

Class XII  
CHEMISTRY (Theory) CBSE 2019

Time : 3 Hrs.

Max. Marks : 70

**General Instructions:**

- I. All questions are compulsory
- II. Section A : Question no. 1 to 5 are very short-answer questions and carry 1 mark each.
- III. Section B: Question no. 6 to 12 are short-answer questions and carry 2 marks each.
- IV. Section C: Question no. 13 to 24 are also short-answer questions and carry 3 marks each.
- V. Section 13: Question no. 25 to 27 are long-answer questions and carry 5 marks each.
- VI. There is no overall choice. However, an internal choice has been provided in two questions of one mark, two questions of two marks, four questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- VII. Use log tables if necessary. Use of calculators is not allowed.

**SECTION-A**

**Question 1: Out of NaCl and AgCl, which one shows Frenkel defect and why?**

**Solution:**

The Frenkel defect is that in which one smaller ion (usually cations) move from its lattice position to an interstitial site i.e. a tetrahedral octahedral hole to form a vacancy in the lattice. Of course, AgCl has the defect because, the size of AgCl is intermediate and since, the size of  $\text{Ag}^+$  cation is smaller than chloride ion so it can move to interstitial spaces causing Frenkel defect while in NaCl (alkali metal halide) they have larger size of cations which do not fit into voids and so the defect is not shown by the alkali metal halides.

**Question 2: Arrange the following in increasing order of boiling points:**



**Solution:**

This increasing order of boiling point can be explained by intermolecular hydrogen bonding. Tertiary amines, cannot engage in hydrogen bonding because they have no hydrogen atom bonded to the nitrogen atom, while primary amine undergoes intermolecular hydrogen bonding. But in case of alcohol, the extent of hydrogen bonding is more as compared to amines because of more electronegative oxygen atom in alcohols.



**Question 3: Why are medicines more effective in colloidal state?**

**OR**

**What is difference between an emulsion and a gel?**

**Solution:**

Some medicines are more effective in colloidal form because medicine in colloidal form is easily absorbed by the body tissues. For example, Antibiotics like streptomycin in the form of the colloidal sol is injected into the body for the more effective result.

OR

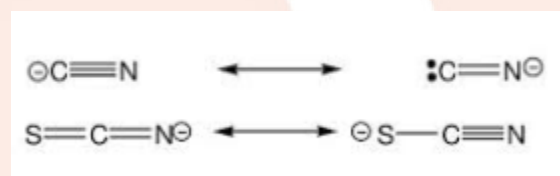
Emulsion: It is a colloidal mixture in which both the dispersed phase and the dispersion medium are liquids. The two or more liquids present in the mixture are generally immiscible in nature. Example: Milk. Gel: It is a colloid in which the dispersed phase i.e. liquid has combined with the dispersion medium i.e. solid to produce a semisolid material. Example: jellies.

**Question 4: Define ambident nucleophile with an example.**

**Solution:**

Ambident Nucleophile- An anionic nucleophile, which has two nucleophilic centres, or two negative sites is known as ambident nucleophile. In this negative charge is delocalized due to resonance.

Example – Cyanide and Thiocyanate are examples of ambident nucleophiles.



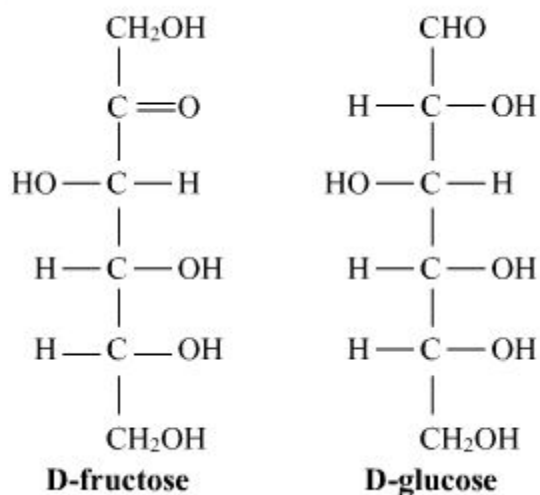
**Question 5: What is the basic structural difference between glucose and fructose?**

OR

**Write the products obtained after hydrolysis of lactose.**

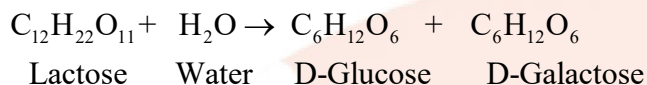
**Solution:**

Both Glucose and Fructose are hexose sugars with six carbon atoms but Glucose is an aldohexose and fructose is ketohexose which means the functional group present in glucose is aldehyde and the functional group in fructose is ketone.



OR

Lactose is composed of  $\beta$ -D galactose and  $\beta$ -D glucose. Thus on hydrolysis, it gives  $\beta$ -D galactose and  $\beta$ -D glucose.



## SECTION B

**Question 6: Write balanced chemical equations for the following processes:**

- (i)  $\text{XeF}_2$  undergoes hydrolysis.
- (ii)  $\text{MnO}_2$  is heated with conc.  $\text{HCl}$ .

OR

**Arrange the following in order of property indicated for each set.**

- (i)  $\text{H}_2\text{O}, \text{H}_2\text{S}, \text{H}_2\text{Se}, \text{H}_2\text{Te}$ - increasing acidic character
- (ii)  $\text{HF}, \text{HCl}, \text{HBr}, \text{HI}$ - decreasing bond enthalpy

**Solution:**

- (i)  $2\text{XeF}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Xe}(\text{g}) + 4\text{HF}(\text{aq}) + \text{O}_2(\text{g})$
- (ii)  $4\text{HCl} + \text{MnO}_2 \rightarrow \text{Cl}_2 + \text{MnCl}_2 + 2\text{H}_2\text{O}$

OR

- (i) The increasing order of acidic character is  $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$
- (ii) The decreasing order of bond enthalpy is  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$

**Question 7: State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations.**

**Solution:**

Raoult's Law: According to Raoult's law, for a solution of two volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution.

$$P_1 \propto x_1$$

Implies that

$$P_1 = P_1^\circ x_1$$

$P_1$  = Partial pressure of component 1.

$x_1$  = mole fraction of component 1.

$P_1^\circ$  = pure vapour pressure of component 1.

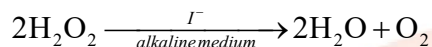
Ideal solution obeys Raoult's law at all concentrations. The conditions obeyed are:

- (i)  $\Delta_{\text{mix}} H = 0$

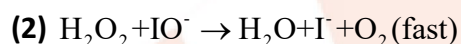
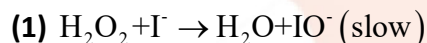
(ii)  $\Delta_{mix} V = 0$ .

### Question 8:

For a reaction



The Proposed mechanism is given below:



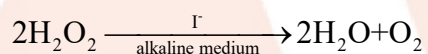
(i) Write rate law for the reaction.

(ii) Write the overall order of reaction.

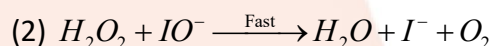
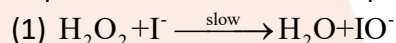
(iii) Out of steps (1) and (2), which one is rate determining step?

**Solution:**

Let us consider the problem:



In Some cases, the rate of reaction depends not only on the reactant but may also depend on the substance present as a catalyst. This is also seen in the above reaction. The rate of reaction depends on the slowest step in case of a complex reaction.



(i) Rate law:

$$\text{Rate} = -\frac{1}{2} \frac{d[\text{H}_2\text{O}_2]}{dt} = k[\text{H}_2\text{O}_2][\text{I}^-]$$

(ii) The overall order of reaction:

$$\text{Rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$$

$$\text{Order} = 1 + 1 = 2$$

(iii) Slowest step is the rate determining step. Hence, step 1 is rate determining step.

**Question 9:** When  $\text{MnO}_2$  is fused with  $\text{KOH}$  in the presence of  $\text{KNO}_3$  as an oxidizing agent, it gives a dark green compound (A).

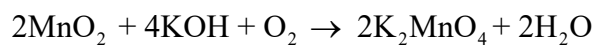
Compound (A) disproportionates in acidic solution to give purple compound (B).

An alkaline solution of compound (B) oxidises  $\text{KI}$  to compound (C) whereas an acidified solution of compound (B) oxidises  $\text{KI}$  to (D).

Identify (A), (B), (C), and (D).

**Solution:**

Potassium permanganate is prepared by fusion of  $\text{MnO}_2$  with an alkali metal hydroxide and an oxidising agent like  $\text{KNO}_3$ . This produces the dark green  $\text{K}_2\text{MnO}_4$  which disproportionates in a neutral or acidic solution to give permanganate.



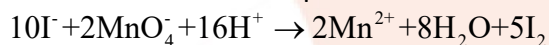
(A) Dark Green



(B) purple

In acid solutions:

Iodine is liberated from potassium iodide:

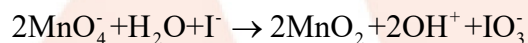


(B)

(D)

In neutral or faintly alkaline solution:

A notable reaction is the oxidation of iodine to iodate:



(B)

(C)

**10 Write IUPAC name of the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]$ . Draw structures of geometrical isomers for this complex. [2]**

OR

**Using IUPAC norms write the formulae for the following :**

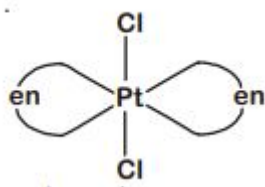
(i) Hexaamminecobalt(III) sulphate

(ii) Potassium trioxalatochromate(III)

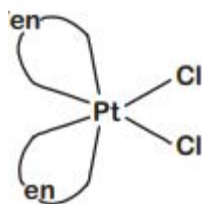
**SOLUTION:**

$[\text{Pt}(\text{en})_2\text{Cl}_2]$  – Dichloridobis(ethane-1,2-diammine)platinum (II)

Geometrical isomer:

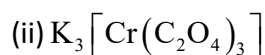
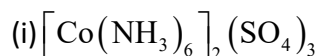


trans isomer



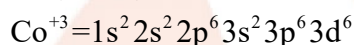
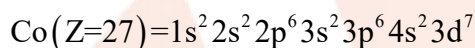
cis isomer

OR

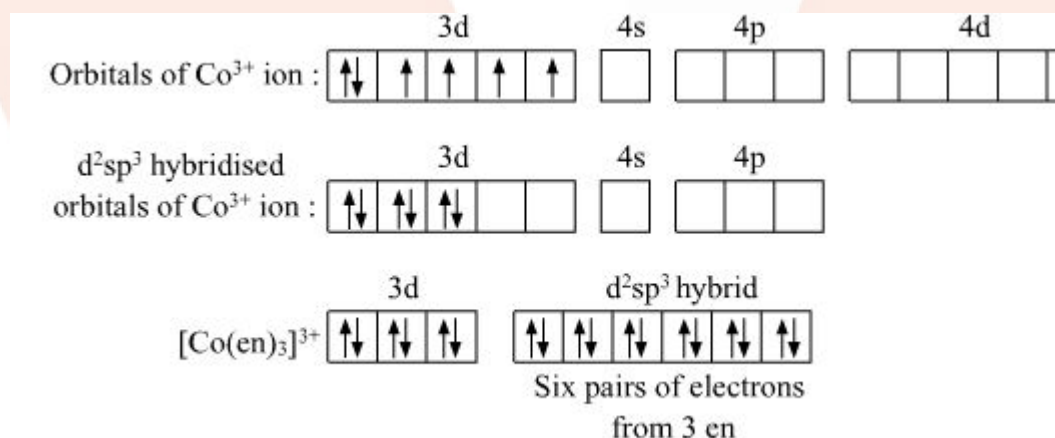
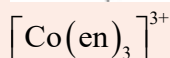
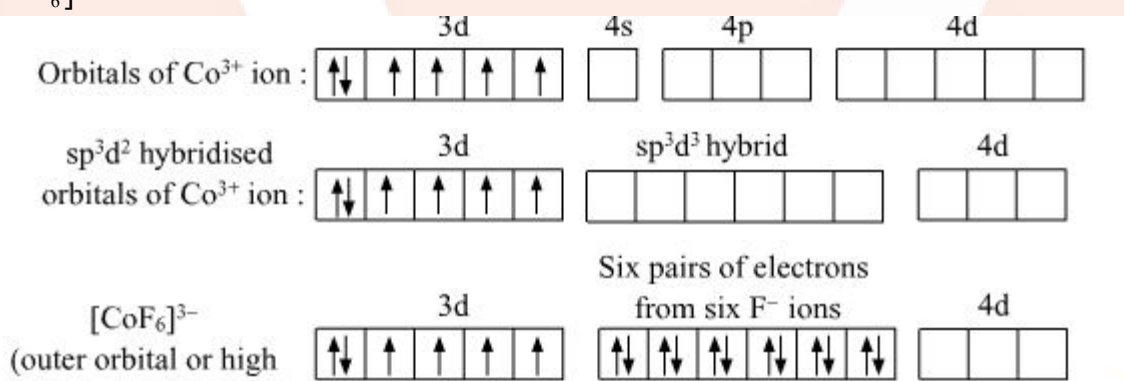
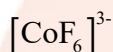


**11 Out of  $[\text{CoF}_6]^{3-}$  and  $[\text{Co}(\text{en})_3]^{3+}$ , which one complex is [2] (i) paramagnetic (ii) more stable (iii) inner orbital complex and (iv) high spin complex (Atomic no. of Co = 27)**

**Solution:**



$\text{F}^-$  is weak field ligand:



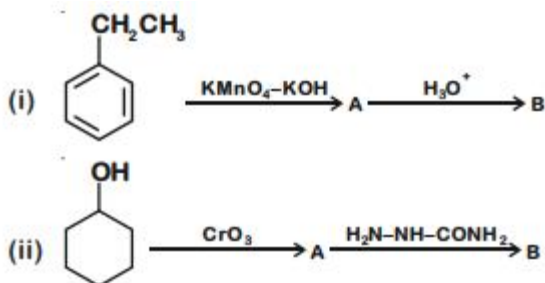
(i)  $[\text{CoF}_6]^{3-}$  is paramagnetic due to presence of four unpaired electrons

(ii)  $[\text{Co}(\text{en})_3]^{3+}$  is more stable due to chelation

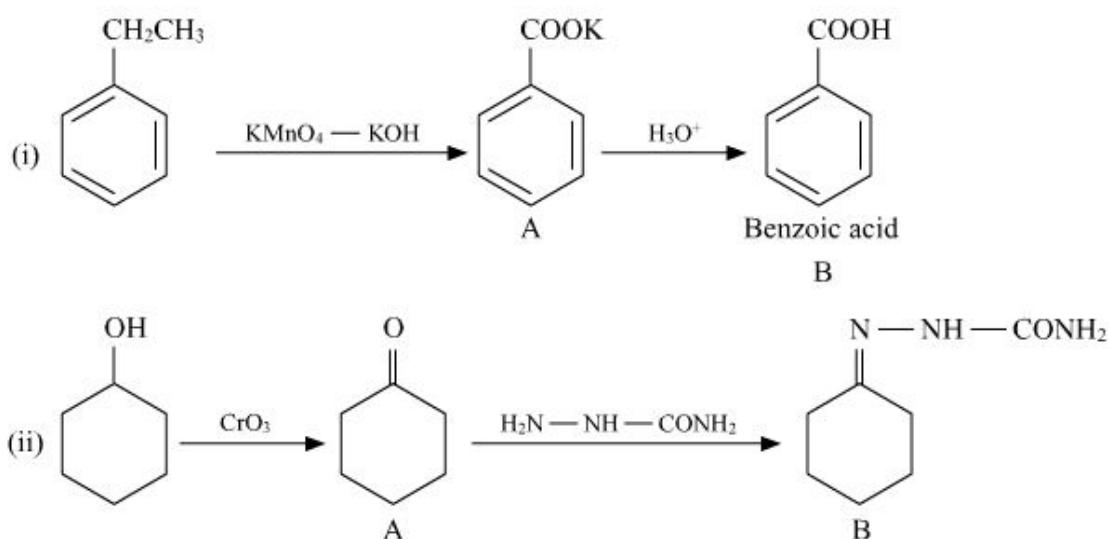
(iii)  $[\text{Co}(\text{en})_3]^{3+}$  forms inner orbital complex ( $\text{d}^2\text{sp}^3$ )

(iv)  $[\text{CoF}_6]^{3-}$  forms high spin complex ( $\text{sp}^3\text{d}^2$ )

**12 Write structures of compounds A and B in each of the following reactions :**



**Solution:**



### SECTION C

**Question 13:** The decomposition of  $\text{NH}_3$  on platinum surface is zero order reaction. If rate constant ( $k$ ) is  $4 \times 10^{-3} \text{ ms}^{-1}$ , how long will it take to reduce the initial concentration of  $\text{NH}_3$  from 0.1 M to 0.064 M.

**Solution:**

**Given that:**

$$k = 4 \times 10^{-3} \text{ Ms}^{-1}$$

$$[A_0] = 0.1 \text{ M}$$

$$[A] = 0.064 \text{ M}$$

For a zero-order reaction,



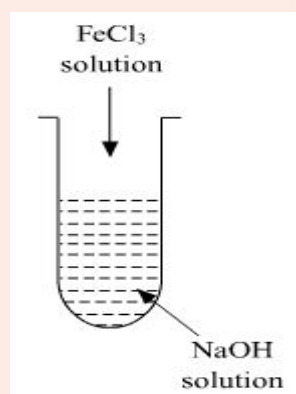
$$k = \frac{1}{t} \{ [A_0] - [A] \}$$

$$4 \times 10^{-3} \text{ Ms}^{-1} = \frac{1}{t} \{ [0.1] - [0.064] \}$$

$$t = \frac{0.1 - 0.064}{4 \times 10^{-3}} = 0.009 \times 10^3 = 9 \text{ seconds}$$

**Question 14: (i) What is the role of activated charcoal in gas mask?**

**(ii) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube? How is the solution represented?**



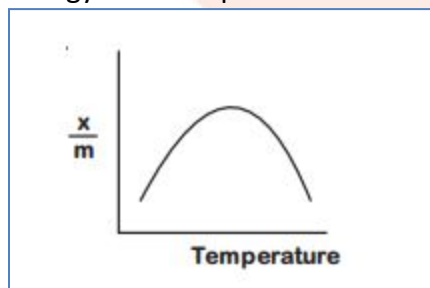
**(iii) How does chemisorption vary with temperature?**

**Solution:**

(i) In gas mask activated charcoal is used to adsorb poisonous gases in coal mines.

(ii) If FeCl<sub>3</sub> is added to NaOH, a negatively charged sol is obtained with adsorption of OH<sup>-</sup> ions. Sol is represented as Fe<sub>2</sub>O<sub>3</sub>.xH<sub>2</sub>O/OH<sup>-</sup> (negatively charged).

(iii) With increase in temperature chemisorption first increases as molecules get activation energy for adsorption. After certain chemisorption decreases. temperature,





**Question 15** An element crystallizes in fcc lattice with a cell edge of 300 pm. The density of the element is  $10.8 \text{ g cm}^{-3}$ . Calculate the number of atoms in 108 g of the element.

**Solution:**

Volume of unit cell

$$= (300 \text{ pm})^3$$

$$= (3.00 \times 10^{-8} \text{ cm})^3$$

$$= 2.7 \times 10^{-23} \text{ cm}^3$$

$$\text{Volume of 108 g of element} = \frac{\text{mass}}{\text{density}} = \frac{108 \text{ g}}{10.8 \text{ g cm}^{-3}} = 10 \text{ cm}^3$$

$$\text{Number of unit cells in this volume} = \frac{10 \text{ cm}^3}{2.7 \times 10^{-23} \text{ cm}^3 / \text{unit cell}} = \frac{10^{24}}{2.7} \text{ Unit cells}$$

Since each FCC unit cell contains 4 atoms, therefore the total number of atoms in 108 g

$$4 \text{ atoms/unit cell} \times \frac{10^{24}}{2.7} \text{ unit cell}$$

$$= 1.48 \times 10^{24} \text{ atoms}$$

**Question 16** A 4% solution(w/w) of sucrose ( $M = 342 \text{ g mol}^{-1}$ ) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose ( $M = 180 \text{ g mol}^{-1}$ ) in water. (Given: Freezing point of pure water = 273.15 K)

**Solution**

$$\text{Molality (m)} = \frac{n}{W_{\text{solvent (kg)}}$$

For sucrose solution:

$$m = \frac{\frac{4}{342}}{\frac{96}{1000}} = \frac{4}{342} \times \frac{1000}{96} = 0.122 \text{ m}$$

$$(\Delta T_f)_1 = (273.15 - 271.15) \text{ K} = 2 \text{ K}$$

$$(\Delta T_f)_1 = K_f m = K_f \times 0.122$$

$$2 = K_f \times 0.122 \quad \dots (1)$$

For glucose solution :

$$m = \frac{\frac{5}{180}}{\frac{95}{1000}} = \frac{5}{180} \times \frac{1000}{95} = 0.292 \text{ m}$$

$$(\Delta T_f)_2 = K_f \times 0.292 \dots (2)$$

Dividing eqn. (2) by (1)

$$\frac{(\Delta T_f)_2}{2} = \frac{K_f \times 0.292}{K_f \times 0.122}$$

$$(\Delta T_f)_2 = \frac{0.292}{0.122} \times 2 = 4.79$$

$$T_f = 273.15 - 4.79 = 268.36 \text{ K}$$

Freezing point of glucose solution will be 268.36 K

**Question 17 (a) Name the method of refining which is**

**(i) Used to obtain semiconductor of high purity.**

**(ii) Used to obtain low boiling metal.**

**(b) Write chemical reactions taking place in the extraction of copper from  $\text{Cu}_2\text{S}$ .**

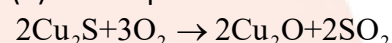
**Solution**

(a)

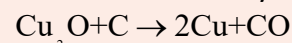
(i) Zone refining

(ii) Distillation

(b) The sulphide ores are roasted to give oxides



The oxide can easily be reduced to metallic copper using coke



**Question 18 Give reasons for the following:**

**(i) Transition elements and their compounds act as catalysts.**

**(ii)  $E^\circ$  value for  $(\text{Mn}^{2+}|\text{Mn})$  is negative whereas for  $(\text{Cu}^{2+}|\text{Cu})$  is positive.**

**(iii) Actinoids show irregularities in their electronic configuration.**

**Solution**

(i) Transition elements and their compounds act as catalysts. This is because of their ability to adopt multiple oxidation states and to form complexes.

(ii)  $E^\circ$  value for  $(\text{Mn}^{2+}|\text{Mn})$  is negative whereas for  $(\text{Cu}^{2+}|\text{Cu})$  is positive as the hydration enthalpy of  $\text{Cu}^{2+}$  ion is not sufficient to compensate the sum of sublimation as well as first and second ionisation enthalpy of copper.

(iii) Actinoids show irregularities in their electronic configuration are related to their stabilities of the  $f_0$ ,  $f_7$  and  $f_{14}$  occupancies of the 5f orbital.

**Question 19: Write the structures of monomers used for getting the following polymers:**

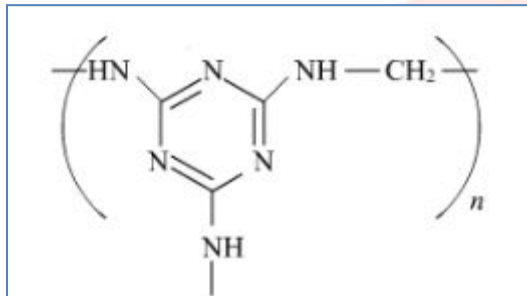
**(i) Nylon-6, 6**

**(ii) Glyptal**

**(iii) Buna-S**

**OR**

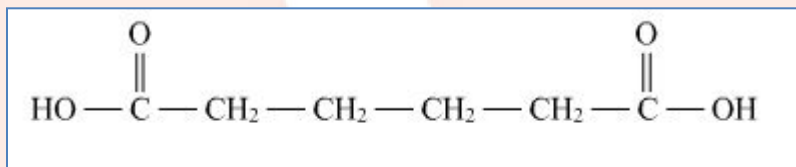
- (i) Is  $\left[ \text{CH}_2 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} \right]_n$  a homopolymer or copolymer? Give reason.  
 (ii) Write the monomers of the following polymer :



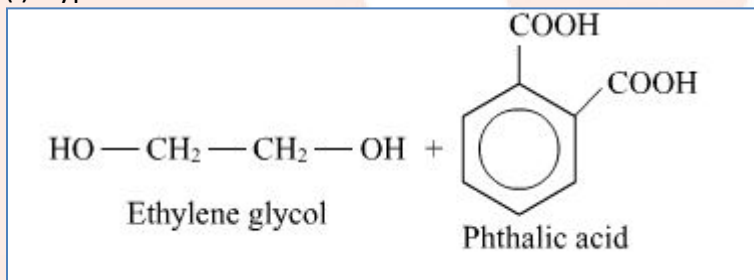
(iii) What is the role of Sulphur in vulcanization of rubber?

**Solution:**

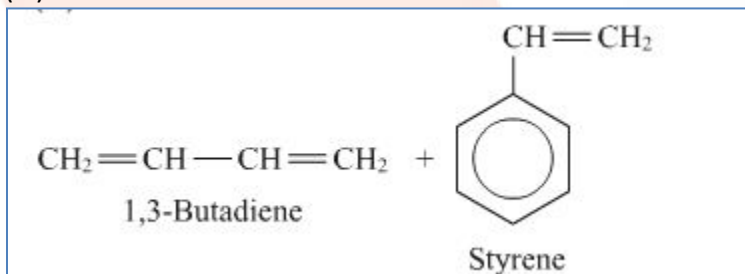
(i) Nylon-6, 6 : Hexamethylenediamine  $\rightarrow \text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$



(i) Glyptal:

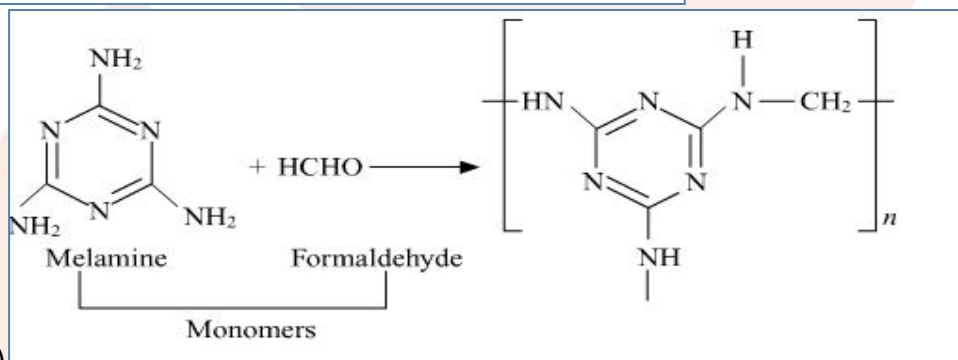
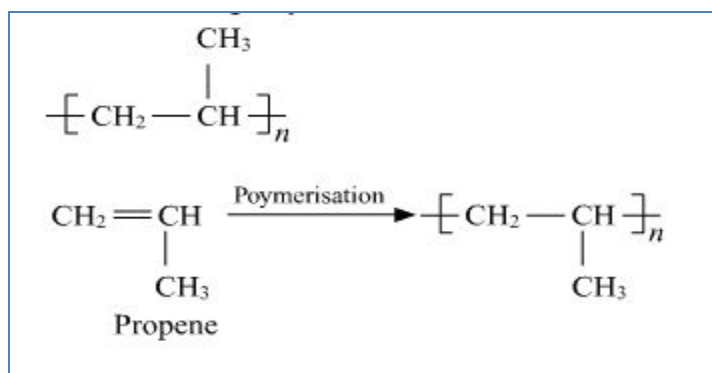


(iii) Buna-S



OR

(i) This is a homopolymer formed by a propene monomer because in this polymerization only one monomer is being used without losing any molecule.



(ii)

(iii) In vulcanization, sulphur forms cross links at the reactive sites of double bonds of natural rubber so the rubber gets stiffened.

**Question 20: (i) What type of drug is used in sleeping pills?**

**(ii) What type of detergents are used in toothpastes?**

**(iii) Why the use of alitame as artificial sweetener is not recommended?**

OR

**Define the following terms with a suitable example in each :**

**(i) Broad-spectrum antibiotics**

**(ii) Disinfectants**

**(iii) Cationic detergents**

**Solution**

(i) Tranquilizers are used in sleeping pills.

(ii) Anionic detergents are used in toothpastes.

(iii) The control of sweetness of food is difficult while using alitame, hence its use as artificial sweetener is not recommended.

OR

(i) Broad-spectrum antibiotics – Antibiotics which kill or inhibit a wide range of gram-positive and gram-negative bacteria are called broad-spectrum antibiotics.

e.g. – Chloramphenicol / Vancomycin / Ofloxacin

(ii) Disinfectants – The chemicals which either kill or prevent the growth of microorganisms are called disinfectants.

e.g. Chlorine or  $\text{SO}_2$

(iii) Cationic detergents – They are quaternary ammonium salts of amines with acetates, chlorides or bromides as anions.

e.g. Cetyltrimethylammonium bromide

**Question 21:**

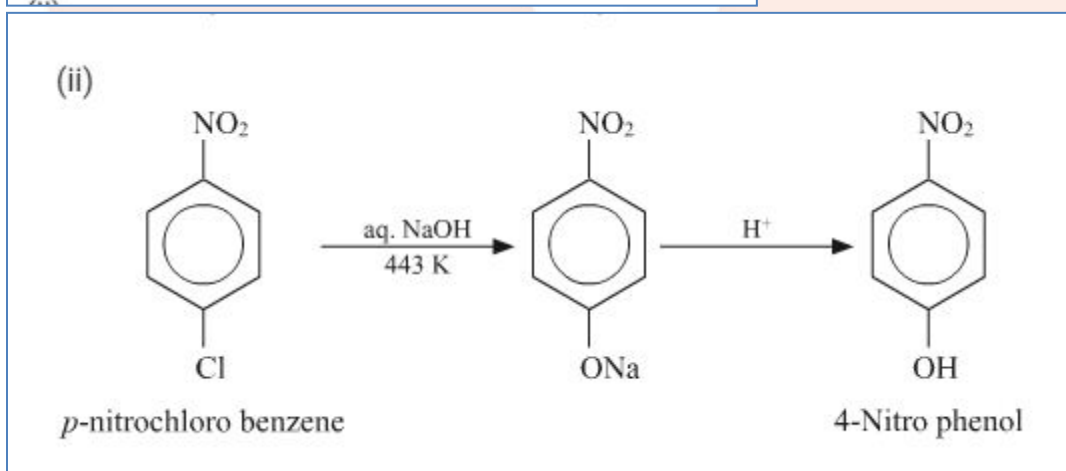
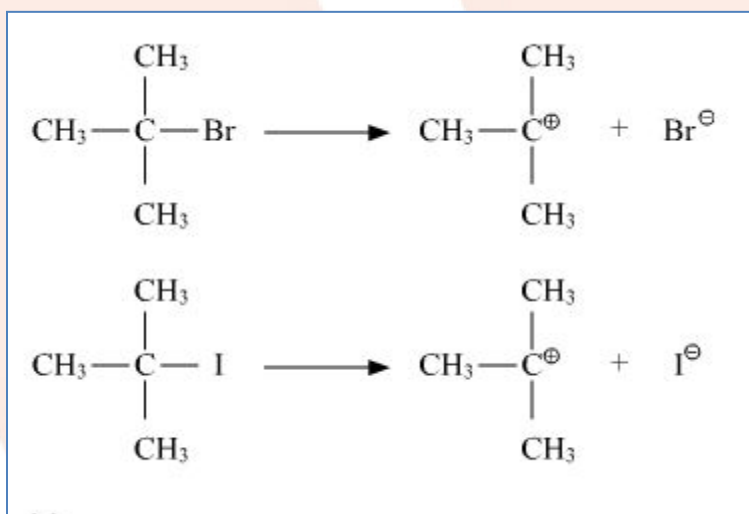
(i) Out of  $(\text{CH}_3)_3\text{C}-\text{Br}$  and  $(\text{CH}_3)_3\text{C}-\text{I}$ , which one is more reactive towards  $\text{S}_\text{N}1$  and why?

(ii) Write the product formed when p-nitrochlorobenzene is heated with aqueous  $\text{NaOH}$  at 443K followed by acidification?

(iii) Why dextro and laevo-rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation?

**Solution**

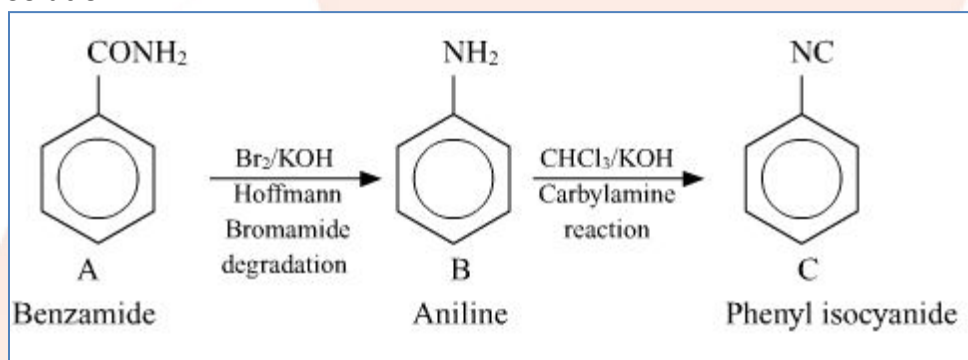
(i) In  $\text{S}_\text{N}1$  reactions, reactivity depends on the stability of carbocation after removing the leaving group from the reactant. Since the carbocation is same here, so, we will see the tendency of leaving group. As we can see in the following reactions Br and I are the leaving groups, out of them I is a better leaving group. Hence  $\text{S}_\text{N}1$  reaction will be faster in  $(\text{CH}_3)_3\text{C}-\text{I}$



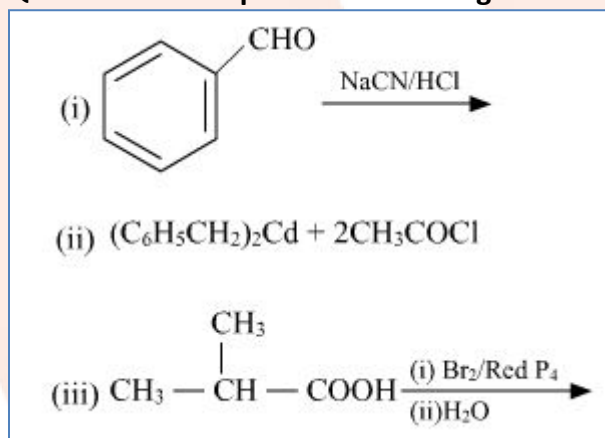
(iii) Dextro and laevo rotatory isomers of Butan-2-ol are enantiomers of each other and both have same boiling point and hence they cannot be separated by fractional distillation.

**22 An aromatic compound 'A' on heating with  $\text{Br}_2$  and KOH forms a compound 'B' of molecular formula  $\text{C}_6\text{H}_7\text{N}$  which on reacting with  $\text{CHCl}_3$  and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C.**

**Solution**



**Question 23: complete the following reactions:**



**OR**

**Write chemical equations for the following reactions :**

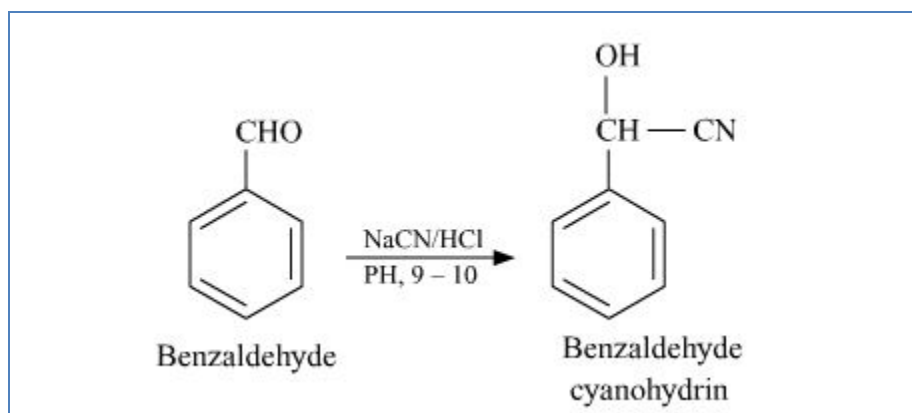
**(i) Propanone is treated with dilute  $\text{Ba}(\text{OH})_2$ .**

**(ii) Acetophenone is treated with  $\frac{\text{Zn(Hg)}}{\text{Conc.HCl}}$ .**

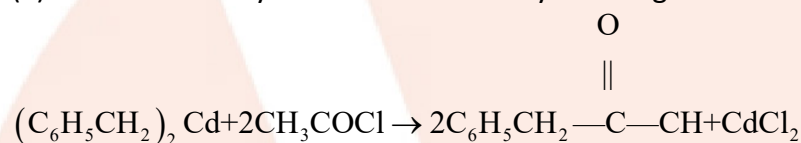
**(iii) Benzoyl chloride is hydrogenated in presence of  $\frac{\text{Pd}}{\text{BaSO}_4}$ .**

**Solution:**

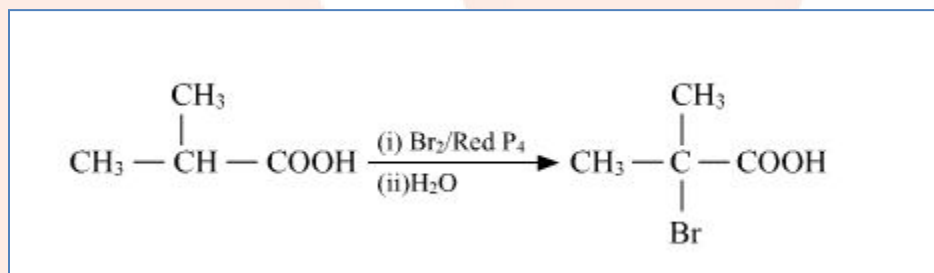
Reaction of benzaldehyde with  $\text{NaCN/HCL}$  gives cyanohydrins.



(II) Treatment of acyl chlorides with dialkylcadmium gives a ketone.

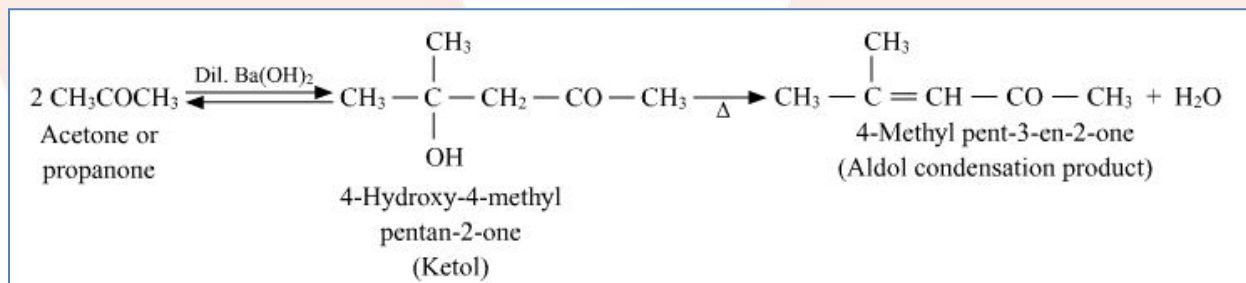


(iii) Carboxylic acid having  $\alpha$ -hydrogen are halogenated at  $\alpha$ -position on treatment with  $\text{Br}_2$  in presence of red phosphorous to give  $\alpha$ -halocarboxylic acids. This is Hell-Volhard-Zelinsky reaction.

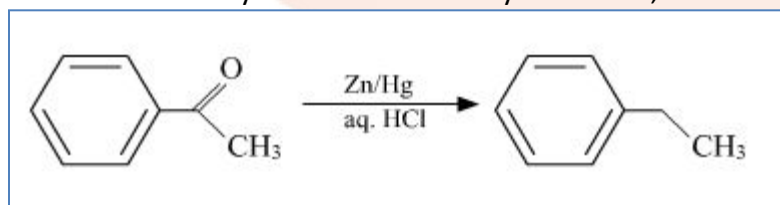


OR

This is a self-aldol condensation reaction.

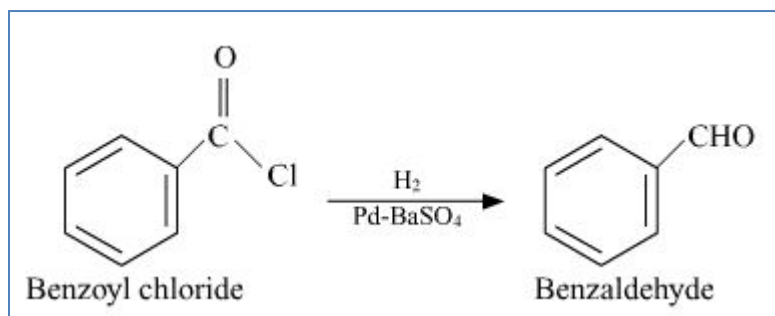


(ii) The reaction of aldehydes and ketones with zinc amalgam ( $\text{Zn/Hg}$ ) in concentrated  $\text{HCl}$ , reduces the aldehyde or ketone to a hydrocarbon, and is called Clemmensen reduction.





(iii) Benzoyl chloride is hydrogenated over catalyst  $\text{Pd-BaSO}_4$  to give benzaldehyde. This reaction is called Rosenmund Reaction.



**Question 24: Differentiate between the following**

(i) Amylose and Amylopectin

(ii) Peptide linkage and Glycosidic linkage

(iii) Fibrous proteins and Globular proteins

OR

Write chemical reactions to show that open structure of D-glucose contains the following :

(i) Straight chain

(ii) Five alcohol groups

(iii) Aldehyde as carbonyl group

**Solution:**

(i)

	Amylose	Amylopectin
(a)	Only $\text{C}_1-\text{C}_4$ glycosidic linkage	$\text{C}_1-\text{C}_4$ glycosidic linkage but, branching occurs by $\text{C}_1-\text{C}_6$ glycosidic linkage
(b)	Water soluble component of starch (15-20%)	Water insoluble component of starch (80-85%)

(ii)

Peptide linkage	Glycosidic linkage
It is $-\text{CONH}-$ linkage which exists in proteins formed by condensation of amino acids.	It is $-\text{O}-$ linkage. In disaccharide two monosaccharide units are joined through oxygen atom i.e. glycosidic linkage.

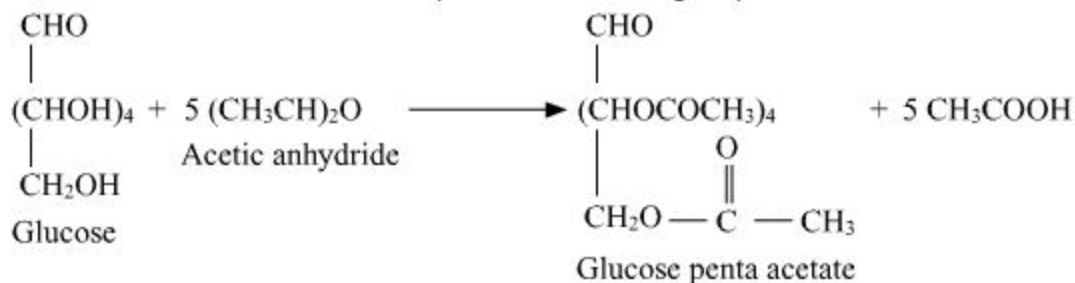
(iii)

	Fibrous proteins	Globular protein
(a)	Polypeptide chains run parallel to give fibre-like structure	Polypeptide chains coil around to give spherical shape
(b)	Generally insoluble in water such as keratin, myosin	Usually soluble in water such as insulin, albumins

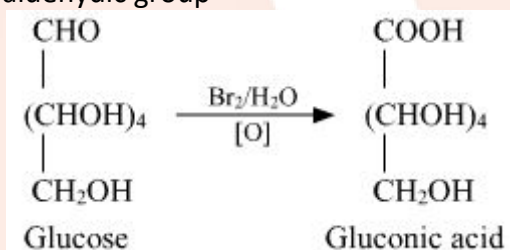
OR

(i) On prolonged heating with HI, glucose forms n-hexane, suggesting that all the six carbon atoms are linked in a straight chain.

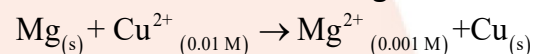
(ii) Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five -OH groups. Since it exists as a stable compound, five -OH groups should be attached to different carbon atoms.



(iii) Glucose gets oxidised to six carbon carboxylic acid (gluconic acid) on reaction with a mild oxidising agent like bromine water. This indicates that the carbonyl group is present as an aldehydic group



**Question 25:**  $E^\circ$  cell for the given redox reaction is 2.71 V



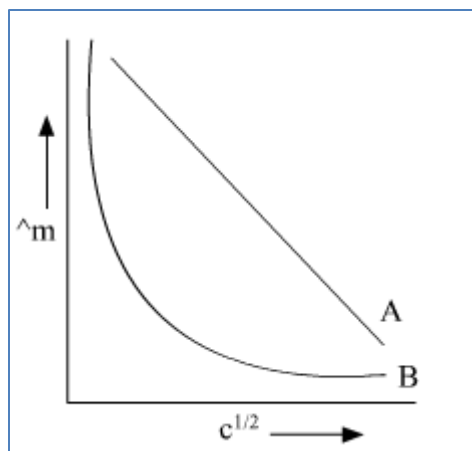
Calculate  $E_{\text{cell}}$  for the reaction. Write the direction of flow of current when an external opposite potential applied is (i) less than 2.71 V and (ii) greater than 2.71 V

OR

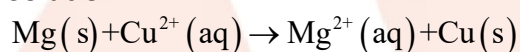
(a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes  $\text{FeSO}_4$  and  $\text{ZnSO}_4$  until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y.

(Molar mass :  $\text{Fe} = 56 \text{ g mol}^{-1}$ ,  $\text{Zn} = 65.3 \text{ g mol}^{-1}$ ,  $1 \text{ F} = 96500 \text{ C mol}^{-1}$ )

(b) In the plot of molar conductivity ( $\Lambda_m$ ) vs square root of concentration ( $c^{1/2}$ ) following curves are obtained for two electrolytes A and B :



**Solution:**



$$Q = \frac{[\text{Mg}^{2+}][\text{Cu}]}{[\text{Mg}][\text{Cu}^{2+}]} = \frac{(0.001)(1)}{(1)(0.01)} = 0.1$$

Using Nernst equation,

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log Q$$

$$E_{\text{cell}} = 2.71 - \frac{0.0591}{2} \log 0.1$$

$$E_{\text{cell}} = 2.74 \text{ V}$$

(i) Since the voltage applied externally is less than  $E_{\text{cell}}$  then the direction of flow of current is from cathode to anode

(ii) When the external voltage applied exceeds  $E_{\text{cell}}$ , the direction of flow of current is from anode to cathode.

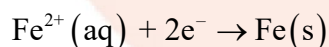
If voltage is applied is greater than 2.74 V, the direction of current is from anode to cathode.

OR

(a)

$$I = 2 \text{ A}$$

$$W_1 = 2.8 \text{ g}$$



96500 × 2 C of charge is required to deposit = 56 g of Fe

9650 C of charge is required to deposit = 2.8 g of Fe

$$\therefore Q = It \text{ or } t = \frac{9650}{2} = 4825 \text{ s}$$

Using Faraday's second law of electrolysis,

$$\frac{W_1 (\text{Weight of Fe deposited})}{W_2 (\text{Weight of Zn deposited})} = \frac{E_1 (\text{Equivalent weight of Fe})}{E_2 (\text{Equivalent weight of Fe})}$$

$$\frac{2.8}{W_2} = \frac{56/2}{65.3/2} = \frac{56}{65.3}$$

Or  $W_2 = 3.265 \text{ g}$

(b) Electrolyte A is strong electrolyte & Electrolyte B is weak electrolyte On extrapolation of  $\Lambda_m$  to concentration approaching zero for strong electrolytes, we get the value of  $\Lambda_m^\circ$  i.e. molar conductance at infinite dilution In the case of weak electrolytes,  $\Lambda_m$  increases steeply on dilution. Therefore,  $\Lambda_m^\circ$  cannot be obtained by extrapolation.

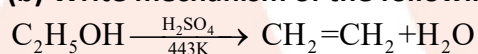
**Question 26:**

**(a) How do you convert the following :**

**(i) Phenol to Anisole**

**(ii) Ethanol to Propan-2-ol**

**(b) Write mechanism of the following reaction :**



**(c) Why phenol undergoes electrophilic substitution more easily than benzene?**

**OR**

**(a) Account for the following :**

**(i) o-nitrophenol is more steam volatile than p-nitrophenol.**

**(ii) t-butyl chloride on heating with sodium methoxide gives 2-methylpropene instead of t-butylmethylether.**

**(b) Write the reaction involved in the following :**

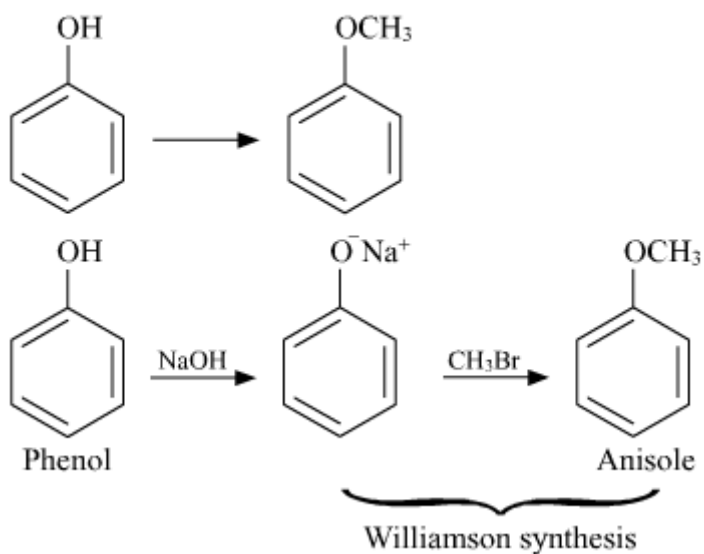
**(i) Reimer-Tiemann reaction**

**(ii) Friedal-Crafts Alkylation of Phenol**

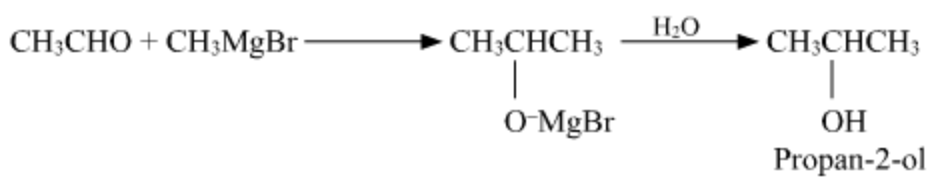
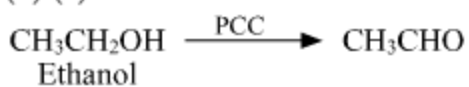
**(c) Give simple chemical test to distinguish between Ethanol and Phenol**

**Solution:**

(a) (i)  
Phenol to anisole

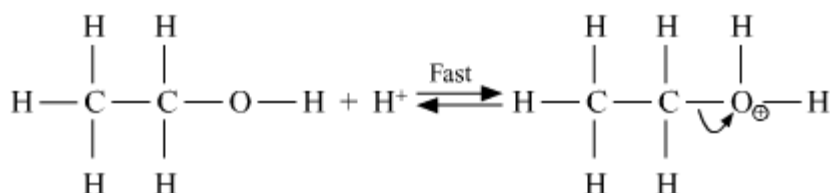


(a) (ii)

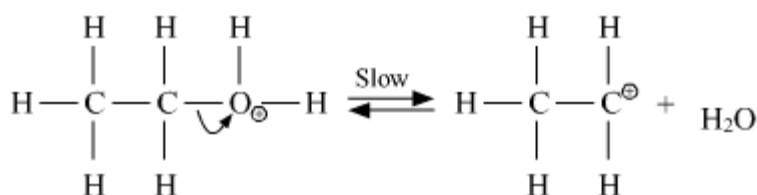


(b) Mechanism : Dehydration of ethanol

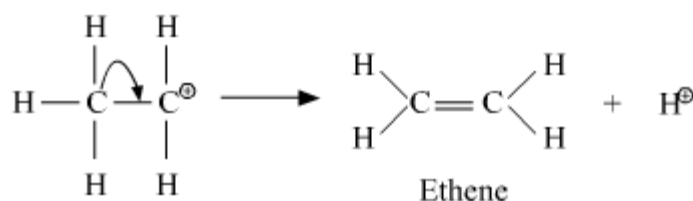
Step 1: Formation of protonated alcohol



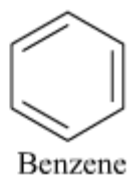
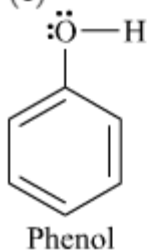
Step 2: Formation of carbocation (slow step)



Step 3: Formation of ethene



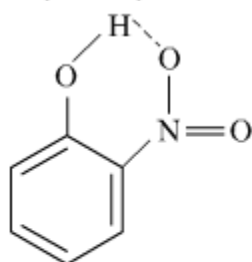
(c)



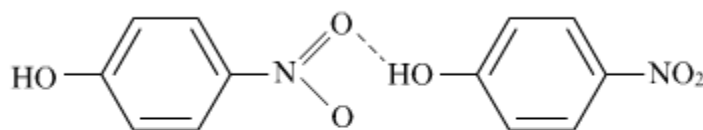
(c) -OH group of phenol is activating group which increases the electron density at ortho/para position within the benzene ring so that electrophile can easily attack at ortho/para position in phenol than in benzene.

OR

(a) (i) o-Nitrophenol is steam volatile due to intramolecular hydrogen bonding while p-nitrophenol is less volatile due to intermolecular hydrogen bonding

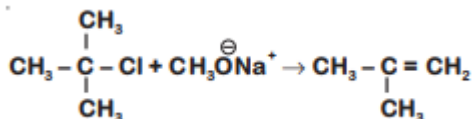


Intramolecular  
hydrogen bonding  
(*o*-nitrophenol)

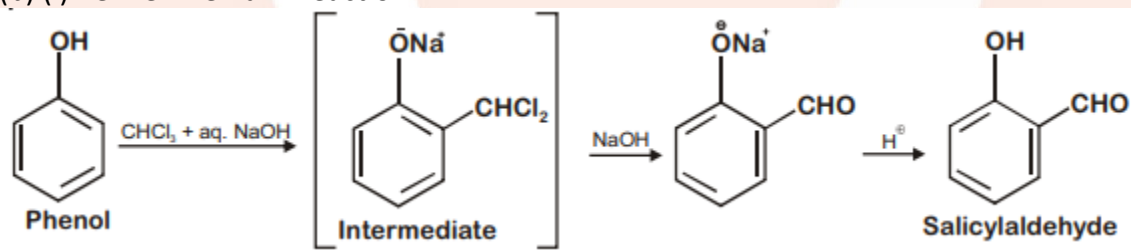


Intermolecular  
hydrogen bonding  
(*p*-nitrophenol)

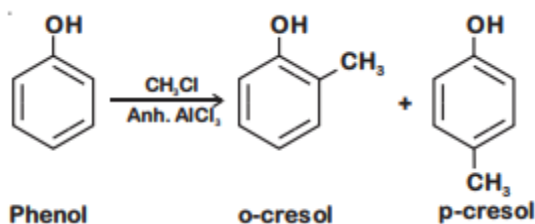
(ii) Sodium methoxide is a strong base hence elimination pre-dominates over substitution



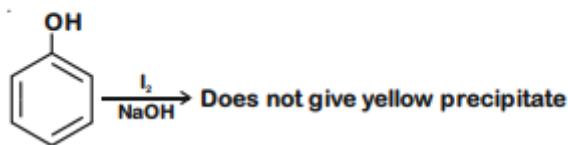
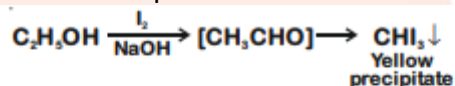
(b) (i) Reimer-Tiemann reaction



(ii) Friedel Craft's reaction of phenol



(c) Ethanol and phenol can be chemically distinguished by Iodoform test



Question 27:

(a) Give reasons for the following :

(i) Sulphur in vapour state shows paramagnetic behaviour.

ii) N-N bond is weaker than P-P bond.

(iii) Ozone is thermodynamically less stable than oxygen.

(b) Write the name of gas released when Cu is added to



(i) dilute  $\text{HNO}_3$  and (ii) conc.  $\text{HNO}_3$

OR

(a)

(i) Write the disproportionation reaction of  $\text{H}_3\text{PO}_3$ .

(ii) Draw the structure of  $\text{XeF}_4$ .

(b) Account for the following :

(i) Although Fluorine has less negative electron gain enthalpy yet  $\text{F}_2$  is strong oxidizing agent.

(ii) Acidic character decreases from  $\text{N}_2\text{O}_3$  to  $\text{Bi}_2\text{O}_3$  in group 15.

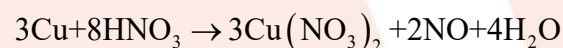
**Solution:**

(a) (i) Sulphur in vapor state exists as  $\text{S}_2$  which has two unpaired electrons in the pi-antibonding molecular orbital and is paramagnetic

(ii) Due to small size of N, there is strong interelectronic repulsion of the non-bonding electrons and as a result the N-N single bond is weaker than P-P single bond.

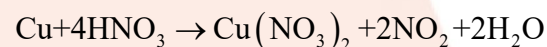
(iii) Decomposition of ozone into oxygen results in the liberation of heat ( $\Delta H < 0$ ) and an increase in entropy ( $\Delta S > 0$ ) resulting in a large negative Gibbs energy change. Hence, ozone is thermodynamically less stable than oxygen.

(b) (i) With dil.  $\text{HNO}_3 \rightarrow$  Nitrogen monoxide ( $\text{NO}$ )



(dil.)

(ii) With Conc.  $\text{HNO}_3 \rightarrow$  Nitrogen dioxide ( $\text{NO}_2$ )

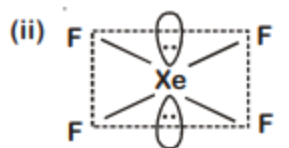


(conc.)

OR

(a)

(i)  $4\text{H}_3\text{PO}_3 \rightarrow 3\text{H}_3\text{PO}_4 + \text{PH}_3$



(b) (i) Due to small size, fluorine has less negative electron gain enthalpy. The oxidizing power is dependent upon hydration energy, bond dissociation energy as well as electron gain enthalpy. Due to small size, fluorine has very high hydration energy, therefore  $\text{F}_2$  acts as strong oxidising agent.

(ii) As electronegativity of atom decreases, acidic strength of oxide decreases, hence acidic character decreases from  $\text{N}_2\text{O}_3$  to  $\text{Bi}_2\text{O}_3$

(c)  $5\text{SO}_2 + 2\text{MnO}_4^- + 2\text{H}_2\text{O} \rightarrow 5\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{Mn}^{2+}$

