LIBERTY PAPER SET

STD. 12 : Chemistry

Full Solution

Time : 3 Hours

ASSIGNMENTMENT PAPER 6

Part A

1. (A) **2.** (C) **3.** (B) **4.** (A) **5.** (C) **6.** (C) **7.** (B) **8.** (C) **9.** (B) **10.** (B) **11.** (C) **12.** (A) **13.** (A) **14.** (C)
15. (A) **16.** (B) **17.** (D) **18.** (B) **19.** (A) **20.** (A) **21.** (C) **22.** (B) **23.** (C) **24.** (C) **25.** (A) **26.** (B)
27. (D) **28.** (C) **29.** (B) **30.** (C) **31.** (B) **32.** (B) **33.** (A) **34.** (D) **35.** (C) **36.** (C) **37.** (C) **38.** (B)
39. (A) **40.** (D) **41.** (D) **42.** (B) **43.** (A) **44.** (A) **45.** (C) **46.** (B) **47.** (C) **48.** (B) **49.** (D) **50.** (B)

Part B

Section A

➢ **Write the answer of the following questions : (Each carries 2 Mark)**

1.

➥ $\wedge^0_{m(HAc)} = \lambda^0_{H+} + \lambda^0_{Ac-} = \lambda^0_{H+} + \lambda^0_{Cl-} + \lambda^0_{Ac-} + \lambda^0_{Na+} - \lambda^0_{Cl-} - \lambda^0_{Na+}$

$= \wedge^0_{m\ (HCl)} + \wedge^0_{m\ (NaAc)} - \wedge^0_{m\ (NaCl)}$

$= (425.9 + 91.0 - 126.4)\ S\ cm^2\ mol^{-1}$

$= 390.5\ S\ cm^2\ mol^{-1}$

2.

➥ $Co \rightarrow Co^{+2} + 2e^-$

$\underline{Ni^{+2} + 2e^- \rightarrow Ni}$

$Co + Ni^{+2} \rightarrow Co^{+2} + Ni$

$E^0_{cell} = E^0_{Cathod} - E^0_{Anode}$

$= -0.25 - (-0.28)$

$= -0\ .25 + 0.28$

$E^0_{cell} = -0.03\ V$

$E^0_{cell} = \frac{0.059}{n} \log K_C$

$n = 2$

$\therefore 0.03 = \frac{0.059}{n} \log K_C$

$\therefore \log K_C = \frac{2 \times 0.03}{0.059}$

$\therefore \log K_C = 1.016$

$\therefore K_C = \text{Antilog}\ (1.016)$

$\therefore K_C = 10.375$

$\therefore K_C \approx 10$

3.

➥ At $T_1 = 293$ K, rate constant $= k_1$

At $T_2 = 313$ K, rate constant $= k_2 = 4k_1$

$R = 8.314\ J\ K^{-1}\ mol^{-1}$

➥ According to Arrhenius equation,

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 \times T_2}\right]$$

$$\log\frac{4k_1}{k_1} = \frac{E_a}{2.303 \times 8.314}\left[\frac{313 - 293}{293 \times 313}\right]$$

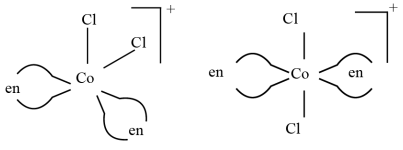
$$E_a = \frac{\log 4 \times 2.303 \times 8.314 \times 293 \times 313}{20}$$

$$E_a = \frac{0.6021 \times 2.303 \times 8.314 \times 293 \times 313}{20}$$

$E_a = 52863.33$ J/mol $= 52.863$ kJ/mol

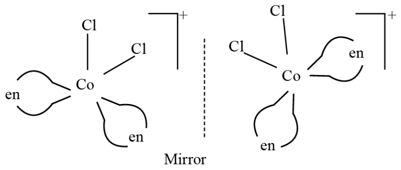
4.

➥ (i) $[CoCl_2(en)_2]^+$ Geometrical isomerism



Cis Trans

- Optical isomerism : Since only cis isomer is optically active, it shows optical isomerism.

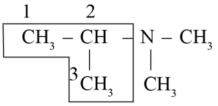


5.

- $$\underset{\text{Ethene}}{CH_2=CH_2} + H\,Br \longrightarrow \underset{\text{Bromoethane}}{2\,CH_3-CH_2-Br} + 2\,Na \xrightarrow{\text{Dry ether}} \underset{\text{Butane}}{CH_3-CH_2-CH_2-CH_3} + 2\,NaBr$$

6.

- (i)



$$CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_3}{|}}{N}-CH_3$$

N, N – Dimethyl propan-2-amine.

(ii) $CH_3-CH_2-NH-COCH_3$

N – Ethylethanamide.

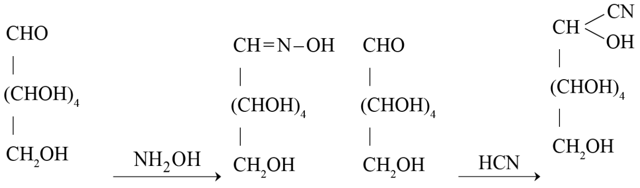
7.

- “The carbohydrates are stored in animal body as glycogen.”
- It is also known as animal starch because its structure is similar to amylopectin and is rather more highly branched.
- It is present in liver, muscles and brain.
- When the body needs glucose, enzymes break down glycogen into glucose.

8.

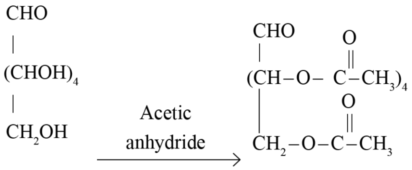
- Glucose reacts with hydroxylamine to form an oxime and adds a molecule of hydrogen cyanide to give cyanohydrin.

These reactions confirm the presence of carbonyl group $(>C=O)$ in glucose.



$$\begin{array}{c}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{array} \xrightarrow{NH_2OH} \begin{array}{c}CH=N-OH\\|\\(CHOH)_4\\|\\CH_2OH\end{array} \qquad \begin{array}{c}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{array} \xrightarrow{HCN} \begin{array}{c}CH\begin{matrix}CN\\OH\end{matrix}\\|\\(CHOH)_4\\|\\CH_2OH\end{array}$$

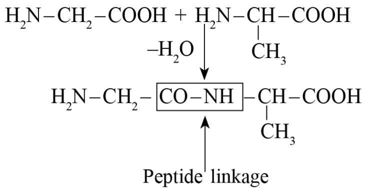
- Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five –OH groups. Since, it exists as a stable compound, five –OH groups should be attached to different carbon atoms.



$$\begin{array}{c}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{array} \xrightarrow[\text{anhydride}]{\text{Acetic}} \begin{array}{l}CHO\\|\\(CH-O-\overset{\overset{O}{\|}}{C}-CH_3)_4\\|\\CH_2-O-\overset{\overset{O}{\|}}{C}-CH_3\end{array}$$

9.

- Proteins are the polymers of α-amino acids and they are connected to each other by peptide bond or peptide linkage.
- Chemically peptide linkage is an amide formed between –COOH group and $-NH_2$ group.
- *"The reaction between two molecules of similar or different amino acids, proceeds through the combination of the amino group of one molecule with the carboxyl group of the other. This results in the elimination of water molecule and formation of a peptide bond – CO – NH –."*
- The product of the reaction is called a dipeptide because it is made up of two amino acids.
- For example when carboxyl group of glycine combines with the amino group of alanine we get a dipeptide glycylalanine.



$$H_2N-CH_2-COOH + H_2N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH \xrightarrow{-H_2O} H_2N-CH_2-\boxed{CO-NH}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$$

Glycylalanine (Gly-Ala)

- The third amino acids combines to a dipeptide, the product is called a tripeptide.
- A tripeptide contains three amino acids linked by two peptide linkages.
- Similarly, when four, five or six amino acids are linked to the respective products are known as tetrapeptide, pentapeptide or hexapeptide, respectively.
- When the number of such amino acids is more than ten, then the products are called polypeptides.
- A polypeptide with more than hundred amino acid residues, having molecular mass higher than 10,000 u is called a protein.
- However, the distinction between a polypeptide and a protein is not very sharp. Polypeptides with fewer amino acids are likely to be called proteins if they ordinarily have a well defined conformation of a protein such as insulin which contains 51 amino acids.

10.

- Iron and steels are the most important construction materials.
- Their production is based on the reduction of iron oxides, the removal of impurities and the addition of carbon and alloying metals such as Cr, Mn and Ni.
- Some compounds are manufactured for special purposes such as TiO for the pigment industry and MnO_2 for use in dry battery cells.
- The battery industry also requires Zn and Ni/Cd.
- UK 'copper' coins are copper-coated steel. The 'silver' UK coins are a Cu/Ni alloy. Many of the metals and/or their compounds are essential catalysts in the chemical industry.
- V_2O_5 catalyses the oxidation of SO_2 in the manufacture of sulphuric acid.
- $TiCl_4$ with $Al(CH_3)_3$ forms the basis of the Ziegler catalysts used to manufacture polyethylene (polythene).
- Iron catalysts are used in the Haber process for the production of ammonia from N_2/H_2 mixtures. Nickel catalysts enable the hydrogenation of fats to proceed.
- In the Wacker process the oxidation of ethyne to ethanal is catalysed by $PdCl_2$. Nickel complexes are useful in the polymerisation of alkynes and other organic compounds such as benzene. The photographic industry relies on the special light-sensitive properties of AgBr.

11.

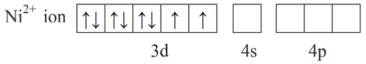
- *"Transition metals are large in size and contain lots of interstitial sites. Transition elements can trap atoms of other elements (that have small atomic size), such as H, C, N, in the interstitial sites of their crystal lattices. The resulting compounds are called interstitial compounds."*

- They are usually non stoichiometric and are neither typically ionic nor covalent,
- For example, TiC, Mn_4N, Fe_3H, $VH_{0.56}$ and $TiH_{1.7}$, etc.
- These compounds are referred to as interstitial compounds.
- The principal physical and chemical characteristics of these compounds are as follows :
  - They have high melting points, higher than those of pure metals.
  - They are very hard, some borides approach diamond in hardness.

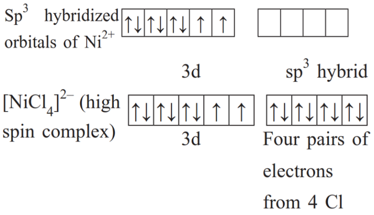
    They retain metallic conductivity.
  - They are chemically inert.

12.

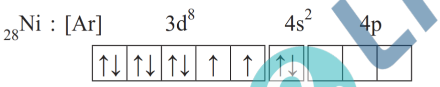
- In $[NiCl_4]^{2-}$ nickel is in +2 oxidation state and has the electronic configuration



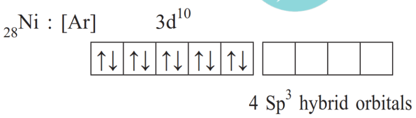
- Cl^- is weak ligand so electron does not get paired.
- In tetrahedral complexes one s and three p orbitals are hybridized to form four equivalent orbitals oriented tetrahedrally.



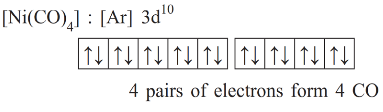
- Each Cl^- ion donates a pair of electrons. The compounds paramagnetic since, it contains two unpaired electrons, and tetrahedral complex.
- In $[Ni(CO)_4]$ Ni is in the zero oxidation state. It's Electronic configuration is



- But CO is a strong field ligand. Therefore, it causes the pairing of unpaired 3d electrons. Also, it causes the 4s electrons to shift to the 3d orbital, thereby giving rise to sp^3 hybridization.



- Each CO donate electron pair to Sp^3 hybrid orbital.



- Since no unpaired electrons are present in this case, $[Ni(CO)_4]$ is diamagnetic.

Section B

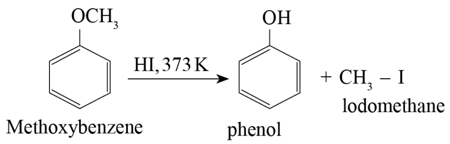
- **Write the answer of the following questions : (Each carries 3 Mark)**

13.

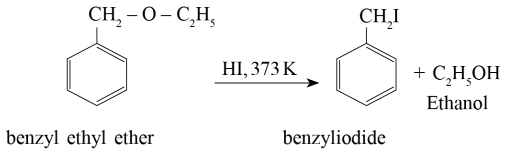
- (i) 1-propoxypropane :

$$\underset{\text{1-propoxypropane}}{CH_3CH_2CH_2OCH_2CH_2CH_3} \xrightarrow[373\text{ K}]{HI} \underset{\text{propan-1-ol}}{CH_3CH_2CH_2-OH} + \underset{\text{1-iodopropane}}{CH_3CH_2CH_2I}$$

- (ii) methoxybenzene :



- (iii) benzyl ethyl ether :



14.

- Half-life of ^{14}C = 5730 years.
- All radioactive decay follows first order kinetics.

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

$$k = \frac{0.693}{t_{\frac{1}{2}}}$$

$$k = \frac{0.693}{5730}\ \text{year}^{-1}$$

- For first order reaction.

$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$$

$$t = \frac{2.303 \times 5730}{0.693}\log\frac{100}{80}$$

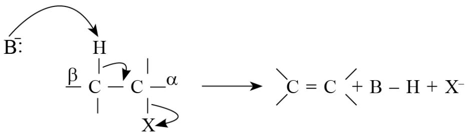
$$t = \frac{2.303 \times 5730}{0.693}\log 1.25$$

$$t = \frac{2.303 \times 5730}{0.693} \times 0.0969$$

$$t = 1845.2\ \text{years.}$$

15.

- When a haloalkane with β-hydrogen atom is heated with alcoholic solution of potassium hydroxide, there is elimination of hydrogen atom from βcarbon and a halogen atom from the α-carbon atom.

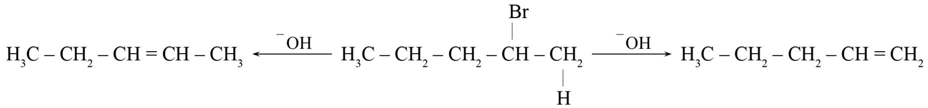


B = Base ; X=Leaving group

- As a result, an alkene is formed as a product. Since β-hydrogen atom is involved in elimination, it is often called β-elimination.

$$\overset{\beta}{C}H_3\overset{\alpha}{C}H_2Cl \xrightarrow[\text{Alcohol KOH}]{\Delta} CH_2 = CH_2 + KCl + H_2O$$

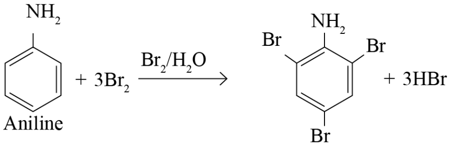
- If there is possibility of formation of more than one alkene due to the availability of more than one β-hydrogen atoms, usually one alkene is formed as the major product.
- These form part of a pattern was first observed by Russian chemist, Alexander Zaitsev (also pronounced as Saytzeff).
- A rule which can be summarised as "in dehydrohalogenation reactions, the preferred product is that alkene which has the greater number of alkyl groups attached to the doubly bonded carbon atoms."


Pent-2-ene (81%) 2-Bromopentane Pent-1-ene (19%)

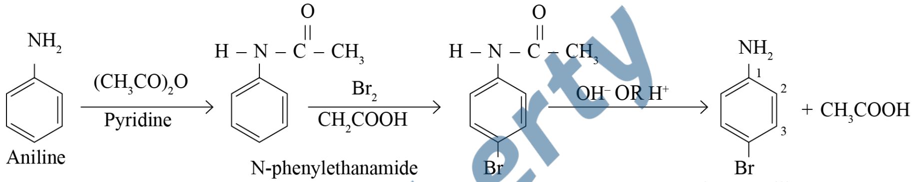
- ➥ Thus, 2-bromopentane gives pent-2-ene as the major product.

16.

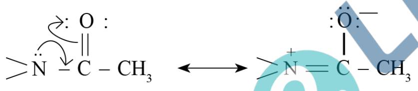
- ➥ Aniline reacts with bromine water at room temperature to give a white precipitate of 2, 4, 6-tribromoaniline.


Aniline 2,4,6-Tribromoaniline

- ➥ Aromatic amine compounds are very reactive towards electrophilic substitution reactions.
- ➥ If we have to prepare monosubstituted aniline derivative than we have to control the activating effect of $-NH_2$ group.
- ➥ This can be done by protecting the $-NH_2$ group by acetylation with acetic anhydride, then carrying out the desired substitution followed by hydrolysis of the substituted amide to the substituted amine.


Aniline N-phenylethanamide (Acetanilide) (Major) 4-bromoaniline

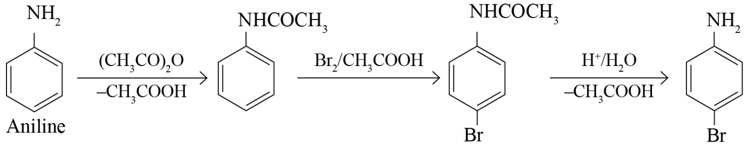
- ➥ The lone pair of electrons on nitrogen of acetanilide interacts with oxygen atom due to resonance as shown below :



- ➥ Hence, the lone pair of electrons on nitrogen is less available for donation to benzene ring by resonance. Therefore activating effect of $-NHCOCH_3$ group is less than that of amino group.

17.

- ➥ Aniline to p-bromo aniline


Aniline p-bromo aniline

18.

- ➥ Preparation :
- ➥ Potassium permanganate is prepared by fusion of MnO_2 with an alkali metal hydroxide and an oxidising agent like KNO_3. This produces the dark green K_2MnO_4 which disproportionates in a neutral or acidic solution to give permanganate.

$$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$$

$$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

- ➥ Commercially it is prepared by the alkaline oxidative fusion of MnO_2 followed by the electrolytic oxidation of manganate (VI).

$$\underset{}{MnO_2} \xrightarrow[\text{with air or } KNO_3]{\text{Fused with KOH, oxidised}} \underset{\text{manganate ion}}{MnO_4^{2-}}$$

$$\underset{\text{manganate}}{MnO_4^{2-}} \xrightarrow[\text{alkaline solution}]{\text{Electrolytic oxidation in}} \underset{\text{permanganate ion}}{MnO_4^{-}}$$

- In the laboratory, a manganese (II) ion salt is oxidised by peroxodisulphate to permanganate.

$$2Mn^{2+} + 5S_2O_8^{2-} + 8H_2O \rightarrow 2MnO_4^{-} + 10SO_4^{2-} + 16H^+$$

- In Acidic Medium oxidising action of $KMnO_4$

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$

(i) Acidified $KMnO_4$ solution oxidizes Fe (II) ions to Fe (III) ions i.e., ferrous ions to ferric ions.

$$\begin{array}{r}
MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O \\
5Fe^{2+} \rightarrow 5Fe^{3+} + 5e^- \\
\hline
5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}
\end{array}$$

(ii) Acidified potassium permanganate oxidizes SO_2 to sulphuric acid.

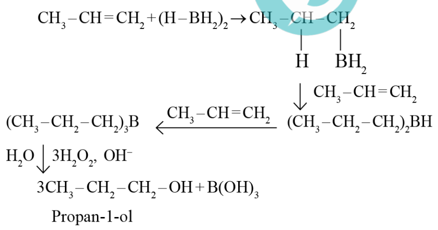
$$\begin{array}{r}
2\,MnO_4^- + 16H^+ + 10e^- \rightarrow 2Mn^{2+} + 8H_2O \\
5SO_2 + 10H_2O \rightarrow 5SO_4^{2-} + 20H^+ + 10e^- \\
\hline
2\,MnO_4^- + 5SO_2 + 2H_2O \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 4H^+
\end{array}$$

(iii) Acidified potassium permanganate oxidizes oxalic acid to carbon dioxide.

$$\begin{array}{r}
2MnO_4^- + 16H^+ + 10e^- \rightarrow 2Mn^{2+} + 8H_2O \\
5C_2O_4^{2-} \rightarrow 10CO_2 + 10e^- \\
\hline
5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O
\end{array}$$

19.

- By hydroboration-oxidation : Diborane $(BH_3)_2$, reacts with alkenes to give trialkyl boranes as addition product. This is oxidised to alcohol by hydrogen peroxide in the presence of aqueous sodium hydroxide.



$$CH_3-CH=CH_2 + (H-BH_2)_2 \rightarrow CH_3-\underset{H}{\underset{|}{CH}}-\underset{BH_2}{\underset{|}{CH_2}}$$

$$\downarrow CH_3-CH=CH_2$$

$$(CH_3-CH_2-CH_2)_3B \xleftarrow{CH_3-CH=CH_2} (CH_3-CH_2-CH_2)_2BH$$

$$H_2O \downarrow 3H_2O_2,\ OH^-$$

$$3CH_3-CH_2-CH_2-OH + B(OH)_3$$

Propan-1-ol

- The addition of borane to the double bond takes place in such a manner that the boron atom gets attached to the sp^2 carbon carrying greater number of hydrogen atoms. The alcohol so formed looks as if it a way opposite to the Markovnikov's rule. In this reaction, alcohol is obtained in excellent yield.

20.

- $$\underset{\text{Butanal}}{CH_3CH_2CH_2CHO} \xrightarrow[\text{Tollen's reugent}]{\text{Amonical } AgNo_3} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH} \quad \underset{\text{Acetylchloride}}{CH_3\ COCl} \xrightarrow[H_2O]{H^+/OH^-} \underset{\text{Acetic acid}}{CH_3\ COOH}$$

$$\underset{\text{Ethylethanoate}}{CH_3\ COOCH_2CH_3} \xrightarrow[H_2O]{H^+/OH^-} \underset{\text{Acetic acid}}{CH_3\ COOH} + \underset{\text{Ethanol}}{CH_3CH_2OH}$$

21.

➥ $\lambda^0_{m\,(HCOOH)} = \lambda^0_{m\,H+} + \lambda^0_{m\,(HCOO-)}$

$= 349.6 + 54.6$

$= 404.2\ \text{S cm}^2\ \text{mol}^{-1}$

➥ degree of dissociation $(\alpha) = \dfrac{\Lambda_m}{\Lambda^0_m}$

$= \dfrac{46.1}{404.2}$

$= 0.1140$

➥ dissociation $(k_a) = \dfrac{\alpha^2 \cdot c}{1 - \alpha}$

$= \dfrac{(0.1140)^2 \times 0.025}{1 - 0.1140}$

$= \dfrac{3.249 \times 10^{-4}}{0.886}$

➥ $k_a = 3.67 \times 10^{-4}$ mol L^{-1}

Section C

➢ **Write the answer of the following questions : (Each carries 4 Mark)**

22.

➥ $W_2 = 2$ g $M_2 = 122$ g.Mol^{-1}

$W_1 = 25$ g

$\Delta T_f = 1.62$ K $K_f = 4.9$ K.kg.Mol^{-1}

percentage association = (?) $n = 2$

$\Delta T_f = i\ .\ K_f\ .\ \dfrac{W_2 \times 1000}{M_2 \times W_1}$

$\therefore\ i = \dfrac{\Delta T_f \times M_2 \times W_1}{K_f \times W_1 \times 1000}$

$= \dfrac{1.62 \times 122 \times 25}{4.9 \times 2 \times 1000}$

$i = 0.5041$

degree of association $(x) = \dfrac{i - 1}{\frac{1}{n} - 1}$

$= \dfrac{0.5041 - 1}{\frac{1}{2} - 1}$

$= \dfrac{0.4959}{0.5}$

$= 0.9918$

$= 99.18$

➥ Therefore, degree of association of benzoic acid in benzene is 99.2%.

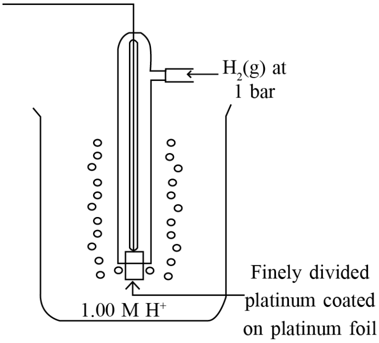
23.

➥ Standard Hydrogen Electrode works as a reference electrode for other half cells.

➥ The standard hydrogen electrode consists of a platinum electrode coated with platinum black. The electrode is dipped in an acidic solution and pure hydrogen gas bubbled through it.

➥ The concentration of both the reduced and oxidised forms of hydrogen is maintained at unity.

- This implies that the pressure of hydrogen gas is one bar and the concentration of hydrogen ion in the solution is one molar.
- When this half cell connected to other half cells, To form a complete all, The SHE can acts as as cathode or anode.



- If it acts as cathode the following reduction reaction takes place on the platinum strip

$$H^+(aq)\ (1\ M) + e^- \rightleftharpoons \frac{1}{2} H_2(g,\ 1\ bar)$$

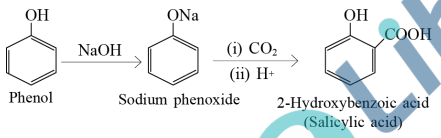
- If it acts as anode the oxidation reaction takes places on the anode

$$\frac{1}{2} H_2(g,\ 1\ bar) \rightleftharpoons H^+(aq,\ 1\ M) + e^-$$

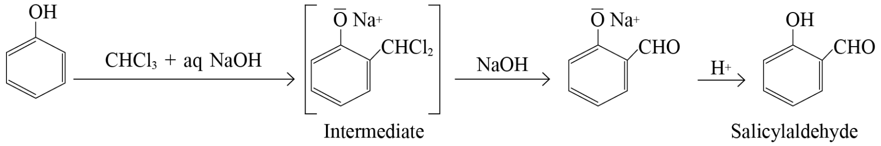
- Electrode potential of Standard Hydrogen gas Electrode is accepted zero at all temperature.

24.

- Phenoxide ion generated by treating phenol with sodium hydroxide is even more reactive than phenol towards electrophilic aromatic substitution. Hence, it undergoes electrophilic substitution with carbon dioxide, a weak electrophile. Ortho hydroxybenzoic acid is formed as the main reaction product.



- On treating phenol with chloroform in the presence of sodium hydroxide, a –CHO group is introduced at ortho position of benzene ring. This reaction is known as Reimer - Tiemann reaction.
- The intermediate substituted benzal chloride is hydrolysed in the presence of alkali to produce salicylaldehyde.



25.

- (iii) $[Co(C_2O_4)_3]^{3-}$
  - Electronic configuration of Cobalt.

$_{27}Co$: [Ar]

$3d^7$					$4s^2$	$4p$		
↑↓	↑↓	↑	↑	↑	↑↓			

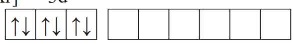
  - In $[Co(C_2O_4)_3]^{3-}$ complex oxidation state of Cobalt is +3.

$_{27}Co^{+3}$: [Ar]

$3d^6$					$4s^2$	$4p$		
↑↓	↑	↑	↑	↑				

  - Oxalate is a strong field ligand. Therefore, it can cause the pairing of the 3d orbital electrons. As there are 6 ligands, hybridization has to be d^2sp^3.

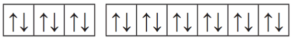
Co^{+3} : [Ar] $3d^6$



d^2sp^3 hybrid orbitals.

- The 6 electron pairs from the 3 oxalate ions (oxalate anion is a bidentate ligand) occupy these d^2sp^3 orbitals.

$[Co(C_2O_4)_3]^{3-}$: [Ar]
$3d^6$

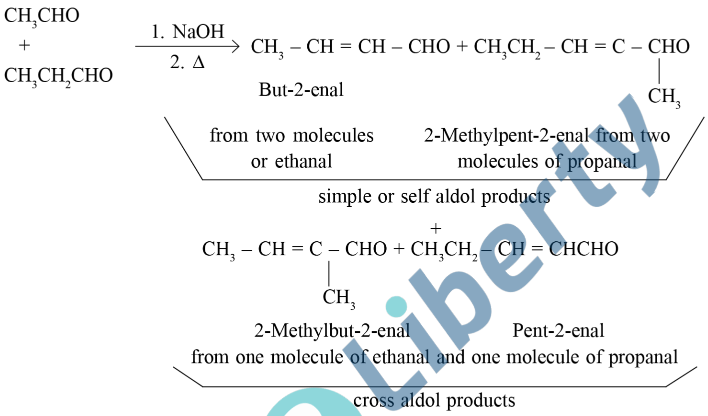


The 6 electron pairs
from the 3 oxalate ions.

- Hence, the geometry of the complex is found to be octahedral and magnetic property is diamagnetic
- $\propto = 0$ B.M

26.

- Cross aldol condensation : *"When aldol condensation is carried out between two different aldehydes and / or ketones, it is called cross aldol condensation."* If both of them contain α-hydrogen atoms, it gives a mixture of four products. This is illustrated below by aldol reaction of a mixture of ethanal and propanal.



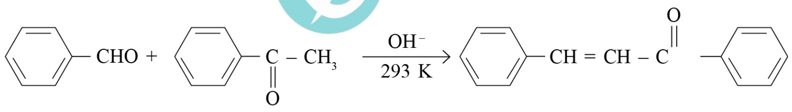
$$\begin{matrix} CH_3CHO \\ + \\ CH_3CH_2CHO \end{matrix} \xrightarrow[2.\ \Delta]{1.\ NaOH} \underbrace{\underset{\text{But-2-enal}}{CH_3-CH=CH-CHO} + CH_3CH_2-CH=\underset{\underset{CH_3}{|}}{C}-CHO}_{\text{simple or self aldol products}}$$

from two molecules or ethanal; 2-Methylpent-2-enal from two molecules of propanal

$$+ \underbrace{CH_3-CH=\underset{\underset{CH_3}{|}}{C}-CHO + CH_3CH_2-CH=CHCHO}_{\text{cross aldol products}}$$

2-Methylbut-2-enal; Pent-2-enal
from one molecule of ethanal and one molecule of propanal

- Ketones can also be used as one component in the cross aldol reactions.



Benzaldehyde Acetophenone

1, 3-Diphenylprop-2-en-1-one
(Benzalacetophenone)
(Major product)

27.

- Half-life of a reaction : *"The time in which the concentration of a reactant is reduced to one half of its initial concentration is called half-life* $\left(t_{\frac{1}{2}}\right)$ *of a reaction."*
- Half-life for zero order reaction :
- For a zero order reaction, rate constant is given by following equation
- $$k = \frac{[R]_0 - [R]}{t}$$

At $t = t_{\frac{1}{2}}$, $[R] = \frac{1}{2}[R]_0$

The rate constant at $t_{\frac{1}{2}}$ becomes

$$k = \frac{[R]_0 - \frac{1}{2}[R]_0}{t_{\frac{1}{2}}}$$

$$t_{\frac{1}{2}} = \frac{[R]_0}{2k}$$

It is clear that $t_{\frac{1}{2}}$ for a zero order reaction is directly proportional to the initial concentration of the reactants and inversely proportional to the rate constant.

- Half-life for first order reaction :
- For the first order reaction,

$$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

$$\text{at } t = t_{\frac{1}{2}} \quad [R] = \frac{[R]_0}{2}$$

- So, the above equation becomes

$$k = \frac{2.303}{t_{\frac{1}{2}}} \log \frac{[R]_0}{\frac{[R]_0}{2}}$$

$$\text{or } t_{\frac{1}{2}} = \frac{2.303}{k} \log 2$$

$$t_{\frac{1}{2}} = \frac{2.303}{k} \times 0.301$$

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

- It can be seen that for a first order reaction, half-life period is constant, i.e. it is independent of initial concentration of the reacting species. The half-life of a first order equation is readily calculated from the rate constant and vice versa.

For zero order reaction $t_{\frac{1}{2}} \times [R]_0$ for first order reaction $t_{\frac{1}{2}}$ is independent of $[R]_0$