EXAM DATE : 12/03/2019

**SET-1**

Code No. 56/1/1

# Class XII

# CHEMISTRY (Theory)

## (CBSE 2019)

Time : 3 Hrs. Max. Marks : 70

***GENERAL INSTRUCTIONS :***

*(i) All questions are compulsory.*

*(ii) Section **A** : Q. no. **1** to **5** are very short-answer questions and carry **1** mark each.*

*(iii) Section **B** : Q. no. **6** to **12** are short-answer questions and carry **2** marks each.*

*(iv) Section **C** : Q. no. **13** to **24** are also short-answer questions and carry **3** marks each.*

*(v) Section **D** : Q. 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

1. Out of NaCl and AgCl, which one shows Frenkel defect and why? [1]

2. Arrange the following in increasing order of boiling points : [1]

$(CH_3)_3N$, $C_2H_5OH$, $C_2H_5NH_2$

3. Why are medicines more effective in colloidal state? [1]

OR

What is difference between an emulsion and a gel?

4. Define ambidient nucleophile with an example. [1]

5. What is the basic structural difference between glucose and fructose? [1]

OR

Write the products obtained after hydrolysis of lactose.

## Section-B

6. Write balanced chemical equations for the following processes : **[2]**

(i) $XeF_2$ undergoes hydrolysis.

(ii) $MnO_2$ is heated with conc. HCl.

**OR**

Arrange the following in order of property indicated for each set :

(i) $H_2O$, $H_2S$, $H_2Se$, $H_2Te$ – increasing acidic character

(ii) HF, HCl, HBr, HI – decreasing bond enthalpy

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. **[2]**

8. For a reaction **[2]**

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below:

(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)

(2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(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?

9. When $MnO_2$ is fused with KOH in the presence of $KNO_3$ 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 KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C), and (D). **[2]**

10. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. 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)

11. Out of $[CoF_6]^{3-}$ and $[Co(en)_3]^{3+}$, which one complex is **[2]**

(i) paramagnetic

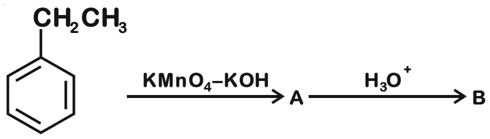
(ii) more stable

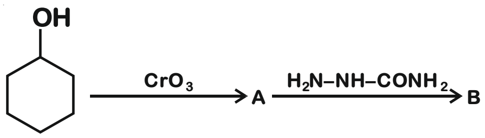
(iii) inner orbital complex and

(iv) high spin complex

(Atomic no. of Co = 27)

12. Write structures of compounds A and B in each of the following reactions : [2]

(i) 

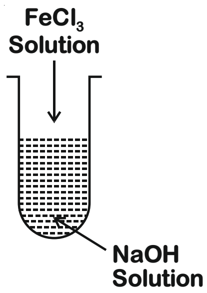
(ii) 

## Section-C

13. The decomposition of $NH_3$ on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3}$ $Ms^{-1}$, how long will it take to reduce the initial concentration of $NH_3$ from 0.1 M to 0.064 M. [3]

14. (i) What is the role of activated charcoal in gas mask? [3]

(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 sol represented?



(iii) How does chemisorption vary with temperature?

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

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

(Given: Freezing point of pure water = 273.15 K) [3]

17. (a) Name the method of refining which is [3]

(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 $Cu_2S$.

18. Give reasons for the following: [3]

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

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

(iii) Actinoids show irregularities in their electronic configuration.

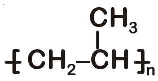
19. Write the structures of monomers used for getting the following polymers: [3]

(i) Nylon-6, 6

(ii) Glyptal

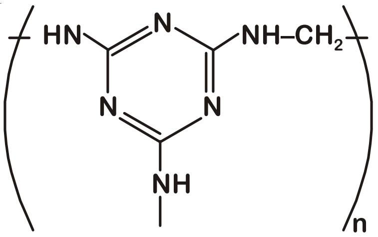
(iii) Buna-S

**OR**



(i) Is $\left[CH_2-\overset{\overset{\displaystyle CH_3}{|}}{CH}\right]_n$ 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?

20. (i) What type of drug is used in sleeping pills? [3]

(ii) What type of detergents are sued 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

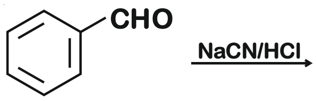
21. (i) Out of $(CH_3)_3C–Br$ and $(CH_3)_3C–I$, which one is more reactive towards $S_N1$ and why? [1]

(ii) Write the product formed when p-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification? [1]

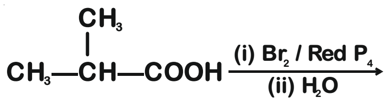
(iii) Why dextro and laevo-rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation? [1]

22. An aromatic compound 'A' on heating with $Br_2$ and KOH forms a compound 'B' of molecular formula $C_6H_7N$ which on reacting with $CHCl_3$ and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C. [3]

23. Complete the following reactions : [3]

(i) 

(ii) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \rightarrow$

(iii) 
$CH_3-\overset{CH_3}{\overset{|}{CH}}-COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Br_2\text{ / Red }P_4}$

**OR**

Write chemical equations for the following reactions :

(i) Propanone is treated with dilute $Ba(OH)_2$.

(ii) Acetophenone is treated with Zn(Hg)/Conc.HCl.

(iii) Benzoyl chloride is hydrogenated in presence of $Pd/BaSO_4$.

24. Differentiate between the following [3]

(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

## Section-D

25. $E^\circ_{cell}$ for the given redox reaction is 2.71 V [5]

$Mg_{(s)} + Cu^{2+}_{(0.01\ M)} \longrightarrow Mg^{2+}_{(0.001\ M)} + Cu_{(s)}$

Calculate $E_{cell}$ for the reaction. Write the direction of flow of current when an external opposite potential applied is

(i) less than 2.71 V and

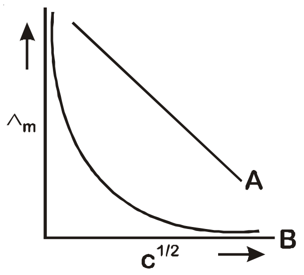
(ii) greater than 2.71 V

**OR**

(a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ 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 : Fe = 56 g $mol^{-1}$, Zn = 65.3 g $mol^{-1}$, 1 F = 96500 C $mol^{-1}$)

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



Answer the following :

(i) Predict the nature of electrolytes A and B.

(ii) What happens on extrapolation of $\wedge_m$ to concentration approaching zero for electrolytes A and B ?

26. (a) How do you convert the following : **[5]**

(i) Phenol to Anisole

(ii) Ethanol to Propan-2-ol

(b) Write mechanism of the following reaction :

$$C_2H_5OH \xrightarrow[443\text{ K}]{H_2SO_4} CH_2 = CH_2 + H_2O$$

(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.

27. (a) Give reasons for the following: **[5]**

(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 $HNO_3$ and

(ii) conc. $HNO_3$

**OR**

(a) (i) Write the disproportionation reaction of $H_3PO_3$.

(ii) Draw the structure of $XeF_4$.

(b) Account for the following :

(i) Although Fluorine has less negative electron gain enthalpy yet $F_2$ is strong oxidizing agent.

(ii) Acidic character decreases from $N_2O_3$ to $Bi_2O_3$ in group 15.

(c) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.

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# Class XII
# CHEMISTRY (Theory)
## (CBSE 2019)
## SOLUTION

***GENERAL INSTRUCTIONS :***

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(vii) *Use log tables if necessary. Use of calculators is **not** allowed.*

## Section-A

1. Out of NaCl and AgCl, which one shows Frenkel defect and why? **[1]**

Sol. AgCl shows Frenkel defect. [½]

Due to large difference in size of cation ($Ag^+$) and anion ($Cl^-$), AgCl shows Frenkel defect. [½]

2. Arrange the following in increasing order of boiling points : **[1]**

$(CH_3)_3N$, $C_2H_5OH$, $C_2H_5NH_2$

Sol. Boiling point : $(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$ **[1]**

3. Why are medicines more effective in colloidal state? **[1]**

**OR**

What is difference between an emulsion and a gel?

**Sol.** Medicines are more effective in colloidal state because colloids have larger surface area and hence their absorption, assimilation and digestion become easier. **[1]**

**OR**

**[1]**

| | Dispersed phase | Dispersion medium |
|---|---|---|
| Emulsion | liquid | liquid |
| Gel | liquid | solid |

4. Define ambidient nucleophile with an example. **[1]**

**Sol.** Nucleophiles which have more than one donor site (nucleophilic centre) are called ambident nucleophiles. **[½]**

For example : $^{-}CN$, $^{-}SCN$ **[½]**

5. What is the basic structural difference between glucose and fructose? **[1]**

**OR**

Write the products obtained after hydrolysis of lactose.

**Sol.** Glucose is an aldohexose and fructose is a ketohexose. **[1]**

**OR**

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\beta\text{ - D - Galactose}}{C_6H_{12}O_6} + \underset{\beta\text{ - D - Glucose}}{C_6H_{12}O_6}$$ **[1]**

## Section-B

6. Write balanced chemical equations for the following processes : **[2]**

(i) $XeF_2$ undergoes hydrolysis.

(ii) $MnO_2$ is heated with conc. HCl.

**OR**

Arrange the following in order of property indicated for each set :

(i) $H_2O, H_2S, H_2Se, H_2Te$ – increasing acidic character

(ii) HF, HCl, HBr, HI – decreasing bond enthalpy

**Sol.** (i) $2XeF_2(s) + 2H_2O(l) \rightarrow 2Xe(g) + O_2(g) + 4HF(aq)$ **[1]**

(ii) $MnO_2 + \underset{\text{conc.}}{4HCl} \rightarrow MnCl_2 + Cl_2 + 2H_2O$ **[1]**

**OR**

(i) Acidic character

$H_2O < H_2S < H_2Se < H_2Te$

Down the group, bond dissociation enthalpy decreases, so acidic character increases. **[1]**

(ii) Bond enthalpy H–F > H–Cl > H–Br > H–I

As size of halogen increases, bond length increases, bond strength decreases. **[1]**

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. **[2]**

Sol. Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. **[1]**

Let us consider two volatile components 1 and 2 having mole fraction $x_1$ and $x_2$ in the solution.

For component 1

$p_1 = p_1^{\circ} x_1$

Similarly for component 2

$p_2 = p_2^{\circ} x_2$

$p_1^{\circ}$ and $p_2^{\circ}$ are the pressure of the two components in the pure state

Therefore, $P_{Tot} = p_1 + p_2 = p_1^{\circ} x_1 + p_2^{\circ} x_2$

Characteristics of the solution which obeys Raoult's law at all concentrations

(1) The total vapour pressure of the solution always lies between the vapour pressures of pure components. **[½]**

(2) Total vapour pressure over the solution varies linearly with mole fraction of component 1 or 2. **[½]**

8. For a reaction **[2]**

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below:

(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)

(2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(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?

Sol. Slowest step is

$H_2O_2 + I^- \rightarrow H_2O + IO^-$

(i) Rate law; $r = k[H_2O_2][I^-]$ **[1]**

(ii) Overall order of reaction = 2 **[½]**

(iii) Since 1st step is the slow step so, it is the rate determining step. **[½]**

9. When $MnO_2$ is fused with KOH in the presence of $KNO_3$ 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 KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C), and (D). **[2]**

**Sol.** $$2MnO_2 + 4KOH + \underset{(\text{from } KNO_3)}{O_2} \longrightarrow \underset{\substack{(\text{dark green})\\(A)}}{2K_2MnO_4} + 2H_2O$$

$$3MnO_4^{2-} + \underset{(\text{acidic medium})}{4H^+} \longrightarrow \underset{\substack{(\text{purple})\\(B)}}{2MnO_4^-} + MnO_2 + 2H_2O$$

B in basic medium converts $I^-$ to $IO_3^-$

$$2MnO_4^- + H_2O + I^- \longrightarrow 2MnO_2 + 2OH^- + \underset{(C)}{IO_3^-}$$

B in acidic medium converts $I^-$ to $I_2$

$$10I^- + 2MnO_4^- + 16H^+ \longrightarrow 2Mn^{2+} + 8H_2O + \underset{(D)}{5I_2}$$

[A] = $K_2MnO_4$ = Potassium manganate [½]

[B] = $KMnO_4$ = Potassium permanganate [½]

[C] = $KIO_3$ = Potassium iodate [½]

[D] = $I_2$ = Iodine [½]

10. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex. [2]

**OR**

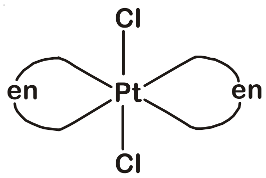
Using IUPAC norms write the formulae for the following :

(i) Hexaamminecobalt(III) sulphate

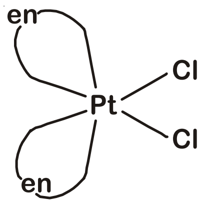
(ii) Potassium trioxalatochromate(III)

**Sol.** $[Pt(en)_2Cl_2]$ – Dichloridobis(ethane-1,2-diammine)platinum (II) [1]

Geometrical isomer :



trans isomer [½]



cis isomer [½]

**OR**

(i) $[Co(NH_3)_6]_2(SO_4)_3$ [1]

(ii) $K_3[Cr(C_2O_4)_3]$ [1]

11. Out of $[CoF_6]^{3-}$ and $[Co(en)_3]^{3+}$, which one complex is **[2]**

(i) paramagnetic

(ii) more stable

(iii) inner orbital complex and

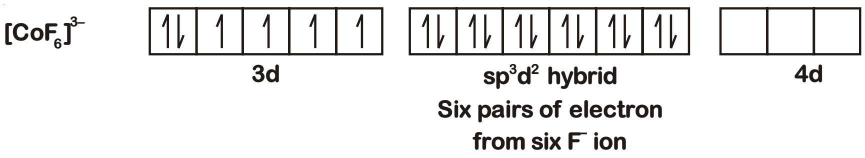
(iv) high spin complex

(Atomic no. of Co = 27)

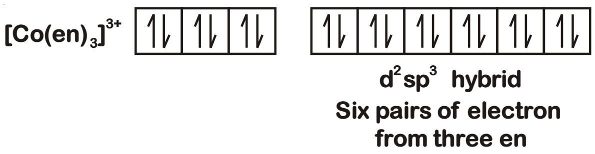
Sol. Co(Z = 27) = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

$Co^{+3} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$

$F^-$ is weak field ligand



en is strong field ligand



(i) $[CoF_6]^{3-}$ is paramagnetic due to presence of four unpaired electrons **[½]**

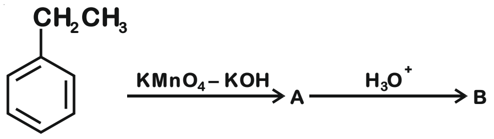
(ii) $[Co(en)_3]^{3+}$ is more stable due to chelation **[½]**

(iii) $[Co(en)_3]^{3+}$ forms inner orbital complex ($d^2sp^3$) **[½]**

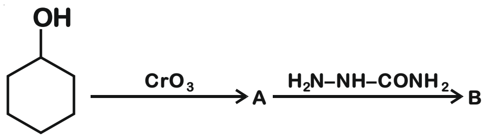
(iv) $[CoF_6]^{3-}$ forms high spin complex ($sp^3d^2$) **[½]**

12. Write structures of compounds A and B in each of the following reactions : **[2]**

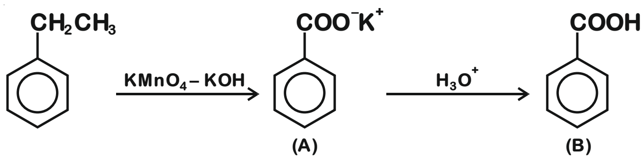
(i)



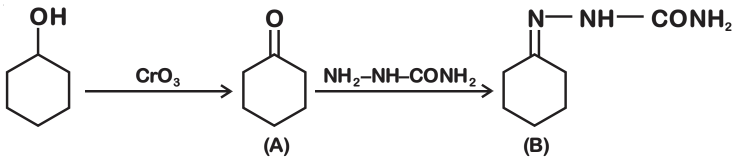
(ii)



Sol. (i) **[1]**



(ii) **[1]**



## Section-C

13. The decomposition of $NH_3$ on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3}$ $Ms^{-1}$, how long will it take to reduce the initial concentration of $NH_3$ from 0.1 M to 0.064 M. [3]

Sol. For zero order reaction

$A_t = A_0 - kt$ [½]

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

$A_t = 0.064$ M

$A_0 = 0.1$ M [½]

$\therefore \quad t = \dfrac{A_0 - A_t}{k}$ [½]

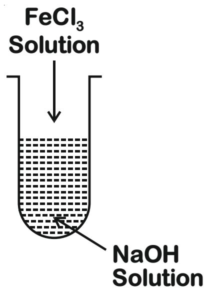
$= \dfrac{0.1 - 0.064}{4 \times 10^{-3}}$ [½]

$= \dfrac{36 \times 10^{-3}}{4 \times 10^{-3}}$

= 9 second [1]

14. (i) What is the role of activated charcoal in gas mask? [3]

(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 sol represented?



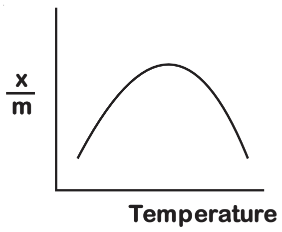
(iii) How does chemisorption vary with temperature?

Sol. (i) In gas mask activated charcoal is used to adsorb poisonous gases in coal mines. [1]

(ii) If $FeCl_3$ is added to NaOH, a negatively charged sol is obtained with adsorption of $OH^-$ ions.

Sol is represented as $\underset{\text{(negatively charged)}}{Fe_2O_3 . xH_2O/OH^-}$ . [1]

(iii) With increase in temperature chemisorption first increases as molecules get activation energy for adsorption. After certain temperature, chemisorption decreases. [1]



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

Sol. Volume of unit cell = $(300\text{ pm})^3$

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

$$= 2.7 \times 10^{-23}\text{ cm}^3$$ [½]

Volume of 108 g of element $= \frac{\text{mass}}{\text{density}} = \frac{108\text{ g}}{10.8\text{ g cm}^{-3}} = 10\text{ cm}^3$ [½]

Number of unit cells in this volume $= \frac{10\text{ cm}^3}{2.7 \times 10^{-23}\text{ cm}^3/\text{unit cell}} = \frac{10^{24}}{2.7}\text{ unit cells}$ [1]

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

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

$= 1.48 \times 10^{24}$ atoms [1]

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

(Given: Freezing point of pure water = 273.15 K) [3]

Sol. Molality(m) $= \frac{n}{W_{\text{solvent(kg)}}}$ [½]

**For Sucrose solution :**

$$m = \frac{\frac{4}{342}}{\frac{96}{1000}} = \frac{4}{342} \times \frac{1000}{96} = 0.122\text{ m}$$ [½]

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

$(\Delta T_f)_1 = K_f m = K_f \times 0.122$ [½]

$2 = K_f \times 0.122$ ...(1)

**For glucose solution :**

$$m = \frac{\frac{5}{180}}{\frac{95}{1000}} = \frac{5}{180} \times \frac{1000}{95} = 0.292\text{ m}$$ [½]

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

Dividing eqn. (2) by (1)

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

$(\Delta T_f)_2 = \frac{0.292}{0.122} \times 2 = 4.79$ [½]

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

Freezing point of glucose solution will be 268.36 K [½]

17. (a) Name the method of refining which is [3]

(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 $Cu_2S$.

Sol. (a) (i) Zone refining [1]

(ii) Distillation [1]

(b)
- The sulphide ores are roasted to give oxides

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$ [½]

- The oxide can easily be reduced to metallic copper using coke

$Cu_2O + C \longrightarrow 2Cu + CO$ [½]

18. Give reasons for the following: [3]

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

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

(iii) Actinoids show irregularities in their electronic configuration.

Sol. (i) Transition elements and their compounds act as catalysts. This is because of their ability to adopt multiple oxidation states and to form complexes. [1]

(ii) E° value for $(Mn^{2+}|Mn)$ is negative whereas for $(Cu^{2+}|Cu)$ is positive as the hydration enthalpy of $Cu^{2+}$ ion is not sufficient to compensate the sum of sublimation as well as first and second ionisation enthalpy of copper. [1]

(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. [1]

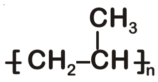
19. Write the structures of monomers used for getting the following polymers: [3]

(i) Nylon-6, 6

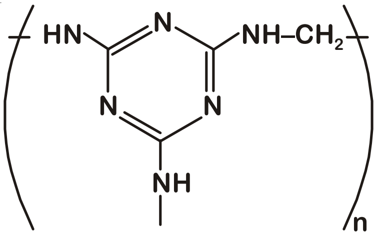
(ii) Glyptal

(iii) Buna-S

**OR**

(i) Is 
$\left[ CH_2-\underset{}{\overset{CH_3}{\overset{|}{C}}}H \right]_n$ a homopolymer or copolymer? Give reason.

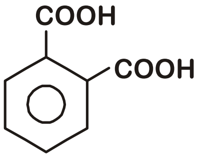
(ii) Write the monomers of the following polymer :



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

**Sol.** (i) Nylon-6,6 : $\underset{\text{Adipic acid}}{HOOC(CH_2)_4COOH} + \underset{\text{Hexamethylenediamine}}{H_2N(CH_2)_6NH_2}$ [1]

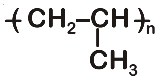
(ii) Glyptal : $\underset{\text{Ethylene glycol}}{HOH_2C–CH_2OH}$ +

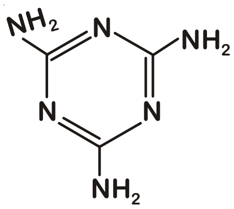


Phthalic acid [1]

(iii) Buna-S : $\underset{\text{1,3-Butadiene}}{CH_2{=}CH–CH{=}CH_2} + \underset{\text{Styrene}}{C_6H_5CH{=}CH_2}$ [1]

**OR**

(i) 
$\left(CH_2–\underset{\underset{CH_3}{|}}{CH}\right)_n$ is homopolymer because only one type of monomer is used in its formation which is $CH_3–CH{=}CH_2$. [1]

(ii) 

Melamine

+ $\underset{\text{Formaldehyde}}{HCHO}$ [1]

(iii) In vulcanization, sulphur forms cross links at the reactive sites of double bonds of natural rubber so the rubber gets stiffened. [1]

20. (i) What type of drug is used in sleeping pills? [3]

(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

**Sol.** (i) Tranquilizers are used in sleeping pills. [1]

(ii) Anionic detergents are used in toothpastes. [1]

(iii) The control of sweetness of food is difficult while using alitame, hence its use as artificial sweetener is not recommended. [1]

**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. [½]

e.g. – Chloramphenicol / Vancomycin / Ofloxacin [½]

(ii) Disinfectants – The chemicals which either kill or prevent the growth of microorganisms are called disinfectants. [½]

e.g. Chlorine or $SO_2$ [½]

(iii) Cationic detergents – They are quaternary ammonium salts of amines with acetates, chlorides or bromides as anions. [½]

e.g. Cetyltrimethylammonium bromide [½]

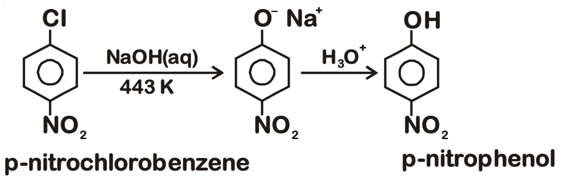
21. (i) Out of $(CH_3)_3C–Br$ and $(CH_3)_3C–I$, which one is more reactive towards $S_N1$ and why? [1]

(ii) Write the product formed when p-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification? [1]

(iii) Why dextro and laevo-rotatory isomers of Butan-2-ol are difficult to separate by fractional distillation? [1]

Sol. (i) $(CH_3)_3C–I$ [½]

Reason: Reactivity towards $S_N1$ depends upon the ease of formation of carbocation. Since C – I bond is weaker than C–Br bond, hence in case of $(CH_3)_3C–I$, carbocation will be formed easily. [½]

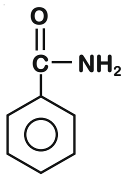
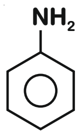
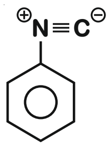
(ii)  [1]

(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. [1]

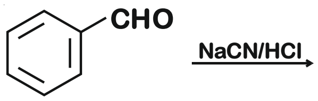
22. An aromatic compound 'A' on heating with $Br_2$ and KOH forms a compound 'B' of molecular formula $C_6H_7N$ which on reacting with $CHCl_3$ and alcoholic KOH produces a foul smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C. [3]

Sol.

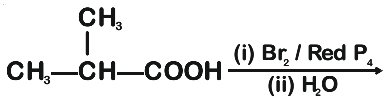
$$\underset{\text{(Aromatic)}}{A} \xrightarrow[\text{KOH}]{Br_2} \underset{(C_6H_7N)}{B} \xrightarrow[\text{KOH}]{CHCl_3} \underset{\text{(Foul smelling)}}{C}$$

| Structure | IUPAC Name | |
|---|---|---|
| A :  | Benzamide | [½ + ½] |
| B :  | Aniline or Benzenamine | [½ +½] |
| C :  | Benzene isonitrile<br>or Isocyanobenzene or Phenylisocyanide | [½ + ½] |

23. Complete the following reactions : [3]

(i) 

(ii) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \rightarrow$

(iii) 

$$CH_3—\underset{}{\overset{CH_3}{\overset{|}{CH}}}—COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Br_2 \text{ / Red } P_4}$$

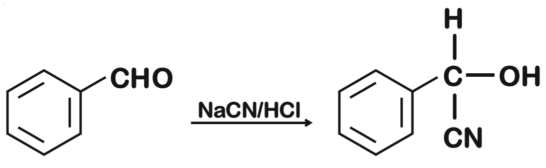
### OR

Write chemical equations for the following reactions :

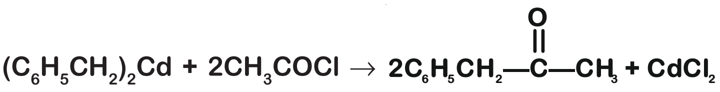
(i) Propanone is treated with dilute $Ba(OH)_2$.

(ii) Acetophenone is treated with Zn(Hg)/Conc.HCl.

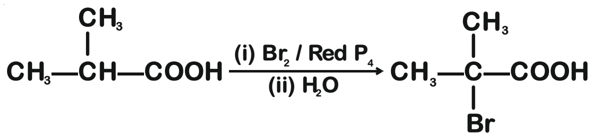
(iii) Benzoyl chloride is hydrogenated in presence of $Pd/BaSO_4$.

**Sol.** (i)  [1]

Cyanohydrin

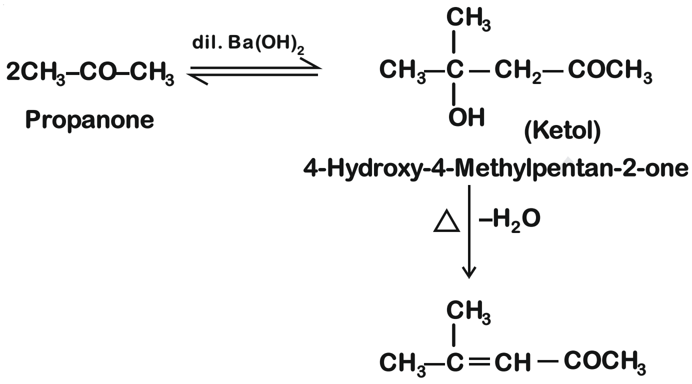
(ii)  [1]

$$(C_6H_5CH_2)_2Cd + 2CH_3COCl \rightarrow 2C_6H_5CH_2\text{—}\overset{\overset{\Large O}{\|}}{C}\text{—}CH_3 + CdCl_2$$

(iii)  [1]

$$CH_3\text{—}\underset{}{\overset{\overset{CH_3}{|}}{C}H}\text{—}COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Br_2 \text{ / Red } P_4} CH_3\text{—}\underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}COOH$$

### OR

(i)  [1]

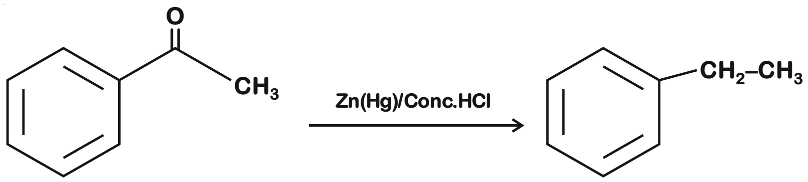
$$2CH_3\text{–}CO\text{–}CH_3 \underset{}{\overset{\text{dil. }Ba(OH)_2}{\rightleftharpoons}} CH_3\text{–}\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{–}CH_2\text{–}COCH_3 \xrightarrow[-H_2O]{\Delta} CH_3\text{–}\overset{\overset{CH_3}{|}}{C}{=}CH\text{–}COCH_3$$

Propanone

(Ketol)

4-Hydroxy-4-Methylpentan-2-one

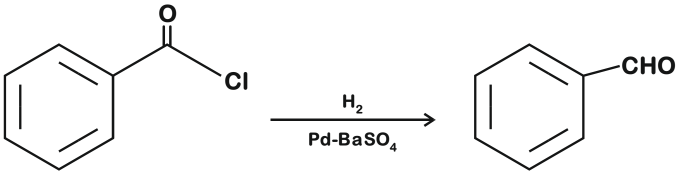
4-Methylpent-3-en-2-one
(Aldol condensation product)

(ii)  [1]

Acetophenone

Ethyl benzene

Clemmensen reduction

(iii)  [1]

Benzoyl chloride

Benzaldehyde

24. Differentiate between the following **[3]**

(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

**Sol.** (i) **[1]**

| | Amylose | | Amylopectin |
|---|---|---|---|
| (a) | Only C1–C4 glycosidic linkage | (a) | C1–C4 glycosidic linkage but, branching occurs by C1–C6 glycosidic linkage |
| (b) | Water soluble component of starch (15-20%) | (b) | Water insoluble component of starch (80-85%) |

(ii) **[1]**

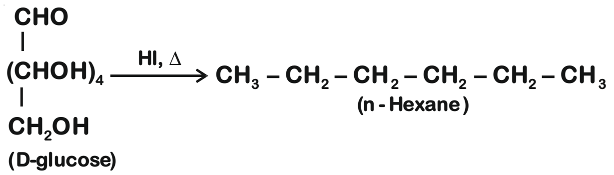
| Peptide linkage | Glycosidic linkage |
|---|---|
| It is –CONH– linkage which exists in proteins formed by condensation of amino acids. | It is –O– linkage. In disaccharide two monosaccharide units are joined through oxygen atom i.e. glycosidic linkage. |

(iii) **[1]**

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

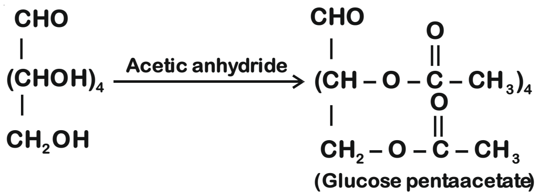
**OR**

(i) **[1]**



$$\underset{\text{(D-glucose)}}{\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH}} \xrightarrow{\text{HI}, \Delta} \underset{\text{(n - Hexane)}}{\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3}$$

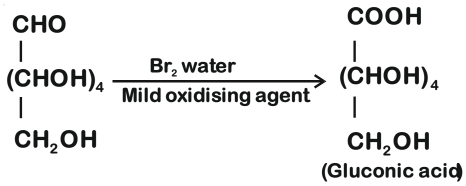
(ii) Formation of pentaacetate.



$$\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH} \xrightarrow{\text{Acetic anhydride}} \underset{\text{(Glucose pentaacetate)}}{\text{CHO}-(\text{CH}-\text{O}-\overset{\overset{\text{O}}{||}}{\text{C}}-\text{CH}_3)_4-\text{CH}_2-\text{O}-\overset{\overset{\text{O}}{||}}{\text{C}}-\text{CH}_3}$$

**[1]**

(iii) **[1]**



$$\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH} \xrightarrow[\text{Mild oxidising agent}]{\text{Br}_2\text{ water}} \underset{\text{(Gluconic acid)}}{\text{COOH}-(\text{CHOH})_4-\text{CH}_2\text{OH}}$$

# Section-D

25. $E^\circ_{cell}$ for the given redox reaction is 2.71 V **[5]**

$Mg_{(s)} + Cu^{2+}_{(0.01\ M)} \longrightarrow Mg^{2+}_{(0.001\ M)} + Cu_{(s)}$

Calculate $E_{cell}$ for the reaction. Write the direction of flow of current when an external opposite potential applied is

(i) less than 2.71 V and

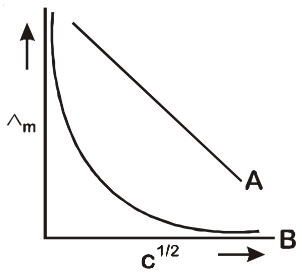
(ii) greater than 2.71 V

**OR**

(a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ 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 : Fe = 56 g $mol^{-1}$, Zn = 65.3 g $mol^{-1}$, 1 F = 96500 C $mol^{-1}$)

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



Answer the following :

(i) Predict the nature of electrolytes A and B.

(ii) What happens on extrapolation of $\wedge_m$ to concentration approaching zero for electrolytes A and B ?

**Sol.** $Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$

$$Q = \frac{[Mg^{2+}][Cu]}{[Mg][Cu^{2+}]} = \frac{(0.001)(1)}{(1)(0.01)} = 0.1$$ **[½]**

Using Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log Q$$ **[1]**

$$= 2.71 - \frac{0.0591}{2}\log 0.1$$ **[½]**

= 2.74 V **[1]**

(i) Since the voltage applied externally is less than $E_{cell}$ then the direction of flow of current is from cathode to anode **[1]**

(ii) When the external voltage applied exceeds $E_{cell}$, the direction of flow of current is from anode to cathode. **[1]**

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

**OR**

(a) $I = 2\ A$

$W_1 = 2.8\ g$

$Fe^{2+}(aq) + 2e^- \longrightarrow Fe(s)$

96500 × 2 C of charge is required to deposit = 56 g of Fe [½]

9650 C of charge is required to deposit = 2.8 g of Fe [½]

$\because \quad Q = It \text{ or } t = \frac{9650}{2} = 4825\ s$ [½]

Using Faraday's second law of electrolysis

$$\frac{W_1 \text{ (Weight of Fe deposited)}}{W_2 \text{ (Weight of Zn deposited)}} = \frac{E_1 \text{ (Equivalent weight of Fe)}}{E_2 \text{ (Equivalent weight of Zn)}}$$ [½]

$$\frac{2.8}{W_2} = \frac{56/2}{65.3/2} = \frac{56}{65.3}$$ [½]

or $W_2 = 3.265\ g$ [½]

(b) Electrolyte A is strong electrolyte [½]

& Electrolyte B is weak electrolyte [½]

On extrapolation of $\wedge_m$ to concentration approaching zero for strong electrolytes, we get the value of $\wedge^\circ_m$ *i.e.* molar conductance at infinite dilution

In the case of weak electrolytes, $\wedge_m$ increases steeply on dilution. Therefore, $\wedge^\circ_m$ cannot be obtained by extrapolation. [1]

26. (a) How do you convert the following : [5]

(i) Phenol to Anisole

(ii) Ethanol to Propan-2-ol

(b) Write mechanism of the following reaction :

$$C_2H_5OH \xrightarrow[443\ K]{H_2SO_4} CH_2 = CH_2 + H_2O$$

(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.

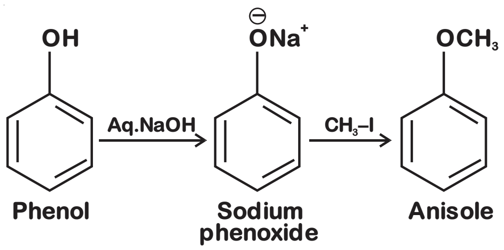
(b) Write the reaction involved in the following :

(i) Reimer-Tiemann reaction

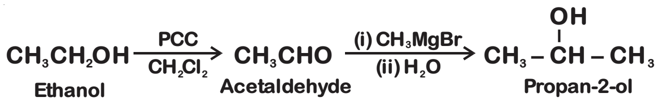
(ii) Friedal-Crafts Alkylation of Phenol

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

**Sol.** (a) (i) [1]



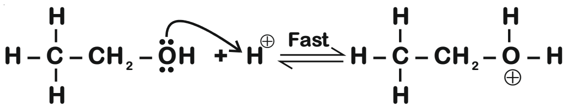
(ii) [1]



$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[CH_2Cl_2]{PCC} \underset{\text{Acetaldehyde}}{CH_3CHO} \xrightarrow[(ii)\,H_2O]{(i)\,CH_3MgBr} \underset{\text{Propan-2-ol}}{CH_3-\overset{\overset{OH}{|}}{C}H-CH_3}$$

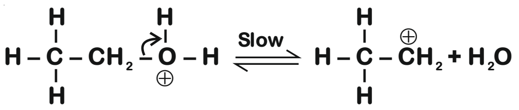
(b) Mechanism of elimination reaction

**Step-1 :** [½]



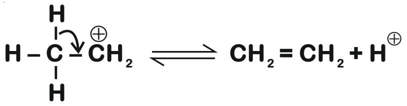
$$H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-\ddot{\underset{\cdot\cdot}{O}}H + \overset{\oplus}{H} \overset{Fast}{\rightleftharpoons} H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-\overset{\overset{H}{|}}{\underset{\oplus}{O}}-H$$

**Step-2 :** [1]



$$H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-\overset{\overset{H}{|}}{\underset{\oplus}{O}}-H \overset{Slow}{\rightleftharpoons} H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\oplus}{C}H_2 + H_2O$$

**Step-3 :** [½]

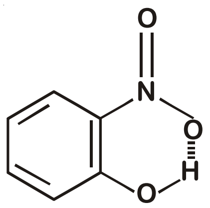


$$H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\oplus}{C}H_2 \rightleftharpoons CH_2=CH_2+\overset{\oplus}{H}$$

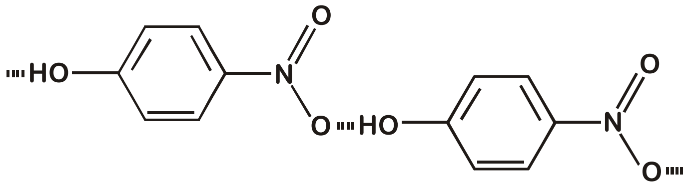
(c) –OH group of phenol is activating group which increases the electron density at ortho/para position within the benzene ring so that electrophile can easily attack at ortho/para position in phenol than in benzene. [1]

**OR**

(a) (i) o-Nitrophenol is steam volatile due to intramolecular hydrogen bonding while p-nitrophenol is less volatile due to intermolecular hydrogen bonding [1]

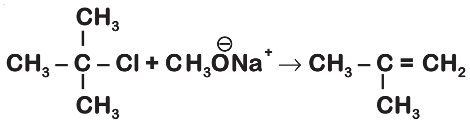


o-Nitrophenol
(Intramolecular
H-bonding)



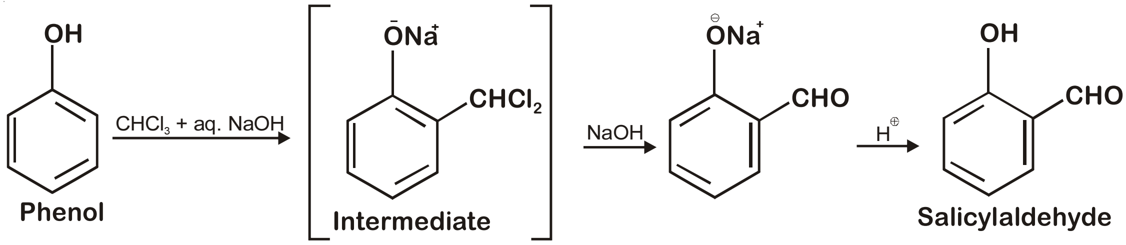
p-Nitrophenol
(Intermolecular H-bonding)

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

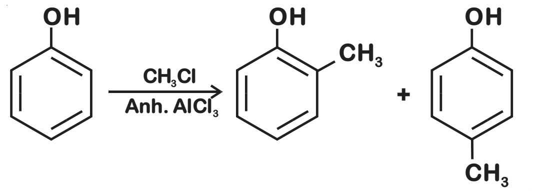


$$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-Cl + CH_3\overset{\ominus}{O}\overset{+}{Na} \rightarrow CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2$$ [1]

(b) (i) Reimer-Tiemann reaction [1]



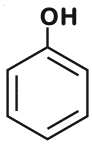
(ii) Friedel Craft's reaction of phenol



Phenol o-cresol p-cresol **[1]**

(c) Ethanol and phenol can be chemically distinguished by Iodoform test **[1]**

$$C_2H_5OH \xrightarrow[NaOH]{I_2} [CH_3CHO] \longrightarrow \underset{\text{Yellow precipitate}}{CHI_3\downarrow}$$



$\xrightarrow[NaOH]{I_2}$ Does not give yellow precipitate

27. (a) Give reasons for the following : **[5]**

   (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 $HNO_3$ and

   (ii) conc. $HNO_3$

**OR**

(a) (i) Write the disproportionation reaction of $H_3PO_3$.

(ii) Draw the structure of $XeF_4$.

(b) Account for the following :

(i) Although Fluorine has less negative electron gain enthalpy yet $F_2$ is strong oxidizing agent.

(ii) Acidic character decreases from $N_2O_3$ to $Bi_2O_3$ in group 15.

(c) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.

**Sol.** (a) (i) Sulphur in vapor state exists as $S_2$ which has two unpaired electrons in the pi-antibonding molecular orbital and is paramagnetic **[1]**

(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. **[1]**

(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 Gibb's energy change. Hence, ozone is thermodynamically less stable than oxygen **[1]**

(b) (i) With dil. $HNO_3 \longrightarrow$ Nitrogen monoxide (NO)

$$3Cu + \underset{\text{(dil.)}}{8HNO_3} \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$ **[1]**

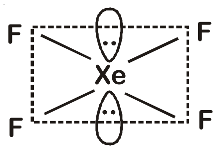
(ii) With Conc.$HNO_3 \longrightarrow$ Nitrogen dioxide ($NO_2$)

$$Cu + \underset{\text{(conc)}}{4HNO_3} \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$ **[1]**

**OR**

(a) (i) $4H_3PO_3 \longrightarrow 3H_3PO_4 + PH_3$ **[1]**

(ii) **[1]**



(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 $F_2$ acts as strong oxidising agent. **[1]**

(ii) As electronegativity of atom decreases, acidic strength of oxide decreases, hence acidic character decreases from $N_2O_3$ to $Bi_2O_3$ **[1]**

(c) $5SO_2 + 2MnO_4^- + 2H_2O \rightarrow 5SO_4^{2-} + 4H^+ + 2Mn^{2+}$. **[1]**

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