Class-XII Session 2022-23
Subject - Chemistry
Sample Question Paper - 21
With Solution

BLUE PRINT

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

(a) have no volume change on mixing (b) have no enthalpy change on mixing

(c) have both the above characteristics (d) have high solubility.

2. Which statement is not correct about alcohol?

(a) Molecular weight of alcohol is higher than water

(b) Alcohol of less no. of carbon atoms is less soluble in water than alcohol of more no. of carbon atoms

(c) Alcohol evaporates quickly

(d) All of the above

3. The correct order of atomic radii is :

(a) Ce > Lu > Ho (b) Ho > Lu > Ce (c) Lu > Ce < Ho (d) Ce > Ho > Lu

4. The catalyst used in Rosenmund's reduction is

(a) $HgSO_4$ (b) $Pd/BaSO_4$ (c) anhydrous $AlCl_3$ (d) anhydrous $ZnCl_2$

5. The halogen which is the most reactive in the halogenation of alkanes under sunlight is ....

(a) Fluorine (b) Chlorine (c) bromine (d) iodine

6. An aqueous solution of hydrochloric acid

(a) obeys Raoult's law (b) shows negative deviation from Raoult's law

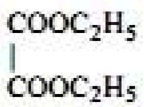
(c) shows positive deviation from Raoult's law (d) obeys Henry's law at all compositions

7. Which of the following reaction is possible at anode?

(a) $2\,Cr^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+$ (b) $F_2 \rightarrow 2F^-$

(c) $(1/2)\,O_2 + 2H^+ \rightarrow H_2O$ (d) None of these.

8. Hinsberg's reagent is :

(a) 
$\begin{array}{c} COOC_2H_5 \\ | \\ COOC_2H_5 \end{array}$
(b) $C_6H_5SO_2Cl$ (c) $C_6H_5SO_2NH_2$ (d) $CH_3COCH_2COOC_2H_5$

9. α - D-(+)-glucose and β-D-(+)-glucose are

(a) conformers (b) epimers (c) anomers (d) enantiomers

10. Which of the following statement is true for the reaction, $H_2 + Br_2 \rightarrow 2HBr$. The rate law is $\frac{dx}{dt} = k[H_2][Br_2]^{1/2}$.

(a) order of reaction is 1.5.

(b) molecularity of the reaction is 2.

(c) by increasing the concentration of Br_2 four times the rate of reaction is doubled.

(d) all the above are correct.

11. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$, is:
(a) V^{2+} and Co^{2+} (b) V^{2+} and Fe^{2+} (c) Co^{2+} and Fe^{2+} (d) Cr^{2+} and Mn^{2+}

12. What is the E°_{cell} for the reaction $Cu^{2+}(aq) + Sn^{2+}(aq) \rightleftharpoons Cu(s) + Sn^{4+}(aq)$ at 25 °C if the equilibrium constant for the reaction is 1×10^6?
(a) 0.5328V (b) 0.3552V (c) 0.1773V (d) 0.7104V

13. The plot of concentration of the reactant vs time for a reaction is a straight line with a negative slope. The reaction follows a rate equation
(a) zero order (b) first order (c) second order (d) third order

14. $[Pt(NH_3)_4Cl_2]Br_2$ complex can show:
(a) Hydrated as well as ionization isomerism. (b) Ionization as well as geometrical isomerism.
(c) Linkage as well as geometrical isomerism. (d) Ionization as well as optical isomerism.

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:** Anilinium chloride is more acidic than ammonium chloride.
Reason: Anilinium ion is resonance stabilized.

16. **Assertion :** Disruption of the natural structure of a protein is called denaturation.
Reason : The change in colour and appearance of egg during cooking is due to denaturation.

17. **Assertion :** S_N2 reactions always proceed with inversion of configuration.
Reason : S_N2 reaction of an optically active aryl halide with an aqueous solution of KOH always gives an alcohol with opposite sign of rotation.

18. **Assertion:** Phenol is a strong acid than ethanol.
Reason: Groups with +M effect decreases acidity at *p*-position.

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. Why is ionic radius of Cu^{2+} less than that of Cr^{2+} whereas atomic number of Cu greater than that of Cr?

20. For the reaction : $aA + bB \rightarrow$ Products, the rate law is given by Rate = $k[A]^m[B]^n$. On making the concentration of A two fold and halving that of B, what will be the the ratio of the new rate to the earlier rate of the reaction?

OR

In a reaction with initially 0.12 M, the concentration of reactant is reduced to 0.06 M in 10 hour and to 0.03 M in 20 hour.
(i) What is order of reaction?
(ii) What is rate constant?

21. Calculate the λ^{∞}_{m} (NH_4OH) when corresponding values of NH_4Cl, NaOH and NaCl are 150, 248·1 and 126·4 S cm^2 mol^{-1} respectively.

22. If two substances A and B have $p_1^{\circ} : p_2^{\circ} = 1 : 2$ and contain mole fraction in solution as 1 : 2. Then, what will be the mole fraction of component 1 in vapour phase ?

23. Account for the following:
(a) Alcohols act as weak bases. (b) Ethanol has higher b.p. than methoxymethane.

OR

(a) Phenol is more acidic than ethanol.
(b) *m*-Aminophenol is a stronger acid than *o*-aminophenol.

24. Rearrange the following compounds as directed below:
   (a) Increasing order of basic strength in their aqueous solutions.
   NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$
   (b) Increasing order of basic strength in gas phase $C_2H_5NH_2$, $(C_2H_5)NH$, $(C_2H_5)_3N$ and CH_3NH_2

25. The tertiary structure of many proteins dissolved in water is disrupted by heating above 80 °C but primary structure is unaffected. 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. (a) State Raoult's law for solutions of volatile solutes.
   (b) The vapour pressure of pure benzene at a certain temperature is 640 mm Hg. A non-volatile solid weighing 2.175g is added to 39.0g of benzene. The vapour pressure of the solution is 600 mm Hg. What is the molecular weight of the solid substance ?

OR

   (a) Calculate the molality of 1 litre solution of 93% H_2SO_4 (weight/volume). The density of the solution is 1.84 g/mL.
   (b) What is the effect of temperature on the solubility of a gas in a liquid?

27. (a) In some reactions, the energy possessed by colliding molecules is more than the threshold energy, yet the reaction is slow. Why?
   (b) State one condition in which a bimolecular reaction may be kinetically of the first order.

28. Convert:
   (a) Ethylalcohol to diethylether (b) 1-Butanol to butanoic acid
   (c) Give two chemical tests to distinguish aldehyde from ketones.

29. How will you convert (a) Butan-2-one to butan-2-ol.
   (b) Acetone to isopropylamine (c) Benzaldehyde to cyanobenzene

30. **Differentiate between the following:**
   (a) Amylose and Amylopectin
   (b) Peptide linkage and Glycosidic linkage
   (c) Fibrous proteins and Globular proteins

OR

Write chemical reactions to show that open structure of D-glucose contains the following:
   (a) Straight chain
   (b) Five alcohol groups
   (c) Aldehyde as carbonyl group

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. Redox reactions play a pivotal role in chemistry and biology. The values of standard redox potential (E°) of two half-cell reactions decide which way the reaction is expected to proceed. A simple example is a Daniel cell in which zinc goes into solution and copper gets deposited. Given below are a set of half-cell reactions (acidic medium) along with their E° (V with respect to normal hydrogen electrode) values. Using this data obtain the correct explanations to questions given.

$I_2 + 2e^- \rightarrow 2I^-$	$E° = 0.54$
$Cl_2 + 2e^- \rightarrow 2Cl^-$	$E° = 1.36$
$Mn^{3+} + e^- \rightarrow Mn^{2+}$	$E° = 1.50$
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	$E° = 0.77$
$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$	$E° = 1.23$

Answer the following questions:
   (a) Explain how iodine ion is oxidised by chlorine.

(b) Sodium fusion extract, obtained from aniline, on treatment with iron (II) sulphate and H_2SO_4 in presence of air gives a Prussian blue precipitate. The blue colour is due to the formation of which complex ?

(c) Explain in why oxygen cannot oxidise chloride ion.

OR

Mn^{2+} is not able to undergo oxidation in presence of O_2, explain.

32. A water insoluble solid "*A*" turns yellow on heating and becomes white again on cooling. When "*A*" is treated with HCl (aq) it forms a clear solution "*B*". "*A*" when treated with NaOH (aq) also gives a clear solution "*C*". When H_2S (g) is bubbled through clear solution "*B*" no change is observed but when H_2S is bubbled through clear solution "*C*", a white precipitate of compound "*D*" is observed.

Answer the following questions :

(a) Identify compound "A"

(b) What is compound "*B*"?

(c) What will be the nature of compound "A"?

OR

The compound obtained during the reaction of "*C*" with H_2S.

SECTION-E

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

33. (a) Draw the structures of optical isomers of

(i) $[Cr(C_2O_4)_3]^{3-}$ (ii) $[PtCl_2(en)_2]^{2+}$ (iii) $[Cr(NH_3)_2Cl_2(en)]^+$

(b) Write the IUPAC nomenclature of the given complex along with its hybridisation and structure.

$K_2[Cr(NO)(NH_3)(CN)_4]$, $\mu = 1.73$ BM

OR

(a) Write the IUPAC names of the following coordination compounds:

(i) $[Pt(NH_3)_2Cl(NO_2)]$ (ii) $K_3[Cr(C_2O_4)_3]$

(b) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why?

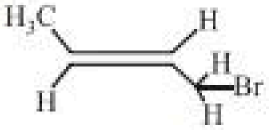
(c) Explain the following cases giving appropriate reasons.

(i) Nickel does not form low spin octahedral complexes.

(ii) The π-complexes are known for the transition metals only.

(iii) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand.

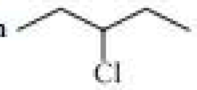
34. (a) What will be the IUPAC name of the following?

(i) 

(ii) $ClCH_2C=CCH_2Br$

(b) Account for the following:

(i) Reaction of alkyl chlorides with aqueous KOH leads to alcohols while with alcoholic KOH, alkenes are major products.

(ii)  reacts faster than  towards S_N1 reaction.

OR

(a) Account for the following:

(i) Order of reactivity of haloalkanes is RI > RBr > RCl.

(ii) Neopentyl chloride, $(CH_3)_3CCH_2Cl$ does not follow S_N2 mechanism.

(b) Write the missing product(s) of the following reaction(s)?

(i) $CH_3CH_2CH=CH_2 + HBr$ (ii) $CH_2=CH_2 + Br_2$

35. Write chemical reactions to carry out the following conversions :

(a) Butan-1-ol to butanoic acid

(b) Benzyl alcohol to phenylethanoic acid

(c) 3-Nitrobromobenzene to 3-Nitrobenzoic acid

(d) 4-Methylacetophenone to benzene-1, 4-dicarboxylic acid

(e) Butanal to butanoic acid.

Solutions

SAMPLE PAPER-2

1. (c) For ideal solution,
$\Delta V_{mixing} = 0$ and $\Delta H_{mixing} = 0$.

2. (b) The solubility of alcohols depend on number of C-atoms of alcohols. The solubility of alcohols in water decreases with the increase in number of C-atoms of alcohol. As resulting molecular weight increases, the polar nature of – OH bond decreases and hence strength of hydrogen bond decreases.

3. (d) Atomic radii follows the order, Ce > Ho > Lu

4. (b) $Pd/BaSO_4$ is used as a catalyst in rosenmund reduction.

5. (b) **Chlorine;** because rate of formation of $\dot{C}H_3$ (one of the propagating steps) is high when $\dot{X}$ is Cl.
$CH_4 + \dot{X} \longrightarrow \dot{C}H_3 + H - X$

6. (b) The attraction between HCl and H_2O molecules is stronger, so the escaping tendency from the solution to the vapour phase will be smaller. Then, the partial vapour pressure will be smaller than predicted by Raoult's law and the system will exhibit a negative deviation.

7. (a) $2Cr^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+$
O.S. of Cr changes from +3 to +6 by loss of electrons. At anode oxidation takes place.

8. (b) Hinsberg's reagent is $C_6H_5SO_2Cl$ which is used to distinguish between primary, secondary and tertiary amines.

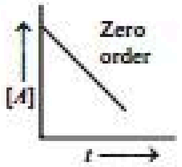
9. (c) As $\alpha - D - (+) -$ glucose and $\beta - D - (+)$ glucose differ in configuration at C – 1 atom so they are colled anomers.

10. (d) Order of reaction $= 1 + \frac{1}{2} = 1.5$
Molecularity of the reaction = 1 + 1 = 2
As, $\frac{dx}{dt} \propto [Br_2]^{1/2}$;
so, the rate of reaction will be doubled if concentration of Br_2 is increased by 4 times.

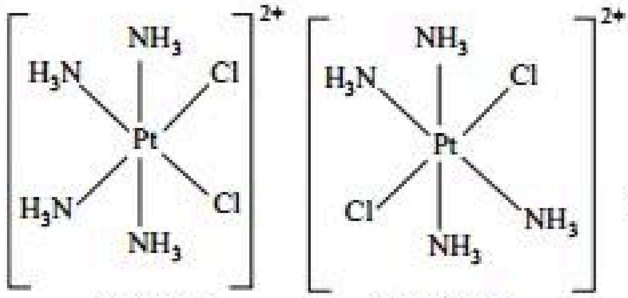
11. (a) Given $\mu = 3.9$ BM
$\mu = \sqrt{n(n+2)}$ BM; $3.9 = \sqrt{n(n+2)}$; $n = 3$
So, the central metal ion has 3 unpaired electrons.
∴ Configuration is either d^3 or d^7 as H_2O is a weak field ligand.
V^{2+} has d^3 configuration.
Co^{2+} has d^7 configuration.

12. (c) $E^0_{cell} = \frac{2.303\,RT}{nF} \log K_{eq} = \frac{0.0591}{n} \log K_{eq}$
$= \frac{0.0591}{2} \log 10^6 = 0.0591 \times 3 = 0.1773$ V

13. (a) Plots of conc. [A] Vs time, t



14. (b) $\left[Pt(NH_3)_4 Cl_2\right]Br_2$ and
$\left[Pt(NH_3)_4 ClBr\right]Cl.\ Br$: Ionization isomer



:

Cis-isomer *Trans*-isomer

Geometrical isomers

15. (c) Anilinium chloride is more acidic than ammonium chloride as it easily looses proton to form aniline (resonance stabilized).
Anilinium ion does not show resonance because charge dispersion at ring may involve unstable pentavalent nitrogen structure.

16. (b) Due to denaturation, a protein molecule uncoils and, form a more random conformation and ultimately precipitates from the solution. Also, during denaturation protein molecule loses its biological activity.
Thus, reason is correct but it is not the correct explanation of assertion.

17. (c) Aryl halides do not undergo nucleophilic substitution under ordinary conditions due to resonance. Due to resonance the carbon–halogen bond acquires partial double bond character, which is shorter and stronger and thus, cannot be substibuted by nucleophiles.

18. (b) Phenol is a stronger acid than ethanol because phenoxide ion is resonance stabilised.
Groups having +M effect present at *p*-position (like halide group), decreases the acidity of phenols.

19. $Cu^{2+}\ [Ar]_{18}\ 3d^9\ 4s^0$
$Cr^{2+}\ [Ar]_{18}\ 3d^4\ 4s^0$
As can be seen from the electronic configuration, above that additional five electrons in Cu^{2+} are present in the same 3*d*-orbitals as compared to Cr^{2+}. Thus, there are greater attractive forces in Cu^{2+} ion between nucleus and 3*d*-electron as compared to Cr^{2+} ion. (2 marks)

20. $(\text{Rate})_1 = k[A]^m[B]^n$; $(\text{Rate})_2 = k(2[A])^m([B]/2)^n$

Hence, $\dfrac{(\text{rate})_2}{(\text{rate})_1} = 2^m \times \left(\dfrac{1}{2}\right)^n = 2^{m-n}$ (2 marks)

OR

Assuming Ist order, i.e., $k = \dfrac{2.303}{t} \log_{10} \dfrac{a}{(a-x)}$, where

a = 0.12 M (½ mark)

For case I : $k = \dfrac{2.303}{10} \log_{10} \dfrac{0.12}{0.06} = 0.069\ \text{hr}^{-1}$

for t = 10 hr; (a-x) = 0.06M (½ mark)

For case II : $k = \dfrac{2.303}{20} \log_{10} \dfrac{0.12}{0.03} = 0.069\ \text{hr}^{-1}$

for t = 20 hr; (a-x) = 0.03M (½ mark)

Reaction is of Ist order and rate constant $k = 0.069\ \text{hr}^{-1}$ (½ mark)

21. $\lambda_m^\infty(NH_4OH) = \lambda_m^\infty(NH_4^+) + \lambda_m^\infty(OH^-)$

Using Kohlrausch law of independent migration of ions, $\lambda^\infty(NH_4OH)$

$= \left[\lambda_m^\infty(NH_4^+) + \lambda_m^\infty(Cl^-)\right] + \left[\lambda_m^\infty(Na^+) + \lambda_m^\infty(OH^-)\right]$

$-\left[\lambda_m^\infty(Na^+) + \lambda_m^\infty\ Cl^-\right]$ (1 mark)

$= \lambda_m^\infty(NH_4Cl) + \lambda_m^\infty(NaOH) - \lambda_m^\infty\ NaCl$

$= 150 + 248{\cdot}1 - 126{\cdot}4 = 271{\cdot}7\ \text{S cm}^2\ \text{mol}^{-1}$. (1 mark)

22. Here, $x_1 = x$ and $x_2 = 2x$ and $p_1^\circ = p$ and $p_2^\circ = 2p$

So, $p_1 = x_1 \times p_1^\circ$

and $p_2 = x_2 \times p_2^\circ$

$p_1 = x \times p$; $p_2 = 2x \times 2p$

$p_1 = x \times p = xp$; $p_2 = 4xp$

$p_{total} = p_1 + p_2 = xp + 4xp = 5xp$ (1 mark)

Mole fraction of component 1 in vapour phase

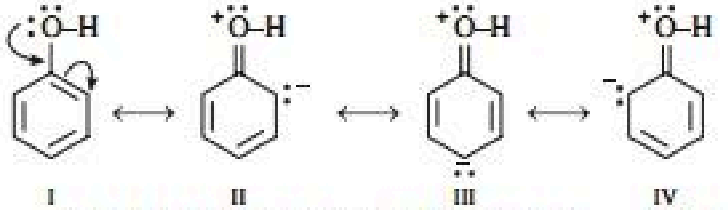
$y_1 = \dfrac{p_1}{p_{total}} \Rightarrow y_1 = \dfrac{xp}{5xp} = 0.2$ (1 mark)

23. (a) Due to presence of lone pair of electrons on oxygen, alcohols behave as Bronsted base (proton acceptors). (1 mark)

(b) Alcohol molecules are capable of forming H–bonds with each other. On the other hand ether molecules do not form H–bonds and thus they do not exhibit association, hence their boiling point are lower than the isomeric alcohols. (1 mark)

OR

(a) Greater acidity of phenol than an alcohol is due to possibility of resonance in phenol which leads to electron-deficient oxygen atom. Presence of electron-deficient oxygen atom (see structures II, III and IV) in turn weakens the $-\overset{+}{O}\longleftarrow H$ bond, and thus facilitates release of proton.



Such structures are not possible in alcohols. (1 mark)

(b) Amino group, being electron releasing, intensifies the negative charge if present at *ortho* and *para* positions (but not *meta* position) and thus makes the phenoxide less stable and thus the parent phenol (*o*-amino phenol) less acidic than phenol. However, when present at *meta* position, it is not involved in the intensification of charge and thus has no additional effect on stability of the corresponding phenoxide ion and hence on acidity of the corresponding phenol (*m*-amino phenol), i.e. it is as acidic as phenol and hence more acidic than *o*-aminophenol. (1 mark)

24. (a) Stability of the corresponding conjugate acids.

$(CH_3)_2\overset{+}{N}H_2$	>	$CH_3\overset{+}{N}H_3$	>	$(CH_3)_3\overset{+}{N}H$	>	NH_4^+
Most stable due to solvation as well as inductive (2 CH_3 gps) effects		Less stable due to one +I gp.		Lesser stable due to less solvation		Least stable due to absence of +I gp.

Thus the relative basic strength of the four parent compounds is

$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$ (1 mark)

(b) Increasing order of basic strength in gas phase is (1 mark)

CH_3NH_2	<	$C_2H_5NH_2$	<	$(C_2H_5)_2NH$	<	$(C_2H_5)_3N$
Least +I effect due to CH_3 group		Lesser +I effect due to 1 ethyl group		Lesser +I effect due to 2 ethyl groups		Max. +I effect due to 3 ethyl groups

25. When proteins dissolved in water is heated above 80 °C, rearrangement of secondary and tertiary structures occurs, as simple heating can cause disruption of these comparatively weaker forces of attraction. However, primary structure remains unaffected as it involves stronger covalent bonds between various amino acid units. (2 marks)

26. (a) Raoult's law: According to Raoult's law, for a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction pressent in the solution (1 mark)

(b) Acc. to relative lowering of vapour pressure

$$\frac{p^\circ - p}{p^\circ} = \frac{w/m}{w/m + W/M}$$

Here, $p^\circ = 640$ mm Hg, $p = 600$ mm Hg, $w = 2.175$g, $W = 39.0$ g, $M = 78$, m = Molecular weight of solute

Substituting the various values in the above equation,

$\dfrac{640-600}{640} = \dfrac{2.175/m}{2.175/m + 39/78}$ (1½ marks)

$m = 65.25$ (½ mark)

OR

(a) Mass of H_2SO_4 in 100 mL of 93% H_2SO_4 solution = 93g
∴ Mass of H_2SO_4 in 1000 mL of the H_2SO_4 solution = 930g
Mass of 1000 mL H_2SO_4 solution = 1000 × 1.84 = 1840g
Mass of water in 1000 mL of solution = 1840 – 930 = 910 g

$$\text{Moles of } H_2SO_4 = \frac{\text{Wt. of } H_2SO_4}{\text{Mol Wt. of } H_2SO_4} = \frac{930}{98} \quad \text{(1 mark)}$$

$$\text{Molality (m)} = \frac{\text{Moles of } H_2SO_4}{\text{Mass of water (in kg)}}$$

$$\text{Molality (m)} = \frac{930}{98} \times \frac{1000}{910} = 10.43 \text{ mol kg}^{-1}$$

∴ Molality of 1 litre solution = 10.43 (1 mark)

(b) Increased temperature causes an increase in kinetic energy. the higher energy causes more motion in the gas molecules which break intermolecular bonds and escape from solution. Therefore, as the temperature increases, the solubility of a gas in a liquid decreases. (1 mark)

27. (a) Though the energy possessed by molecules is more than the threshold energy and the reaction should proceed at a reasonable rate yet in some cases the reaction is slow. It is due to the fact that in such cases the reacting molecules are not properly oriented. Due to this the number of effective collision decreases and so the reaction is slower than expected rate. (1 + 1 = 2 mark)

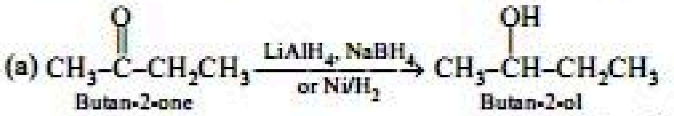
(b) A bimolecular reaction may be kinetically of the first order by taking one of the reactants in large excess so that it may not contribute towards the order of reaction. (1 mark)

28. (a) $2C_2H_5OH \xrightarrow[415K]{\text{conc. } H_2SO_4} C_2H_5—OC_2H_5 + H_2O$

(1 mark)

(b) $CH_3CH_2CH_2CH_2OH \xrightarrow[\text{Oxidation}]{KMnO_4/\text{dil } H_2SO_4}$
$CH_3CH_2CH_2COOH$ (1 mark)

(c) Aldehydes forms silver mirror with Tollen's reagent and forms red precipitate with Fehling solution, and restore the pink colour of Schiff's reagent. Ketones do not respond to any of these tests. (1 mark)

29. (a)


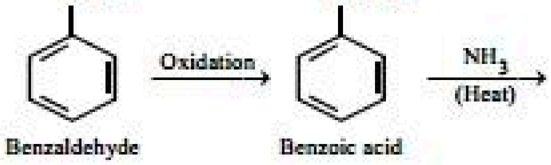
$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2CH_3 \xrightarrow[\text{or Ni/}H_2]{LiAlH_4,\ NaBH_4} CH_3-\overset{\overset{OH}{|}}{C}H-CH_2CH_3$$

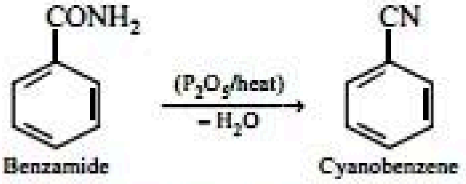
Butan-2-one Butan-2-ol

(1 mark)

(b) $\underset{\text{Acetone}}{(CH_3)_2C=O} \xrightarrow[-H_2O]{NH_2OH} \underset{\text{Acetoxime}}{(CH_3)_2C=NOH}$

$\xrightarrow[\text{Reduction}]{LiAlH_4} \underset{\text{Isopropylamine}}{(CH_3)_2CHNH_2}$ (1 mark)

(c)




(1 mark)

30. (a) Amylose and Amylopectin

Amylose: It is a linear polymer of α-D glucose having approximately 200 – 1000 α-D-glucose units. C-1 of one α-D glucose is attached to C-4 of another α-D glucose with glycosidic bond. It is water soluble and it forms 15-20% part of starch and give blue colour with I_2.

Amylopectin: It is a branched chain polymer of α-D glucose which is constituted by hundreds of small chain having 20-30 α-D glucose unit. In it small chain are formed by glycosidic bonds between C-1 and C-4. These chain are joined by $C_1—C_6$ bonds. This fraction does not give blue colour with I_2. (1 mark)

(b) Peptide linkage and Glycosidic linkange

The bond conecting two or more similar or different amino acid in protein is commonly called *peptide bond* or *peptide linkage*. In the formation of peptide bond —NH_2 group of one amino acid is condensed with —COOH of adjacent amino acid to form —CONH linkage. When —OH group of hemiacetal carbon of one monosaccharide is condensed with — OH group of another, glycosidic bond is formed, which links two monosacharide together. (1 mark)

(c)

Fibrous Proteins	**Globular Proteins**
(i) Proteins which are made up of linear, thread like molecules are called fibrous protein. In these molecules, poly-peptide chains are held together with H bonds.	(i) In these proteins poly-peptides attain spherical shape and poly-peptides are held together with relatively weaker-H-bonds.
(ii) They are insoluble in water but soluble in strong acid and bases. **Example:** Keratin, Myosin	(ii) They are soluble in water, alkalies, salt solutions and acid solutions. **Example:** Globulin, Pepsin

(1 mark)

OR

(a) Glucose on heating with HI and red phosphorous at 100°C, it forms *n*-hexane. This proves the presence of straight chain of six carbon atom in glucose. (1 mark)

(b) Glucose forms pentaacetyl derivatives with acid chloride and acid anhydride in the presence of anhydrous zinc chloride. It proves that one molecule of glucose contains five —OH groups. (1 mark)

(c) Glucose reacts with hydrogen cyanide to form, cyanohydrin. This reaction proves the presence of carbonyl group. (1 mark)

31. (a) $2I^- + Cl_2 \longrightarrow I_2 + 2Cl^-$

$E^\circ = E^\circ_{I^-/I_2} + E^\circ_{Cl_2/Cl^-} = -0.54 + 1.36 ; E^\circ = 0.82V$

(1 mark)

E° is positive hence, iodide ion is oxidized by chlorine.

(b) The precipitate formed in this reaction is of $Fe_4[Fe(CN)_6]_3$ (1 mark)

(c) No, oxygen cannot oxidised chloride ion because reduction potential of chloride ion is higher than oxygen. (2 marks)

OR

Reduction potential of Mn^{+3}/Mn^{+2} is higher than that of O_2. Therefore Mn^{+3} undergo reduction and water is oxidised to O_2. (2 marks)

32. (a) Compound "A" will be ZnO. (1 mark)

(b) B is $ZnCl_2$ (1 mark)

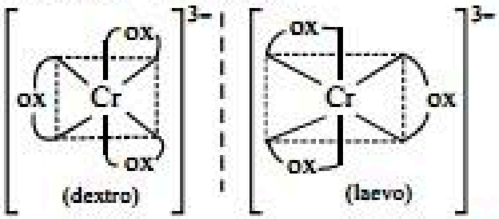
(c) It is amphoteric in nature. (2 marks)

OR

$$\underset{\text{"A"}}{ZnO} + 2NaOH(aq) \longrightarrow \underset{\text{"C"}}{Na_2ZnO_2} + H_2O$$

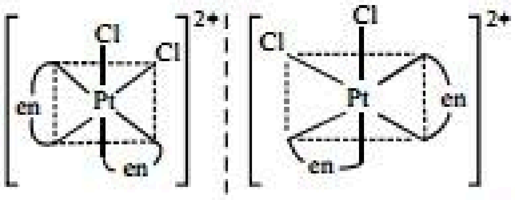
"C" + $H_2S \rightarrow ZnS$ (2 marks)

33. (a) (i) $[Cr(C_2O_4)_3]^{3-} \Rightarrow [Cr(ox)_3]^{3-}$



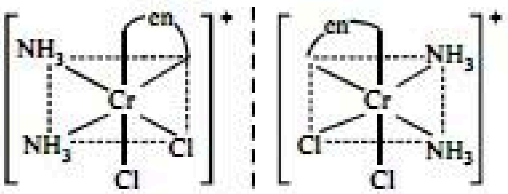
(1 mark)

(ii) cis - $[PtCl_2(en)_2]^{2+}$



(1 mark)

(iii) cis - $[Cr(NH_3)_2Cl_2(en)]^+$



(1 mark)

(b) The spin magnetic moment, μ of the complex is 1.73 BM.

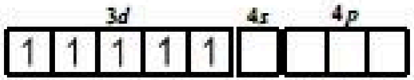
$\mu = \sqrt{n(n+2)} = 1.73 \Rightarrow n = 1$

It means that nucleus of the complex, chromium ion **has one unpaired electron.** So the ligand NO is **unit positively** charged. (½ mark)

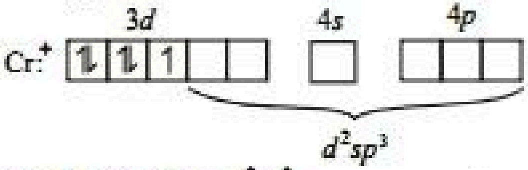
IUPAC name :

Potassium amminetetracyanonitrosochromate (I). (½ mark)

Electronic configuration of Cr^+ :

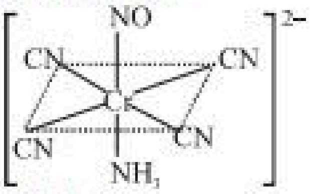


Electronic configuration of Cr^+ under the influence of strong field ligand CN^-



(½ mark)

So, Hybridisation : d^2sp^3



Shape : Octahedral (½ mark)

OR

(a) (i) Diamminechloridonitrito-N-platinum (II) (½ mark)

(ii) Potassium trioxalatochromate (III) (½ mark)

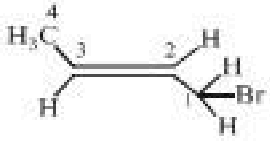
(b) In $Ni(CO)_4$, Ni is in zero oxidation state whereas in $NiCl_4^{2-}$, it is in +2 oxidation state. In the presence of CO ligand, the unpaired *d*-electrons of Ni pair up but Cl^- being a weak ligand is unable to pair up the unpaired electrons. (1 mark)

(c) (i) For octahedral complexes, coordination number should be 6. Since, nickel has $[Ar]3d^84s^2$ configuration *i.e.*, only one *d*-orbital is empty, so it can only form high spin octahedral complexes. (1 mark)

(ii) The transition metals/ions contain vacant *d*-orbitals to accomodate the electron pair donated by ligands containing π-electrons while the other metals do not have empty *d*-orbitals hence π complexes are formed by only transition metal atoms/ions. (1 mark)

(iii) In the presence of a strong field ligand such as CN^- ion, crystal field splitting energy is more than the third ionisation enthalpy $(\Delta_i H_3)$ for the oxidation of Co^{2+} to Co^{3+} ion. Therefore, Co^{2+} is easily oxidised to Co^{3+}. (1 mark)

34. (a) (i)



1-Bromobut-2-ene

(1 mark)

(ii) $\overset{4}{Cl}CH_2\overset{3}{C} \equiv \overset{2}{C}\overset{1}{C}H_2Br$ (1 mark)

1-Bromo-4-chlorobut-2-yne.

(b) (i) In aqueous solution, KOH is almost completely ionised to give OH^- ions which being a strong nucleophile leads to substitution reaction to form alcohols. In case of alcoholic solution of KOH ($C_2H_5OH + KOH \rightarrow C_2H_5O^- + K^+$), alkoxide ($RO^-$) ions are present which being much stronger base than OH^- ions causes elimination of a molecule of HCl leading to alkenes. (2 marks)

(ii) 3° Alkyl halide (former one) reacts faster than the 2° alkyl halide (latter one) due to greater stability of 3° carbocations over 2° carbocations. (1 mark)

OR

(a) (i) For a given alkyl group, the order of reactivity is R–I > R–Br > R–Cl > R–F. This is due to C–X bond energy, C–I bond dissociation enthalpy is minimum, while the C–F bond dissociation enthalpy is maximum. Hence R – I is most reactive, while R–F is least reactive. (1½ marks)

(ii) In neopentyl chloride, carbon bearing chlorine is sterically hindered due to bulky $(CH_3)_3C-$ group, hence not attacked easily by nucleophile to form transition state (S_N2 mechanism).

$$(CH_3)_3C-CH_2-Cl \xrightarrow[S_N2]{Nu:} \text{Transition state not formed}$$

(1½ marks)

(b) (i) $CH_3CH_2CH=CH_2 + HBr \xrightarrow[\text{anti-markov. addition}]{\text{Peroxide}}$

$CH_3CH_2CH_2CH_2Br$ (1 mark)

(ii) $H_2C=CH_2 + Br_2 \xrightarrow{CCl_4} BrCH_2-CH_2Br$

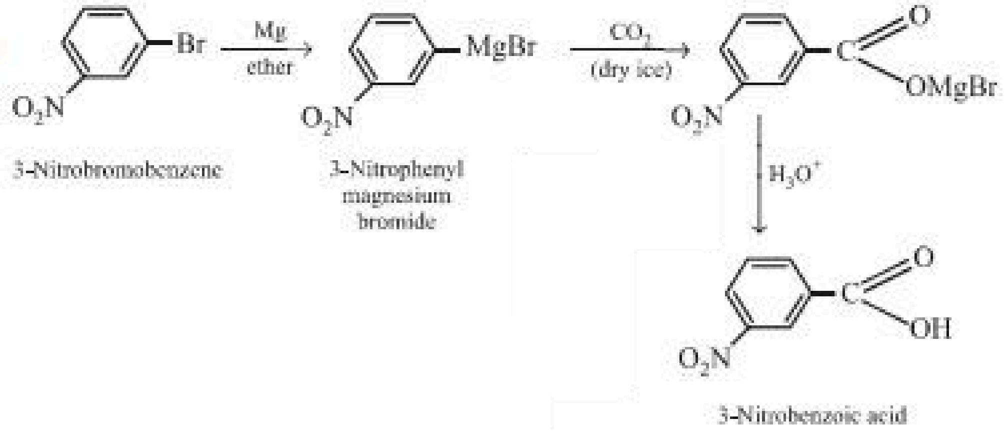
(1 mark)

35. (a) $\underset{\text{Butan-l-ol}}{CH_3\,CH_2CH_2CH_2\,OH} \xrightarrow{\text{Acidified } K_2Cr_2O_7} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$ (1 mark)

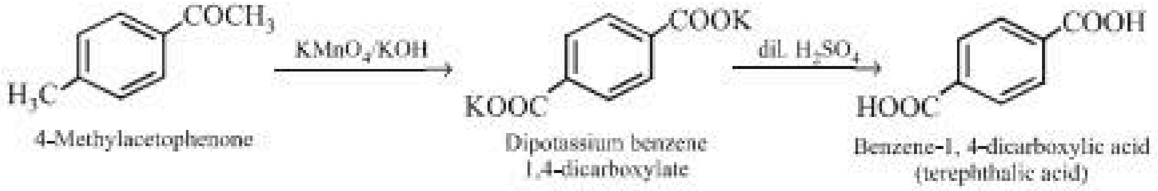
(b) (1 mark)

$$\begin{tikzcd} \underset{\text{Benzyl alcohol}}{C_6H_5CH_2OH} \arrow[r, "HBr"] & \underset{\text{Benzyl bromide}}{C_6H_5CH_2Br} \arrow[r, "KCN"] & \underset{\text{Benzyl cyanide}}{C_6H_5CH_2CN} \arrow[d, "\Delta"', "H_3O^+"] \\ & & \underset{\text{Phenylethanoic acid}}{C_6H_5CH_2COOH} \end{tikzcd}$$

(c) (1 mark)



(d) (1 mark)



(e) $\underset{\text{Butanal}}{CH_3CH_2CH_2CHO} \xrightarrow[\text{(tollen's reagent)}]{\text{Ammoniacal } AgNO_3} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$ (1 mark)