Class-XII Session 2022-23
Subject - Chemistry
Sample Question Paper - 25
With Solution

BLUE PRINT

S. No.	Chapter Name	Section-A (MCQs & A/R) 1 Mark		Section-B (VSA) 2 Marks		Section-C (SA) 3 Marks		Section-D (Case Study) 4 Marks		Section-E (LA) 5 Marks		Total Marks
		Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	Q. No.	Marks	
1	Solutions	3, 15	2	19	2	30	3					7
2	Electrochemistry	7	1	20	2					34	5	8
3	Chemical Kinetics	9, 16	2							33	5	7
4	d -and f -Block Elements	2, 14	2	22	2	27, 28. a	4					8
5	Coordination Compounds	4, 13	2	25	2	28. b, c	2					6
6	Haloalkanes and Haloarenes	5, 12	2	24	2	26	3					7
7	Alcohols, Phenols and Ethers	8	1							35	5	6
8	Aldehydes, Ketones and Carboxylic Acids	10, 17	2	23	2			31	4			8
9	Amines	1, 11, 18	3			29	3					6
10	Biomolecules	6	1	21	2			32	4			7
	Total Marks (Total Questions)	18	18	7	14	5	15	2	8	3	15	70

Time : 3 Hours **Max. Marks : 70**

General Instructions

Read the following instructions carefully

(a) *There are 35 questions in this question paper with internal choice.*

(b) *SECTION A consists of 18 multiple-choice questions carrying 1 mark each.*

(c) *SECTION B consists of 7 very short answer questions carrying 2 marks each.*

(d) *SECTION C consists of 5 short answer questions carrying 3 marks each.*

(e) *SECTION D consists of 2 case- based questions carrying 4 marks each.*

(f) *SECTION E consists of 3 long answer questions carrying 5 marks each.*

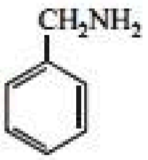
(g) ***All questions are compulsory.***

(h) ***Use of log tables and calculator are not allowed.***

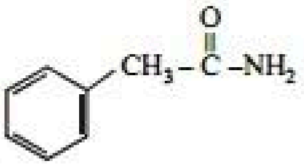
SECTION-A

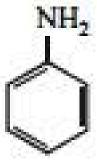
The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Which of the following compounds can be prepared in good yield by Gabriel phthalimide synthesis?

(a) 

(b) $CH_3-CH_2-NHCH_3$

(c) 

(d) 

2. In which of the following pairs both the ions are coloured in aqueous solutions?

(a) Sc^{3+}, Ti^{3+} (b) Sc^{3+}, Co^{2+} (c) Ni^{2+}, Cu^{+} (d) Ni^{2+}, Ti^{3+}

(At. no. : Sc = 21, Ti = 22, Ni = 28, Cu = 29, Co = 27)

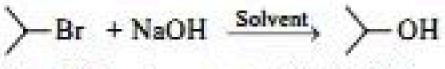
3. How much ethyl alcohol must be added to 1 litre of water so that the solution will freeze at –14°C?
(K_f for water = 1.86°C/mol)

(a) 7.5 mol (b) 8.5 mol (c) 9.5 mol (d) 10.5 mol

4. The hypothetical complex chloro-diaquatriamminecobalt (III) chloride can be represented as

(a) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$ (b) $[Co(NH_3)_3(H_2O)Cl_3]$

(c) $[Co(NH_3)_3(H_2O)_2Cl]$ (d) $[Co(NH_3)_3(H_2O)_3]Cl_3$

5. 

For which solvent rate of S_N2 will be maximum?

(a) Benzene (b) 100% H_2O

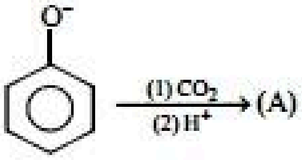
(c) 100% acetone (d) 75% H_2O + 25% acetone

6. Denaturation of proteins leads to loss of its biological activity by

(a) Formation of amino acids (b) Loss of primary structure

(c) Loss of both primary and secondary structures (d) Loss of both secondary and tertiary structures

7. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to
(a) produce high purity water
(b) create potential difference between two electrodes
(c) generate heat
(d) remove adsorbed oxygen from elctrode surfaces

8. 

Which of the following is true statement about the reaction?
(a) Ortho isomer is major if PhONa is used
(b) Para isomer is major if PhOK is used
(c) Product formed is further used for preparation of drug aspirin
(d) All of these

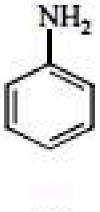
9. Diazonium salt decomposes as

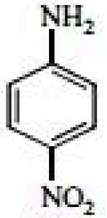
$C_6H_5N_2^+Cl^- \rightarrow C_6H_5Cl + N_2$

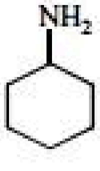
At 0°C, the evolution of N_2 becomes two times faster when the initial concentration of the salt is doubled. Therefore, it is
(a) a first order reaction
(b) a second order reaction
(c) independent of the initial concentration of the salt
(d) a zero order reaction

10. Aldehydes and ketones can be distinguished by :
(a) Ammonia (b) H_2SO_4 (c) Alkaline $KMnO_4$ (d) Fehling solution

11. The correct order of basicity of the following compounds


(A)


(B)


(C)

(a) B>A>C (b) A>B>C (c) C>A>B (d) C>B>A

12. A set of compounds in which the reactivity of halogen atom in the ascending order is
(a) chlorobenzene, vinyl chloride, chloroethane
(b) chloroethane, chlorobenzene, vinyl chloride
(c) vinyl chloride, chlorobenzene, chloroethane
(d) vinyl chloride, chloroethane, chlorobenzene

13. Which of the following is paramagnetic?

(a) $\left[Fe(CN)_6\right]^{4-}$ (b) $\left[Ni(CO)_4\right]$ (c) $\left[Ni(CO)_4\right]^{2-}$ (d) $\left[CoF_6\right]^{3-}$

14. The starting material for the manufacture of $KMnO_4$ is
(a) pyrolusite (b) manganite (c) magnatite (d) haematite

In the following questions (15-18) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is wrong statement.
(d) Assertion is wrong, but reason is correct statement.

15. **Assertion :** If one component of a solution obeys Raoult's law over a certain range of composition, the other component will not obey Henry's law in that range.

16. **Assertion :** The rate of the reaction is the rate of change of concentration of a reactant or a product.
Reason : Rate of reaction remains constant during the course of reaction.

17. **Assertion :** Isobutanal does not give iodoform test.
Reason : It does not have α-hydrogen.

18. **Assertion:** N, N-Diethylethanamine is more basic than N, N-Dimethylethanamine.
Reason: + I effect of ethyl is more than methyl.

SECTION-B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. Arrange the following solutions in increasing order of osmotic pressure:
(i) 34.2 g L^{-1} of sucrose (ii) 60 g L^{-1} of urea (iii) 90 g L^{-1} of glucose

20. Using the E^0 values of X and Y, predict which is better for coating the surface of iron to prevent rust and why?

Given: $[E^0_{(Fe^{2+}/Fe)} = -0.44\ V$

$E^0_{(X^{2+}/X)} = -2.36\ V$

$E^0_{(Y^{2+}/Y)} = -0.14\ V]$

21. (a) Write the Zwitter ion structure of glycine.
(b) What type of substance is phenyl alanine hydroxylase? What is its importance for us?

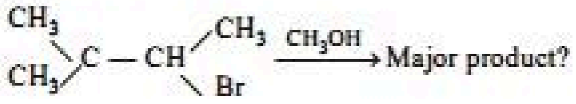
22. Give reasons for the following:
(a) Cr^{3+} exhibits paramagnetism. (b) Mn exhibits more number of oxidation states than V.

23. How do you convert the following?
(a) Ethanal to Propanone
(b) Toluene to Benzoic acid

OR

Account for the following :
(a) Aromatic carboxylic acids do not undergo Friedel Crafts reaction.
(b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.

24. Complete the following reactions:

(a) 

(b) Ethylbenzene $\xrightarrow[\text{(iii) alc.KOH}]{\text{(i) } Br_2, Fe \quad \text{(ii) } Cl_2, \Delta}$ Major product?

25. What are chelates and the chelating agents?

OR

$[Fe(CN)_6]^{3-}$ ion has magnetic moment of 1.73 B.M. while $[Fe(H_2O)_6]^{3+}$ has a magnetic moment of 5.92 B.M. Explain.

SECTION-C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. Give reasons for the following :

(a) The presence of – NO_2 group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution reactions.

(b) *p*-Dichlorobenzene has higher melting point than that of ortho or meta isomer.

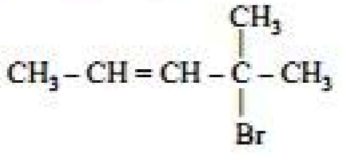
(c) Thionyl chloride method is preferred for preparing alkyl chloride from alcohols.

OR

(a) Write equation for preparation of 1-iodobutane from 1-chlorobutane.

(b) Out of 2-bromopentane, 2-bromo-2-methylbutane and 1-bromopentane, which compound is most reactive towards elimination reaction and why?

(c) Give IUPAC name of



$$CH_3-CH=CH-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle Br}{|}}{C}}-CH_3$$

27. What are paramagnetic substances? Account for the paramagnetic character of transition metal compounds. How does the paramagnetic character of the bivalent ions of first transition metal series vary from Ti (Z = 22) to copper (Z = 29)?

28. Answer any **3** of the followings:

(a) Scandium the first member of first transition series does not exhibit variable oxidation state. Explain.

(b) Write the chemical formula for pentaamminechloroplatinum (IV) chloride.

(c) Write IUPAC name for linkage isomer of $[Co(NH_3)_5ONO]Cl_2$.

(d) Name the type of isomerism exhibited by the following isomers:

$[Pt(NH_3)_4][PtCl_6]$ and $[Pt(NH_3)_4Cl_2][PtCl_4]$

29. Give the structures of A, B and C in the following reaction :

(a) $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C$

(b) $C_6H_5NO_2 \xrightarrow{Sn+HCl} A \xrightarrow[273\,K]{NaNO_2+HCl} B \xrightarrow[\Delta]{H_2O/H^+} C$

30. Given reasons for the following :

(a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

(b) Aquatic animals are more comfortable in cold water than in warm water.

(c) Elevation of boiling point of 1 M KCl solution is nearly double than of 1 M sugar solution.

SECTION-D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

31. The carbonyl carbon atom is sp^2-hybridised and forms three sigma bonds. The fourth valence electron of carbon remains in its *p*-orbital and forms a π-bond with oxygen by overlap with *p*-orbital of an oxygen. In addition, the oxygen atom also has two non bonding electron pairs. Thus, the carbonyl carbon and the three atoms attached to it lie in the same plane and the π-electron cloud is above and below this plane. The bond angles are approximately 120° as expected of a trigonal coplanar structure. Aldehydes and ketones are generally prepared by oxidation of primary and secondary alcohols. The aldehydes and ketones undergo a number of reactions due to the acidic nature of α-hydrogen. The acidity of α-hydrogen atoms of carbonyl compounds is due to the strong electron withdrawing effect of the carbonyl group and resonance stabilisation of the conjugate base.

Answer the following questions :

- (a) Why does acetaldehyde on treatment with alkali give aldol?
- (b) Hydroxyketones are not directly used in Grignard reaction—Justify.
- (c) What is the expected product when RCOCl, $(RCO)_2O$ and RCOOR all react with Grignard reagents?

OR

Formaldehyde is a planar molecule—Explain.

32. Proteins are the most abundant molecules of the living system and form the fundamental basis of structure and functions of life. The word protein is derived from Greek word, "proteios" which means primary or of prime importance. All proteins are polymers of α-aminoacids. Amino acids contain amino group and carboxyl functional groups and classified as acidic, basic or neutral depending upon the relative number of amino and carboxyl groups in the molecule. proteins are the polymers of α-amino acids and they are connected to each other by peptide bond. Peptide likage is an amide formed between —COOH gp and —NH_2 group. Proteins are classified into two types on the basis of molecular shape. Fibrous protein in which polypeptide chains run parallel and held together by H-bonds and disulphide bond. Another type is globular protein in which chains of polypetide coil around to give spherical shape.

Answer the following questions :

- (a) What is denaturation?
- (b) Give one example of denaturation?
- (c) What happens when denaturation occurs. How does the peptide bond form in protein?

OR

What is isoelectric point? Does the isoelectric point migrate under the influence of electric field?

SECTION-E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

33. (a) The decomposition of a compound is found to follow the first order rate law. If it takes 15 minutes for 20 percent of the original material to react, calculate
  - (i) the specific rate constant.
  - (ii) the time in which 10 percent of the original material remains unreacted.
  - (iii) the time it takes for the next 20 percent of the reactant left to react.

(b) Why does liquid bromine react slowly as compared to vapours of bromine?

(c) Why does the rate of a reaction not remain constant throughout the reaction?

OR

For the chemical reaction, $A + 2B \longrightarrow 2C + D$, the experimentally determined information has been tabulated below :

Experiment	$[A]_0$	$[B]_0$	Initial rate of reaction
1	0.30	0.30	0.096
2	0.60	0.30	0.384
3	0.30	0.60	0.192
4	0.60	0.60	0.768

For the above reaction,

- (a) Calculate the order of reaction w.r.t. both the reactants A and B.
- (b) Write the expression for rate law.
- (c) Calculate the value of the rate constant.
- (d) Write the expression for the rate of reaction in terms of A and C.

34. (a) The value of Λ^{∞} for NH_4Cl, NaOH and NaCl are 129.8, 248.1 and 126.4 ohm^{-1} cm^2 mol^{-1} respectively. Calculate Λ^{∞} for NH_4OH solution.

(b) The equivalent conductivities of acetic acid at 298 K at the concentrations of 0.1 M and 0.001M are 5.20 and 49.2 S cm^2 eq^{-1} respectively. Calculate the degree of dissociation of acetic acid at these concentrations.

Given that : $\Lambda^{\infty}(H^+)$ and $\Lambda^{\infty}(CH_3COO^-)$

are 349.8 and 40.9 ohm^{-1} cm^2 eq^{-1} respectively.

OR

(a) Calculate ΔG° for the reaction :

$Cu^{2+}(aq) + Fe(s) \rightleftharpoons Fe^{2+}(aq) + Cu(s)$

Given that : $E^0_{Cu^{2+}/Cu} = +0.34$ V, $E^0_{Fe^{2+}/Fe} = -0.44$ V

(b) A solution of copper (II) sulphate is electrolysed between copper electrodes by a current of 10.0 amperes passing for one hour. What changes occur at the electrodes and in the solution ?

35. (a) Out of t-butyl alcohol and n-butanol, which one will undergo acid catalyzed dehydration faster and why?

(b) Carry out the following conversions:

(i) Phenol to salicylaldehyde

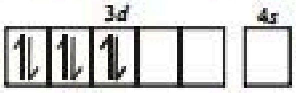
(ii) *t*-Butylchloride to *t*-butyl ethyl ether

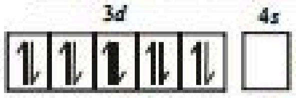
(iii) Propene to propanol

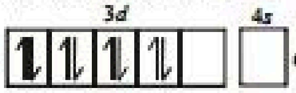
Solutions

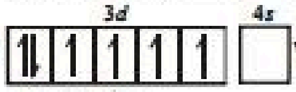
SAMPLE PAPER-8

1. (a) Gabriel phthalimide synthesis gives 1° amine in good yield.
2. (d) $Sc^{3+}: 1s^2, 2s^2p^6, 3s^2p^6d^0, 4s^0$; no unpaired electron.
$Cu^+: 1s^2, 2s^2p^6, 3s^2p^6d^{10}, 4s^0$; no unpaired electron.
$Ni^{2+}: 1s^2, 2s^2p^6, 3s^2p^6d^8, 4s^0$; unpaired electrons are present.
$Ti^{3+}: 1s^2, 2s^2p^6, 3s^2p^6d^1, 4s^0$; unpaired electron is present
$Co^{2+}: 1s^2, 2s^2p^6, 3s^2p^6d^7, 4s^0$; unpaired electrons are present
So from the given options the only correct combination is Ni^{2+} and Ti^{3+}.
3. (a) $\Delta T_f = K_f m$
$$\Delta T_f = K_f \frac{n_2 \times 1000}{w_1}; 14 = 1.86 \times \frac{n_2 \times 1000}{1000}$$
$n_2 = 7.5$ mol
4. (a) The complex chlorodiaquatriammine cobalt (III) chloride can be represented as $[CoCl(NH_3)_3(H_2O)_2]Cl_2$. (1 mark)
5. (c) For S_N2 reaction polar aprotic solvent is needed.
6. (d)
7. (b) In $H_2 - O_2$ fuel cell, the combustion of H_2 occurs to create potential difference between the two electrodes.
8. (d)
9. (a) As doubling the initial conc. doubles the rate of reaction, order = 1
10. (d) Aldehydes can reduce while ketones cannot reduce Fehling's solution. (1 mark)
11. (c) Aliphatic amines are more basic than aromatic amines. Resonance decreases the basic character due to delocalisation of shared pair of electrons on nitrogen within benzene nucleus. Further electron withdrawing if $(-NO_2)$ decreases basicity.
12. (a) $CH_3CH_2Cl > CH_2=CHCl > C_6H_5Cl$
13. (d) Electronic configuration of

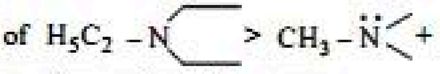
Fe^{2+}:  due to strong field ligand

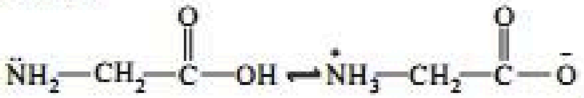
Ni :  due to strong field ligand

Ni^{2+}:  due to strong field ligand

Co^{3+}:  Weak field ligand, no pairing

Hence, $[CoF_6]^{3-}$ is paramagnetic. (1 mark)

14. (a) Pyrolusite (It is MnO_2)
15. (b) (1 mark)
16. (c) Rate of a reaction does not remain constant during the course of reaction because rate depends upon the concentration of reactants which decreases with time. (1 mark)
17. (c) Isobutanal does not give iodoform test because it does not have $-COCH_3$ group. (1 mark)
18. (a) K_b of  + I effect of C_2H_5-group is more than CH_3- group.
N, N-Diethylethanamine
19. Osmotic pressures of different solutions can be calculated by using van't Hoff equation.
(i) $M = \frac{34.2}{342} = 0.1 \text{ mol L}^{-1}, \pi = iMRT = 1 \times 0.1\ RT = 0.1\ RT$ (½ mark)
(ii) $M = \frac{60}{60} = 1 \text{ mol L}^{-1}, \pi = iMRT = 1 \times 1RT = RT$ (½ mark)
(iii) $M = \frac{90}{180} = 0.5 \text{ mol L}^{-1}, \pi = iMRT = 1 \times 0.5\,RT = 0.5\,RT$ (½ mark)
The increasing order of osmotic pressure is (i) < (iii) < (ii) (½ mark)
20. Corrosion is basically a process of oxidation, so oxidation potential is considered here.
Oxidation potential of Fe = 0.44 V
Oxidation potential of X = 2.36 V
Oxidation potential of Y = 0.14 V
Since, A has a higher oxidation potential than that of iron, so it will oxidise faster than Fe. Therefore, A is better for coating. (2 marks)
21. (a) It is also called dipolar ion and its structure is as follows :



$$\ddot{N}H_2-CH_2-\overset{\overset{O}{\|}}{C}-OH \rightleftharpoons \overset{+}{N}H_3-CH_2-\overset{\overset{O}{\|}}{C}-\bar{O}$$

(1 mark)

(b) Phenyl alanine hydroxylase is an enzyme. The deficiency of the enzyme causes disease phenyl ketonuria. (1 mark)

22. (a) Cr^{3+} exhibits paramagnetism due to the presence of unpaired electrons in $4d$-orbitals.

$Cr^{3+} \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$ (1 mark)

(b) $V (Z = 23) \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

$Mn (Z = 25) \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

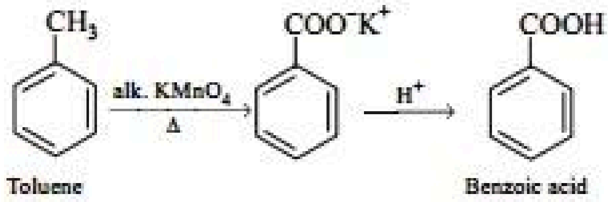
Mn exhibits more number of oxidation states as it can loose upto seven electrons from both $4s$-and $3d$-orbitals, whereas V can loose maximum five electrons. (1 mark)

23. (a) **Ethanal to propanone:** CH_3CHO to CH_3COCH_3

$$\underset{\text{Ethanal}}{CH_3CHO} \xrightarrow{CH_3MgBr} \underset{\substack{|\\OH}}{CH_3CHCH_3} \xrightarrow{CrO_3} \underset{\text{Propanone}}{CH_3COCH_3}$$

(1 mark)

(b) **Toluene to Benzoic acid:**



(1 mark)

OR

(a) Aromatic carboxylic acids do not undergo Friedel crafts reaction. This is because the carboxyl group is an electron withdrawing group and hence deactivates the benzene ring towards Friedel crafts reaction. The catalyst (anhydrous $AlCl_3$) gets bonded to the carboxyl group thus preventing the desired reaction. (1 mark)

Note

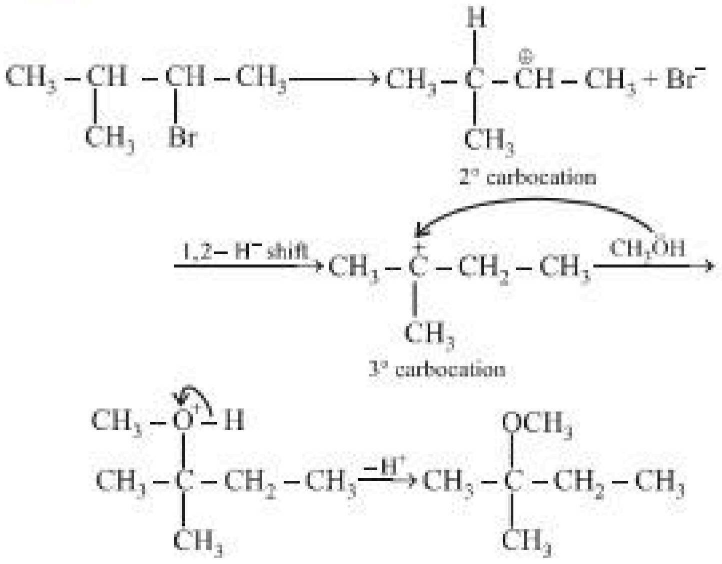
The Friedel-crafts alkylation may give polyalkylated products, so the Friedel-crafts acylation is a valuable alternative. The acylated products may easily be converted to the corresponding alkanes via clemmensen reduction or wolff-kishner reduction.

(b) pK_a value of 4–nitrobenzoic acid is lower than that of benzoic acid. This is because in 4-nitrobenzoic acid, nitro group being electron withdrawing in nature, makes the O–H bond in –COOH more polar, thus facilitating the release of H^+. Thus, 4-nitrobenzoic acid is more acidic. More is the acidity, lesser is the pK_a value. (1 mark)

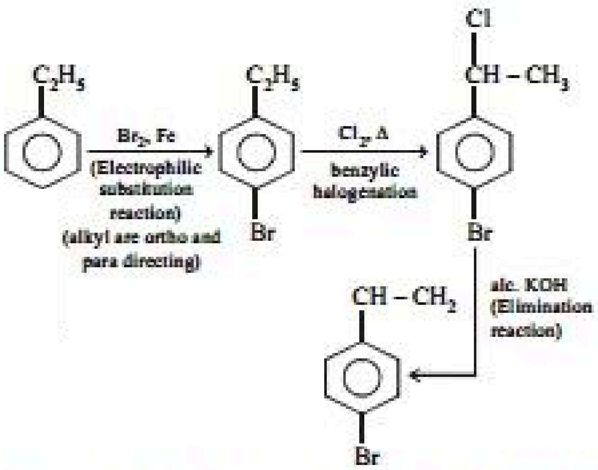
Note

Acid strength increases as we move to the right along a row of the periodic table, and as we move down a column.

24. (a)



(b)



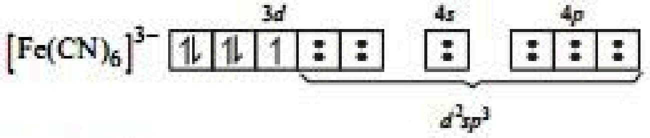
25. A chelate is a complex or coordination compound which is formed when a multi dentate ligand attaches to a metal ion. It is a five or six-membered ring that includes the central metal ion and atoms of the ligand.

A chelating agent is a multidentate ligand. It simultaneously attaches to two or more positions in the coordination sphere of a central metal, e.g., ethylenediamine.

(1 + 1 = 2 marks)

OR

$[Fe(CN)_6]^{3-}$ has one unpaired electron (d^2sp^3-hybridization of Fe^{3+}) while $[Fe(H_2O)_6]^{3+}$ has five unpaired electrons (sp^3d^2-hybridization of Fe^{3+}),

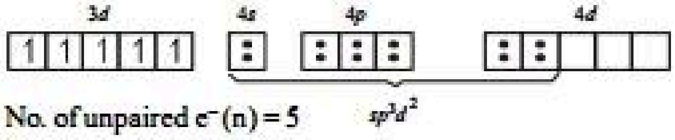


No. of unpaired e^- (n) = 1

Magnetic moment $= \sqrt{n(n+2)}$ B.M. $= \sqrt{3} = 1.73$ B.M.

(1 mark)

$[Fe(H_2O)_6]^{3+}$

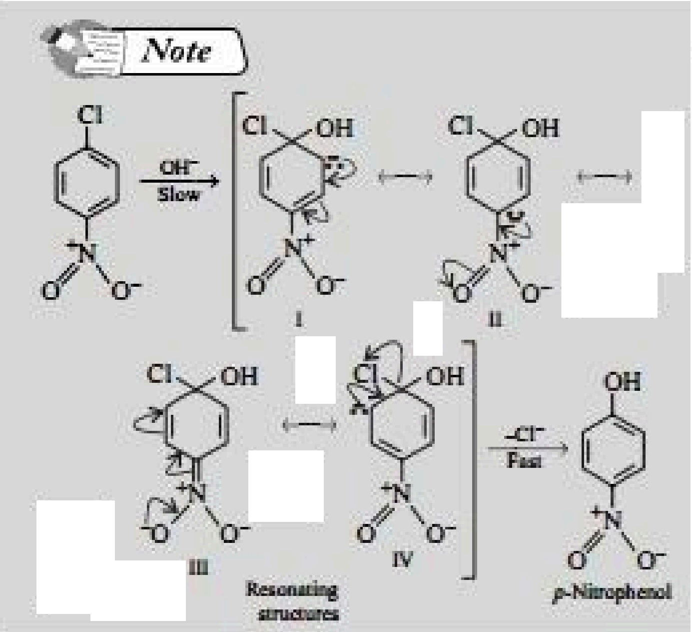


No. of unpaired e^- (n) = 5

Magnetic moment

$= \sqrt{n(n+2)}$ B.M. $= \sqrt{5\times7} = \sqrt{35} = 5.92$ B.M. (1 mark)

26. (a) The presence of electron-withdrawing groups such as $-NO_2$, $-CN$, etc. at *o*-and *p*-positions (but not at *m*-position) w.r.t. the halogen greatly activates the halogen towards nucleophilic displacemnt. The NO_2 group at *o*- and *p*- positions withdraws electrons from the benzene ring and thus makes the ring electron deficient and facilitates the attack of the nucleophile (OH^-) on haloarenes. (1 mark)



(b) *p*-Dichlorobenzene, being symmetrical, fits tightly in its crystal lattice. Thus the intermolecular forces of attraction in the *p*-isomer are stronger than those in the *o*-and *m*- isomers; which requires larger amount of energy to melt or dissolve the *p*-isomer than the *o*- and *m*-isomers. Consequently, the melting point of the *p*-isomer will be higher and its solubility lower than the corresponding *o*-and *m*-isomers. (1 mark)

(c) Thionyl chloride method is preferred over hydrogen chloride or phosphorus pentachloride method since both the by-products (SO_2 and HCl) in this reaction being gases escape leaving the chloro alkanes in almost pure state.

$$R-OH + \underset{\text{Thionyl chloride}}{SOCl_2} \xrightarrow{\text{Pyidine}} \underset{\text{Haloalkane}}{R-Cl} + SO_2\uparrow + HCl\uparrow$$

(1 mark)

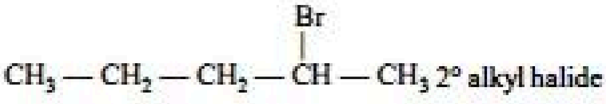
OR

(a) $$\underset{\text{1-chlorobutane}}{CH_3CH_2CH_2CH_2Cl} + NaI \xrightarrow{\text{acetone}} \underset{\text{1-Iodobutane}}{CH_3CH_2CH_2CH_2I} + NaCl\downarrow$$

(1 mark)

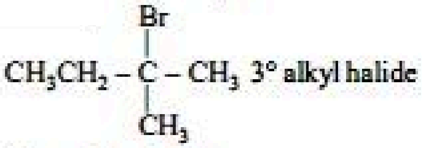
(b) 2-Bromo-2-methyl butane is most reactive towards elimination reaction.

$$\underset{\text{1-Bromopentane}}{CH_3-CH_2CH_2CH_2CH_2-Br} \text{ 1° alkyl halide}$$



$$CH_3-CH_2-CH_2-\overset{Br}{\overset{|}{CH}}-CH_3 \text{ 2° alkyl halide}$$

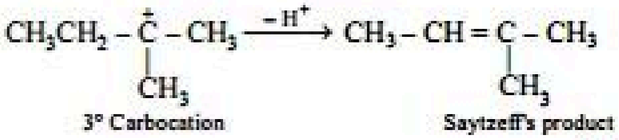
2-Bromopentane



$$CH_3CH_2-\overset{Br}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_3 \text{ 3° alkyl halide}$$

2-Bromo-2-methylbutane

3° Alkyl halide is most reactive towards elimination reaction (E_1) due to the formation of more stable 3° carbocation which loses proton to form alkene.



$$\underset{\text{3° Carbocation}}{CH_3CH_2-\overset{+}{\underset{CH_3}{\underset{|}{C}}}-CH_3} \xrightarrow{-H^+} \underset{\text{Saytzeff's product}}{CH_3-CH=\underset{CH_3}{\underset{|}{C}}-CH_3}$$

(1 mark)

(c) 4-Bromo-4-methylpent-2-ene. (1 mark)

27. Paramagnetic substances are those substances which have unpaired electrons. They are attracted by magnetic field. (1 mark)

Transition metals having unpaired electrons are paramagnetic in nature. (1 mark)

Paramagnetic character increases from Ti to Cr because number of unpaired electrons increases and then decreases due to decrease in number of unpaired electrons. (1 mark)

28. (a) Sc loses all the three electrons ($3d^1 4s^2$) to show + 3 oxidation state to attain stable inert gas configfuration. (1 mark)

(b) $[PtCl(NH_3)_5]Cl_3$ (1 mark)

(c) Linkage isomer of $[Co(NH_3)_5ONO]Cl_2$ is $[Co(NH_3)_5NO_2]Cl_2$. Its IUPAC name is pentaamminenitrito-N- cobalt (III) chloride. (1 mark)

(d) Coordination isomerism. (1 mark)

29. (a) $$\mathrm{C_6H_5N_2^+Cl^-} \xrightarrow{\mathrm{CuCN}} \underset{(A)}{\mathrm{C_6H_5CN}} \xrightarrow{\mathrm{H_2O/H^+}}$$

$$\underset{(B)}{\mathrm{C_6H_5COOH}} \xrightarrow[\Delta]{\mathrm{NH_3}} \underset{(C)}{\mathrm{C_6H_5CONH_2}}$$

(½ + ½ + ½ = 1½ marks)

(b) $$\mathrm{C_6H_5NO_2} \xrightarrow{\mathrm{Sn+HCl}} \underset{(A)}{\mathrm{C_6H_5NH_2}} \xrightarrow[\mathrm{273K}]{\mathrm{NaNO_2+HCl}}$$

$$\underset{(B)}{\mathrm{C_6H_5N_2^+Cl^-}} \xrightarrow[\Delta]{\mathrm{H_2O/H^+}} \underset{(C)}{\mathrm{C_6H_5OH}}$$

(½ + ½ + ½ = 1½ marks)

30. (a) Osmotic pressure method is preferred for the determination of molar masses of macromolecules. This is because it is done around room temperature and molarity of solution is used instead of molality. As compared to other colligative properties, its magnitude is large even for very dilute solutions. This method is preferred for biomolecules as they are not stable at higher temperatures and polymers have poor solubility. (1 mark)

(b) Aquatic animals are more comfortable in cold water than in warm water. This is because as temperature increase, solubility of gases in water decreases (from Le-chatelier's principle). Thus, in warm water the amount of oxygen available decreases. As a result, aquatic animals are more comfortable in cold water. (1 mark)

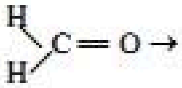
(c) Elevation of boiling point for 1M KCl solution is nearly double than that of 1 M sugar solution. This is because elevation of boiling point depends on the value of 'i'. KCl being a strong electrolyte completely dissociates in water to give K^+ and Cl^- ions. Thus, $i = 2$ for KCl. On the other hand, sugar does not dissociate/associate in water so $i = 1$ for sugar solution. Hence $\Delta T_b\,(KCl) = 2\Delta T_b$ (sugar) (1 mark)

31. (a) Acetaldehyde gives aldol condensation reaction because it contains α-hydrogen. (1 mark)

(b) Grignard reagents are highly reactive, so react with the hydroxyl group. (1 mark)

(c) RCOCl, $(RCO)_2O$ and RCOOR' all add two molecules of Grignard reagents to give 3° alcohols.

OR



→ The central carbonyl carbon is hybridized

(2 marks)

32. (a) Disruption of the natural structure of a protein is called denaturation. (1 mark)

(b) When egg is cooked, the proteins present in egg gets denatured and it is evident from the change in colour and appearance of the egg. (1 mark)

(c) The primary structure of proteins remains intact during denaturation but the secondary and tertiary structures get disrupted.

In the formation of proteins, $-NH_2$ group of one amino acid condenses with $-COOH$ group of other with the elimination of a water molecule to form a peptide bond.

OR

The isoelectric point, is the pH at which a molecule carries no net electrical charge or is electrically neutral. It is represented by pH(I) or pI.

At isoelectric point, amino acids are present zwitter ionic form, which is actually neutral. Therefore, the proteins donot migrate at isoelectric point under the influence of electric field. (2 marks)

33. (a) (i) Calculation of specific rate constant (k).

For the first order reaction, $k = \frac{2.303}{t}\log\frac{a}{a-x}$

a = 100% ; x = 20%; (a − x) = (100 − 20) = 80% ; t = 15 min

$$k = \frac{2.303}{(15\text{ min})}\log\frac{100}{80} =$$

$$\frac{2.303}{(15\text{ min})}\log 1.25 = \frac{2.303}{(15\text{ min})} \times 0.0969$$

$= 0.015\text{ min}^{-1}$ (1 mark)

(ii) Calculation of time in which 10% of original substance remains unreacted.

a = 100% ; (a − x) = 10% ; $k = 0.015\text{ min}^{-1}$

$$t = \frac{2.303}{k}\log\frac{a}{a-x} = \frac{2.303}{(0.015\text{ min}^{-1})}\log\frac{100}{10}$$

$= 153.5\text{ min}$ (1 mark)

(iii) Calculation of time in which 20% of the reactant left to react after first 15 minutes.

a = 80% ; x = 80 × 20/100 = 16% ; (a − x) = (80 − 16) = 64% ; $k = 0.015\text{ min}^{-1}$

$$t = \frac{2.303}{k}\log\frac{a}{a-x} = \frac{2.303}{(0.015\text{ min}^{-1})}\log\frac{80}{64}$$

$$= \frac{2.303}{(0.015\text{ min}^{-1})}\log 1.25$$

$$= \frac{2.303}{(0.015\text{ min}^{-1})} \times 0.0969 = 15\text{ min}$$ (1 mark)

(b) In the vapour state, the molecules of bromine have more kinetic energy than in the liquid state. Therefore, collisions with the molecules of other reactants in the vapour state will be faster than in the liquid state. Moreover, in the vapour state, the surface area available for the chemical reaction is more as compared to the liquid state. Hence, bromine in the vapour state reacts at a faster rate compared with the liquid state. (1 mark)

(c) The rate of reaction represents the change in molar concentration of reacting species taking part in the reaction per unit time. Since the change in molar concentration is not uniform, the rate of reaction does not remain constant. (1 mark)

OR

(a) Calculation of order with respect to A and B.

Let the rate law equation for the reaction be : rate = $k[A]^x[B]^y$.

The rates for the four experiments may be written as :

$0.096 = k[0.30]^x[0.30]^y$ .... (i)

$0.384 = k[0.60]^x[0.30]^y$ .... (ii)

$0.192 = k[0.30]^x[0.60]^y$ .... (iii)

$0.768 = k[0.60]^x[0.60]^y$ .... (iv) (½ mark)

Dividing eqn. (ii) by eqn. (i), we get

$$\frac{0.384}{0.096} = \frac{k[0.60]^x[0.30]^y}{k[0.30]^x[0.30]^y}$$ (½ mark)

or $4 = (2)^x$

$(2)^2 = (2)^x$ or $x = 2$ (½ mark)

Dividing eqn. (iii) by eqn. (i), we get

$$\frac{0.192}{0.096} = \frac{k[0.30]^x[0.60]^y}{k[0.30]^x[0.30]^y}$$

or $2 = (2)^y$

$y = 1$ (½ mark)

Order w.r.t. A = 2 ; B = 1

(b) Rate law expression ; Rate (r) = $k[A]^2[B]^1$ (1 mark)

(c) Rate constant (k)

$$= \frac{\text{Rate (r)}}{[A]^2[B]^1} = \frac{0.096}{(0.30)^2 \times (0.30)} = \frac{0.096}{0.027} = 3.56$$ (1 mark)

(d) Rate of reaction in terms of A and C : Rate

$$= \frac{-d[A]}{dt} = \frac{1}{2}\frac{d[C]}{dt}$$ (½ + ½ = 1 mark)

34. (a) $\Lambda^{\infty}_{NH_4OH} = \lambda^{\infty}_{NH_4^+} + \lambda^{\infty}_{OH^-}$

$$\Lambda^{\infty}_{NH_4OH} = \lambda^{\infty}_{NH_4^+} + \lambda^{\infty}_{Cl^-} + \lambda^{\infty}_{Na^+} - \lambda^{\infty}_{OH^-} - \lambda^{\infty}_{Cl^-}$$

(1 mark)

$\Lambda^{\infty}_{NH_4OH} = \Lambda^{\infty}_{NH_4Cl} + \Lambda^{\infty}_{NaOH} - \Lambda^{\infty}_{NaCl}$

$= 129.8 + 248.1 - 126.4$

$= 251.5\ ohm^{-1}cm^2mol^{-1}$ (1 mark)

(b) Degree of dissociation is given by: $\alpha = \frac{\Lambda}{\Lambda^{\infty}}$

(½ mark)

Evaluation of $\Lambda^{\infty}_{CH_3COOH}$,

$\Lambda^{\infty}_{CH_3COOH} = \lambda^{\infty}_{CH_3COO^-} + \lambda^{\infty}_{H^+} = 40.9 + 349.8 = 390.7$ $ohm^{-1}\ cm^2\ eq^{-1}$ (½ mark)

Evaluation of degree of dissociation at C = 0.1 M

$$\alpha = \frac{\Lambda}{\Lambda^{\infty}} = \frac{5.20}{390.7} = 0.013$$

$\alpha = 1.3\%$ (1 mark)

Evaluation of degree of dissociation at C = 0.001 M,

$$\alpha = \frac{\Lambda}{\Lambda^{\infty}} = \frac{49.2}{390.7} = 0.125 \text{ i.e., } 12.5$$

$\alpha = 12.5\%$ (1 mark)

OR

(a) The cell reactions are :

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

At cathode : $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ (1 mark)

We know that :

$\Delta G^0 = -nFE^0_{cell}$; $n = 2$ mol

$E^0_{cell} = [E^0_{(Cu^{2+}/Cu)} - E^0_{(Fe^{2+}/Fe)}]$

$= (+0.34\ V) - (-0.44\ V) = +0.78\ V$ (1 mark)

$F = 96500\ C\ mol^{-1}$

$\therefore \quad \Delta G^0 = -nFE^0_{cell}$

$= -(2\ mol) \times (96500\ C\ mol^{-1}) \times (+0.78\ V)$

$= -150540\ CV = -150540\ J$ ($\because$ 1 CV = 1 J)

(1 mark)

(b) According to Faraday's first law of electrolysis :

The reaction at cathode :

$Cu^{2+} + 2e^- \longrightarrow Cu$ (½ mark)

63.5 $\quad 2 \times 96500\ C$

The quantity of charge passed = I × t = (10 amp) × (1 × 60 × 60s) = 36000 C (½ mark)

2 × 96500 C of charge deposit copper = 63.5g

36000 C of charge deposit copper

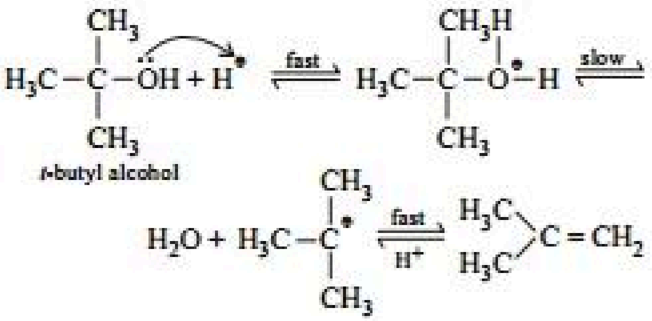
$$= \frac{(63.5g)}{(2 \times 96500C)} \times (36000C) = 11.84g$$ (1 mark)

Thus, 11.84g of copper will dissolve from the anode and the same amount from the solution will get deposited on the cathode. The concentration of the solution will remain unchanged.

35. (a) In the acid catalysed dehydration of alcohols, the slowest step or the rate determining step is the formation of carbocation. Thus dehydration of tertiary alcohols will be fastest because tertiary carbocation is most stable.

(1 + 1 = 2 Marks)

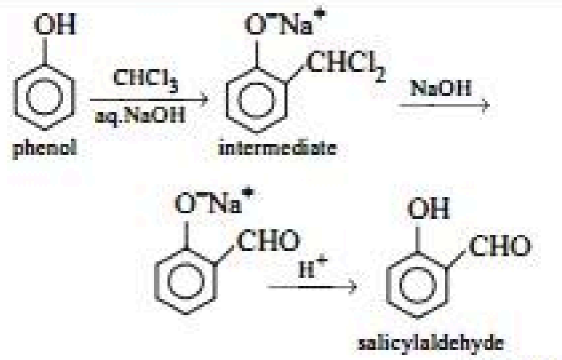
Note:



Note

It is an example of Reimer-Tiemann reaction. Reimer-Tiemann reaction is an electrophillic substitution reaction in which dichlorocarbene is generated in the first step and act as strong electrophile.

(b) (i)

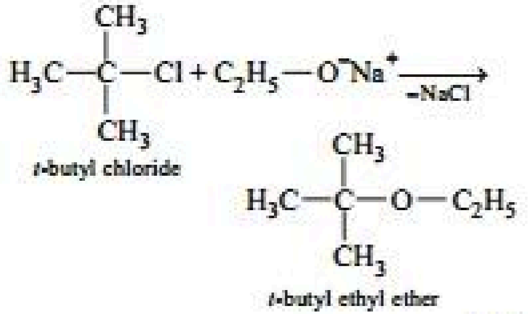


(1 mark)

Note

It is an example of Williamson Synthesis. Williamson synthesis is S_N2 reaction. Nucleophile attacks from the back side which results in inversion of configuration at the site of the leaving group.

(ii)



(1 mark)

(iii) $6\underset{\text{propene}}{CH_3-CH=CH_2}+\underset{\text{diborane}}{B_2H_6}\longrightarrow$

$2(CH_3-CH_2-CH_2)_3B$

$(CH_3-CH_2-CH_2)_3B\xrightarrow{H_2O_2}$

$\underset{\text{propanol}}{CH_3-CH_2-CH_2-OH}+\underset{\text{boric acid}}{B(OH)_3}$

(1 mark)