - II

Preparation of alcohol, Phenol and Ethers

1. Ethanol is prepared industrially by

(a) Hydration of ethylene	(b) Fermentation of sugars
(c) Both the above	(d) None of these

2. Ethyl alcohol is industrially prepared from ethylene by

(a) Permanganate oxidation	(b) Catalytic reduction
(c) Absorbing in H_2SO_4 followed by hydrolysis	(d) Fermentation

3. Propene, $CH_3 - CH = CH_2$ can be converted to 1-propanol by oxidation. Which set of reagents among the following is ideal to effect the conversion

(a) Alkaline $KMnO_4$	(b) B_2H_6 and alkaline H_2O_2
(c) O_3 / Zn dust	(d) $OsO_4 / CH_4, Cl_2$

4. Which one of the following will produce a primary alcohol by reacting with CH_3MgI

(a) Acetone	(b) Methyl cyanide	(c) Ethylene oxide	(d) Ethyl acetate
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5. The fermentation of starch to give alcohol occurs mainly with the help of

(a) O_2	(b) Air	(c) CO_2	(d) Enzymes
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6. Coconut oil upon alkaline hydrolysis gives

(a) Glycol	(b) Alcohol	(c) Glycerol	(d) Ethylene oxide
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7. Which enzyme converts glucose and fructose both into ethanol

(a) Diastase	(b) Invertase	(c) Zymase	(d) Maltase
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8. Chlorination of toluene in the presence of light and heat followed by treatment with aqueous $NaOH$ gives

(a) <i>o</i> -cresol	(b) <i>p</i> -cresol	(c) 2, 4-dihydroxy toluene	(d) Benzyl alcohol
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9. In the commercial manufacture of ethyl alcohol from starchy substances by fermentation method, which enzymes stepwise complete the fermentation reaction

(a) Diastase, maltase and zymase	(b) Maltase, zymase and invertase
(c) Diastase, zymase and lactase	(d) Diastase, invertase and zymase

10. Primary alcohols can be obtained from the reaction of the $RMgX$ with

(a) CO_2	(b) $HCHO$	(c) CH_3CHO	(d) H_2O
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11. On heating aqueous solution of benzene diazonium chloride, which is formed

(a) Benzene	(b) Chlorobenzene	(c) Phenol	(d) Aniline
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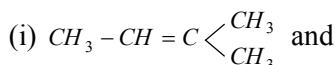
12. LiAlH_4 converts acetic acid into
 (a) Acetaldehyde (b) Methane (c) Ethyl alcohol (d) Methyl alcohol
13. Formaldehyde gives an additive product with methyl magnesium iodide which on aqueous hydrolysis gives
 (a) Isopropyl alcohol (b) Ethyl alcohol
 (c) Methyl alcohol (d) Propyl alcohol
14. Benzyl alcohol is obtained from benzaldehyde by
 (a) Fittig's reaction (b) Cannizaro's reaction
 (c) Kolbe's reaction (d) Wurtz's reaction
15. Benzene diazonium chloride on boiling with dilute sulphuric acid gives
 (a) Toluene (b) Benzoic acid (c) Benzene (d) Phenol
16. The reaction given below is known as

$$\text{C}_2\text{H}_5\text{ONa} + \text{IC}_2\text{H}_5 \longrightarrow \text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{NaI}$$
 (a) Kolbe's synthesis (b) Wurtz's synthesis
 (c) Williamson's synthesis (d) Grignard's synthesis
17. Salicylaldehyde can be prepared from
 (a) Phenol and chloroform
 (b) Phenol, chloroform and sodium hydroxide
 (c) Phenol, carbon tetrachloride and NaOH
 (d) None of these
18. If formaldehyde and potassium hydroxide are heated, then we get
 (a) Acetylene (b) Methane (c) Methyl alcohol (d) Ethyl formate
19. An organic compound dissolved in dry benzene evolved hydrogen on treatment with sodium. It is
 (a) A ketone (b) An aldehyde (c) A tertiary amine (d) An alcohol
20. $A \xrightarrow[\text{dil. H}_2\text{SO}_4]{\text{K}_2\text{Cr}_2\text{O}_7} B \xrightarrow[\text{H}_2\text{O}]{\text{CH}_3\text{MgI}} \text{CH}_3 - \underset{\text{OH}}{\overset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{CH}_3}$. The reactant A is
 (a) $\text{CH}_3\text{CHOHCH}_3$ (b) CH_3COCH_3
 (c) $\text{C}_2\text{H}_5\text{OH}$ (d) CH_3COOH
21. The reaction, water gas $(\text{CO} + \text{H}_2) + \text{H}_2$ 673 K, 300 atmosphere in presence of the catalyst $\text{Cr}_2\text{O}_3 / \text{ZnO}$ is used for the manufacture of
 (a) HCHO (b) HCOOH (c) CH_3OH (d) CH_3COOH
22. $\text{CH}_2 = \text{CH}_2 + \text{B}_2\text{H}_6 \xrightarrow[\text{H}_2\text{SO}_4]{\text{NaOH}}$ Product.
 Product in above reaction is
 (a) $\text{CH}_3\text{CH}_2\text{CHO}$ (b) $\text{CH}_3\text{CH}_2\text{OH}$ (c) CH_3CHO (d) None of these

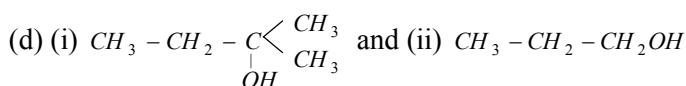
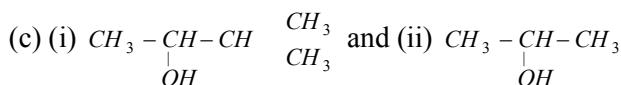
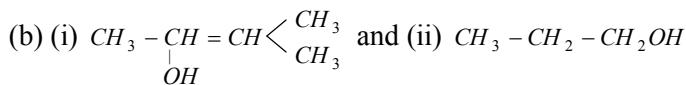
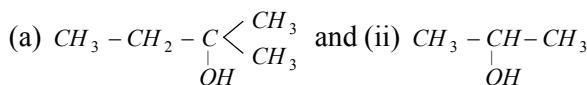
23. Phenolphthalein is obtained by heating phthalic anhydride with conc. H_2SO_4 and
 (a) Benzyl alcohol (b) Benzene
 (c) Phenol (d) Benzoic acid
24. Maltose on hydrolysis gives
 (a) Mannose + glucose (b) Galactose + glucose
 (c) Glucose (d) Mannose + fructose
25. Absolute alcohol can be obtained from rectified spirit
 (a) By removing the water in it using concentrated sulphuric acid
 (b) By removing the water using phosphorus pentoxide
 (c) By distilling with the appropriate amount of benzene
 (d) By distilling over plenty of quick lime
26. Grignard reagent reacts with compounds containing which of the following groups
 (a) $>C=O$ (b) $-C\equiv N$ (c) $>C=S$ (d) All of these
27. Oil + $NaOH_{(aq)}$ $\xrightarrow{\Delta}$ Glycerol + Soap
 Above reaction is called
 (a) Saponification (b) Esterification
 (c) Hydrogenation (d) None of these
28. Acetone on treatment with $CH_3 - Mg - I$ and on further hydrolysis gives
 (a) Isopropyl alcohol (b) Primary alcohol
 (c) Acetic acid (d) 2-methyl 2-propanol
29. In the following reaction 'A' is
 $C_2H_5MgBr + H_2C - \overset{H_2O}{\underset{\begin{array}{c} | \\ O \end{array}}{CH_2}} \rightarrow A$
 (a) $C_2H_5CH_2CHO$ (b) $C_2H_5CH_2CH_2OH$
 (c) $C_2H_5CH_2OH$ (d) C_2H_5CHO
30. Sodium benzene sulphonate reacts with $NaOH$ and then on acidic hydrolysis, it gives
 (a) Phenol (b) Benzoic acid (c) Benzene (d) Disodium benzaldehyde
31. Phenol is obtained by heating aqueous solution of
 (a) Aniline (b) Benzene diazonium chloride
 (c) Benzoic acid (d) None of these
32. C_2H_5MgI reacts with $HCHO$ to form last product
 (a) CH_3CHO (b) C_3H_7OH (c) CH_3COCH_3 (d) CH_3COOCH_3

33. Which one is not synthesized by Grignard reagent
 (a) Primary alcohol (b) Secondary alcohol
 (c) A ketone (d) An ester
34. Reaction of aqueous sodium hydroxide on (i) ethyl bromide and (ii) chlorobenzene gives
 (a) (i) Ethene and (ii) *o*-chlorophenol
 (b) (i) Ethyl alcohol and (ii) *o*-chlorophenol
 (c) (i) Ethyl alcohol and (ii) phenol
 (d) (i) Ethyl alcohol and (ii) no reaction
35. $RMgBr$ on reaction with an excess of oxygen followed by hydrolysis gives
 (a) RH (b) $ROOR$ (c) $ROOH$ (d) ROH
36. The reaction between an ester and excess of Grignard reagent shall finally result in a
 (a) Primary alcohol (b) Secondary alcohol
 (c) Tertiary alcohol (d) Ketone
37. The compound that will react most readily with $NaOH$ to form methanol is
 (a) $(CH_3)_4N^+I^-$ (b) CH_3OCH_3 (c) $(CH_3)_3S^+I^-$ (d) $(CH_3)_3Cl$
38. When 2-ethylanthraquinol dissolved in a mixture of benzene and cyclohexanol is oxidised, the product is
 (a) Ethanol (b) Hydrogen peroxide (c) Anthracene (d) None of these
39. Which gas is eliminated in fermentation
 (a) O_2 (b) CO_2 (c) N_2 (d) H_2
40. Action of nitrous acid with ethylamine produces
 (a) Ethane (b) Ammonia (c) Ethyl alcohol (d) Nitroethane
41. The product of reduction of benzaldehyde is
 (a) Benzoic acid (b) Benzyl alcohol (c) Benzene (d) Catechol
42. Commercially methanol is prepared by
 (a) Reduction of CO in presence of $ZnO.Cr_2O_3$
 (b) Methane reacts with water vapours at $900^\circ C$ in presence of Ni catalyst
 (c) Reduction of $HCHO$ by $LiAlH_4$
 (d) Reduction of $HCHO$ by aqueous $NaOH$

43. Action of water in the presence of sulphuric acid with the following alkenes



(ii) $CH_3 - CH = CH_2$ gives



44. From Williamson's synthesis preparation of which of following is possible

- | | |
|-----------------------------|-----------------------------|
| (a) Only symmetrical ethers | (b) Only symmetrical ethers |
| (c) Both types | (d) None of these |

45. In the reaction $Ar - OH + Rx \xrightarrow{\text{alkali}} A$, A is

- | | | | |
|-----------------|----------------------|--------------|--------------|
| (a) An aldehyde | (b) An aryl chloride | (c) An ether | (d) A ketone |
|-----------------|----------------------|--------------|--------------|

46. Williamson's synthesis is used to prepare

- | | | | |
|-------------|-------------------|------------|--------------|
| (a) Acetone | (b) Diethyl ether | (c) P.V.C. | (d) Bakelite |
|-------------|-------------------|------------|--------------|

47. When an alkyl halide is allowed to react with a sodium alkoxide the product most likely is

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|-----------------|--------------|--------------|-----------------------|
| (a) An aldehyde | (b) A ketone | (c) An ether | (d) A carboxylic acid |
|-----------------|--------------|--------------|-----------------------|

48. In Williamson's synthesis, ethoxyethane is prepared by

- | | |
|---|--|
| (a) Passing ethanol over heated alumina | (b) Sodium ethoxide with ethyl bromide |
| (c) Ethyl alcohol with sulphuric acid | (d) Ethyl iodide and dry silver oxide |

49. Formation of diethyl ether from ethanol is based on a

- | | |
|----------------------------|----------------------------------|
| (a) Dehydration reaction | (b) Dehydrogenation reaction |
| (c) Hydrogenation reaction | (d) Heterolytic fission reaction |

50. The compound formed when ethyl bromide is heated with dry silver oxide is

- | | |
|--------------------|-------------------|
| (a) Dimethyl ether | (b) Diethyl ether |
| (c) Methyl alcohol | (d) Ethyl alcohol |

51. The reagent used for the preparation of higher ether from halogenated ethers is

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|----------------------|----------------------|
| (a) conc. H_2SO_4 | (b) Sodium alkoxide |
| (c) Dry silver oxide | (d) Grignard reagent |

52. Acetyl bromide reacts with excess of CH_3MgI followed by treatment with a saturated solution of NH_4Cl gives

- | | |
|-------------------------|-------------------|
| (a) 2-methyl-2-propanol | (b) Acetamide |
| (c) Acetone | (d) Acetyl iodide |

- 53.** What is obtained when chlorine is passed in boiling toluene and product is hydrolysed
 (a) *o*-Cresol (b) *p*-Cresol
 (c) 2, 4-Dihydroxytoluene (d) Benzyl alcohol
- 54.** Which of the following is formed when benzaldehyde reacts with sodium hydroxide
 (a) Benzyl alcohol (b) Benzoic acid
 (c) Glucose (d) Acetic acid
- 55.** When ethanal reacts with CH_3MgBr and C_2H_5OH /dry HCl the product formed are
 (a) Ethyl alcohol and 2-propanol (b) Ethane and hemi-acetal
 (c) 2-propanol and acetal (d) Propane and methyl acetate
- 56.** Which of the following is industrially prepared by passing ethylene into hypochlorous acid
 (a) Ethylene glycol (b) Ethylene oxide (c) Ethylene dinitrate (d) Ethane
- 57.** In which case methyl-*t*-butyl ether is formed
 (a) $(C_2H_5)_3CONa + CH_3Cl$ (b) $(CH_3)_3CONa + CH_3Cl$
 (c) $(CH_3)_3CONa + C_2H_5Cl$ (d) $(CH_3)_3CONa + CH_3Cl$
- 58.** Which of the following combinations can be used to synthesize ethanol
 (a) CH_3MgI and CH_3COCH_3 (b) CH_3MgI and C_2H_5OH
 (c) CH_3MgI and $CH_3COOC_2H_5$ (d) CH_3MgI and $HCOOC_2H_5$
- 59.** $C_6H_5 - CH = CHCHO \xrightarrow{X} C_6H_5CH = CHCH_2OH$. In the above sequence X can be
 (a) H_2 / Ni (b) $NaBH_4$ (c) $K_2Cr_2O_7 / H^+$ (d) Both (a) and (b)
- 60.** Alkenes convert into alcohols by
 (a) Hydrolysis by dil. H_2SO_4
 (b) Hydration of alkene by alkaline $KMnO_4$
 (c) Hydrolysis by water vapours and conc. H_2SO_4
 (d) Hydration of alkene by aqueous KOH
- 61.** Acetic acid and CH_3OH are obtained on large scale by destructive distillation of
 (a) Wood (b) Coal (c) Turpentine (d) Crude oil
- 62.** Which is formed when benzylamine react with nitrous acid
 (a) C_6H_5OH (b) C_6H_5ON (c) $C_2H_5N_2OH$ (d) $C_6H_5CH_2OH$
- 63.** Acid catalyzed hydration of alkenes except ethene leads to the formation of
 (a) Primary alcohol
 (b) Secondary or tertiary alcohol
 (c) Mixture of primary and secondary alcohols
 (d) Mixture of secondary and tertiary alcohols

64. Methylphenyl ether can be obtained by reacting
 (a) Phenolate ions and methyl iodide
 (b) Methoxide ions and bromobenzene
 (c) Methanol and phenol
 (d) Bromo benzene and methyl bromide

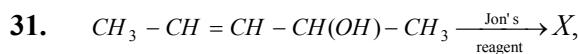
EXERCISE - III

Properties of alcohol, Phenol and Ethers

1. Which compound is formed when CH_3OH reacts with $CH_3 - Mg - X$
 (a) Acetone (b) Alcohol (c) Methane (d) Ethane
2. A compound X of formula C_3H_8O yields a compound C_3H_6O , on oxidation. To which of the following classes of compounds could X be?
 (a) Secondary alcohol (b) Alkene
 (c) Aldehyde (d) Tertiary alcohol
3. The boiling point of alcohol are than corresponding thiols
 (a) More (b) Same (c) Either of these (d) Less
4. Methyl alcohol can be distinguished from ethyl alcohol using
 (a) Fehling solution (b) Schiff's reagent
 (c) Sodium hydroxide and iodine (d) Phthalein fusion test
5. A compound X with molecular formula C_3H_8O can be oxidised to a compound Y with the molecular formula $C_3H_6O_2$. X is most likely to be
 (a) Primary alcohol (b) Secondary alcohol
 (c) Aldehyde (d) Ketone
6. An alcohol on oxidation is found to give CH_3COOH and CH_3CH_2COOH . The structure of the alcohol is
 (a) $CH_3CH_2CH_2OH$ (b) $(CH_3)_2C(OH)CH_2CH_3$
 (c) $CH_3CH_2CHOHCH_3$ (d) $CH_3CH(OH)CH_2CH_2CH_3$
7. An organic liquid A containing C, H and O has a pleasant odour with a boiling point of $78^\circ C$. On boiling A with conc. H_2SO_4 a colourless gas is produced which decolourises bromine water and alkaline $KMnO_4$. One mole of this gas also takes one mole of H_2 . The organic liquid A is
 (a) C_2H_5Cl (b) C_2H_5CHO (c) C_2H_6 (d) C_2H_5OH
8. An aromatic amine (A) was treated with alcoholic potash and another compound (Y) when foul smelling gas was formed with formula C_6H_5NC . Y was formed by reacting a compound (Z) with Cl_2 in the presence of slaked lime. The compound (Z) is
 (a) $C_6H_5NH_2$ (b) C_2H_5OH (c) CH_3OCH_3 (d) $CHCl_3$

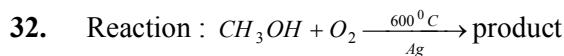
9. Rectified spirit obtained by fermentation contains 4.5% of water. So in order to remove it, rectified spirit is mixed with suitable quantity of benzene and heated. Benzene helps because
(a) It is dehydrating agent and so removes water
(b) It forms the lower layer which retains all the water so that alcohol can be distilled off
(c) It forms an azeotropic mixture having high boiling point and thus allows the alcohol to distill over
(d) It forms low boiling azeotropic mixtures which distill over, leaving behind pure alcohol which can then be distilled
10. $C_6H_5OH + ClCOCH_3 \xrightarrow{\text{aq. NaOH}} C_6H_5OCOCH_3$
is an example of
(a) Dow's reaction (b) Reimer-Tiemann reaction
(c) Schotten-Baumann reaction (d) Kolbe's reaction
11. Ortho-nitrophenol is steam volatile whereas para-nitrophenol is not. This is due to
(a) Intramolecular hydrogen bonding present in ortho-nitrophenol
(b) Intermolecular hydrogen bonding
(c) Intramolecular hydrogen bonding present in para-nitrophenol
(d) None of these
12. Reaction of phenol with dil. HNO_3 gives
(a) *p* and *m*-nitrophenols (b) *o*- and *p*-nitrophenols
(c) Picric acid (d) *o*- and *m*-nitrophenols
13. Phenol is less acidic than
(a) Acetic acid (b) *p*-nitrophenol (c) Both (a) and (b) (d) None of these
14. The strongest acid among the following aromatic compounds is
(a) *ortho*-nitrophenol (b) *para*-chlorophenol
(c) *para*-nitrophenol (d) *meta*-nitrophenol
15. Diazo-coupling is useful to prepare some
(a) Pesticides (b) Proteins (c) Dyes (d) Vitamins
16. Glycerol reacts with $P_4 + I_2$ to form
(a) Aldehyde (b) Allyl iodide (c) Allyl alcohol (d) Acetylene
17. When glycerine is added to a litre of water which of the following behaviour is observed
(a) Water evaporates more easily
(b) The temperature of water is increased
(c) The freezing point of water is lowered
(d) The viscosity of water is lowered
18. Final product formed on reduction of glycerol by hydroiodic acid is
(a) Propane (b) Propanoic acid (c) Propene (d) Propyne

- 19.** Glycerol was distilled with oxalic acid crystals and the products were led into Fehling solution and warmed. Cuprous oxide was precipitated. It is due to
 (a) CO (b) $HCHO$ (c) CH_3CHO (d) $HCOOH$
- 20.** Kolbe-Schmidt reaction is used for
 (a) Salicylic acid (b) Salicylaldehyde (c) Phenol (d) Hydrocarbon
- 21.** Which of the following explains the viscous nature of glycerol
 (a) Covalent bonds (b) Hydrogen bonds
 (c) Vander Wall's forces (d) Ionic forces
- 22.** On heating glycerol with conc. H_2SO_4 , a compound is obtained which has a bad odour. The compound is
 (a) Glycerol sulphate (b) Acrolein
 (c) Formic acid (d) Allyl alcohol
- 23.** Isopropyl alcohol on oxidation forms
 (a) Acetone (b) Ether (c) Ethylene (d) Acetaldehyde
- 24.** Benzenediazonium chloride on reaction with phenol in weakly basic medium gives
 (a) Diphenyl ether (b) *p*-hydroxyazobenzene
 (c) Chlorobenzene (d) Benzene
- 25.** The alcohol that produces turbidity immediately with $ZnCl_2 +$ conc. HCl at room temperature
 (a) 1-hydroxybutane (b) 2-hydroxybutane
 (c) 2-hydroxy-2-methylpropane (d) 1-hydroxy-2-methylpropane
- 26.** The reagent which easily reacts with ethanol and propanol is
 (a) Fehling solution (b) Grignard reagent
 (c) Schiff's reagent (d) Tollen's reagent
- 27.** Propene is the product obtained by dehydrogenation of
 (a) 2-propanol (b) 1-propanol (c) Propanal (d) *n*-propyl alcohol
- 28.** Which of the following statements is correct
 (a) Phenol is less acidic than ethyl alcohol
 (b) Phenol is more acidic than ethyl alcohol
 (c) Phenol is more acidic than carboxylic acid
 (d) Phenol is more acidic than carbonic acid
- 29.** Boiling point of alcohol is comparatively higher than that corresponding alkane due to
 (a) Intermolecular hydrogen bonding (b) Intramolecular hydrogen bonding
 (c) Volatile nature (d) None of these
- 30.** When Phenol is heated with phthalic anhydride in concentrated sulphuric acid and the hot reaction mixture is poured into a dilute solution of sodium hydroxide, the product formed is
 (a) Alizarin (b) Methyl orange (c) Fluorescein (d) Phenolphthalein



Product X is

- (a) $CH_3CH_2CH_2CH(OH)CH_3$ (b) $CH_3CH = CHCOCH_3$
 (c) Both (a) and (b) are correct (d) $CH_3CH_2CH_2COCH_3$



The product is

- (a) $CH_2 = C = O$ (b) $H_2C = O$ (c) C_2H_4 (d) C_2H_2

33. Ethylene glycol, on oxidation with per-iodic acid, gives

- (a) Oxalic acid (b) Glycol (c) Formaldehyde (d) Glycollic acid

34. An unknown compound 'D', first oxidised to aldehyde and then acitic acid by a dilute solution of $K_2Cr_2O_7$ and H_2SO_4 . The unknown compound 'D' is

- (a) CH_3CHO (b) CH_2CH_3OH (c) CH_3CH_2OH (d) $CH_3CH_2CH_3$

35. The reaction of ethylene glycol with PI_3 gives

- (a) ICH_2CH_2I (b) $CH_2 = CH_2$ (c) $CH_2 = CHI$ (d) $ICH = CHI$

36. The compound 'A' when treated with ceric ammonium nitrate solution gives yellow ppt. The compound 'A' is

- (a) Alcohol (b) Aldehyde (c) Acid (d) Alkane

37. Which of the following product is formed, when ether is exposed to air

- (a) Oxide (b) Alkanes (c) Alkenes (d) Peroxide of diethyl ether

38. During dehydration of alcohols to alkenes by heating with conc. H_2SO_4 the initiation step is

- (a) Protonation of alcohol molecule (b) Formation of carbocation
 (c) Elimination of water (d) Formation of an ester

39. Phenol is less acidic than

- (a) Ethanol (b) Methanol (c) *o*-nitrophenol (d) *p*-methylphenol

40. The compound which gives the most stable carbonium on dehydration is

- (a) $CH_3 - CH - CH_2OH$
 $\quad \quad \quad |$
 $\quad \quad \quad CH_3$
- (b) $CH_3 - C - OH$
 $\quad \quad \quad |$
 $\quad \quad \quad CH_3$
- (c) $CH_3 - CH_2 - CH_2 - CH_2OH$
- (d) $CH_3 - CH - CH_2 - CH_3$
 $\quad \quad \quad |$
 $\quad \quad \quad OH$

41. At higher temperature, iodoform reaction is given by

- (a) $CH_3CO_2CH_3$ (b) $CH_3CO_2C_2H_5$ (c) $C_6H_5CO_2CH_3$ (d) $CH_3CO_2C_6H_5$

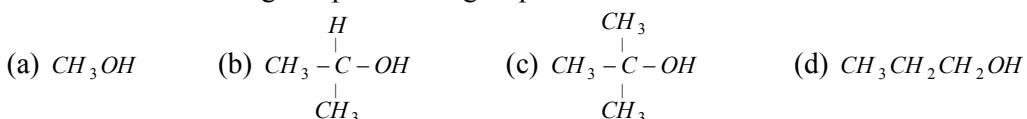
42. Cresol has
 (a) Alcoholic – OH (b) Phenolic – OH
 (c) – COOH (d) – CHO
43. In $CH_3CH_2OH \xrightarrow[350^\circ C]{X} CH_2 = CH_2 + H_2O$;
 'X' is
 (a) $NaCl$ (b) $CaCl_2$ (c) P_2O_5 (d) Al_2O_3
44. Sodium phenoxide reacts with CO_2 at 400 K and $4\text{-}7\text{ atm}$ pressure to give
 (a) Sodium salicylate (b) Salicylaldehyde
 (c) Catechol (d) Benzoic acid
45. The reaction of C_2H_5OH with H_2SO_4 does not give
 (a) Ethylene (b) Diethyl ether (c) Acetylene (d) Ethyl hydrogen sulphate
46. The order of stability of carbonium ions is
 (a) Methyl > ethyl > iso-propyl > tert-butyl (b) Tert-butyl > iso-propyl > ethyl > methyl
 (c) Iso-propyl > tert-butyl > ethyl > methyl (d) Tert-butyl > ethyl > iso-propyl > methyl
47. Which statement is not correct about alcohol
 (a) Alcohol is lighter than water
 (b) Alcohol evaporates quickly
 (c) Alcohol of less no. of carbon atoms is less soluble in water than alcohol of high no. of carbon atoms
 (d) All of these
48. An organic compound A reacts with sodium metal and forms B . On heating with conc. H_2SO_4 , A gives diethyl ether. A and B are
 (a) C_2H_5OH and C_2H_5ONa (b) C_3H_7OH and CH_3ONa
 (c) CH_3OH and CH_3ONa (d) C_4H_9OH and C_4H_9ONa
49. In the Liebermann's nitroso reaction, sequential changes in the colour of phenol occurs as
 (a) Brown or red \rightarrow green \rightarrow red \rightarrow deep blue
 (b) Red \rightarrow deep blue \rightarrow green
 (c) Red \rightarrow green \rightarrow white
 (d) White \rightarrow red \rightarrow green
50. Which one of the following reactions does not yield an alkyl halide
 (a) Diethyl ether $+ Cl_2$ (b) Diethyl ether $+ HI$
 (c) Diethyl ether and PCl_5 (d) Diethyl ether $\xrightarrow{\text{Reduction}} X \xrightarrow{SO_2Cl_2} \text{ }$
51. Compound A reacts with PCl_5 to give B which on treatment with KCN followed by hydrolysis gave propionic acid. What is A and B respectively
 (a) C_3H_8 and C_3H_7Cl (b) C_2H_6 and C_2H_5Cl
 (c) C_2H_5Cl and C_2H_5Cl (d) C_2H_5OH and C_2H_5Cl

- 52.** The increasing order of acidity among phenol, *p*-methylphenol, *m*-nitrophenol and *p*-nitrophenol is
 (a) *m*-nitrophenol, *p*-nitrophenol, phenol, *p*-methylphenol
 (b) *p*-methylphenol, *m*-nitrophenol, phenol, *p*-nitrophenol
 (c) *p*-methylphenol, phenol, *m*-nitrophenol, *p*-nitrophenol
 (d) Phenol, *p*-methylphenol, *p*-nitrophenol, *m*-nitrophenol
- 53.** Which of the following is not characteristic of alcohols
 (a) Lower alcohols are stronger and have bitter taste
 (b) Higher alcohols are stronger and have bitter taste
 (c) The boiling points of alcohols increase with increasing molecular mass
 (d) The lower alcohols are soluble in water
- 54.** In reaction of alcohols with alkali metal, acid etc. which of the following alcohol will react fastest
 (a) Secondary (b) Tertiary (c) Primary (d) All equal
- 55.** Order of reactivity of alcohols towards sodium metal is
 (a) *Pri* > *Sec* > *Ter* (b) *Pri* > *Sec* < *Ter*
 (c) *Pri* < *Sec* > *Ter* (d) *Pri* < *Sec* < *Ter*
- 56.** 23 g of Na will react with methyl alcohol to give
 (a) One mole of oxygen (b) One mole of H_2
 (c) $\frac{1}{2}$ mole of H_2 (d) None of these
- 57.** Which reagent is useful in converting 1-butanol to 1-bromobutane
 (a) $CHBr_3$ (b) Br_2 (c) CH_3Br (d) PBr_3
- 58.** The $-OH$ group of methyl alcohol cannot be replaced by chlorine by the action of
 (a) Chlorine (b) Hydrogen chloride
 (c) Phosphorus trichloride (d) Phosphorus pentachloride
- 59.** Which of the following gives ketone on oxidation
 (a) $(CH_3)_3COH$ (b) $CH_3CH_2CH_2OH$ (c) $(CH_3)_2CHCH_2OH$ (d) $CH_3CHOHCH_3$
- 60.** Phenol is treated with bromine water and shaken well. The white precipitate formed during the process is
 (a) *m*-bromophenol (b) 2, 4-dibromophenol
 (c) 2, 4, 6-tribromophenol (d) A mixture of *o*- and *p*-bromophenols
- 61.** Which compound has the highest boiling point
 (a) Acetone (b) Diethyl ether (c) Methanol (d) Ethanol
- 62.** When vapour of ethanol are passed over platinised asbestos in excess of air, the compound formed is
 (a) CH_3CHO (b) CH_3COCH_3 (c) C_2H_2 (d) CH_3COOH

63. Dehydration of ethanol gives

- (a) Acetic acid (b) Ethane (c) Ethylene (d) Acetylene

64. Which of the following compound will give positive iodoform test



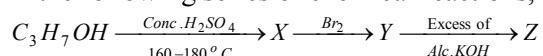
65. Absolute ethanol cannot be obtained by simple fraction of a solution of ethanol and water because

- (a) Their B.P.'s are very nearer (b) Ethanol remains dissolved in water
(c) They form a constant boiling mixture (d) Ethanol molecules are solvated

66. The alcohol which easily reacts with conc. HCl is

- (a) $CH_3 - CHOH - CH_2 - CH_3$ (b) $(CH_3)_3 - C - OH$
(c) $CH_3 - CH_2 - CH_2 - CH_2 - OH$ (d) $(CH_3)_3 - CH - CH_2OH$

67. In the following series of chemical reactions, identify Z



- | | |
|--|--|
| (a) $CH_3 - \underset{NH_2}{CH} - \underset{NH_2}{CH_2}$ | (b) $CH_3 - \underset{OH}{CH} - \underset{OH}{CH_2}$ |
| (c) $CH_3 - C = CH_2$ | (d) $CH_3C \equiv CH$ |

68. Alcohols of low molecular weight are

- (a) Soluble in water (b) Soluble in all solvents
(c) Insoluble in all solvents (d) Soluble in water on heating

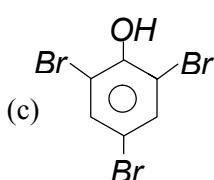
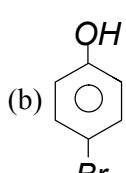
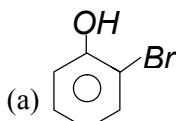
69. Which of the following compounds is oxidised to prepare methyl ethyl ketone

- (a) 2 - propanol (b) 1 - butanol (c) 2 - butanol (d) Tert-butyl alcohol

70. Which of the following is acidic

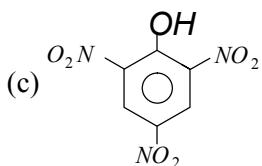
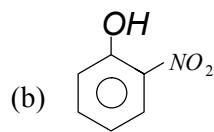
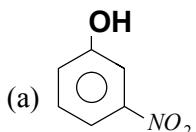
- (a) CH_3OH (b) C_6H_5OH (c) $(CH_3)_2CHOH$ (d) CH_3CH_2OH

71. With excess bromine, phenol reacts of form



- (d) Mixture of (a) and (b)

72. Which is obtained on treating phenol, with dilute HNO_3



(d) None of these

73. Primary alcohols on dehydration give

- (a) Alkenes (b) Alkanes (c) Both (a) and (b) (d) None of these

74. Primary and secondary alcohols on action of reduced copper give

- (a) Aldehydes and ketones respectively (b) Ketones and aldehydes respectively
 (c) Only aldehydes (d) Only ketones

75. Methyl alcohol on oxidation with acidified $K_2Cr_2O_7$ gives

- (a) CH_3COCH_3 (b) CH_3CHO (c) $HCOOH$ (d) CH_3COOH

76. Ethyl alcohol on oxidation with $K_2Cr_2O_7$ gives

- (a) Acetic acid (b) Acetaldehyde (c) Formaldehyde (d) Formic acid

77. Lucas test is used for

- (a) Alcohols (b) Amines (c) Diethyl ether (d) Glacial acetic acid

78. When phenol reacts with ammonia in presence of $ZnCl_2$ at $300^\circ C$, it gives

- (a) Primary amine (b) Secondary amine (c) Tertiary amine (d) Both (b) and (c)

79. Azo-dyes are prepared from

- (a) Aniline (b) Benzaldehyde (c) Benzoic acid (d) Phenol

80. A compound that easily undergoes bromination is

- (a) Phenol (b) Toluene (c) Benzene (d) Benzoic acid

81. Which of the following has lowest boiling point

- (a) *p*-nitrophenol (b) *m*-nitrophenol (c) *o*-nitrophenol (d) phenol

82. In esterification, the reactivity of alcohols is

- (a) $1^\circ > 2^\circ > 3^\circ$ (b) $3^\circ > 2^\circ > 1^\circ$ (c) Same in all cases (d) None of these

83. The role of conc. H_2SO_4 in the esterification process is

- | | |
|-----------------------|------------------------------------|
| (a) Catalyst | (b) Dehydrating agent |
| (c) Hydrolysing agent | (d) Dehydrating agent and catalyst |

- 96.** Which of the following produces violet colour with $FeCl_3$ solution
 (a) Enols (b) Ethanol (c) Ethanal (d) Alkyl halides
- 97.** When heated with NH_3 under pressure alone or in presence of zinc chloride phenols are converted into
 (a) Aminophenols (b) Aniline
 (c) Nitrobenzene (d) Phenyl hydroxylamine
- 98.** Because of resonance the oxygen atom of $-OH$ group of phenol
 (a) Acquires positive charge (b) Acquires negative charge
 (c) Remains unaffected (d) Liberates
- 99.** When glycerol is heated with $KHSO_4$ it gives
 (a) $CH_2 = CH - CH_3$ (b) $CH_2 = CH - CH_2OH$
 (c) $CH_2 = CH - CHO$ (d) $CH_2 = C = CH_2$
- 100.** An organic compound X on treatment with acidified $K_2Cr_2O_7$ gives a compound Y which reacts with I_2 and sodium carbonate to form tri-odomethane. The compound X is
 (a) CH_3OH (b) $CH_3 - CO - CH_3$ (c) CH_3CHO (d) $CH_3CH(OH)CH_3$
- 101.** The reaction of conc. HNO_3 and phenol forms
 (a) Benzoic acid (b) Salicylic acid (c) *o*-and *p*-nitrophenol (d) Picric acid
- 102.** Phenol is
 (a) A weaker base than NH_3
 (b) Stronger than carbonic acid
 (c) Weaker than carbonic acid
 (d) A neutral compound
- 103.** Phenol at $25^\circ C$ is
 (a) A white crystalline solid (b) A transparent liquid
 (c) A gas (d) Yellow solution
- 104.** At low temperature phenol reacts with Br_2 in CS_2 to form
 (a) *m*-bromophenol (b) *o*-and *p*-bromophenol
 (c) *p*-bromophenol (d) 2, 4, 6-tribromophenol
- 105.** Oxidation of ethanol by chromic acid forms
 (a) Ethanol (b) Methanol (c) 2-propanone (d) Ethanoic acid
- 106.** Which of the following not gives effervescence with $NaHCO_3$
 (a) Phenol (b) Benzoic acid (c) 2, 4-dinitrophenol (d) 2, 4, 6-trinitrophenol
- 107.** Conc. H_2SO_4 reacts with C_2H_5OH at $170^\circ C$ to form
 (a) CH_3COCH_3 (b) CH_3COOH (c) CH_3CHO (d) C_2H_4
- 108.** Which compound has hydrogen bonding
 (a) Toluene (b) Phenol (c) Chlorobenzene (d) Nitrobenzene

109. Which statement is true

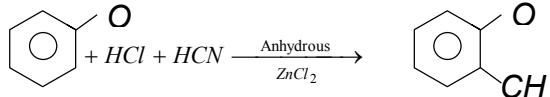
- (a) C_6H_5OH is more acidic than C_2H_5OH
- (b) C_6H_5OH is less acidic than C_2H_5OH
- (c) C_6H_5OH react with $NaHCO_3$
- (d) C_6H_5OH gives oxime with NH_2OH and HCl

110. Read the following statements carefully :

- (A) A secondary alcohol on oxidation gives a ketone
- (B) Ethanol reacts with conc. H_2SO_4 at $180^\circ C$ to yield ethylene
- (C) Methanol reacts with iodine and sodium hydroxide to give a yellow precipitate of iodoform
- (D) Hydrogen gas is liberated when sodium is added to alcohol. Select the correct statements from the above set:

- (a) A, B (b) C, D (c) A, B, D (d) A, C, D

111. The following reaction :



is known as

- (a) Perkin reaction (b) Gattermann reaction
- (c) Kolbe reaction (d) Gattermann-Koch reaction

112. Carbylamine test is done by heating alcoholic KOH with

- (a) Chloroform and silver powder
- (b) Trihalogen methane and primary amine
- (c) Alkyl halide and primary amine
- (d) Alkyl cyanide and primary amine

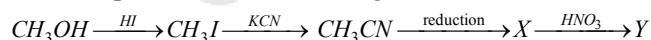
113. Isopropyl alcohol heated at $300^\circ C$ with copper catalyst to form

- (a) Acetone (b) Dimethyl ether (c) Acetaldehyde (d) Ethane

114. Dehydrogenation of $\text{CH}_3 - \underset{\substack{| \\ OH}}{\text{CH}} - \text{CH}_3$ gives

- (a) Acetone (b) Acetaldehyde (c) Acetic acid (d) Acetylene

115. In the sequence of the following reactions



X and Y are respectively

- (a) $\text{CH}_3\text{CH}_2\text{NH}_2$ and $\text{CH}_3\text{CH}_2\text{OH}$ (b) $\text{CH}_3\text{CH}_2\text{NH}_2$ and CH_3COOH
- (c) $\text{CH}_3\text{CH}_2\text{OH}$ and CH_3CHO (d) CH_3OCH_3 and CH_3CHO

116. Alcohols (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, (ii) $\text{CH}_3 - \text{CHOH} - \text{CH}_3$ and (iii) $\text{CH}_3 - \text{C}(\text{CH}_3)(\text{OH}) - \text{CH}_3$ were treated with Lucas reagent (Conc. $HCl + \text{ZnCl}_2$). What results do you expect at room temperature

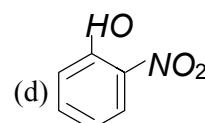
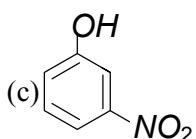
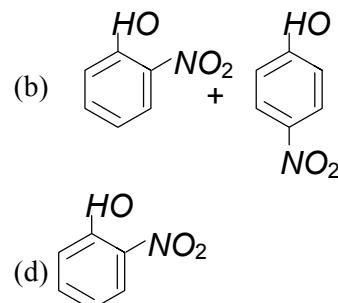
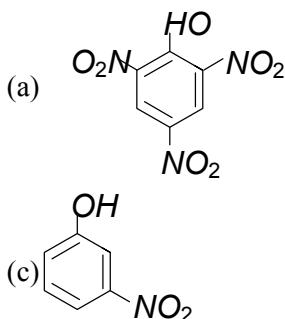
- (a) (ii) and (iii) react immediately and (i) in about 5 minutes
- (b) (iii) reacts immediately, (ii) reacts in about 5 minutes and (i) not at all
- (c) (i) reacts immediately, (ii) reacts in about 5 minutes and (iii) not at all
- (d) (i) reacts in about 5 minutes, (ii) reacts in about 15 minutes and (iii) not at all

- 117.** Ethylene may be obtained by dehydration of which of the following with concentrated H_2SO_4 at $160 - 170^\circ C$
- (a) C_2H_5OH (b) CH_3OH (c) $CH_3CH_2CH_2OH$ (d) $(CH_3)_2CHCH_2OH$
- 118.** The final product of the oxidation of ethyl alcohol is
- (a) Ethane (b) Acetone (c) Acetaldehyde (d) Acetic acid
- 119.** The compound obtained by heating salicylic acid with phenol in the presence of phosphorus oxychloride is
- (a) Salol (b) Aspirin (c) Oil of wintergreen (d) *o*-chlorobenzoyl chloride
- 120.** When phenol is allowed to react with Br_2 in (i) CS_2 solution and (ii) in aqueous solution, the resulting compounds are
- (a) (i) 2, 4, 6-tribromophenol and (ii) *o*-and *p*-bromophenol
 (b) (i) *m*-bromophenol and (ii) 2, 3, 4-tribromophenol
 (c) (i) *o*-and *p*-bromophenol and (ii) 2, 4, 6-tribromophenol
 (d) (i) *o*- and *m*-bromophenol and (ii) 2, 3, 4-tribromophenol
- 121.** Which of the following is not true in case of reaction with heated copper at $300^\circ C$
- (a) Phenol \rightarrow Benzyl alcohol (b) Primary alcohol \rightarrow Aldehyde
 (c) Secondary alcohol \rightarrow Ketone (d) Tertiary alcohol \rightarrow Olefin
- 122.** Which of the following is the most suitable method for removing the traces of water from ethanol
- (a) Heating with Na metal (b) Passing dry HCl through it
 (c) Distilling it (d) Reacting with Mg
- 123.** With oxalic acid, glycerol at $260^\circ C$ gives
- (a) Allyl alcohol (b) Glyceryl mono-oxalate
 (c) Formic acid (d) Glyceraldehyde
- 124.** Absolute alcohol cannot be prepared by fractional distillation of rectified spirit since
- (a) It forms azeotropic mixture (b) It is used as power alcohol
 (c) It is used in wines (d) None of the above
- 125.** The reagent used for the dehydration of an alcohol is
- (a) Phosphorus pentachloride (b) Calcium chloride
 (c) Aluminium oxide (d) Sodium chloride
- 126.** Which one of the following compounds gives a positive iodoform test
- (a) Pentanal (b) 1-phenyl ethanol (c) 2-phenyl ethanol (d) 3-pentanol
- 127.** What amount of bromine will be required to convert 2 g of phenol into 2, 4, 6-tribromophenol
- (a) 4.00 (b) 6.00 (c) 10.22 (d) 20.44
- 128.** Ethyl alcohol exhibits acidic character on reacting with
- (a) Acetic acid (b) Sodium metal
 (c) Hydrogen iodide (d) Acidic potassium dichromate

- 129.** The mixture of ethanol and water cannot be separated by distillation because
 (a) They form a constant boiling mixture (b) Alcohol molecules are solvated
 (c) Their boiling points are very near (d) Alcohol remains dissolved in water
- 130.** The reaction between an alcohol and an acid with the elimination of water molecule is called
 (a) Esterification (b) Saponification
 (c) Etherification (d) Elimination
- 131.** The compound with the highest boiling point is
 (a) CH_4 (b) CH_3OH (c) CH_3Cl (d) CH_3Br
- 132.** The boiling point of ethyl alcohol should be less than that of
 (a) Propane (b) Formic acid (c) Dimethyl ether (d) None of these
- 133.** Which of the following is not characteristic of alcohols
 (a) They are lighter than water
 (b) Their boiling points rise fairly uniformly with increasing molecular weight
 (c) Lower members are insoluble in water and organic solvents but solubility regularly increases with molecular weight
 (d) Lower members have pleasant smell and burning taste, while higher members are odourless and tasteless
- 134.** At room temperature the alcohol that do not reacts with Lucas reagent is
 (a) Primary alcohol (b) Secondary alcohol
 (c) Tertiary alcohol (d) All these three
- 135.** By means of calcium chloride which of following can be dried
 (a) Methanol (b) Ethanol (c) Both (a) and (b) (d) None of these
- 136.** Lucas test is used to distinguish between
 (a) 1° , 2° and 3° alcohols (b) 1° , 2° and 3° amines
 (c) Aldehydes and ketones (d) Alkenes and alkynes
- 137.** Among the following, the compound that undergoes nitration readily is
 (a) Benzoic acid (b) Toluene (c) Phenol (d) Nitrobenzene
- 138.** Phenol $\xrightarrow[\text{Distillation}]{Zn} A \xrightarrow[\text{Conc. } HNO_3]{\text{Conc. } H_2SO_4} B \xrightarrow[\text{NaOH}]{Zn} C$
 In the above reaction A, B and C are the following compounds
 (a) C_6H_6 , $C_6H_5NO_2$ and aniline
 (b) C_6H_6 , dinitrobenzene and metanitroaniline
 (c) Toluene, metanitrobenzene and metatoluedine
 (d) C_6H_6 , $C_6H_5NO_2$ and hydrazobenzene
- 139.** $CH_3 - O - C_3H_7$ and $C_2H_5 - O - C_2H_5$
 exhibit which type of isomerism
 (a) Metamerism (b) Position (c) Chain (d) Functional

140. Phenol reacts with CCl_4 in presence of aqueous alkali and forms a product which on hydrolysis gives
(a) Salicylaldehyde (b) Salicylic acid
(c) Benzaldehyde (d) Benzoic acid
141. In fermentation by zymase, alcohol and CO_2 are obtained from the following sugar
(a) Glucose (b) Invert sugar (c) Fructose (d) All of these
142. The order of melting point of *ortho*, *para*, *meta*-nitrophenol is
(a) $o > m > p$ (b) $p > m > o$ (c) $m > p > o$ (d) $p > o > m$
143. The alcohol which does not give a stable compound on dehydration is
(a) Ethyl alcohol (b) Methyl alcohol (c) *n*-propyl alcohol (d) *n*-butyl alcohol
144. When ethyl alcohol (C_2H_5OH) is mixed with ammonia and passed over heated alumina, the compound formed is
(a) $C_2H_5NH_2$ (b) C_2H_4 (c) $C_2H_5OC_2H_5$ (d) CH_3OCH_3
145. A mixture of methanol vapours and air is passed over heated copper. The products are
(a) Carbon monoxide and hydrogen (b) Formaldehyde and water vapour
(c) Formic acid and water vapour (d) Carbon monoxide and water vapour
146. In the esterification reaction of alcohols
(a) OH^- is replaced by CH_3COO group (b) OH^- is replaced by chlorine
(c) H^- is replaced by sodium metal (d) OH^- is replaced by C_2H_5OH
147. A compound *A* on oxidation gave acetaldehyde, then again on oxidation gave acid. After first oxidation it was reacted with ammoniacal $AgNO_3$, then silver mirror was produced. *A* is likely to be
(a) Primary alcohol (b) Tertiary alcohol
(c) Acetaldehyde (d) Acetone
148. Phenol $\xrightarrow[H^+]{CHCl_3/NaOH}$ Salicyldehyde
- The above reaction is known as
(a) Riemer Tiemann reaction (b) Bucherer reaction
(c) Gattermann synthesis (d) Perkin reaction
149. Alcohol which gives red colour with Victor Meyer test is
(a) C_2H_5OH (b) $CH_3 - CH - CH_3$ (c) $C(CH_3)_3OH$ (d) None of these
150. Conc. H_2SO_4 heated with excess of C_2H_5OH at $140^\circ C$ to form
(a) $CH_3CH_2 - O - CH_3$ (b) $CH_3CH_2 - O - CH_2CH_3$
(c) $CH_3 - O - CH_2 - CH_2 - CH_3$ (d) $CH_2 = CH_2$
151. Rate of substitution reaction in phenol is
(a) Slower than the rate of benzene (b) Faster than the rate of benzene
(c) Equal to the rate of benzene (d) None of these

152. Phenol reacts with dilute HNO_3 at normal temperature to form



153. One mole of phenol reacts with bromine to form tribromophenol. How much bromine is used

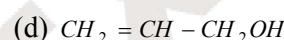
- (a) 1.5 mol (b) 3 mol (c) 4.5 mol (d) 6 mol

154. In presence of $NaOH$, phenol react with $CHCl_3$ to form *o*-hydroxy benzaldehyde. This reaction is called

- (a) Riemer-Tiemann's reaction (b) Sandmeyer's reaction
 (c) Hoffmann's degradation reaction (d) Gattermann's aldehyde synthesis

155. Which of the following vapours passed over heated copper to form acetone

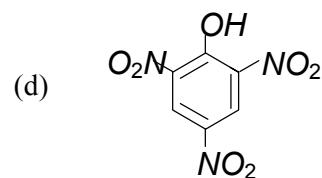
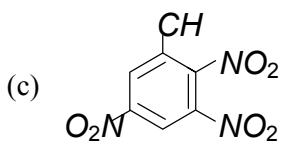
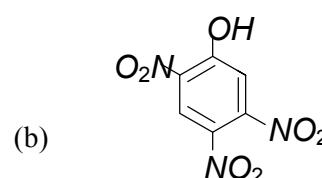
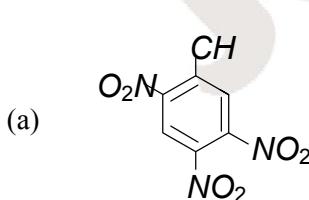
- (a) $H_3C - CH_2 - CH_2OH$ (b) $CH_3 - CH - CH_3$
 $\quad \quad \quad \quad \quad \quad \quad |$
 $\quad \quad \quad \quad \quad \quad \quad OH$



156. Methyl alcohol (methanol), ethyl alcohol (ethanol) and acetone (propanone) were treated with iodine and sodium hydroxide solutions. Which substances will give iodoform test

- (a) Only ethyl alcohol (b) Only methyl alcohol and ethyl alcohol
 (c) Only ethyl alcohol and acetone (d) Only acetone

157. TNT has the structure



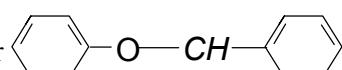
158. The vapour pressure of aqueous solution of methanol is

- (a) Equal to water (b) Equal to methanol
 (c) More than water (d) Less than water

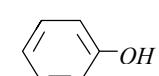
- 159.** Glycerol reacts with conc. HNO_3 and conc. H_2SO_4 to form
 (a) Glycerol mononitrate (b) Glycerol dinitrate
 (c) Glycerol trinitrate (d) Acrolein
- 160.** Glycerol heated with oxalic acid at $110^\circ C$ to form
 (a) Formic acid (b) Oxalic acid
 (c) Allyl alcohol (d) Glycerol trioxalate
- 161.** Dimethyl ether and ethyl alcohol are
 (a) Branched isomer (b) Position isomer
 (c) Functional isomer (d) Tautomer
- 162.** The process of manufacture of absolute alcohol from rectified spirit is
 (a) Fractional distillation (b) Steam distillation
 (c) Azeotropic distillation (d) Vacuum distillation
- 163.** When ethyl alcohol reacts with acetic acid, the products formed are
 (a) Sodium ethoxide + hydrogen (b) Ethyl acetate + water
 (c) Ethyl acetate + soap (d) Ethyl alcohol + water
- 164.** Picric acid is (at $25^\circ C$)
 (a) A white solid (b) A colourless liquid
 (c) A gas (d) A bright yellow solid
- 165.** Phenol on distillation with zinc dust gives
 (a) C_6H_6 (b) C_6H_{12} (c) $C_6H_5OC_6H_5$ (d) $C_6H_5 - C_6H_5$
- 166.** Methanol and ethanol are miscible in water due to
 (a) Covalent character (b) Hydrogen bonding character
 (c) Oxygen bonding character (d) None of these
- 167.** By distilling glycol with fuming sulphuric acid, which of following is obtained
 (a) Glycerol (b) Pinacol (c) Dioxan (d) Ethylene oxide
- 168.** The compound which gives the most stable carbonium ion on dehydration is
 (a) $CH_3 - \underset{CH_3}{\underset{|}{C}} - CH_2OH$
 (b) $CH_3 - \underset{CH_3}{\underset{|}{C}} - OH$
 (c) $CH_3 - CH_2 - CH_2 - CH_2OH$
 (d) $CH_3 - \underset{CH_3}{\underset{|}{C}} - CH_2 - CH_2 - CH_3$
- 169.** In CH_3CH_2OH which bond dissociates heterolytically
 (a) $C - C$ (b) $C - O$ (c) $C - H$ (d) $O - H$
- 170.** Which compound is soluble in water
 (a) CS_2 (b) C_2H_5OH (c) CCl_4 (d) $CHCl_3$

- 183.** When primary alcohol is oxidised with chlorine, it produces
 (a) $HCHO$ (b) CH_3CHO (c) CCl_3CHO (d) C_3H_7CHO
- 184.** Alcohols combine with acetylene in the presence of mercury compounds as catalyst to form
 (a) Acetals (b) Xanthates (c) Vinyl ethers (d) None of the above
- 185.** The compound which will give negative iodoform test is
 (a) CH_3CHO (b) CH_3CH_2OH (c) Isopropyl alcohol (d) Benzyl alcohol
- 186.** Which of the following is most acidic
 (a) Phenol (b) Benzyl alcohol (c) *m*-chlorophenol (d) Cyclohexanol
- 187.** Number of metamers represented by molecular formula $C_4H_{10}O$ is
 (a) 4 (b) 3 (c) 2 (d) 1
- 188.** When ether is exposed in air for sometime an explosive substance produced is
 (a) Peroxide (b) TNT (c) Oxide (d) Superoxide
- 189.** Ether which is liquid at room temperature is
 (a) $C_2H_5OCH_3$ (b) CH_3OCH_3 (c) $C_2H_5OC_2H_5$ (d) None of these
- 190.** In the following reaction

$$C_2H_5OC_2H_5 + 4[H] \xrightarrow{\text{Red P+HI}} 2X + H_2O$$
, X is
 (a) Ethane (b) Ethylene (c) Butane (d) Propane
- 191.** Diethyl ether absorbs oxygen to form
 (a) Red coloured sweet smelling compound (b) Acetic acid
 (c) Ether suboxide (d) Ether peroxide
- 192.** Diethyl ether can be decomposed by heating with
 (a) HI (b) $NaOH$ (c) Water (d) $KMnO_4$
- 193.** On boiling with concentrated hydrobromic acid, phenyl ethyl ether will yield
 (a) Phenol and ethyl bromide (b) Phenol and ethane
 (c) Bromobenzene and ethanol (d) Bromobenzene and ethane
- 194.** Ether is formed when ethyl alcohol is heated with conc. H_2SO_4 . The conditions are
 (a) Excess of H_2SO_4 and $170^\circ C$ (b) Excess of C_2H_5OH and $140^\circ C$
 (c) Excess of C_2H_5OH and $180^\circ C$ (d) Excess of conc. H_2SO_4 and $100^\circ C$

- 195.** The ether 

when treated with HI produces CH_2OH

- (a)  (b)  (c)  (d) 

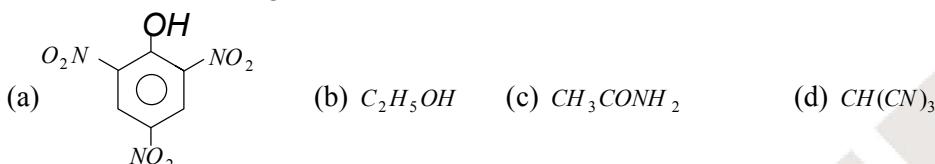
207. A substance $C_4H_{10}O$ yields on oxidation a compound C_4H_8O which gives an oxime and a positive iodoform test. The original substance on treatment with conc. H_2SO_4 gives C_4H_8 . The structure of the compound is

- (a) $CH_3CH_2CH_2CH_2OH$ (b) $CH_3CH(OH)CH_2CH_3$
 (c) $(CH_3)_3COH$ (d) $CH_3CH_2-O-CH_2CH_3$

208. Ethylene glycol reacts with excess of PCl_5 to give

- (a) 1, 1-dichloroethane (b) 1, 2-dichloroethane
 (c) 1, 1, 1-trichloroethane (d) 1, 1, 2-tetrachloroethane

209. Which of the following will not react with $NaOH$



210. The boiling point of methanol is greater than that of methyl thiol because

- (a) There is intramolecular hydrogen bonding in methanol and intermolecular hydrogen bonding in methyl thiol
 (b) There is intermolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol
 (c) There is no hydrogen bonding in methanol and intermolecular hydrogen bonding in methyl thiol
 (d) There is intramolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol

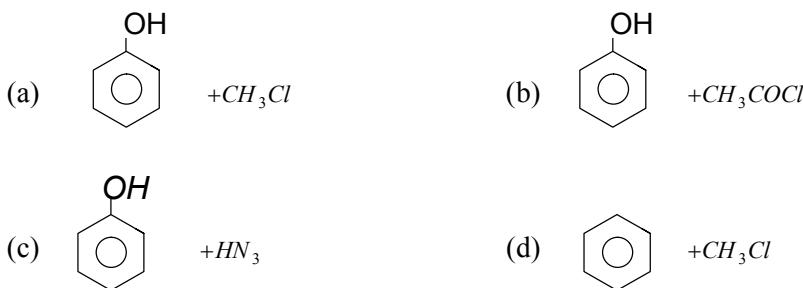
211. In the reaction $\begin{array}{c} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{array} + \begin{array}{c} COOH \\ | \\ COOH \end{array} \xrightarrow{110^\circ C} (A)$ product (A) will be

- (a) Glycerol monoformate (b) Allyl alcohol
 (c) Formaldehyde (d) Acetic acid

212. Which of the following will not form a yellow precipitate on heating with an alkaline solution of iodine

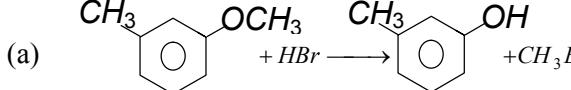
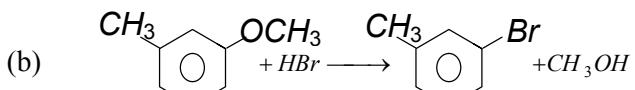
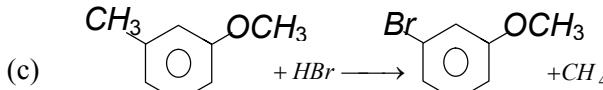
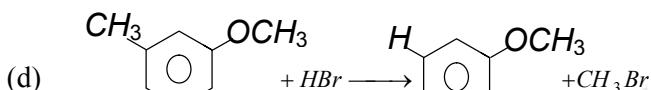
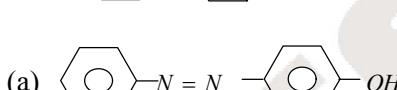
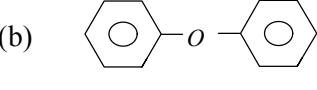
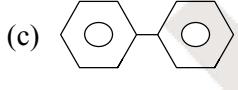
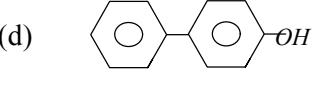
- (a) CH_3OH (b) CH_3CH_2OH (c) $CH_3CH(OH)CH_3$ (d) $CH_3CH_2CH(OH)CH_3$

213. In Friedal-Crafts acylation, besides $AlCl_3$, the other reactants are



- 214.** Which of the following reagents will produce salicyldehyde on reaction with phenol
- (a) $CHCl_3 / NaOH$
 - (b) $CCl_4 / NaOH$
 - (c) $CH_2Cl_2 / NaOH$
 - (d) $CH_3Cl / NaOH$
- 215.** At 530 K , glycerol reacts with oxalic acid to produce
- (a) Allyl alcohol
 - (b) Formic acid
 - (c) Glyceraldehyde
 - (d) Glycerol monooxalate
- 216.** With anhydrous zinc chloride, ethylene glycol gives
- (a) Formaldehyde
 - (b) Acetylene
 - (c) Acetaldehyde
 - (d) Acetone
- 217.** Which of the following compound give yellow precipitate with I_2 and $NaOH$
- (a) CH_3OH
 - (b) $CH_3CH_2CH_2OH$
 - (c) $C_2H_5OC_2H_5$
 - (d) CH_3CH_2OH
- 218.** Amongst the following, HBr reacts fastest with
- (a) Propane-1-ol
 - (b) Propane-2-ol
 - (c) 2-methyl propane-1-ol
 - (d) 2-methyl propane-2-ol
- 219.** Which of the following react with benzoic acid to form ethyl benzoate
- (a) Ethyl alcohol
 - (b) Cinnamic acid
 - (c) Sodium ethoxide
 - (d) Ethyl chloride
- 220.** When phenyl magnesium bromide reacts with *t*-butanol, the product would be
- (a) Benzene
 - (b) Phenol
 - (c) *t*-butyl benzene
 - (d) *t*-butyl ether
- 221.** Which of the following is used as catalyst for preparing Grignard reagent
- (a) Iron powder
 - (b) Dry ether
 - (c) Activated charcoal
 - (d) MnO_2
- 222.** Ethyl alcohol is heated with conc. H_2SO_4 . The product formed is
- (a) $CH_3 - \overset{\overset{O}{||}}{C} - OC_2H_5$
 - (b) C_2H_6
 - (c) C_2H_4
 - (d) C_2H_2
- 223.** Dehydration of 2-butanol yield
- (a) 1-butene
 - (b) 2-butene
 - (c) 2-butyne
 - (d) Both (a) and (b)
- 224.** Fats, on alkaline hydrolysis, gives
- (a) Oils
 - (b) Soaps
 - (c) Detergents
 - (d) Glycol + acid
- 225.** When vapours of an alcohol are passed over hot reduced copper, alcohol is converted into alkene quickly, the alcohol is
- (a) Primary
 - (b) Secondary
 - (c) Tertiary
 - (d) None of these
- 226.** The adduct of the compound '*A*' obtained by the reaction with excess of isopropyl magnesium iodide, upon hydrolysis gives a tertiary alcohol. The compound '*A*' is
- (a) An ester
 - (b) A secondary alcohol
 - (c) A primary alcohol
 - (d) An aldehyde

- 227.** If there be a compound of the formula $CH_3C(OH)_3$, which one of the following compounds would be obtained from it without reaction with any reagent
 (a) CH_3OH (b) C_2H_5OH (c) CH_3COOH (d) $HCHO$
- 228.** Which of the following can work as a dehydrating agent for alcohols
 (a) H_2SO_4 (b) Al_2O_3 (c) H_3PO_4 (d) All of these
- 229.** What is formed when glycerol reacts with HI
 (a) $\begin{array}{c} CH_2OH \\ | \\ CHI \\ | \\ CH_2OH \end{array}$ (b) $\begin{array}{c} CH_2 \\ || \\ CH \\ || \\ CH_2I \end{array}$ (c) $\begin{array}{c} CH_3 \\ | \\ CH_2 \\ | \\ CH_3 \end{array}$ (d) $\begin{array}{c} CH_2OH \\ | \\ C=O \\ | \\ CH_3 \end{array}$
- 230.** The dehydration of 2-methyl butanol with conc. H_2SO_4 gives
 (a) 2-methyl butene as major product (b) Pentene
 (c) 2-methyl but-2-ene as major product (d) 2-methyl pent-2-ene
- 231.** Which alcohol reacts with fatty acids to form fats
 (a) Ethanol (b) Glycerol (c) Methanol (d) Isopropanol
- 232.** Which will dehydrate easily
 (a) 3-methyl-2-butanol (b) Ethyl alcohol
 (c) 2-methyl propane-2-ol (d) 2-methyl butanol-2
- 233.** $A \xleftarrow[\Delta]{Cu} CH_3CH_2OH \xrightarrow[\Delta]{Al_2O_3} B$. A and B respectively are
 (a) Alkene, alkanal (b) Alkyne, alkanal
 (c) Alkanal, alkene (d) Alkene, alkyne
- 234.** Which one of the following reactions would produce secondary alcohol
- (a) $C_6H_5\overset{O}{\underset{\parallel}{C}}CH_3 \xrightarrow[2.H^+]{1.CH_3MgBr} \text{Product}$
- (b) $C_6H_5\overset{O}{\underset{\parallel}{C}}CH_3 \xrightarrow[2.H^+]{1.LiAlH_4} \text{Product}$
- (c) $CH_3CHO \xrightarrow[2.H^+]{1.LiAlH_4} \text{Product}$
- (d) $CH_3\overset{O}{\underset{\parallel}{C}}CH_3 \xrightarrow[2.Br_2]{1.OH^-} \text{Product}$
- 235.** On reaction with hot conc. H_2SO_4 , which one of the following compounds loses a molecule of water
 (a) CH_3COCH_3 (b) CH_3COOH (c) CH_3OCH_3 (d) CH_3CH_2OH
- 236.** The best method to prepare cyclohexene from cyclohexanol is by using
 (a) Conc. $HCl + ZnCl_2$ (b) Conc. H_3PO_4
 (c) HBr (d) Conc. HCl
- 237.** Which of the following compound is most acidic
 (a) CH_4 (b) C_2H_6 (c) $CH \equiv CH$ (d) C_2H_5OH

- 238.** C_2H_5OH can be differentiated from CH_3OH by
- (a) Reaction with HCl
 - (b) Reaction with NH_3
 - (c) By iodoform test
 - (d) By solubility in water
- 239.** A compound does not react with 2,4 di-nitrophenyl hydrazine and Na , compound is
- (a) Acetone
 - (b) Acetaldehyde
 - (c) CH_3OH
 - (d) $CH_2 = CHOCH_3$
- 240.** Which of the following reaction is correctly represented
- (a) 
- (b) 
- (c) 
- (d) 
- 241.** Tertiary butyl alcohol gives tertiary butyl chloride on treatment with
- (a) Conc. HCl /anhydrous $ZnCl_2$
 - (b) KCN
 - (c) $NaOCl$
 - (d) Cl_2
- 242.** $HO - \text{C}_6\text{H}_4 - + \text{C}_6\text{H}_4 - O - N_2^+Cl^- \xrightarrow{\text{base}}$
- (a) 
 - (b) 
 - (c) 
 - (d) 
- 243.** In which of the following reactions carbon carbon bond formation takes place
- (a) Cannizzaro
 - (b) Reimer-Tiemann
 - (c) HVZ reaction
 - (d) Schmidt reaction
- 244.** Reaction of phenol with chloroform/sodium hydroxide to give *o*-hydroxy benzaldehyde involves the formation of
- (a) Dichloro carbene
 - (b) Trichloro carbene
 - (c) Chlorine atoms
 - (d) Chlorine molecules
- 245.** Which is not correct
- (a) Phenol is more acidic than acetic acid
 - (b) Ethanol is less acidic than phenol
 - (c) Ethanol has lower boiling point than ethane
 - (d) Ethyne is a non-linear molecule

EXERCISE - IV

Uses of alcohol, Phenol and Ethers

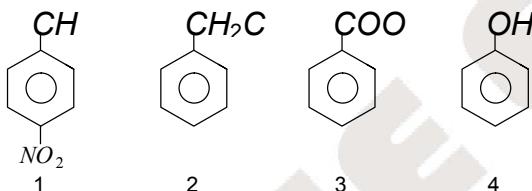
1. Glycerol is used in the manufacture of
(a) Dynamite (b) Varnish (c) Paints (d) Soft drinks
2. Glycerol as a triester present in
(a) Petroleum (b) Kerosene
(c) Vegetable oil and fat (d) Naphtha
3. In presence of air, fermentation of ethyl alcohol by azotobacter bacteria forms
(a) $CH_2 = CH_2$ (b) C_2H_6 (c) CH_3CHO (d) CH_3COOH
4. Aspirin is also known as
(a) Methyl salicylic acid (b) Acetyl salicylic acid
(c) Acetyl salicylate (d) Methyl salicylate
5. Substances used in bringing down the temperature in high fevers are called
(a) Pyretics (b) Antipyretics (c) Antibiotics (d) Antiseptics
6. When glycol is heated with dicarboxylic acid, the products are
(a) Polyesters (b) Polyethers (c) Polyethylene (d) No reaction at all
7. Cresol is
(a) A mixture of three cresols with little phenol
(b) Used as dye for wood
(c) A soapy solution of cresols
(d) Having an aldehyde group
8. Phenol is used in the manufacture of
(a) Bakelite (b) Polystyrene (c) Nylon (d) PVC
9. In cold countries ethylene glycol is added to water in the radiators to
(a) Bring down the specific heat of water
(b) Lower the viscosity
(c) Reduce the viscosity
(d) Make water a better lubricant
10. Power alcohol is
(a) An alcohol of 95% purity
(b) A mixture of petrol hydrocarbons and ethanol
(c) Rectified spirit
(d) A mixture of methanol and ethanol

24. Diethyl ether finds use in medicine as
 (a) A pain killer (b) A hypnotic (c) An antiseptic (d) An anaesthetic
25. Washing soap can be prepared by saponification with alkali of the oil
 (a) Rose oil (b) Paraffin oil (c) Groundnut oil (d) Kerosene
26. Ether can be used
 (a) As a general anaesthetic (b) As a refrigerant
 (c) In perfumery (d) All of these
27. The Bouveault-Blanc reduction involves
 (a) C_2H_5OH / Na (b) $LiAlH_4$ (c) $C_2H_5MgX^-$ (d) Zn / HCl
28. Which is used as an antifreeze
 (a) Glycol (b) Ethyl alcohol (c) Water (d) Methanol

EXERCISE - V

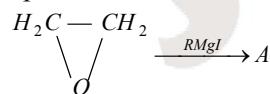
OBJECTIVE QUESTION

1. Which will undergo a Friedel-Craft's alkylation reaction



- (a) 1, 2 and 4 (b) 1 and 3 (c) 2 and 4 (d) 1 and 2

2. The product 'A' in the following reaction is



- (a) $RCHOHR$ (b) $RCHOH \cdot CH_3$ (c) $R > CH_2 > CH_2 > OH$ (d) $\frac{R}{R} > CHCH_2OH$

3. Glycerol boils at $290^\circ C$ with slight decomposition. Impure glycerine can be purified by

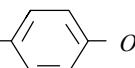
- (a) Steam distillation (b) Simple distillation
 (c) Vacuum distillation (d) Extraction with a solvent

4. Phenol $\xrightarrow{\text{Oxidation}} A \xrightarrow{\text{Oxidation}} B \xrightarrow{\text{Oxidation}} C \xrightarrow{\text{Oxidation}} D$

Name of the above reaction is

- (a) Liebermann's reaction (b) Phthalein fusion test
 (c) Reimer-Tiemann reaction (d) Schottenf-Baumann reaction

5. The correct order of boiling point for primary (1°), secondary (2°) and tertiary (3°) alcohols is
 (a) $1^\circ < 2^\circ < 3^\circ$ (b) $3^\circ > 2^\circ > 1^\circ$ (c) $2^\circ > 1^\circ > 3^\circ$ (d) $2^\circ < 3^\circ < 1^\circ$
6. What will be the products of reaction if methoxybenzene reacts with HI
 (a) Methyl alcohol (methanol) + iodobenzene
 (b) Methyl iodide (iodomethane) + benzene
 (c) Methyle iodide + phenol
 (d) Methyl iodide + iodobenzene
7. Ethylene reacts with Baeyer's reagent to give
 (a) Ethane (b) Ethyl alcohol (c) Ethylene glycol (d) None of these
8. Which of the following statements is correct regarding ease of dehydration in alcohols
 (a) Primary > Secondary (b) Secondary > Tertiary
 (c) Tertiary > Primary (d) None of these
9. Oxiran is
 (a) Ethylene oxide (b) Diethyl ether
 (c) Ethyl glycolate (d) Glycolic ester
10. Propan-1-ol can be prepared from propene by alcohol
 (a) H_2O / H_2SO_4 (b) $Hg(OAc)_2 / H_2O$ followed by $NaBH_4$
 (c) B_2H_6 followed by H_2O_2 (d) CH_3CO_2H / H_2SO_4
11. Distinction between primary, secondary and tertiary alcohol is done by
 (a) Oxidation method (b) Lucas test
 (c) Victor Meyer method (d) All of these
12. Oxidation of which of the following by air in presence of vanadium pentoxide gives phenol
 (a) Toluene (b) Benzene
 (c) Benzaldehyde (d) Phenyl acetic acid
13. The most suitable method of the separation of a 1 : 1 mixture of *ortho* and *para* nitrophenols is
 (a) Distillation (b) Sublimation
 (c) Crystallization (d) Chromatography
14. Which of the following does not form phenol or phenoxide
 (a) C_6H_5Cl (b) C_6H_5COOH
 (c) $C_6H_5N_2Cl$ (d) $C_6H_5SO_3Na$
15. Which of the following will be obtained by keeping ether in contact with air for a long time
 (a) $C_2H_5 > O > CH(CH_3) > O > OH$ (b) $C_2H_5 > OCH_2 > OH$
 (c) $C_2H_5 > O > C_2H_5OH$ (d) $CH_3 > O > CH(CH_3) > O > OH$

- 16.** When a mixture of ethanol and methanol is heated in the presence of concentrated H_2SO_4 the resulting organic product or products is/are
- $CH_3OC_2H_5$
 - CH_3OCH_3 and $C_2H_5OC_2H_5$
 - $CH_3OC_2H_5$ and CH_3OCH_3
 - $CH_3OC_2H_5$, CH_3OCH_3 and $C_2H_5OC_2H_5$
- 17.** In the following groups
- | | | | |
|--------|--------|------------|--------------|
| $>OAc$ | $>OMe$ | $>OSO_2Me$ | $>OSO_2CF_3$ |
| I | II | III | IV |
- The order of leaving group ability is
- I > II > III > IV
 - IV > III > I > II
 - III > II > I > IV
 - II > III > IV > I
- 18.** Epoxides are
- Cyclic ethers
 - Not ethers
 - Aryl-alkyl ethers
 - Ethers with another functional group
- 19.** The reaction of $CH_3CH \text{ N } CH$  $-OH$ with HBr gives
- $CH_3CHBrCH_2$  $-OH$
 - CH_3CH_2CHBr  $-OH$
 - $CH_3CHBrCH_2$  $-Br$
 - CH_3CH_2CHBr  $-Br$
- 20.** Which of the following compounds on boiling with $KMnO_4$ (alk.) and subsequent acidification will not give benzoic acid
- Benzyl alcohol
 - Acetophenone
 - Anisole
 - Toluene
- 21.** The best reagent to convert pent-3-en-2-ol into pent-3-in-2-one is
- Acidic permanganate
 - Acidic dichromate
 - Chromic anhydride in glacial acetic acid
 - Pyridinium chloro-chromate
- 22.** When alcohol reacts with concentrated H_2SO_4 intermediate compound formed is
- Carbonium ion
 - Alkoxy ion
 - Alkyl hydrogen sulphate
 - None of these

EXERCISE - VI

ASSERTION & REASON

Read the assertion and reason carefully to mark the correct option out of the options given below:

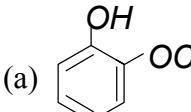
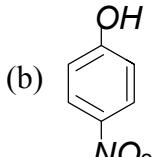
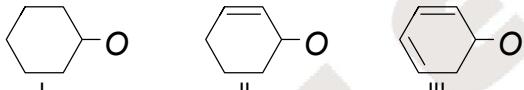
- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
- (c) If assertion is true but reason is false.
- (d) If the assertion and reason both are false.
- (e) If assertion is false but reason is true.

1. **Assertion :** A triester of glycerol and palmitic acid on boiling with aqueous $NaOH$ gives a solid cake having soapy touch
Reason : Free glycerol is liberated which is a greasy solid
2. **Assertion :** Phenol is a weak acid than ethanol
Reason : Groups with + M effect and – I effect decrease acidity at *p*-position
3. **Assertion :** Phenol is more reactive than benzene towards electrophilic substitution reaction
Reason : In the case of phenol, the intermediate carbocation is more resonance stabilized
4. **Assertion :** Phenol undergo Kolbe reaction, ethanol does not.
Reason : Phenoxide ion is more basic than ethoxide ion.
5. **Assertion :** Lucas reagent is a mixture of anhydrous $ZnCl_2$ and concentrate HCl
Reason : Primary alcohol produce ppt. with Lucas reagents.
6. **Assertion :** Resorcinol turns $FeCl_2$ solution purple.
Reason : Resorcinol have phenolic group.
7. **Assertion :** Glycerol is purified by distillation under reduced pressure.
Reason : Glycerol is a trihydric alcohol.
8. **Assertion :** Alcohol and phenol can be distinguished by sodium hydroxide.
Reason : Phenol is acidic while alcohol is neutral.
9. **Assertion :** Alcohols are dehydrated to hydrocarbons in the presence of acidic zeolites.
Reason : Zeolites are porous catalysts.
10. **Assertion :** The major products formed by heating $C_6H_5CH_2OCH_3$ with HI are $C_6H_5CH_I$ and CH_3OH .
Reason : Benzyl cation is more stable than methyl cation.
11. **Assertion :** The *pKa* of acetic acid is lower than that of phenol.
Reason : Phenoxide ion is more resonance stabilized.
12. **Assertion :** Alcoholic fermentation involves conversion of sugar into ethyl alcohol by yeast.
Reason : Fermentation involves the slow decomposition of complex organic

- 13.** **Assertion :** The water solubility of the alcohols follow the order *t*-butyl > *s*-butyl alcohol > *n*-butyl alcohol.
Reason : Alcohols form *H*-bonding with water to show soluble nature.
- 14.** **Assertion :** Absolute ethanol can be obtained by simple fractional distillation of a mixture of alcohol and water.
Reason : The absolute alcohol boils at 78.3°C .
- 15.** **Assertion :** Acid catalysed dehydration of *t*-butanol is slower than *n*-butanol.
Reason : Dehydration involves formation of the protonated alcohol, ROH_2^+ .
- 16.** **Assertion :** Tertiary alcohols give turbidity immediately with Lucas reagent.
Reason : A mixture of conc.*HI* + anhydrous ZnCl_2 is called Lucas reagent.
- 17.** **Assertion :** 4-nitrophenol is more acidic than 2, 4, 6-trinitrophenol.
Reason : Phenol is a weaker acid than carbonic acid.
- 18.** **Assertion :** Phenols cannot be converted into esters by direct reaction with carboxylic acids.
Reason : Electron withdrawing groups increase the acidity of phenols.
- 19.** **Assertion :** *tert*-butyl alcohol undergoes acid catalysed dehydration readily than propanol.
Reason : 3° alcohols do not give Victor-Meyer's test.
- 20.** **Assertion :** The ease of dehydration of alcohols follows the order. Primary > Secondary > Tertiary.
Reason : Dehydration proceeds through the formation of oxonium ions.
- 21.** **Assertion :** Phenol reacts with acyl halides in presence of pyridine to form phenyl acetate.
Reason : Benzoylation of phenol is carried out in the presence of NH_4OH .
- 22.** **Assertion :** Alcohols are easily protonated than phenols.
Reason : Alcohols undergo intermolecular hydrogen bonding due to the presence of highly electronegative oxygen.
- 23.** **Assertion :** Phenol is less acidic than *p*-nitrophenol.
Reason : Phenolate ion is more stable than *p*-nitrophenolate ion.
- 24.** **Assertion :** Treatment of phenol with nitrous acid yields *p*-benzoquinone monoxime.
Reason : *p*-nitrosophenol and *p*-benzoquinone monoxime are tautomers.
- 25.** **Assertion :** Reimer-Tiemann reaction of phenol with CCl_4 in NaOH at 340 K gives salicylic acid as the major product.
Reason : The reaction occurs through intermediate formation of dichlorocarbene.
- 26.** **Assertion :** Primary and secondary alcohols can be distinguished by Victor-Meyer's test.
Reason : Primary alcohols form nitrolic acid which dissolve in NaOH to form blood red colouration but secondary alcohols form pseudonitrotes which give blue colouration with NaOH .
- 27.** **Assertion :** HIO_4 cleaves 1, 2-glycols but not 1, 3- or higher glycols.
Reason : Only 1, 2-glycols form cyclic esters which subsequently undergo cleavage to form carbonyl compounds.

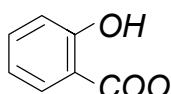
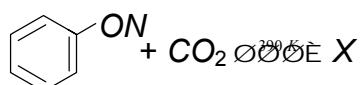
28. **Assertion :** Dehydration of glycerol with $KHSO_4$ gives acrolein.
Reason : Acrolein is an α, β -unsaturated aldehyde.
29. **Assertion :** Both symmetrical and unsymmetrical ethers can be prepared by Williamson's synthesis.
Reason : Williamson's synthesis is an example of nucleophilic substitution reaction.
30. **Assertion :** Etherates are coordination complexes of ethers with Lewis acids.
Reason : Ethers are easily cleaved by mineral acids such as HCl and H_2SO_4 at 373 K.
31. **Assertion :** $(CH_3)_3CBr$ and CH_3CH_2ONa react to form $(CH_3)_3C>O>CH_2CH_3$.
Reason : Good yields of ethers are obtained when tert-alkyl halides are treated with alkoxides.
32. **Assertion :** A rate of hydrolysis of methyl chloride to methanol is higher in DMF than in water.
Reason : Hydrolysis of methyl chloride follows second order kinetics.
33. **Assertion :** *t*-Butyl methyl ether is not prepared by the reaction of *t*-butyl bromide with sodium methoxide.
Reason : Sodium methoxide is a strong nucleophile.

SELF EVALUATION TEST

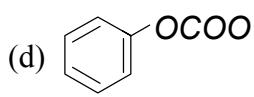
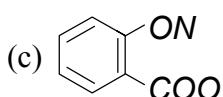
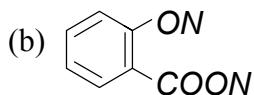
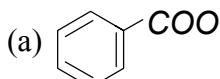
1. $\text{CH}_3 > \underset{\text{OH}}{\text{CH}} > \text{CH}_3 \text{O} \text{---} \text{O} \text{---} \text{O} \text{---} \text{A} \text{O} \text{---} \text{B} \text{O} \text{---} \text{C} \text{O} \text{---} \text{D}$ Here, D is
- (a) $\text{CH}_3 > \underset{\text{CH}_3}{\text{CH}} > \text{O} > \text{CH}_2 > \text{CH}_3$ (b) $\text{CH}_3 > \text{O} > \underset{\text{CH}_3}{\text{CH}} > \text{CH}_2\text{CH}_3$
 (c) $\text{CH}_3 > \underset{\text{CH}_3}{\text{CH}} > \text{CH}_2\text{CH}_2\text{OH}$ (d) $\text{CH}_3 > \text{CH}_2 > \underset{\text{CH}_3}{\text{CH}} > \text{CH}_2\text{OH}$
2. Phenol is more acidic than
- (a)  (b) 
- (c) C_2H_2 (d) Both (a) and (c)
3. In the reaction, $\text{C}_6\text{H}_5\text{CHO} < (\text{CH}_3\text{CO})_2\text{O} \rightarrow \text{A}$ product (A) is
- (a) Acetaldehyde (b) Cinnamic acid
 (c) β -nephthol (d) Phenol
4. The correct order of ease of dehydration of following is
- 
- (a) I > II > III (b) III > II > I (c) I > III > II (d) III > I > II
5. PCl_5 reacts with a compound containing
- (a) $>\text{SO}_3$ group (b) $-OH$ group (c) $>\text{NO}_3$ group (d) $-NO$ group
6. Cumene process is the most important commercial method for the manufacture of phenol. Cumene is
- (a) 1-methyl ethyl benzene (b) Ethyl benzene
 (c) Vinyl benzene (d) Propyl benzene

7. The compound X in the reaction

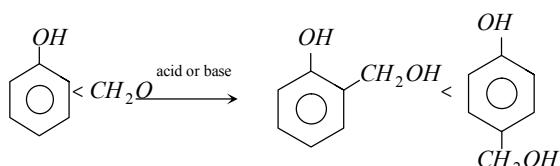
[Roorkee 1999]



is



8. Reaction

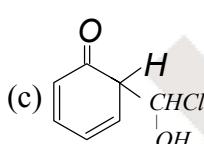
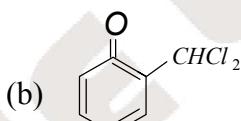
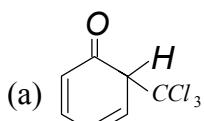


is called

- (a) Lederer Manasse reaction
(c) Benzoin condensation

- (b) Claisen condensation
(d) Etard reaction

9. When phenol is reacted with CHCl_3 and NaOH followed by acidification, salicyldehyde is obtained. Which of the following species are involved in the above mentioned reaction as inter mediate [DCE 2000]

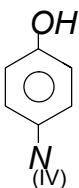
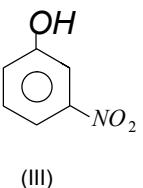
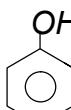


(d) All of these

10. The order of solubility of alkanols in water is

- (a) Propanol < Butanol > Pentanol
(c) Propanol > Butanol < Pentanol
- (b) Propanol > Butanol > Pentanol
(d) Propanol = Butanol = Pentanol

11. In the following compounds

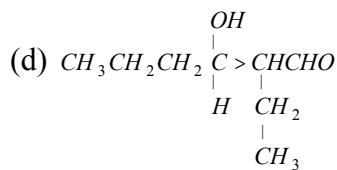
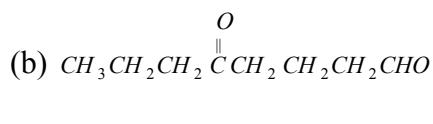
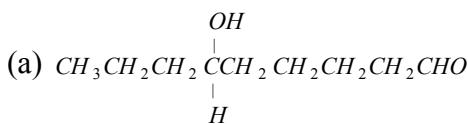


The order of acidity is

- (a) III > IV > I > II
(b) I > IV > III > II

- (c) II > I > III > IV
(d) IV > III > I > II

12. Butanal with dilute $NaOH$ gives



13. The correct order of the solubility of the different alcohols in water is

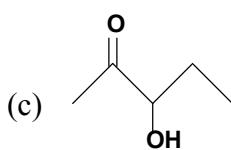
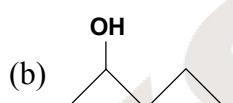
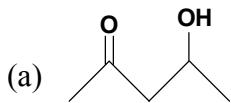
(a) *n*-propyl alcohol > ethyl alcohol > *n*-butyl alcohol

(b) Ethyl alcohol > *n*-butyl alcohol > *n*-propyl alcohol

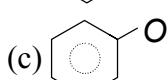
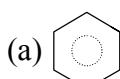
(c) *n*-butyl alcohol > *n*-propyl alcohol > ethyl alcohol

(d) Ethanol > *n*-propanol > *n*-butyl alcohol

14. Which one of the following will most readily be dehydrated in acidic condition [IIT-JEE (Screening) 2000]



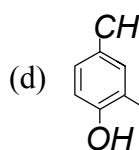
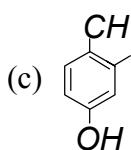
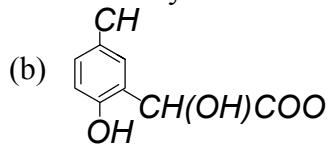
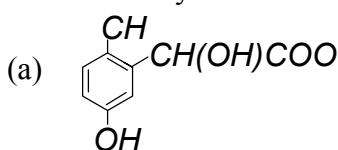
15. Which of the following compounds will be most easily attacked by an electrophile



16. Fittig's reaction produces

(a) Alkane (b) Alcohol (c) Diphenyl (d) Diethyl ether

17. p-cresol reacts with chloroform in alkaline medium to give the compound A which adds hydrogen cyanide to form, the compound B. The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of the carboxylic acid is



ANSWER KEY**EXERCISE - I****General introduction of alcohol, Phenol & Ethers**

1	b	2	d	3	c	4	d	5	a
6	c	7	c	8	b	9	c	10	b
11	b	12	c	13	c	14	a	15	c
16	b	17	b	18	b	19	b	20	b
21	a	22	c	23	a	24	a	25	b
26	a	27	c	28	a	29	c	30	d
31	a	32	b	33	c	34	b	35	d
36	d	37	b	38	a	39	a		

EXERCISE - II**Preparation of alcohol, Phenol and Ethers**

1	c	2	c	3	b	4	c	5	d
6	c	7	c	8	d	9	a	10	b
11	c	12	c	13	b	14	b	15	d
16	c	17	b	18	c	19	d	20	b
21	c	22	b	23	c	24	c	25	c
26	d	27	a	28	d	29	b	30	a
31	b	32	b	33	d	34	c	35	d
36	c	37	a	38	a	39	b	40	c
41	b	42	a	43	a	44	c	45	c
46	b	47	c	48	b	49	a	50	b
51	d	52	a	53	d	54	a	55	c
56	a	57	b	58	c	59	b	60	bc
61	a	62	d	63	b	64	a		

EXERCISE - III**Properties of alcohol, Phenol and Ethers**

1	c	2	a	3	a	4	c	5	a
6	d	7	d	8	b	9	d	10	c
11	a	12	b	13	c	14	c	15	c
16	b	17	c	18	c	19	d	20	a
21	b	22	b	23	a	24	b	25	c
26	b	27	a	28	b	29	a	30	d
31	b	32	b	33	c	34	c	35	b
36	a	37	d	38	a	39	c	40	b
41	d	42	b	43	d	44	a	45	c
46	b	47	c	48	a	49	a	50	a
51	d	52	c	53	b	54	c	55	a
56	c	57	d	58	a	59	d	60	c
61	d	62	a	63	c	64	b	65	c
66	b	67	d	68	b	69	c	70	b
71	c	72	c	73	a	74	a	75	c
76	a	77	a	78	a	79	d	80	a
81	c	82	a	83	d	84	b	85	c
86	a	87	b	88	d	89	b	90	c
91	b	92	d	93	d	94	b	95	a
96	a	97	b	98	a	99	c	100	d
101	d	102	c	103	a	104	b	105	d
106	a	107	d	108	b	109	a	110	c
111	b	112	b	113	a	114	a	115	a
116	b	117	a	118	d	119	a	120	c
121	a	122	d	123	a	124	a	125	c
126	b	127	c	128	b	129	a	130	a
131	b	132	b	133	c	134	a	135	d

136	a	137	b	138	d	139	a	140	b
141	a	142	b	143	b	144	a	145	b
146	a	147	a	148	a	149	a	150	b
151	b	152	b	153	b	154	a	155	b
156	c	157	d	158	c	159	c	160	a
161	c	162	c	163	b	164	d	165	a
166	b	167	c	168	b	169	d	170	b
171	c	172	b	173	b	174	b	175	a
176	a	177	c	178	a	179	b	180	c
181	b	182	b	183	c	184	a	185	d
186	c	187	b	188	a	189	c	190	a
191	d	192	a	193	a	194	b	195	ad
196	d	197	b	198	b	199	b	200	a
201	b	202	c	203	d	204	a	205	b
206	a	207	b	208	b	209	b	210	b
211	a	212	a	213	b	214	a	215	a
216	c	217	d	218	d	219	a	220	a
221	b	222	a	223	d	224	b	225	c
226	a	227	c	228	d	229	b	230	a
231	b	232	d	233	c	234	b	235	d
236	b	237	d	238	c	239	d	240	a
241	a	242	a	243	b	244	a	245	a

EXERCISE - IV**Uses of alcohol, Phenol and Ethers**

1	a	2	c	3	d	4	b	5	b
6	a	7	a	8	a	9	a	10	b
11	d	12	d	13	d	14	b	15	d
16	d	17	b	18	c	19	c	20	b
21	c	22	c	23	c	24	d	25	c
26	d	27	a	28	a				

EXERCISE - V**Critical Thinking Questions**

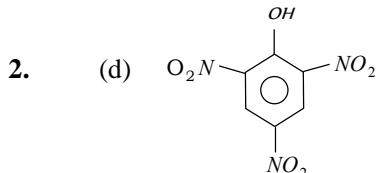
1	c	2	c	3	c	4	a	5	a
6	c	7	c	8	c	9	a	10	c
11	d	12	b	13	a	14	b	15	a
16	d	17	b	18	a	19	b	20	c
21	c	22	a						

EXERCISE - VI**Assertion & Reason**

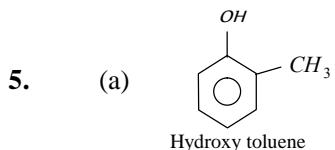
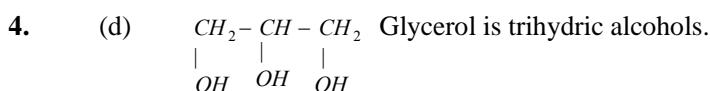
1	c	2	d	3	a	4	c	5	c
6	a	7	b	8	a	9	b	10	a
11	c	12	a	13	b	14	e	15	e
16	c	17	e	18	b	19	b	20	e
21	c	22	b	23	c	24	b	25	c
26	a	27	a	28	b	29	b	30	c
31	d	32	c	33	b				

ANSWER & SOLUTION

EXERCISE - I

General introduction of alcohol, Phenol & Ethers


2, 4, 6-trinitrophenol or picric acid



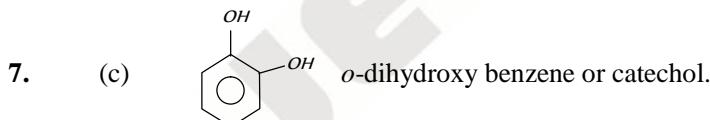
Hydroxy toluene

6. (c) % of C = $\frac{\text{Mass of C}}{\text{Mass of substance}} \times 100$

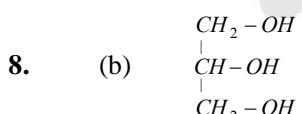
$$CCl_4 = \frac{12}{154} \times 100 = 7.79\%$$

$$C_6H_6Cl_6 = \frac{72}{291} \times 100 = 24.74\%$$

$$CH_2OH - CH_2OH = \frac{24}{62} \times 100 = 38.70\%.$$



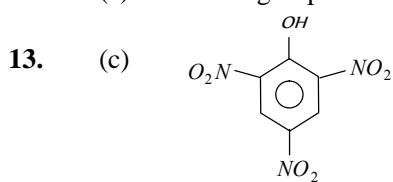
o-dihydroxy benzene or catechol.



one secondary and two primary alcoholic groups.

11. (b) Carbinol is CH_3OH (Methanol).

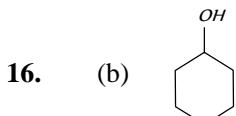
12. (c) – OH group is attached to primary carbon.



(Picric acid) or 2, 4, 6-trinitrophenol

Picric acid is phenolic while others are non phenolic.

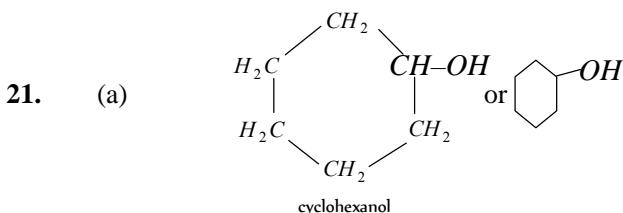
15. (c) Butanal $CH_3 - CH_2 - CH_2 - CHO$, an aliphatic aldehyde.



Cyclohexanol is a secondary alcohol because $-OH$ group is linked to 2° carbon.

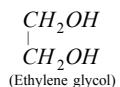
18. (b) C_2H_5OH and $CH_3 - O - CH_3$ are isomers.

20. (b) 5-10 % methyl and remaining ethanol is called methylated spirit. It is also known as denatured alcohol because it is unfit for drinking.



23. (a) 5% aqueous solution of phenol at room temperature is called as carbolic acid.

25. (b) Glycols are dihydric alcohols (having two hydroxyl groups). Ethylene glycol is the first member of this series.



26. (a) Methanol is also referred as wood alcohol or wood spirit or wood naphtha as the earliest method for its preparation was by destructive distillation of wood.

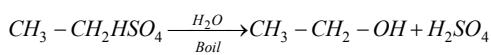
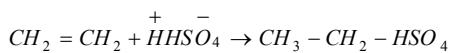
34. (b) Ether is basic because lone pairs of electrons are present on oxygen atom, $R - \overset{\bullet\bullet}{O} - R$.

39. (a) Thio alcohol is known as mercaptans.

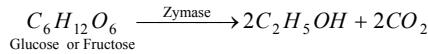
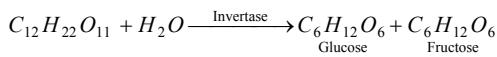
EXERCISE - II

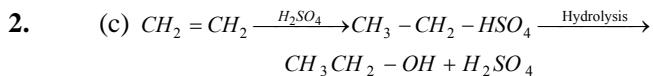
Preparation of alcohol, Phenol and Ethers

1. (c) Hydration of alkenes

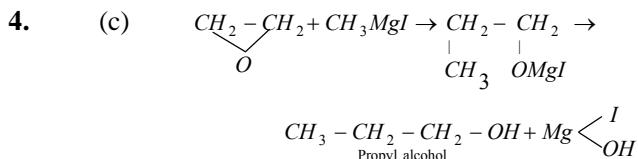
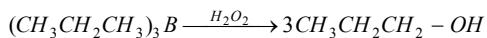
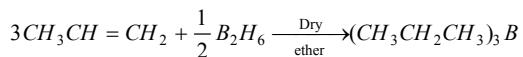


Fermentation of sugars:

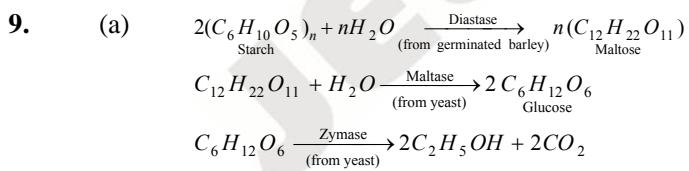
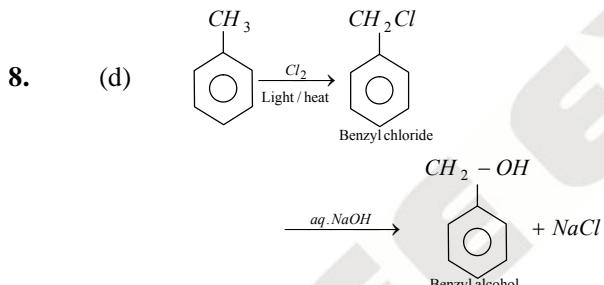
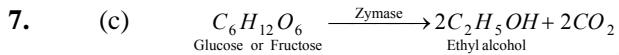




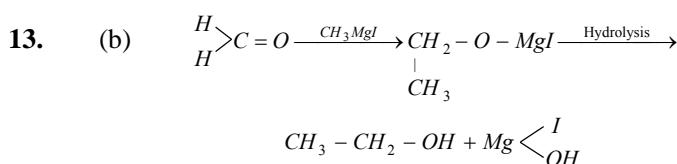
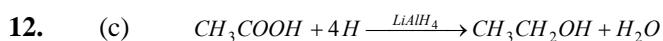
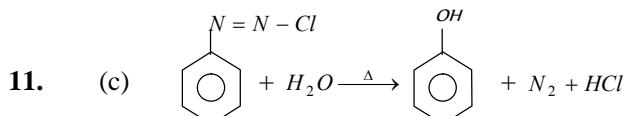
3. (b) Hydroboration oxidation (Industrial preparation of alcohol)

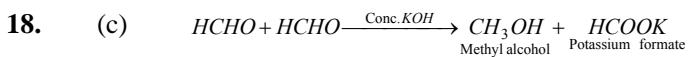
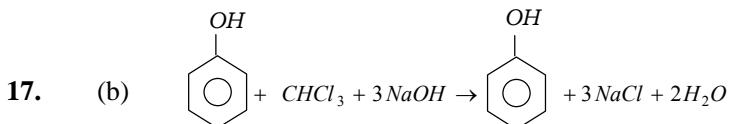
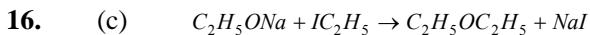
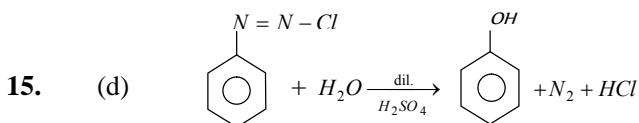
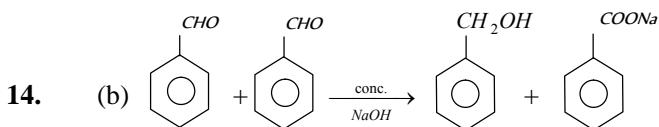


6. (c) Coconut oil + Alkali \rightarrow Soap + Glycerol
It is a saponification reaction.

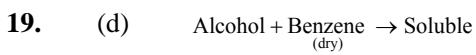


10. (b)

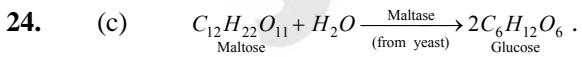
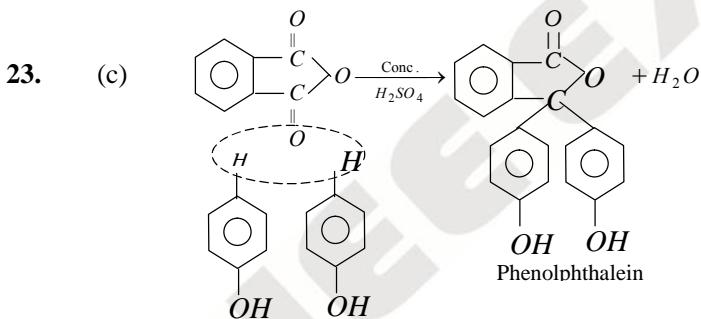
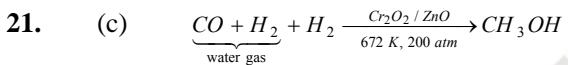




It is cannizzaro's reaction.

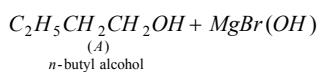
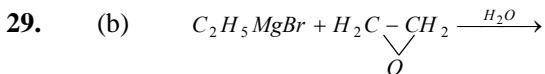
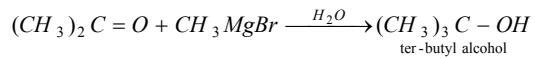


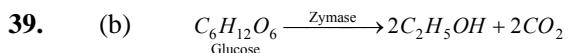
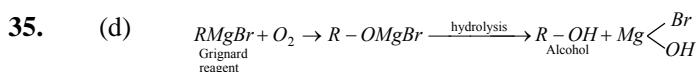
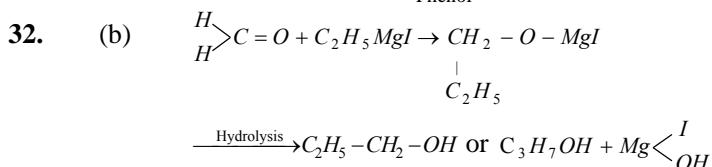
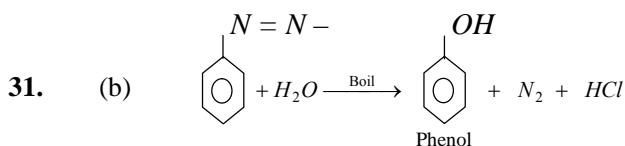
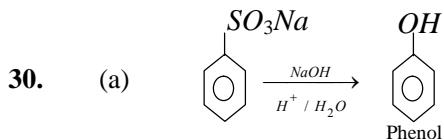
(Alcohol) $R-OH + Na \rightarrow R-ONa + H_2$



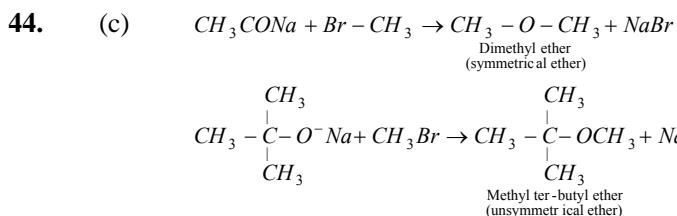
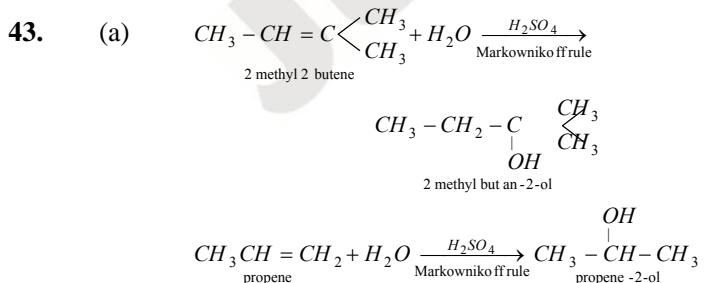
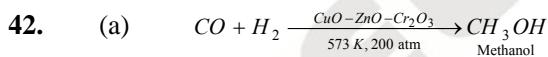
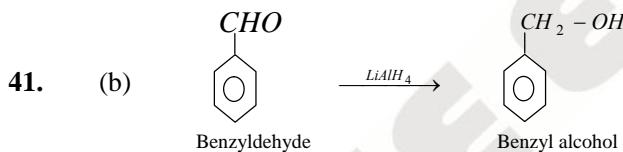
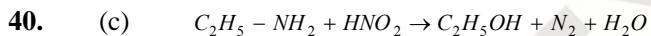
26. (d) Grignard reagent reacts with compounds containing multiple bonds like
 $C=O, > C=S, > C \equiv N . >$

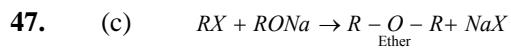
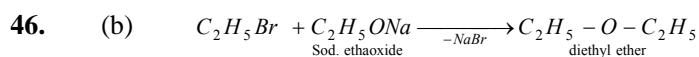
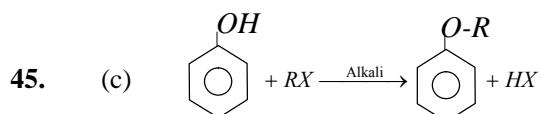
28. (d) Acetone reacts with Grignard's reagent to give tertiary alcohol.



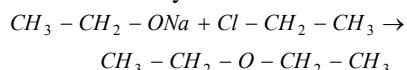


During fermentation CO_2 gas is eliminated.

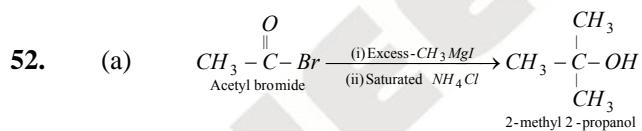
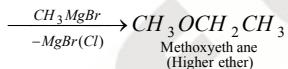
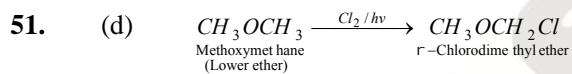
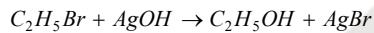
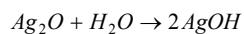




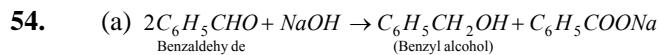
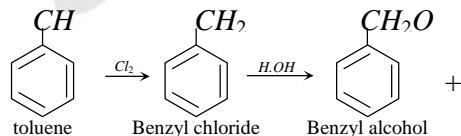
It is a Williamson's synthesis reaction.



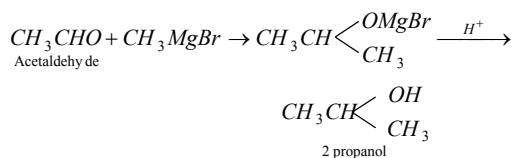
If we take moist Ag_2O then alcohol is formed

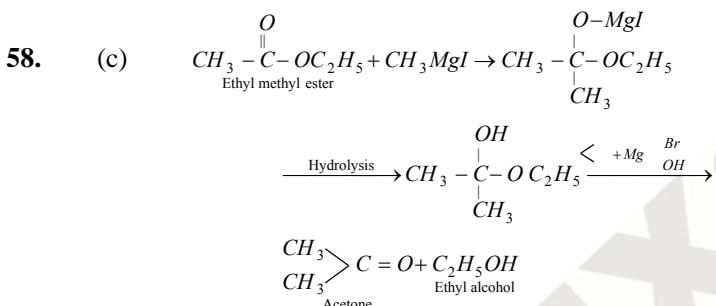
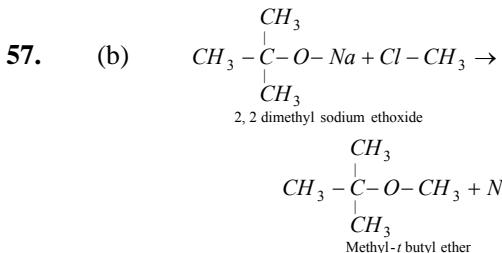
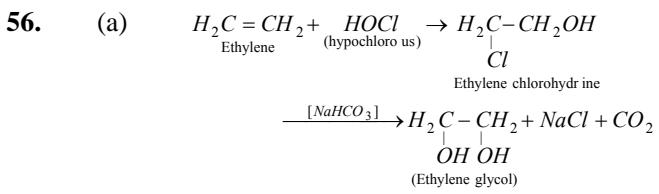
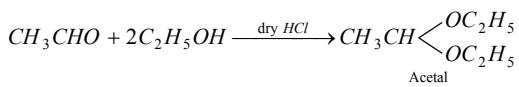


53. (d) When chlorine is passed in boiling toluene, substitution inside chain takes place and benzyl chloride is obtained which on hydrolysis give benzyl alcohol.

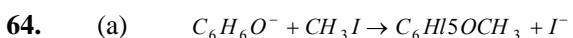
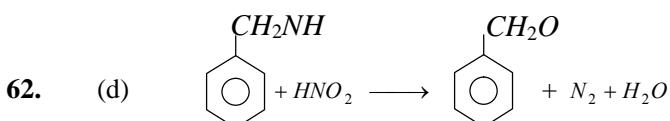
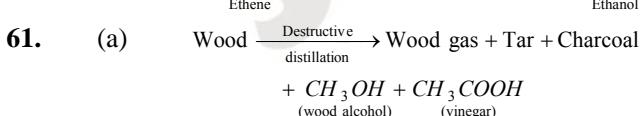
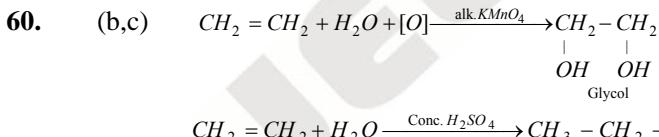
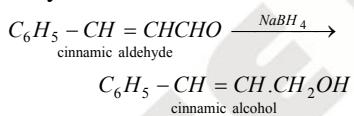


55. (c) Ethanal with CH_3MgBr gives propanol-2 (after hydrolysis) and with C_2H_5OH , it gives acetal.



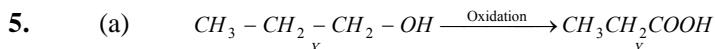
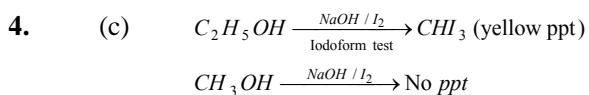


59. (b) $NaBH_4$ and $LiAlH_4$ attacks only carbonyl group and reduce it into alcohol group.
They do not attack on double bond.

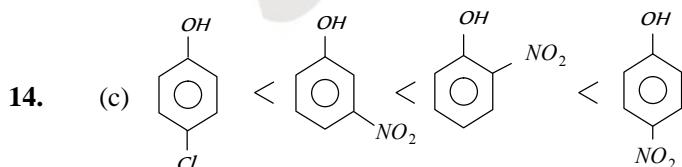
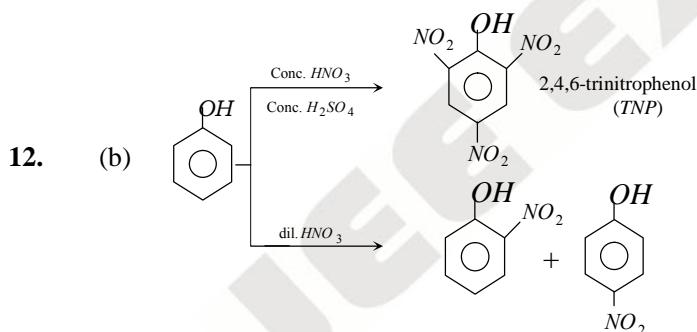
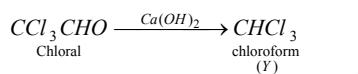
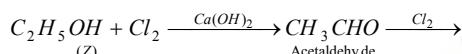
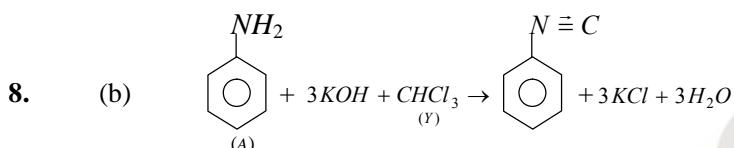


EXERCISE - III

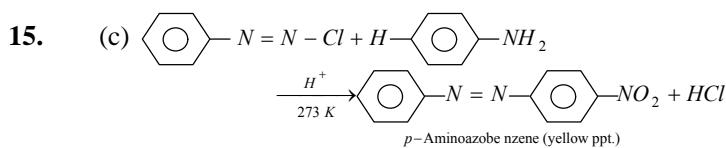
Properties of alcohol, Phenol and Ethers

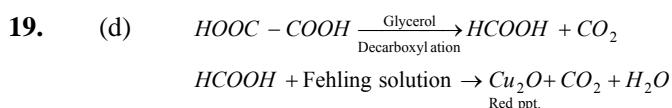
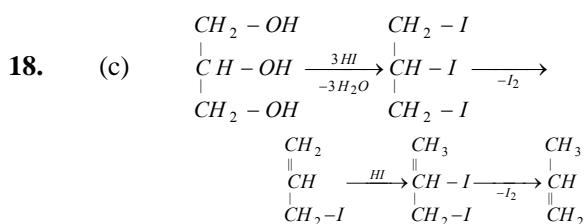
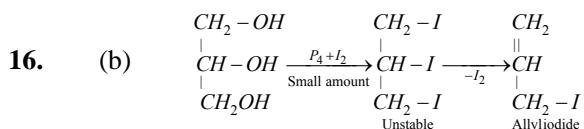


Since on oxidation same no. of carbon atoms are obtained in as therefore alcohol is primary

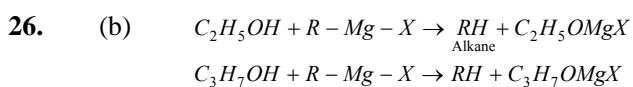
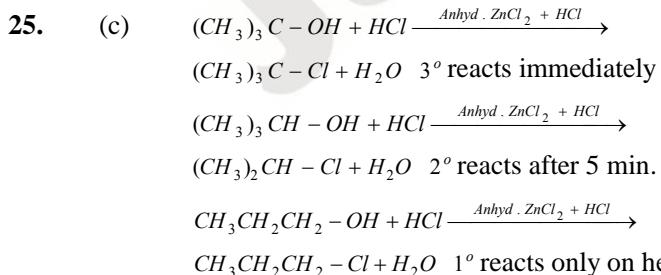
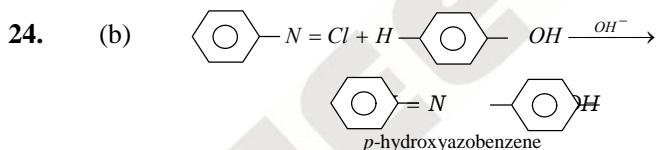
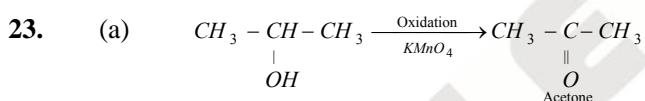
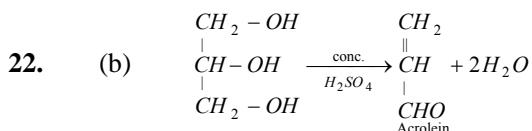


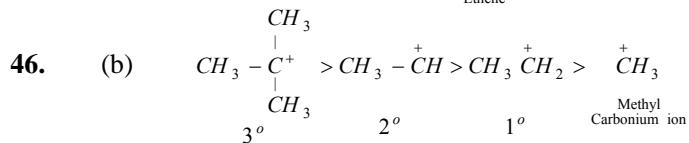
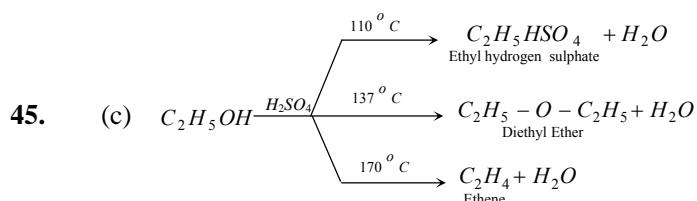
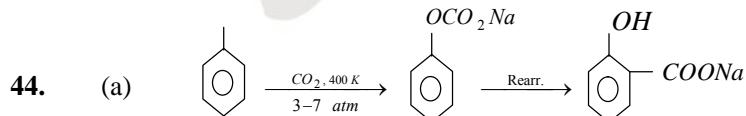
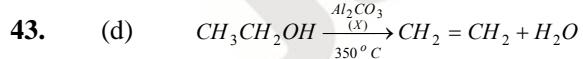
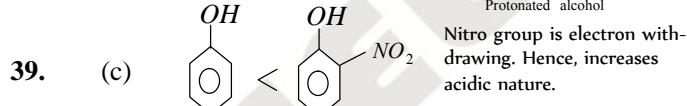
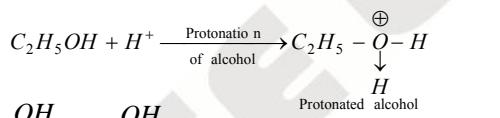
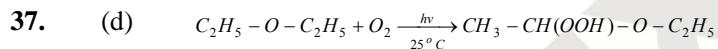
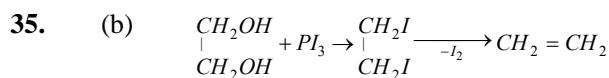
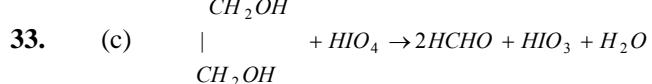
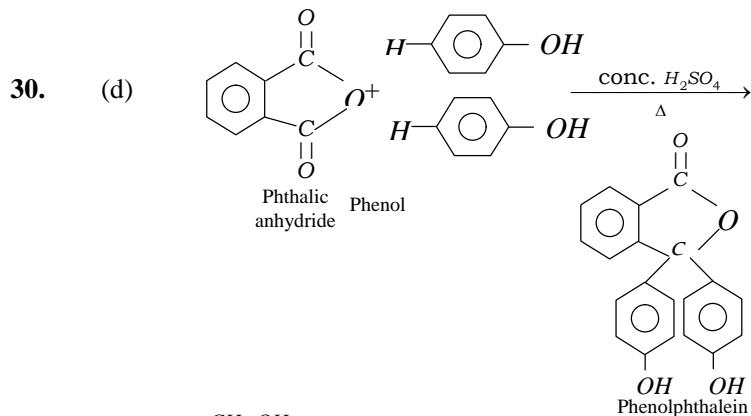
Increasing acidic character





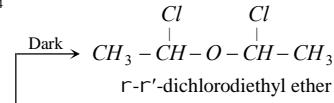
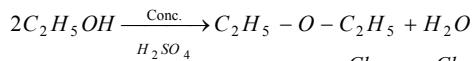
- 21.** (b) Glycerol undergoes extensive hydrogen bonding due to the presence of 3 $-OH$ groups. As a result the glycerol molecules are highly associated and thus it has high viscosity.



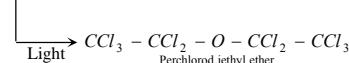


47. (c) Alcohols having less number of carbon atoms are more soluble in water.

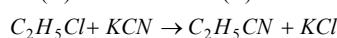
48. (a) $C_2H_5OH + Na \rightarrow C_2H_5ONa$



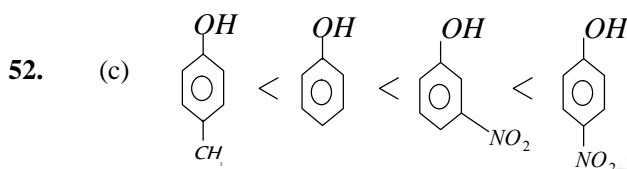
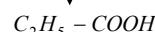
50. (a) $C_2H_5O - C_2H_5 \xrightarrow{\text{Cl}}$



51. (d) $C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$
 (A) (B)



(B) \downarrow Hydrolysis



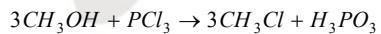
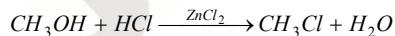
53. (b) Higher alcohols are stronger and have bitter taste.

54. (c) Order of reactivity with alkali metal (e.g.-Sodium) follows the order $1^\circ > 2^\circ > 3^\circ$.

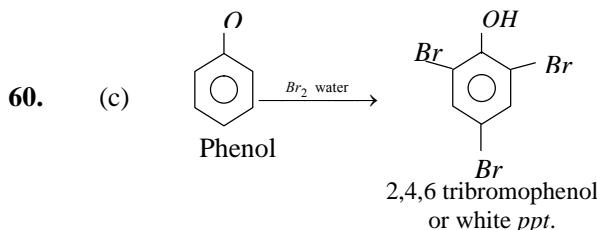
56. (c) $CH_3OH + Na \xrightarrow[\substack{1 \text{ mole} \\ (23 \text{ gms})}]{\substack{1 \text{ mole} \\ (23 \text{ gms})}} CH_3ONa + \frac{1}{2}H_2$

57. (d) $3CH_3CH_2CH_2CH_2 - OH + PBr_3 \rightarrow 3CH_3CH_2CH_2CH_2 - Br + H_3PO_3$

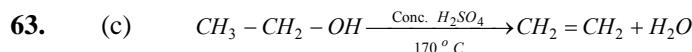
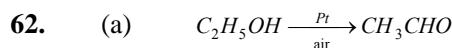
58. (a) $CH_3OH + Cl_2 \rightarrow$ No reaction



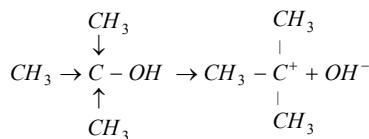
59. (d) $CH_3 - \underset{\substack{| \\ OH}}{CH} - CH_3 \xrightarrow{[O]} CH_3 - \underset{\substack{|| \\ O}}{C} - CH_3$



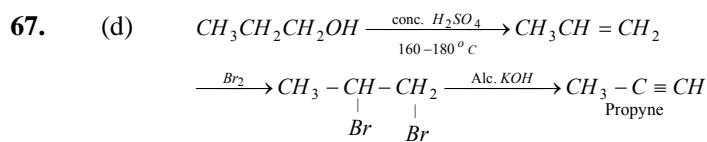
61. (d) Due to hydrogen bonding.



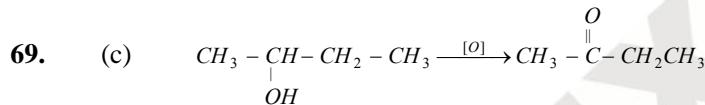
66. (b) Tertiary alcohol readily reacts with halogen acid



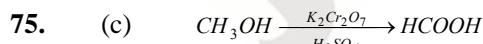
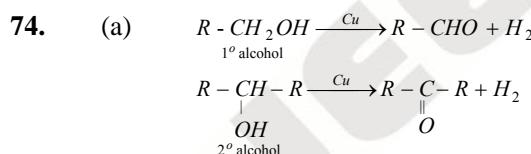
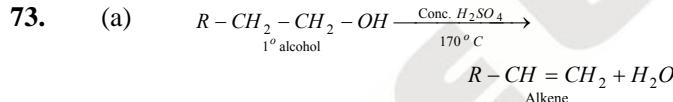
Presence of 3 alkyl group increases electron density on 3° carbon atom. Hence $-OH$ group is easily removed. After the removal of $-OH$ group 3° carbonium ion is formed which is most stable



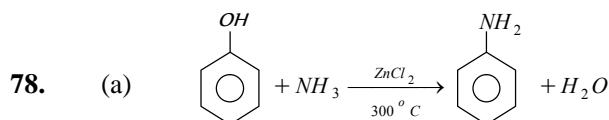
68. (b) Lower alcohols are soluble in all solvents.



70. (b) Due to the resonance stabilisation of phenoxide ion.

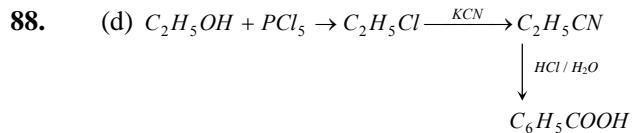


77. (a) Lucas test is used for the distinction of primary secondary and tertiary alcohols.

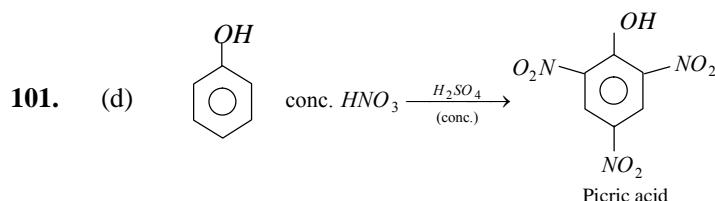
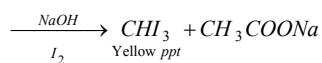
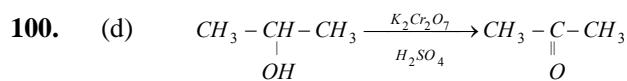
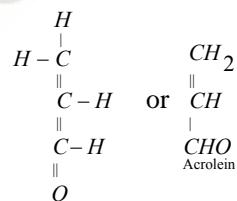
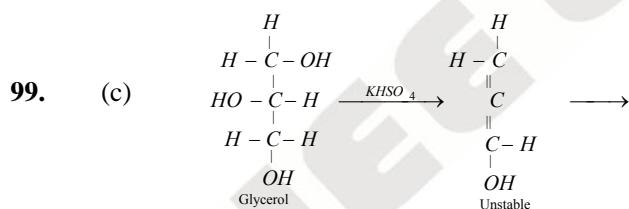
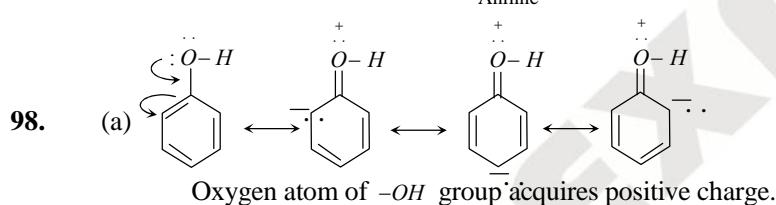
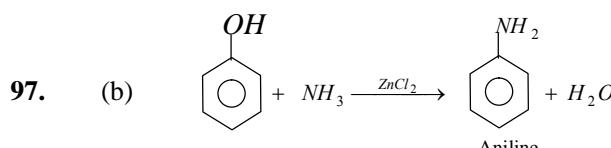


80. (a) A compound that undergoes bromination easily is phenol. Due to presence of $-OH$ group the ring becomes much more active in substitution reactions. The bromination occurs due to availability of electrons on ortho and para position.

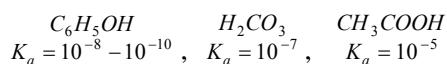
81. (c) *o*-Nitrophenol has intramolecular *H*-bonding.



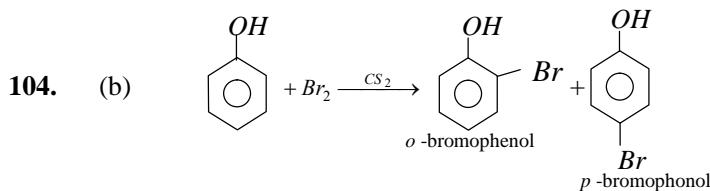
- 89.** (b) $LiAlH_4$ + ether, is reducing agent.



- 102.** (c) Phenol is weaker acid than carbonic acid

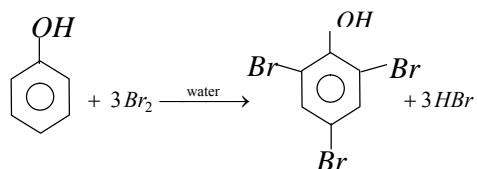


- 103.** (a)

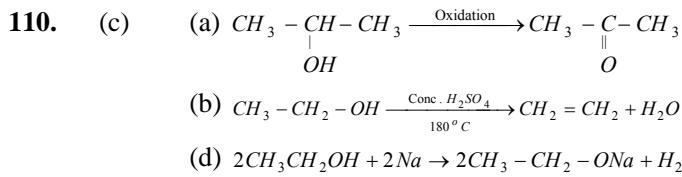
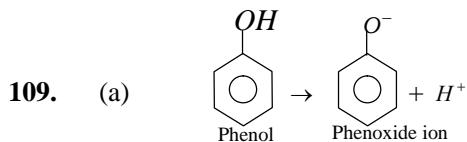
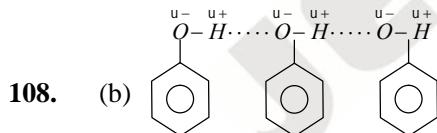
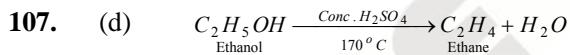


In presence of non-polar solvent (CS_2) the ionization of phenol is suppressed. The ring is slightly activated and hence mono substitution occurs.

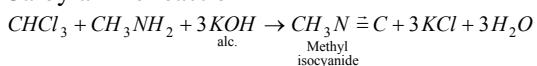
On the other hand with Br_2 in water phenol forms 2,4,6-tribromo phenol.



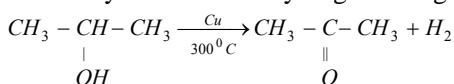
In aqueous solution phenol ionizes to give phenoxide ion. Due to the presence of negative charge on oxygen the benzene ring is highly activated and hence trisubstituted product is obtained.



- 112.** (b) Carbylamine reaction

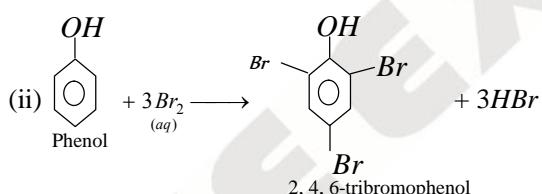
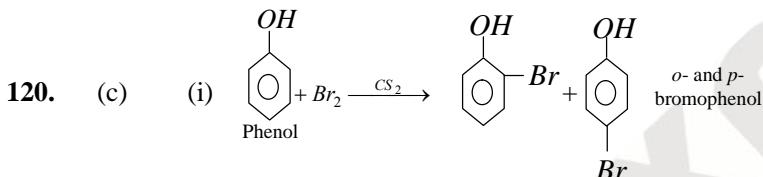
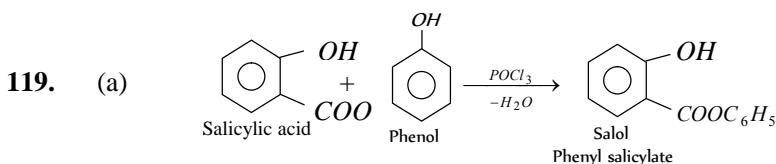


- 113.** (a) Secondary alcohol on dehydrogenation gives acetone



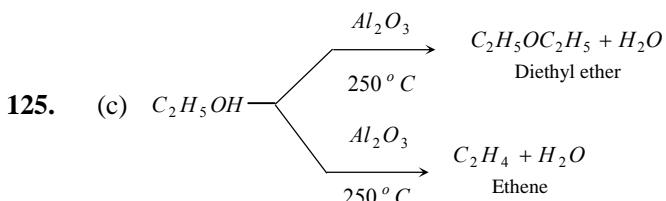
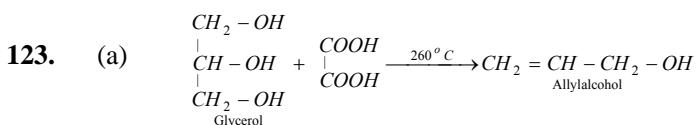
- 114.** (a) $\begin{matrix} CH_3 - C - CH_3 \\ | \\ OH \end{matrix} \xrightarrow{[O]} \begin{matrix} CH_3 - C - CH_3 \\ || \\ O \end{matrix}$

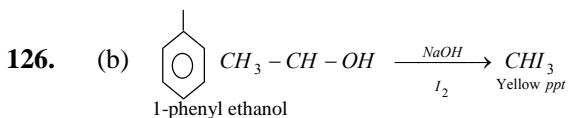
- 118.** (d) $C_2H_5OH + [O] \rightarrow CH_3CHO \rightarrow CH_3COOH$.



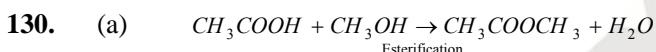
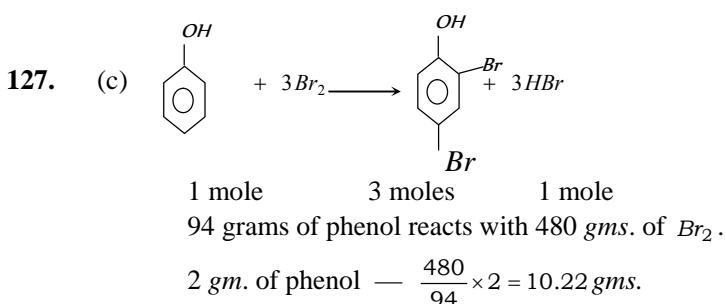
In *aq.* solution phenol ionize to give phenoxide in which highly activates benzene ring and give trisubstituted product while in presence of CS_2 an inert solvent phenol is unable to ionize due to which benzene ring is slightly activated. Hence, monosubstituted product is obtained.

- 122.** (d) Traces of water from ethanol is removed by reacting with *Mg* metal.

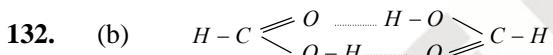




Iodoform test is given by compounds in which $CH_3 - \underset{OH}{\overset{|}{CH}} -$ or $CH_3 - \underset{O}{\overset{|}{CH}} -$ group is present.



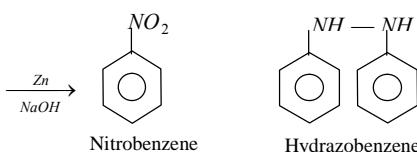
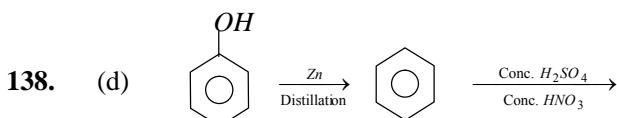
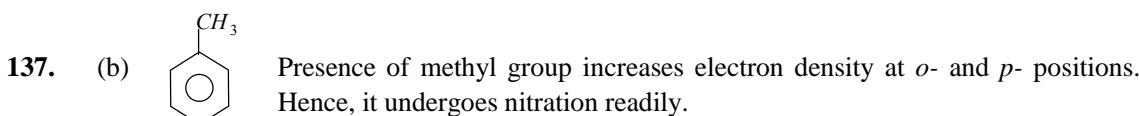
131. (b) CH_3OH has highest boiling point because of hydrogen bonding.

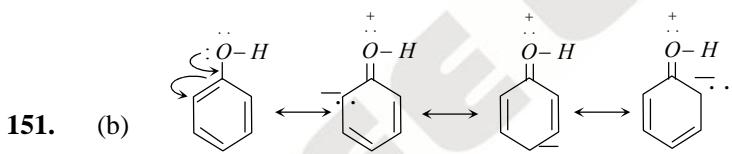
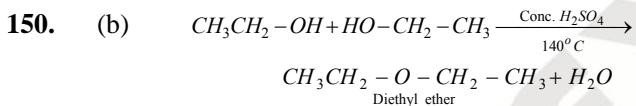
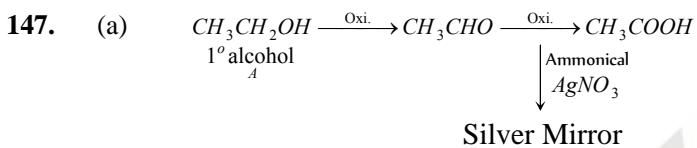
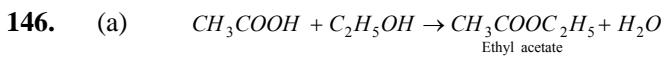
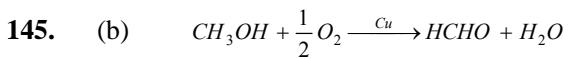
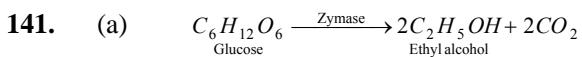
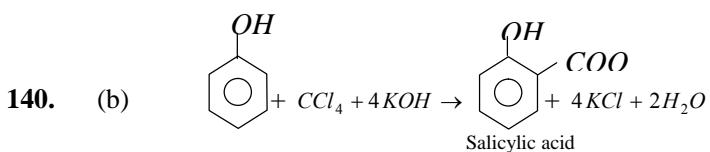


Formic acid forms dimer due to which strength of $H -$ bond increases Hence, boiling point increases.

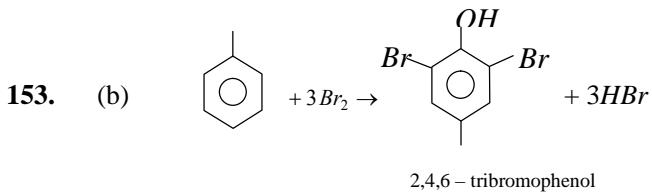
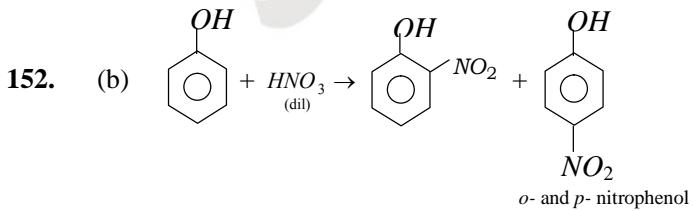
133. (c) Lower members are soluble in water and solubility decreases with increasing molecular mass because hydrophobic character increases.

135. (d) Alcohols can not be dried using anhydrous $CaCl_2$ because it forms an addition compound $CaCl_2 \cdot 4CH_3OH$.

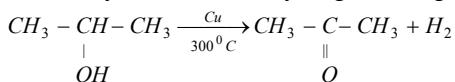




Rate of electrophilic substitution reaction in phenol is faster than in benzene because presence of $-OH$ group increases electron density at *o*- and *p*- positions.

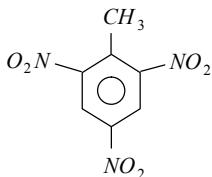


- 155.** (b) Secondary alcohol on dehydrogenation gives acetone



- 156.** (c) $C_2H_5OH \xrightarrow{NaOH / I_2} CHI_3$
 $CH_3COCH_3 \xrightarrow{NaOH / I_2} CHI_3$
 $CH_3OH \xrightarrow{NaOH / I_2} \text{No reaction.}$

- 157.** (d) 2,4,6 Trinitro toulene (TNT)



- 159.** (c) $\begin{array}{c} CH_2 - OH \\ | \\ CH - OH + 3HNO_3 \\ | \\ CH_2 - OH \end{array} \xrightarrow[H_2SO_4]{\text{Conc. } H_2SO_4} \begin{array}{c} CH_2 - ONO_2 \\ | \\ CH - ONO_2 + 3H_2O \\ | \\ CH_2 - ONO_2 \\ \text{Glycerol trinitrate} \end{array}$

- 160.** (a) $\begin{array}{c} CH_2 - OH \\ | \\ CH - OH + COOH \\ | \\ CH_2 - OH \end{array} \xrightarrow[-H_2O]{110^{\circ}C} \begin{array}{c} CH_2 - O - CO - COOH \\ | \\ CH - OH \\ | \\ CH_2 - OH \\ \text{Glycerol mono-oxolate} \end{array}$
 $\begin{array}{c} CH_2 - O - CO - H \\ | \\ CH - OH \\ | \\ CH_2 - OH \\ \text{Glycerol mono-formate} \end{array} \xrightarrow{\text{Hydrolysis}} \begin{array}{c} CH_2 - OH \\ | \\ CH - OH \\ | \\ CH_2 - OH \\ + \\ HCOOH \\ \text{Formic acid} \end{array}$

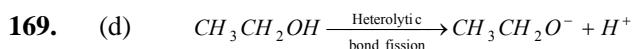
- 163.** (b) $C_2H_5OH + CH_3COOH \xrightarrow{\text{Esterification}} \begin{array}{c} CH_3COOC_2H_5 + H_2O \\ \text{Ethyl acetate} \end{array}$

- 165.** (a)

- 166.** (b) Hydrogen bonding : $\begin{array}{c} \text{u-} \quad \text{u+} \\ | \quad | \\ O - H \dots O - H \dots O - H \\ | \quad | \quad | \\ R \quad H \quad R \\ \text{Alcohol} \quad \text{Water} \quad \text{Alcohol} \end{array}$

- 167.** (c) $\begin{array}{c} HO \diagup \quad CH_2 \quad \diagdown CH_2 \\ \diagdown \quad \diagup \\ HO \quad \quad \quad OH \quad OH \\ | \quad \quad \quad | \\ CH_2 \quad \quad \quad CH_2 \\ \text{Ethylene glycol} \end{array} \xrightarrow[\text{H}_2\text{SO}_4]{\text{Fuming}} \begin{array}{c} CH_2 - CH_2 \\ \diagup \quad \diagdown \\ O \quad \quad O \\ \diagdown \quad \diagup \\ CH_2 - CH_2 \end{array} + 2H_2O$

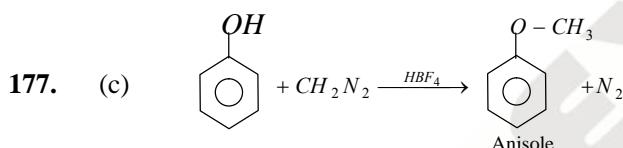
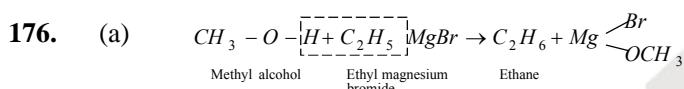
168. (b) Tertiary carbonium ion is the most stable and it will be given by dehydration of tertiary alcohol.



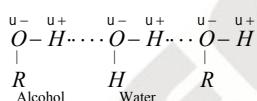
170. (b) C_2H_5OH is soluble in water due to H -bonding.

173. (b) When ethanol dissolves in water then emission of heat and contraction in volume.

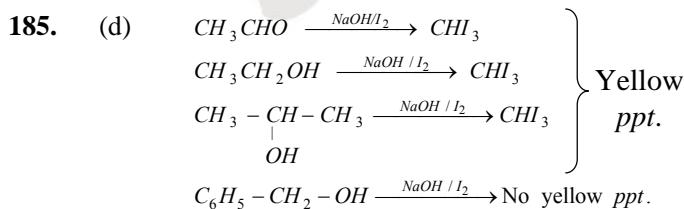
175. (a) Azeotropic distillation method –
Rectified spirit + Benzene + water
 ↓ Fractional distillation
 First fraction at 331.8 K is ternary azeotrope
 $(H_2O\ 7.4\% + \text{Benzene } 74\% + \text{alcohol } 18.5\%)$
 Second fraction 341.2 K is a binary azeotrope
 $(\text{Benzene } 67.7\% + \text{Alcohol } 32.2\%)$
 Last fraction at $351K$ is absolute alcohol.



180. (c) Alcohol is soluble in water due to H -bonding



183. (c) $CH_3CH_2-OH + 2Cl_2 \rightarrow CCl_3-CHO$
 Oxidation will occur with chlorination of methyl group.

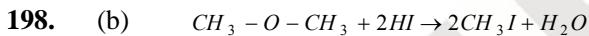
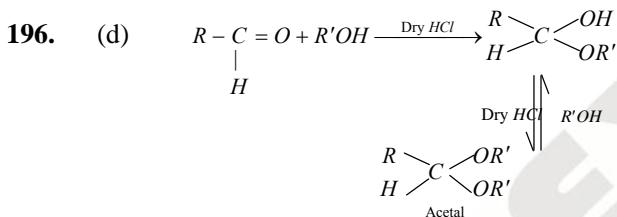
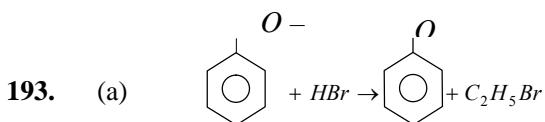
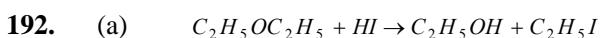
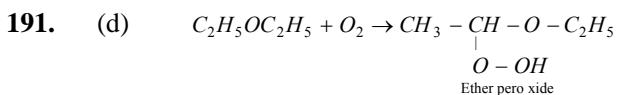
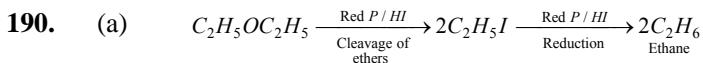


186. (c) Benzyl alcohol and cyclohexanol are not acidic while phenol and *m*-chlorophenol are acidic due to presence of electron withdrawing groups like $-NO_2$, $-Cl$, $-CN$ increases the acidic character of phenols. Hence, *m*-chlorophenol is more acidic than phenol.

- 187.** (b) Three, these are

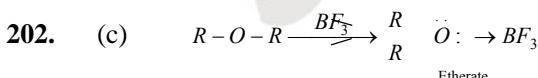
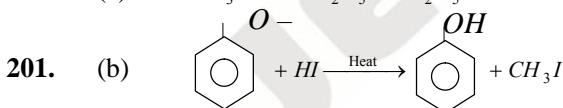
$CH_3CH_2OCH_2CH_3$ (I), $CH_3OCH_2CH_2CH_3$ (II)
and $CH_3OCH(CH_3)_2$ (III). Here I and II, I and III
are pairs of metamers.

- 189.** (c) CH_3OCH_3 and $C_2H_5OCH_3$ are gases while $C_2H_5OC_2H_5$ (b.p. 308 K) is low boiling liquid.



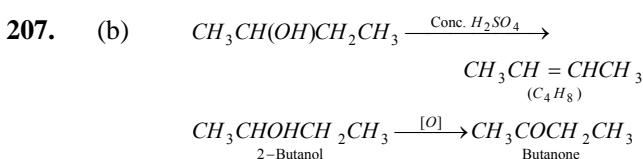
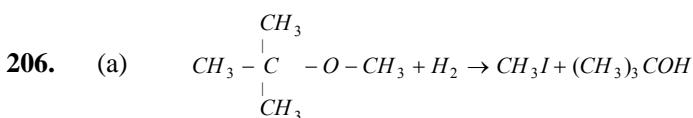
- 199.** (b) Only alkyl aryl ethers e.g., $C_6H_5OCH_3$ undergoes electrophilic substitution reactions.

- 200.** (a) $CH_3COCl + C_2H_5O - C_2H_5 \rightarrow$ No reaction



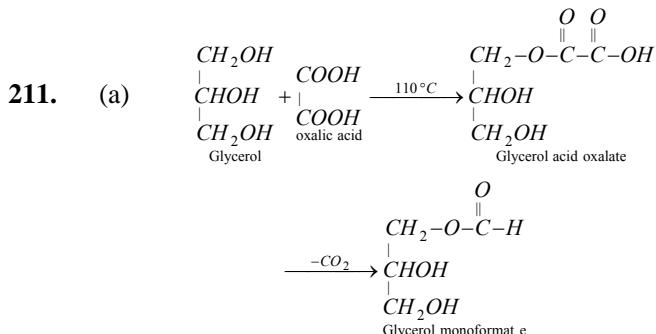
- 203.** (d) Due to inter-molecular hydrogen bonding in alcohols boiling point of alcohols is much higher than ether.

- 205.** (b) $CH_3 - OCH_3$ does not have replaceable $H -$ atom.

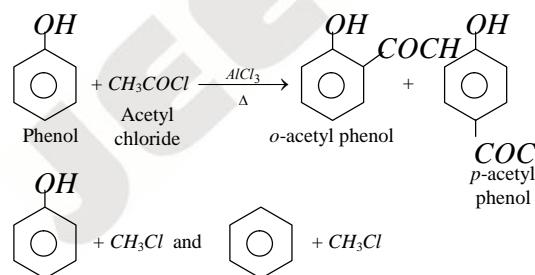


Butanone gives both an oxime and positive iodoform test, therefore, the original compound is 2-butanol.

208. (b) $\begin{array}{c} CH_2OH + 2PCl_5 \rightarrow CH_2Cl + 2POCl_3 + 2HCl \\ | \qquad \qquad \qquad | \\ CH_2OH \qquad \qquad CH_2Cl \\ \text{Ethylene glycol} \qquad \qquad \qquad \text{1, 2 dichloroethane} \end{array}$
209. (b) C_2H_5OH (ethanol) is a very weak acid hence it does not react with $NaOH$. However it reacts with metallic sodium.
210. (b) Methanol has high boiling point than methyl thiol because there is intermolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol.

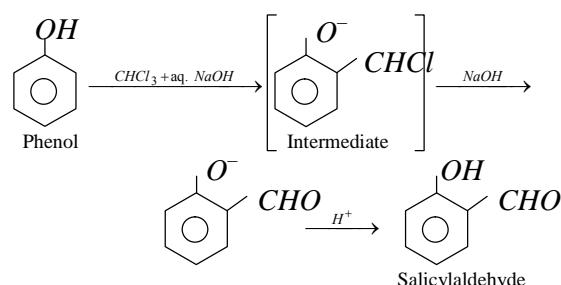


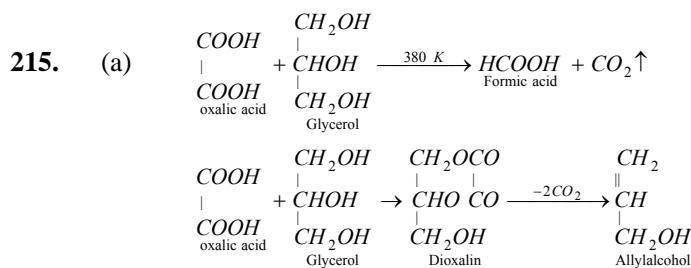
212. (a) Formation of a yellow precipitate on heating a compound with an alkaline solution of iodine is known as iodoform reaction. Methyl alcohol does not respond to this test. Iodoform test is exhibited by ethyl alcohol, acetaldehyde, acetone, methyl ketone and those alcohols which possess $CH_3CH(OH)-$ group.
213. (b) In Friedel-Crafts acylation, aromatic compounds such as benzene, phenol etc. undergo acylation with CH_3COCl in the presence of anhydrous $AlCl_3$ and gives ortho and para derivatives. Intermediate is $CH_3C^+ = O$ (acylium ion) of this reaction.



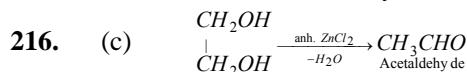
In fact denotes Friedel-Crafts alkylation.

214. (a) This reaction is known as Reimer-Tiemann reaction.

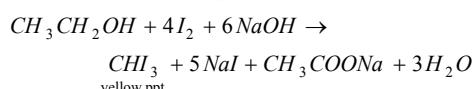




Thus at 530 K allyl alcohol is formed.

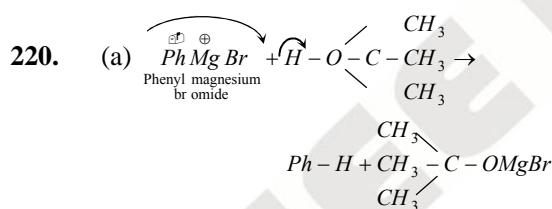
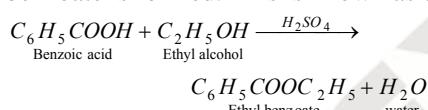


217. (d) Ethyl alcohol give positive iodoform test (*i.e.* yellow ppt. with I_2 and $NaOH$)

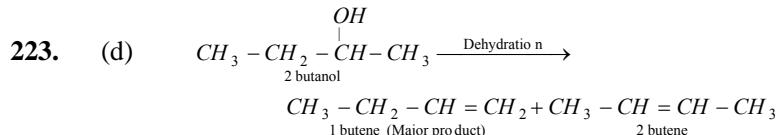
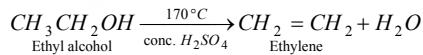


218. (d) Tertiary alcohols react fastest with hydrogen halides 2 methyl propan-2-ol is a tertiary alcohol.

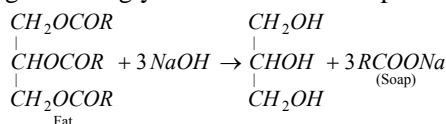
219. (a) When benzoic acid reacts with ethyl alcohol in the presence of sulphuric acid ethyl benzoate is formed. This is known as esterification.

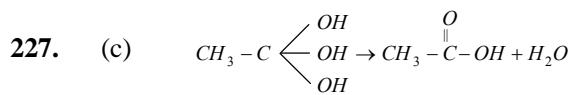
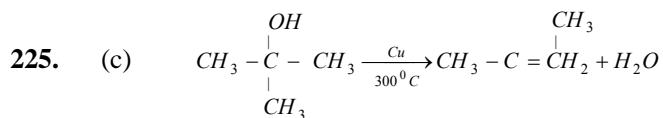


222. (a) Ethyl alcohol on dehydration with conc. H_2SO_4 at $170^\circ C$ gives ethylene.



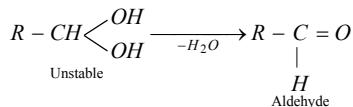
224. (b) Fats are esters of higher fatty acids with glycerol, hence on alkaline hydrolysis they give back glycerol and sodium or potassium salt of acid (this is called soap).



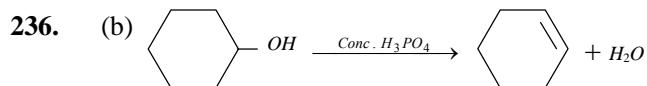
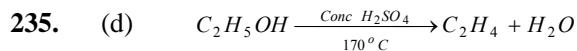
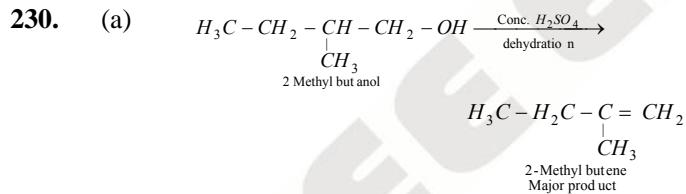
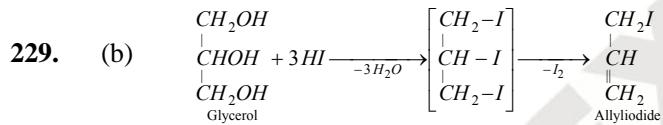
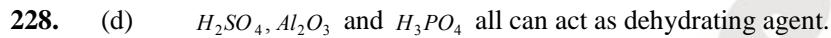
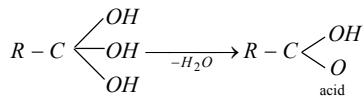


If two or more $-OH$ groups are present on carbon atom then it immediately loses water molecule and forms acid or aldehyde.

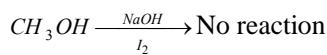
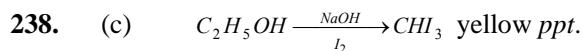
Two $-OH$ groups on the same carbon aldehyde is formed



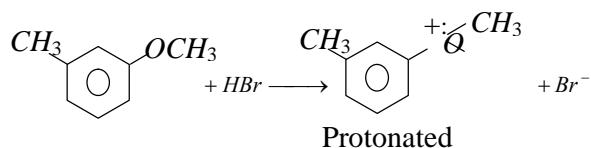
Three $-OH$ groups on the same carbon acid is formed.



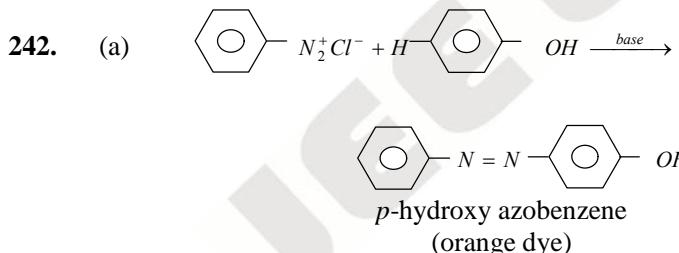
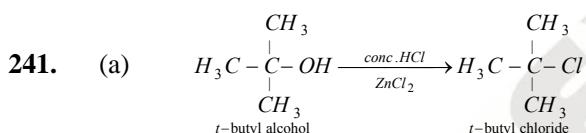
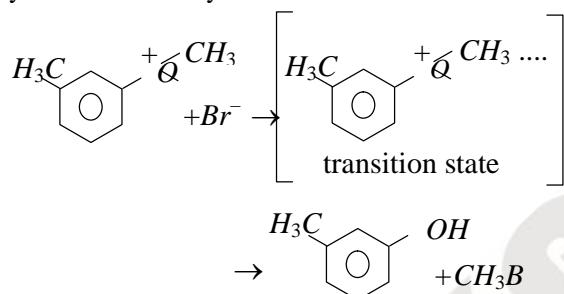
Because conc. H_3PO_4 acts as a dehydrating agent.



- 239.** (d) It is not acetaldehyde or acetone as does not react with hydrazine. It is not CH_3OH as does not react with Na .
- 240.** (a) The ether molecule gets protonated by the hydrogen of the acid to form protonated ether or oxonium salt.

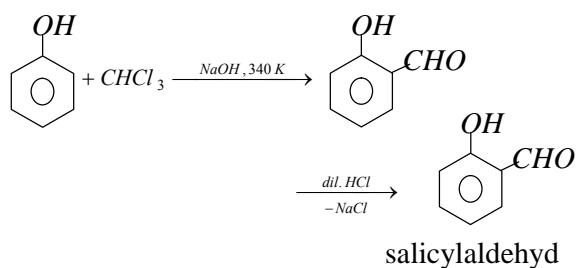


The protonated ether undergoes nucleophilic attack by halide ion (X^-) and forms alkyl alcohol and alkyl halide

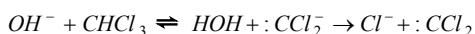


This is an example of coupling reaction

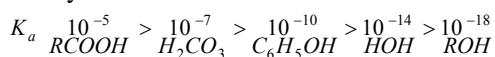
243. (b) Reimer-Tiemann reaction involves the carbon carbon bond formation.



- 244.** (a) This is Reimer-Tiemann reaction where the electrophile is dichlorocarbene ($:CCl_2$) generated from chloroform by the action of a base.



- 245.** (a) Phenols are much more acidic than alcohols but less so than carboxylic acids or even carbonic acid. This is indicated by the values of ionisation constants. The relative acidity follows the order:

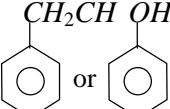


EXERCISE - IV

Uses of alcohol, Phenol and Ethers

EXERCISE - V

Critical Thinking Questions

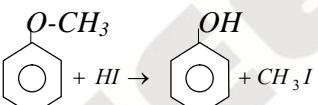
1. (c)  will undergoes a Friedel Craft's alkylation on ortho or para position because of more electron density.

2. (c) $CH_2 = CH_2 + RMgI \rightarrow \begin{matrix} CH_2 - CH_2 - R \\ | \\ OMgI \end{matrix} \xrightarrow{HOH}$
 $MgI(OH) + R - CH_2 - CH_2 - OH$

3. (c) The liquids which decompose at its boiling point can be purified by vacuum distillation. Glycerol which decomposes at its boiling point ($-563K$) can be distilled without decomposition at $453K$ under $12mm\ Hg$ pressure.

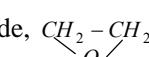
4. (a) Liebermann's reaction.

5. (a) 1° alcohol $>$ 2° alcohol $>$ 3° alcohol
Boiling point of alcohols decreases as the number of branches increases.

6. (c) 

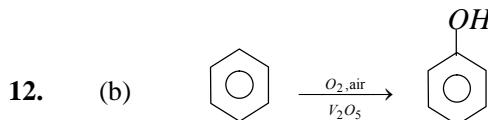
7. (c) $3CH_2 = CH_2 + 2KMnO_4 + 4H_2O \rightarrow$
 $\begin{matrix} CH_2 - OH \\ 3 | \\ CH_2 - OH \end{matrix} + 2KMnO_2 + 2KOH$
Glycol

8. (c) Correct order of dehydration in alcohols $3^\circ > 2^\circ > 1^\circ$.

9. (a) Oxiran is ethylene oxide, 

10. (c) $6CH_3 - CH = CH_2 + B_2H_6 \xrightarrow{H_2O_2}$
 $CH_3 - CH_2 - CH_2 OH$

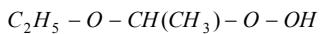
11. (d) Distinction between primary, secondary and tertiary alcohol is done by all three methods : oxidation, Victor Meyer and Lucas test.



13. (a) *o*- and *p*-nitrophenols are separated by steam distillation because *o*-nitrophenol is steam volatile while *p*-isomer is not.

14. (b) Benzoic acid.

15. (a) $R - O - R' \xrightarrow{O_2 / \text{light}}$



16. (d) $CH_3OH + CH_3OH \xrightarrow{H_2SO_4(\text{Conc})} CH_3OCH_3$

$CH_3OH + C_2H_5OH \xrightarrow{H_2SO_4(\text{Conc})} CH_3OC_2H_5$

$C_2H_5OH + C_2H_5OH \xrightarrow{H_2SO_4(\text{Conc})} C_2H_5OC_2H_5$

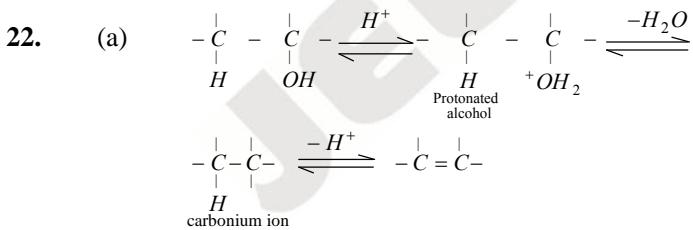
17. (b) IV > III > I > II.

18. (a) Cyclic ethers are called epoxides. $\begin{array}{c} CH_2 - CH_2 \\ \diagdown \quad \diagup \\ O \end{array}$

19. (b) $CH_3 - CH = CH - \text{C}_6\text{H}_4 - OH \xrightarrow{HBr}$
 $CH_3 - CH_2 - \underset{\substack{| \\ Br}}{CH} - \text{C}_6\text{H}_4 - OH$

20. (c) $\text{C}_6\text{H}_5 - OCH_3$ on $KMnO_4$ oxidation does not give benzoic acid.

21. (c) Chromic anhydride in glacial acetic acid is the best reagent to convert pen-3-en-2-ol into pent-3-in-2-one.



In all cases intermediate is carbonium ion, and there may be 1, 2-hydride or 1, 2-methyl shift to form more stable carbonium ion.

EXERCISE - VI

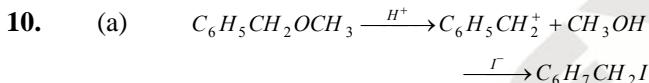
Assertion & Reason

3. (a) It is correct that phenol is more reactive than benzene.

4. (c) It is correct that sodium phenoxide (sodium salt of phenol) and CO_2 on heating from sodium salicylate. This is known as Kolbe's reaction. Ethanol does not respond to this

reaction. Therefore, assertion is true. But the reason that phenoxide ion is more basic than ethoxide ion is not correct.

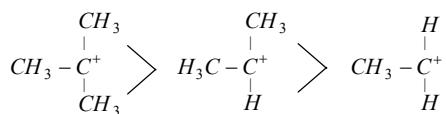
5. (c) Lucas reagent is a mixture of anhydrous $ZnCl_2$ and coc. HCl is used for the distinction of monohydric alcohol. Tertiary alcohols on addition produce a precipitate immediately while secondary alcohols produce ppt. after 5 minutes. Primary alcohols do not produce any precipitate. Therefore, assertion is true but reason is false.
6. (a) Phenols on treatment with neutral $FeCl_3$ solution produce purple colour, resorcinol contains phenolic group hence in treatment with $FeCl_3$ solution it gives purple colour. Here both assertion and reason are correct and reason is a correct explanation of assertion.
7. (b) Glycerol is purified by distillation under reduced pressure because it decomposes on heating below its melting point. It is a trihydric alcohol. Here, both assertion and reason are true but reason is not a correct explanation of assertion.
8. (a) Alcohols and phenols can be distinguished by treating with $NaOH$. Phenols react with $NaOH$ to produce sodium phenoxide because phenols are acidic and alcohols are neutral. Both assertion and reason are true and reason is correct explanation.
9. (b) Zeolites are shape-selective porous solid acid catalysts, their catalytic activity originates from the presence of highly acidic $Al-O(H)-Si$ hydroxyl in the framework.



This can be explained on the basis of S_N1 mechanism. The carbonium ion produced being benzylum ion. Since this type is more stable than alkylum ion.

11. (c) Lower the value of pK_a , more acidic will be the compound. Acetic acid is more acidic than phenol. This indicates that carboxylate ion should be more stable than the phenoxide ion and it is clear that carboxylate ion has more equivalent resonating structures than the phenoxide ion.
12. (a) The conversion of sugar into ethyl alcohol by yeast is called alcoholic fermentation.
- $$\begin{aligned} C_{12}H_{22}O_{11} + H_2O &\xrightarrow{\text{Invertase}} C_6H_{12}O_6 + C_6H_{12}O_6 \\ &\quad \text{Glucose} \qquad \text{Fructose} \\ C_6H_{12}O_6 &\xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2 \\ &\quad \text{Ethyl alcohol} \end{aligned}$$
13. (b) The tendency to show H -bonding decreases with increasing hydrophobic character of carbon chain. The hydrophobic character of carbon chain increases with the length of carbon chain.
14. (e) Ethyl alcohol forms azeotropic mixture with water which distils with unchanged composition (about 75% ethanol) and thus absolute alcohol cannot be obtained by simple distillation.
15. (e) The dehydration of *t*-butanol involves the formation of 3° carbocation which is more stable than 1° carbocation in *n*-butanol. Thus, tendency to lose water becomes more in *t*-butanol.

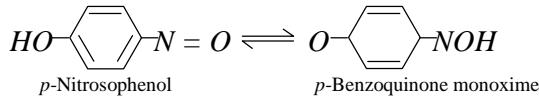
16. (c) A mixture of conc. HCl + anhyd. $ZnCl_2$ is called Lucas reagent.
17. (e) Electron withdrawing groups such as $-NO_2$, $-CN$, $-X$, increase the acidity. Greater the number of electron withdrawing groups more is the acidic character i.e. 2, 4, 6-trinitrophenol is more acidic than 4-nitrophenol.
18. (b) Phenols cannot be converted into esters by direct reaction with carboxylic acids since phenols are less nucleophilic than alcohols.
19. (b) Alcohol which forms the more stable carbocation undergoes dehydration more readily. Since tert-butyl alcohol forms more stable tert-butyl cation, therefore, it undergoes dehydration most readily than propanol.
20. (e) The ease of dehydration of alcohols can be explained on the basis of stability of the intermediate carbocation. Greater the stability of the carbocation formed, greater will be the rate of reaction. The order of stability of carbocation formed is



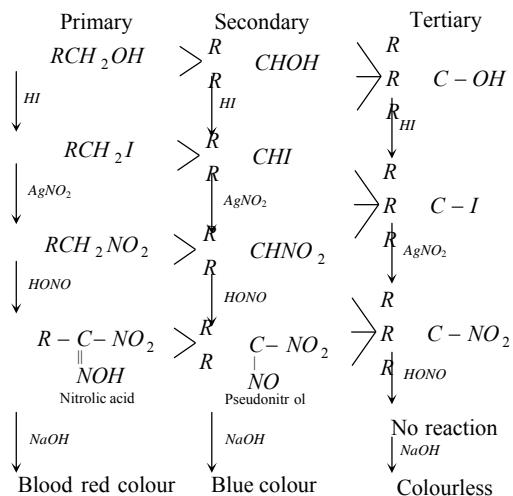
This is due to the electron releasing ($+I$) effect of the alkyl group. Therefore the ease of dehydration of alcohols follows the order.

Tertiary > secondary > primary alcohol.

21. (c) Benzoylation in phenols is usually carried out in the presence of aqueous $NaOH$ because benzoyl chloride is not readily hydrolysed by alkalies.
22. (b) In phenols, the lone pairs of electrons on the oxygen atom are delocalised over the benzene ring due to resonance and hence are not easily available for protonation. On the other hand, in alcohols, the lone pairs of electrons on oxygen atom are localized due to the absence of resonance and hence are easily available for protonation.
23. (c) p -Nitrophenolate ion is more stable than phenolate ion.
24. (b) Nitrous acid gives nitrosomine ion (NO^+) which attacks phenol at less hindered p -position of form p -nitrosophenol which is a tautomer of p -benzoquinone monoxide.



25. (c) Nucleophilic attack of phenolate ion through the ortho-carbon atom occurs on CCl_4 to form an intermediate which on hydrolysis gives salicylic acid.
26. (a) Victor-Meyer's test is used to distinguish primary, secondary and tertiary alcohols.



28. (b) Removal of two molecules of water gives a product which tautomerises to yield acrolein-an α , β -unsaturated aldehyde.

29. (b) Depending upon whether the alkyl halide and the alkoxide ion carry the same or different alkyl groups both symmetrical and unsymmetrical ethers can be prepared by Williamsons synthesis.

30. (c) Ethers being Lewis bases form etherates with Lewis acids.

31. (d) $(CH_3)_3CONa$ and CH_3CH_2Br react to form $(CH_3)_3C-O-CH_2CH_3$. Good yields of ethers are obtained when primary alkyl halides are treated with alkoxides derived from any alcohol. 1° , 2° or 3° .

SELF EVALUATION TEST

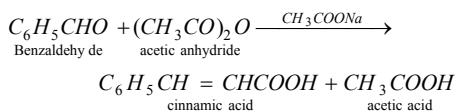
ANSWER & SOLUTION

1. (c) The reaction sequence is as follows

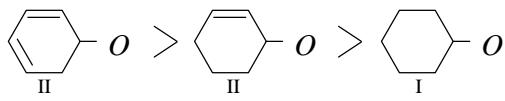
$$\begin{array}{ccc}
 CH_3 - CH - CH_3 & \xrightarrow{PBr_3} & CH_3 - CH - CH_3 \\
 | & & | \\
 OH & & Br \\
 2 \text{ propanol} & & [A] \\
 \\
 CH_3 & & O \\
 | & & / \quad \backslash \\
 CH_3 - CH - MgBr & \xrightarrow{CH_2 - CH_2} & \\
 | & & \\
 [B] & & \\
 \\
 (CH_3)_2 CH \cdot CH_2 CH_2 OMgBr & \xrightarrow[-Mg(OH)Br]{H_2O} & (CH_3)_2 CH \cdot CH_2 CH_2 OH \\
 [C] & & [D] \\
 & & \text{isopentyl alcohol} \\
 & & \text{or 3 methyl butane 2-ol}
 \end{array}$$

2. (d) Methoxy group due to $+I$ effect increase electron density on OH – group, thus making it less acidic. Thus *o*-methoxy phenol and acetylene are less acidic than phenol, *p*-nitrophenol is more acidic than phenol

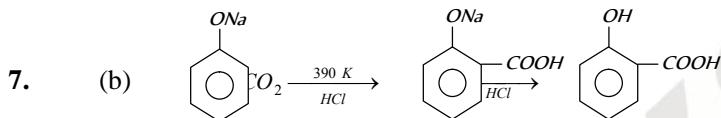
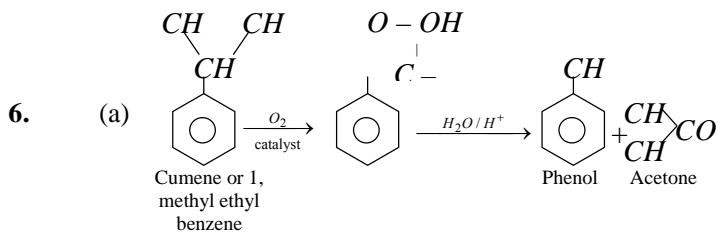
3. (b) Perkin reaction is the condensation reaction in which an aromatic aldehyde is heated with an aromatic aldehyde is heated with an anhydride of an aliphatic acid in presence of sodium salt of same acid to form γ, δ unsaturated acid.



4. (b) The correct order of stability of carbocation is as follows

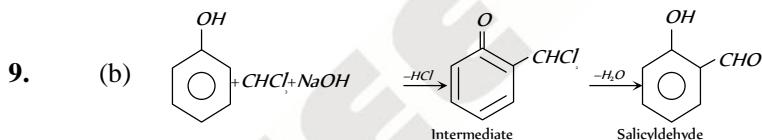


5. (b) PCl_5 is used in organic chemistry to replace the $-OH$ group by $-Cl$ and carbonylic oxygen by $(-\text{Cl}_2)$.



It is Kolbe's reaction.

8. (a) It is Lederer Manasse reaction.



10. (b) Propanol > Butanol > Pentanol

The solubility of alcohols in water decreases as the molecular mass increases. As the size of alkyl group increases, hydrophobic character increases, Hence solubility decreases.

11. (d) IV > III > I > II.

$-\text{NO}_2$ group is electron withdrawing group while $-\text{CH}_3$ group is electron releasing group.

12. (d) $2\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CHO} + \text{dil. NaOH} \rightarrow$