COMPETENCY-FOCUSED PRACTICE QUESTIONS

ISC-CLASS XII

CHEMISTRY

PAPER 1-THEORY

PREFACE

With a growing emphasis on competency-based education globally, the educational landscape in India has also steered towards high-quality learning experiences that allow learners to incorporate critical thinking and problem-solving approaches. This approach goes beyond rote memorisation and focuses on developing the skills and knowledge that students need to apply in their real-world scenarios.

The Council for the Indian School Certificate Examinations (CISCE), as a national-level progressive examination board, has taken several steps to infuse competency-based education in CISCE schools through teacher capacity-building on item development for competency-based assessments and the incorporation of competency-focused questions at the ICSE and ISC levels from the examination year 2024.

To further facilitate the adoption of competency-based assessment practices in schools and to support teachers and students towards the preparation for attempting higher-order thinking questions in future board examinations, Item Banks of **Competency-Focused Practice Questions** for selected subjects at the ICSE and ISC levels have been developed. This Item Bank consists of a rich variety of questions, both objective and subjective in categories, aimed at enhancing the subject-specific critical and analytical thinking skills of the students.

In this Item Bank, each question is accompanied by the topic and cognitive learning domain/s that it intends to capture. The cognitive domains reflected in these questions include understanding, analysis, application, evaluation and creativity, along with some questions of the higher-order recall domain. The Answer Key at the end presents the possible answers to a given question, but it is neither limiting nor exhaustive.

These practice questions are also meant to serve as teacher resources for classroom assignments and as samplers to develop their own repository of competency-focused questions. Apart from offering a good practice of higher-order thinking skills, engaging with these questions would allow students to gauge their own subject competencies and use these *assessments for learning* to develop individual learning pathways.

During the development of this Item Bank, a large pool of questions was prepared by a team of experienced CISCE teachers. The questions that were finalised by the internal and external reviewers as being higher-order competency-focused questions have been collated in this item bank.

I acknowledge and appreciate all the ICSE and the ISC subject matter experts who have contributed to the development and review of these high-quality competency-focused questions for CISCE students.

We are hopeful that teachers and students will utilise these questions to support their teaching-learning processes.

July 2024

Dr. Joseph Emmanuel
Chief Executive & Secretary
CISCE

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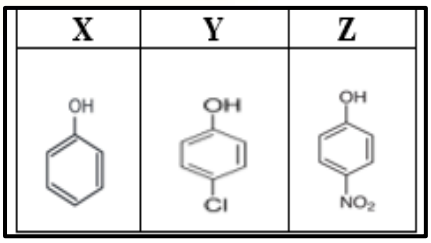
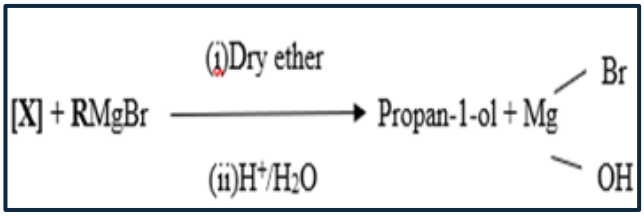
COMPETENCY-FOCUSED PRACTICE QUESTIONS

ISC-CLASS XII

Chemistry

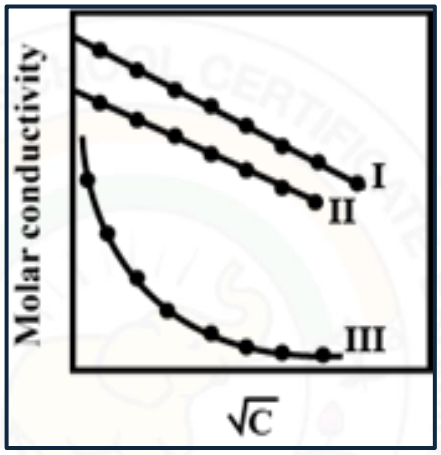
I: Multiple Choice Questions (1 Mark Each)

S.No.	Questions
1.	***[Alcohols, Phenols and Ethers]*** Which of the following reactions will **NOT** form an ether through Williamsons synthesis? I: $C_2H_5ONa + CH_3Br \rightarrow$ II: $C_6H_5Cl + C_2H_5ONa \rightarrow$ III: $C_6H_5ONa + CH_3I \rightarrow$ IV: $C_2H_5ONa + (CH_3)_3C—Br \rightarrow$ (a) I and III (b) II and III (c) III and IV (d) II and IV **(Application)**
2.	***[Alcohols, Phenols and Ethers]*** The correct order of acidic strength among the following organic compound is:  (a) Z > X > Y (b) Y > X > Z (c) Z> Y > X (d) X > Z > Y **(Understanding)**

S.No.	Questions
3.	***[Alcohols, Phenols and Ethers]*** For the reaction:  What are **X** and **R** respectively in the given reaction? (a) X: Acetaldehyde R: methyl (b) X: Formaldehyde R: methyl (c) X: Acetaldehyde R: ethyl (d) X: Formaldehyde R: ethyl **(Application)**
4.	***[Block Elements]*** An element **[X]** has an outer electronic configuration as $3d^5$ $4s^2$. The *maximum* oxidation state and *most* common oxidising state of the element will be: (a) +5, +3 (b) +2, +2 (c) +7, +3 (d) +7, +2 **(Understanding)**
5.	***[Organic Compounds containing Nitrogen]*** Secondary amines can be prepared by reduction. Identify the compound that will form a secondary amine on reaction with $LiAlH_4$? (a) Methyl cyanide (b) Methyl isocyanide (c) Acetamide (d) Nitroethane **(Recall)**
6.	***[Organic Compounds containing Nitrogen]*** Which of the following is most basic? (a) Aniline (b) Ethylamine (c) Ammonia (d) Benzylamine **(Analysis)**

S.No.	Questions
7.	***[Solutions]*** Depression in freezing point is a colligative property. At the same concentration in aqueous solution, select the solution that will show the largest freezing point depression. (a) Na_3PO_4 (b) $C_{12}H_{22}O_{11}$ (c) NaCl (d) K_2SO_4 **(Evaluate)**
8.	***[Solutions]*** When the molality of the dilute solution is multiplied by four, what will be the resulting effect on the molal depression constant (K_f)? (a) Four times (b) Unchanged (c) Halved (d) Eight times **(Evaluate)**
9.	***[Solutions]*** If Sodium nitrate is completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.05 mol of sodium nitrate is dissolved in 1 kg of water is: (K_f = 1.86 K kg mol^{-1}) (a) 0.1860 (b) 1.860 (c) 0.0186 (d) 0.279 **(Evaluate)**
10.	***[Chemical Kinetics]*** For a reaction A → B + C, when a student X doubled the concentration of 'A', the rate of reaction was found to increase by eight times. The unit of rate constant (k) will be: (a) s^{-1} (b) $mol^{-1}Ls^{-1}$ (c) $mol^{-2}L^2s^{-1}$ (d) mol $L^{-1}s^{-1}$ **(Application)**
11.	***[Chemical Kinetics]*** Which of the following combinations is **INCORRECT** regarding order and molecularity of a hypothetical reaction? (a) order = 2, molecularity = 1 (b) order = 3/2, molecularity 2 (c) order =1 molecularity =2 (d) order = ½ molecularity = 3/2 **(Recall)**

S.No.	Questions
12.	***[Biomolecules]*** With which of the following reagent both glucose and fructose will produce the same product? (a) Bromine water (b) Hydroxyl amine (c) Phenyl hydrazine (d) Conc. HNO_3 **(Understanding)**
13.	***[Biomolecules]*** What kind of bond will be formed when glycine and alanine are condensed together? (a) Zwitter ionic bond (b) Glycosidic bond (c) Peptide bond (d) Coordinate bond **(Understanding)**
14.	***[Organic Compounds containing Nitrogen]*** The reaction of the compound A with NH_3 give an aromatic amine B. This amine on treatment with nitrous acid forms a diazonium salt which is used in the preparation of A. **Identify A and B.** (a) $C_6H_5NH_2$ and C_6H_5Cl. (b) C_6H_5Cl and C_6H_5OH. (c) C_6H_5CN and C_6H_5Cl. (d) C_6H_5Cl and $C_6H_5NH_2$ **(Analysis)**
15.	***[Haloalkanes and Haloarenes]*** Rahul wants to prepare chloroform in the laboratory using ethanol. The correct order of preparation is: (a) oxidation, liberation of Cl_2, hydrolysis and chlorination. (b) liberation of Cl_2, oxidation, chlorination, hydrolysis. (c) hydrolysis, oxidation, chlorination, liberation of chlorine. (d) chlorination, hydrolysis, oxidation, liberation of chlorine. **(Recall & Understanding)**
16.	***[Haloalkanes and Haloarenes]*** The C-X bond length in haloarenes is shorter due to: (a) resonance with Benzene ring. (b) formation of carbocation. (c) Van der Waals forces. (d) polarisation of bond. **(Recall & Understanding)**

S.No.	Questions
17.	***[Electrochemistry]*** How much charge is required for the reduction of 1mole of Cu^{+2} to Cu? (a) 193500C (b) 193000C (c) 192500C (d) 193600C **(Evaluate)**
18.	***[Electrochemistry]***  The above graph indicates the variation of molar conductivity of different electrolytes. NaCl, CH_3COOH, KCl represented as I, II, and III respectively. The order of increase in molar conductivity with concentration is: (a) (II), (III), (I) (b) (I), (III), (II) (c) (III), (II), (I) (d) (III), (I), (II) **(Evaluate & Analysis)**
19.	***[Coordination Compounds]*** On adding silver nitrate solution to $CoBr_2Cl.4NH_3$, I mole of light-yellow precipitate of compound X is obtained. Which of the following statement explains this? (a) 2 bromine atoms are linked by primary valency. (b) 2 bromine atoms are linked by secondary valency. (c) 1 bromine atom is linked by primary valency. (d) 1 chlorine atom is linked by primary valency. **(Analysis)**

S.No.	Questions
20.	***[Coordination Compounds]*** Gia applied magnetic field around $[Fe(H_2O)_6]^{2+}$ and $[Fe(CN)_6]^{4-}$, she found that $[Fe(H_2O)_6]^{2+}$ is strongly attracted towards magnet. Which of the following explains this correctly? (P) CN^- is a weak ligand. (Q) H_2O is a weak ligand. (R) $[Fe(H_2O)_6]^{2+}$ is inner orbital complex. (S) $Fe(CN)_6]^{4-}$ is low spin complex. (a) Only (S) (b) Both (P) and (Q) (c) Only (R) (d) Both (Q) and (S) **(Application)**
21.	***[Haloalkanes and Haloarenes]*** Toluene reacts with chromyl chloride in CCl_4 to give compound (X). Which of the following test is most likely to be shown by compound (X)? (a) Yellow precipitate of iodoform (b) Brick red precipitate by Fehling solution (c) Silver mirror by Tollen's test (d) Orange red dye by coupling reaction **(Understanding)**
22.	***[Aldehydes, Ketones and Carboxylic Acids]*** Which of the following compound is the *most* and *least* reactive towards nucleophilic substitution reaction respectively? (I) Acetone (II) Benzaldehyde (III) Formaldehyde (IV) Acetophenone (a) (III) and (IV) (b) (I) and (II) (c) (II) and (I) (d) (IV) and (III) **(Understanding)**
23.	***[Chemical Kinetics]*** From a plot of rate (Y-axis) and concentration (X- axis), a student concluded that the order of reaction is zero. What he must have observed in the graph? (a) A parallel line with X axis. (b) A line passing from the origin with positive slope. (c) A line with negative slope with an intercept. (d) A zig zag curve. **(Recall)**

II: Assertion-Reason Questions (1 Mark Each)

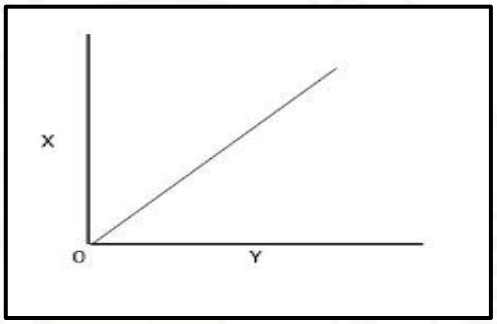
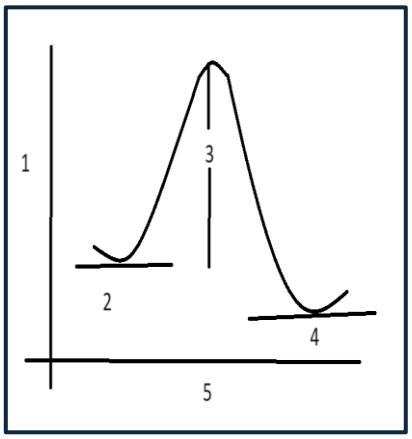
S.No.	Questions
24.	***[Haloalkanes and Haloarenes]*** **Assertion (A):** Electrophilic substitution reactions in haloarenes takes place in ortho and para positions and the major product is para substituted haloarenes. **Reason (R):** The halogen in the ring is not ortho and para directing, and the yield is more of para because of resonance stabilisation. (a) Both Assertion (A) and Reason (R) are correct, and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are correct, and Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. **(Understanding)**
25.	***[Aldehydes, Ketones and Carboxylic Acids]*** **Assertion(A):** Benzaldehyde on nitration gives Ortho and para nitro benzaldehyde. **Reason (R):** -CHO group in benzaldehyde shows –I effect and benzene ring shows +R effect. (a) Both Assertion (A) and Reason (R) are correct, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and reason (R) are correct, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. **(Understanding)**
26.	***[Chemical Kinetics]*** **Assertion (A):** The half-life of a first order reaction does not depend on initial concentration of the reactant. **Reason(R):** The initial reaction expression is present in the expression for rate constant. (a) Both Assertion (A) and Reason (R) are correct, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion(A) and Reason (R) are correct, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. **(Recall)**

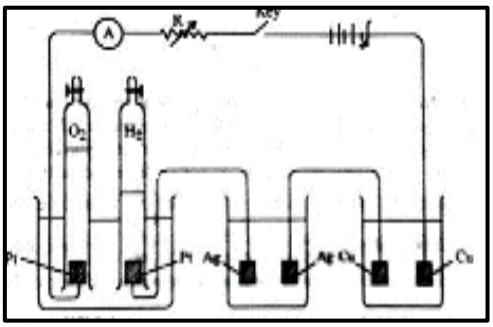
S.No.	Questions
27.	***[Alcohols, Phenols and Ethers]*** **Assertion (A):** Ethanol is less acidic than water. **Reason (R):** The electron releasing inductive effect of the ethyl group decreases the acidic character. (a) Both Assertion (A) and Reason (R) are correct, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are correct, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. **(Application)**
28.	***[Biomolecules]*** **Assertion (A):** Nucleic acids are present in all living cells. **Reason (R):** They are not responsible for passing the genetic information from the parent cell to the new cell. (a) Both Assertion (A) and Reason (R) are correct, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are correct, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. **(Recall)**

III: Fill in the Blanks (1 Mark Each)	
S.No.	**Questions**
29.	***[Block Elements]*** The orange colour of dichromate solution changes to _____ on heating with an alkali due to the formation of _____ ions. **(Understanding)**
30.	***[Alcohols, Phenols and Ethers]*** The pKa value of o-nitrophenol is _____ than p-nitrophenol and its acidic character is _____ than p-nitrophenol. **(Understanding)**
31.	***[Organic Compounds containing Nitrogen]*** _____amines do not undergo acylation as they lack replaceable hydrogen whereas _____ amines undergo acylation reaction. **(Understanding)**
32.	***[Solutions]*** The Van't Hoff factor for aqueous acetic acid is _____ than one while that of acetic acid in benzene is _____than one. **(Application)**
33.	***[Chemical Kinetics]*** A first order reaction is half complete in 20 minutes, it will be 75% complete in _____ minutes and 87.5% complete in _____ minutes. **(Application)**
34.	***[Biomolecules]*** Fibrous proteins are _____ in water whereas the globular proteins are _____ in water. **(Understanding)**
35.	***[Haloalkanes and Haloarenes]*** Elimination reactions of Haloalkanes takes place in the presence of _____KOH at_____ position of carbon atom. **(Recall)**
36.	***[Electrochemistry]*** When the concentration of the solution of a weak electrolyte is _____, its ____ conductivity increases. **(Understanding)**
37.	***[Aldehydes, Ketones and Carboxylic Acids]*** The melting point of acetic acid is _____ than propanoic acid whereas the boiling point of acetic acid is _____than propanoic acid. **(Understanding)**
38.	***[Coordination Compounds]*** The complex ion $[Co(NH_3)_5(NO_2)]^{2+}$ is _____ stable towards an acid than $[Co(NH_3)_5(ONO)]^{2+}$. The type of isomerism shown is called _____ isomerism. **(Application)**

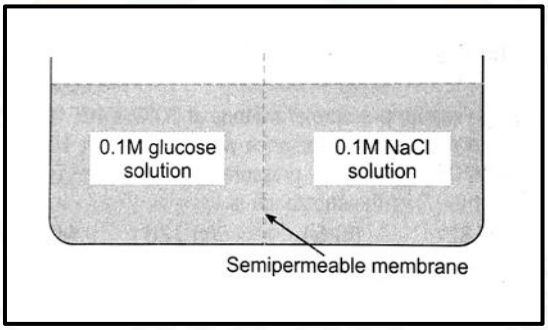
IV: Very Short Answer Questions (2 Marks Each)

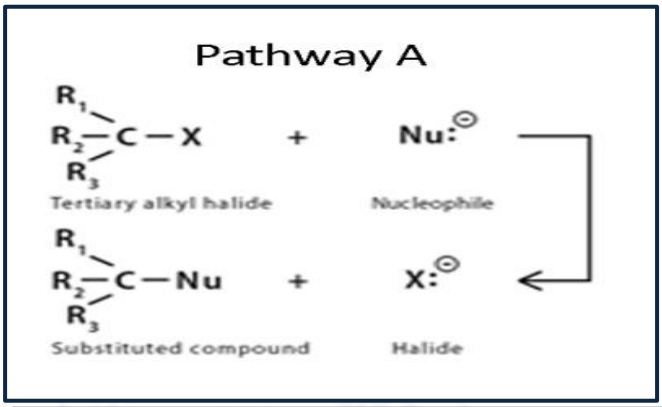
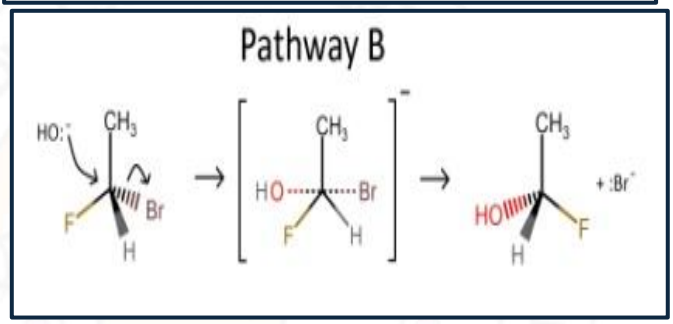
S.No.	Questions
39.	*[Alcohols, Phenols and Ethers]* The boiling point (b.p.) of methyl amine, ethane and methanol is 265K, 185K and 333K respectively. How can one account for these different boiling points? **(Application)**
40.	*[Coordination Compounds]* Do you think [Co(en)3]3+ will show optical isomerism? If yes, draw the possible isomers and name them. If no, explain why? **(Application)**
41.	*[Coordination Compounds]* Based on Valence Bond Theory (VBT), discuss the hybridisation, shape and charge on metal in $[Ni(CO)_4]$ complex. Do you think, charge of copper metal will be same or different in $[Cu(CO)_4]$? **(Application)**
42.	*[Organic Compounds containing Nitrogen]* Two students X and Y were studying the basicity of compounds. X wrote that ammonia is less basic than methylamine whereas Y wrote that ammonia is more basic than methylamine. According to you, whose answer is correct? How have you concluded this? **(Application)**
43.	*[Organic Compounds containing Nitrogen]* A student has carried out a suitable test to differentiate between (a) ethyl amine and diethyl amine and (b) ethanol and ethyl amine. What could that chemical test be to differentiate the pairs in (a) and (b). **(Understanding)**
44.	*[Biomolecules]* Give a reason for each given below: (a) Except glycine, all other naturally occurring ά-amino acids are optically active. (b) Zwitter ion is also known as a dipolar ion. **(Recall)**

S.No.	Questions
45.	*[Biomolecules]* Complete: (a) CHO | $(CHOH)_4$ + HI → _____ | CH_2OH (b) Enzymes are known as bio catalysts. Explain. **(Recall)**
46.	*[Chemical Kinetics]*  Predict the order of reaction and name X and Y axes. **(Recall and Understanding)**
47.	*[Chemical Kinetics]* Find the three-fourths life, $t_{3/4}$ of a first order reaction, $k=7.4x10^{-5}s^{-1}$ **(Evaluate)**
48.	*[Chemical Kinetics]* Study the graph given below and label the numbers:  **(Analysis)**

S.No.	Questions
49.	*[Electrochemistry]* Rohan arranged three coulometers in series and passed one faraday of charge for a definite time to all three electrolytes as shown in the picture given below:  HCL Solution $AgNO_3$ Solution $CuSO_4$ solution (a) What will be ratio of number of moles of positive ions liberated at cathode in each coulometer? (b) If he passed ***4825*** coulombs of charge through the electrolytes, how many ***gram-equivalent*** of copper will be deposited at the cathode? **(Application)**
50.	*[Electrochemistry]* Yash measures the conductivity of two different solutions of **1M Ethanoic acid** and **1M HCl** each at 25°C. (a) Will he observe the same conductivity value for both the solutions? Justify your answer. (b) What will be the effect on conductivities when he keeps on diluting the solutions? Explain with the help of a graph. **(Understanding)**
51.	*[Electrochemistry]* The standard reduction potentials of the following electrodes are given below. Answer the questions that follow: **Electrodes** / **SRP values**: Fe^{2+}/Fe -0.44V; Mg^{2+}/Mg -2.37V; $I_2/2I^-$ +0.54V; Ag^+/Ag +0.88V (a)Which substance/s could be used to convert iodide ions to iodine? (b) From the given reactions which reaction is spontaneous and why? **I:** $Fe^{2+} + 2Ag \rightarrow 2Ag^{+1} + Fe$ **II:** $Fe^{2+} + Mg \rightarrow Mg^{2+} + Fe$ **(Analysis)**

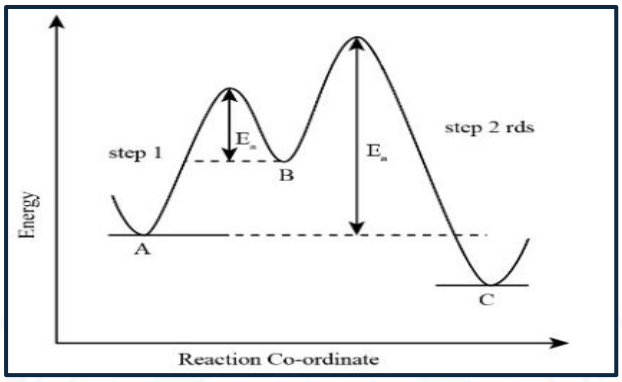
S.No.	Questions
52.	***[Aldehydes, Ketones and Carboxylic Acids]*** From the organic compounds given below: *I. Acetophenone* *II. Enzaldehyde* *III. Benzophenone* (a) Arrange the compounds in the decreasing order of reactivity towards addition of HCN. (b) Give a chemical reaction when compound ***I*** is treated with compound ***II*** in the presence of a dilute alkali. **(Application)**
53.	***[Aldehydes, Ketones and Carboxylic Acids]*** How will you prepare the following compounds? Give chemical reaction for: (a) Butan-2-one from propanoic acid. (b) m-chlorotoluene from benzaldehyde. **(Application)**
54.	***[Block Elements]*** Give reason: (a) d-block elements exhibit larger number of oxidation state than f-block elements. (b) Increase in atomic number does not change atomic radii among the transition elements. **(Application)**
55.	***[Block Elements]*** Halides of transition elements in higher oxidation states are more covalent. Give reason. **(Analysis)**
56.	***[Block Elements]*** Write equation for the following observations: (a) Potassium permanganate on reaction with potassium iodide in acidic medium releases iodine gas, water and the sulphates of potassium and manganese. Give the balanced equation for the reaction. (b) Potassium permanganate on reaction with oxalic acid in acidic medium gives salts of Potassium and Manganese along with water molecules and carbon dioxide gas. Give the complete and balanced equation. **(Recall)**
57.	***[Alcohols, Phenols and Ethers]*** (a) What is meant by hydroboration –oxidation reaction? Explain with an equation to show the final product formed during the reaction. (b) Arrange the following in the increasing order of their acidic strength. Justify the order: Phenol, 4-methyl phenol, 3-nitrophenol. **(Understanding)**

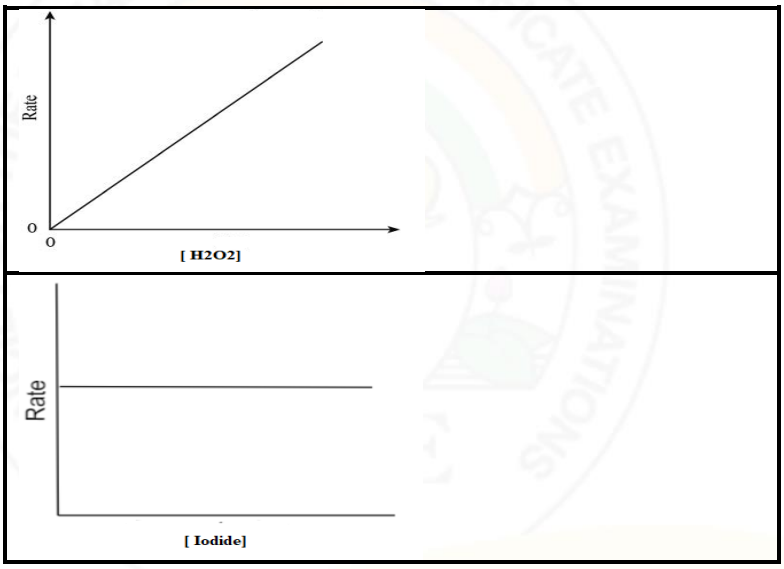
S.No.	Questions
58.	***[Haloalkanes and Haloarenes & Alcohols, Phenols and Ethers]*** You are provided with KOH (alc. and aq), Cl_2, HBr, acidified $K_2Cr_2O_7$, NaOH and soda lime. Using these reagents carry out following conversion: (a) Propanoic acid to Ethanol. (b) Chloropropane to propan-2-ol. **(Application)**
59.	***[Solutions]*** (a) What is the significance of Van't Hoff factor? (b) Devise the relationship between Van't Hoff factor and degree of dissociation for the aqueous solution of barium chloride. **(Understanding)**
60.	***[Solutions]*** Observe the following diagram and answer the questions that follows:  **A** **B** (a) In which direction, the flow of solvent will take place. (b) Infer on which compartment pressure should be applied to stop the flow of solvent? What is that pressure called? **(Analysis)**
61.	***[Solutions]*** 2.517 g of Naphthalene is dissolved in 150 g CS_2,the solution boils at 319.70 K. The boiling point of CS_2 is 319.4 K. Calculate the molecular mass of naphthalene. K_b for CS_2 is 2.34 K kg mol^{-1}. **(Application)**

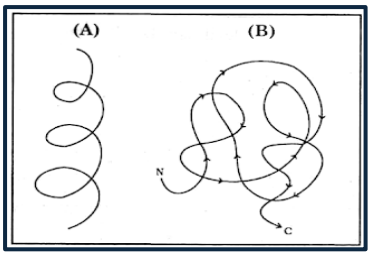
S.No.	Questions
62.	***[Haloalkanes and Haloarenes]*** Given below are the *two* types of mechanism of the reaction:   Answer the following questions: (a) Why is the product obtained in (A) pathway optically inactive? (b) Investigate the effect of plane polarised light on the product of (B) pathway? Which pathway shows faster reaction? **(Evaluate)**

V: Short Answer Questions (3 Marks Each)

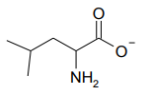
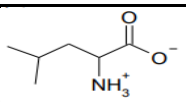
S.No.	Questions
63.	*[Aldehydes, Ketones and Carboxylic Acids]* This box gives a list of aldehydes and ketones. Choose the appropriate aldehyde/ ketone that reacts with CH_3MgBr to form a 1^0 alcohol, 2^0 alcohol and a 3^0 alcohol. CH_2O C_2H_4O C_3H_6O C_3H_8O C_2H_3O CHO **(Application)**
64.	*[Alcohols, Phenols and Ethers]* Give reason: (a) The K_a for p- nitro hydroxy benzene is 6.9×10^{-8} whereas o-nitro benzene is 6.0×10^{-8}. (b) Aromatic Ethers are insoluble in dipolar compounds. (c) The C-O bonds in ethers are polar. **(Application)**
65.	*[Organic Compounds containing Nitrogen]* Mention **True or False** and correct the wrong statements. (a) The observed order of basic strength of amines is: $NH_3 > (C_2H_5)_2NH > (C_2H_5)_3N$. (b) +I effect is maximum in 1^0 amine than 3^0 amine. (c) N,N-dimethyl aniline is a stronger base than aniline. **(Analysis)**
66.	*[Organic Compounds containing Nitrogen]* In the box certain reagents are given in the form of clues. Identify the clue and complete the equation. dehydrating agent, alkali dissolved in alcohol, Primary amine, anaesthesia, poisonous gas, salt, universal solvent. $-NH_2 + \_\_\_ + \_\_\_ \rightarrow$ $\_\_\_ + \_\_\_ + \_\_\_$. **(Analysis & Application)**

S.No.	Questions
67.	*[Chemical Kinetics]* (a) A patient was given a certain amount of iodine-131 as a part of a diagnostic procedure for thyroid disorder. Given that the half-life of radioactive ^{131}I is 8 days, what fraction of the initial ^{131}I would be present in a patient after 32 days if none of it were eliminated through natural body processes? (b) The potential energy diagram, for a multistep reaction is given below:  (i) Which step will be the rate determining step of the reaction? (ii) Which step is faster A→B or B→ C? **(Analysis)**

S.No.	Questions
68.	*[Chemical Kinetics]* (a) Aman and Rohan were working on the kinetics involved in decomposition of hydrogen peroxide in the presence of iodide ions. $H_2O_{2(l)} \longrightarrow H_2O + ½\ O_{2(g)}$ They both had their respective hypothesis as follows: According to Aman the rate will be affected by changing the concentrations of hydrogen peroxide and iodide ions as iodide ions are involved in the reaction. According to Rohan the rate will only be affected by changing the concentration of hydrogen peroxide. They carried out several experiments to check their respective hypothesis. Their results are shown graphically below:  (i) What do you think whose hypothesis is correct and why? (ii) Do you think that the half -life of this reaction will change if concentration of hydrogen peroxide is reduced to half. Give a reason. (b) In a chemical reaction, two reactants take part. The rate of reaction is directly proportional to the concentration of one of them and inversely proportional to the concentration of other. What will be the unit of its rate constant if the concentration terms are in mol/L? **(Analysis)**

S.No.	Questions
69.	*[Biomolecules]* (a) Observe the structures of protein given below and answer the questions that follows:  (i) Which type of structures do **A and B** represent? (ii) How can these structures be converted to primary structure? (b) Write a balanced chemical reaction of D-glucose with excess of phenyl hydrazine. **(Analysis)**

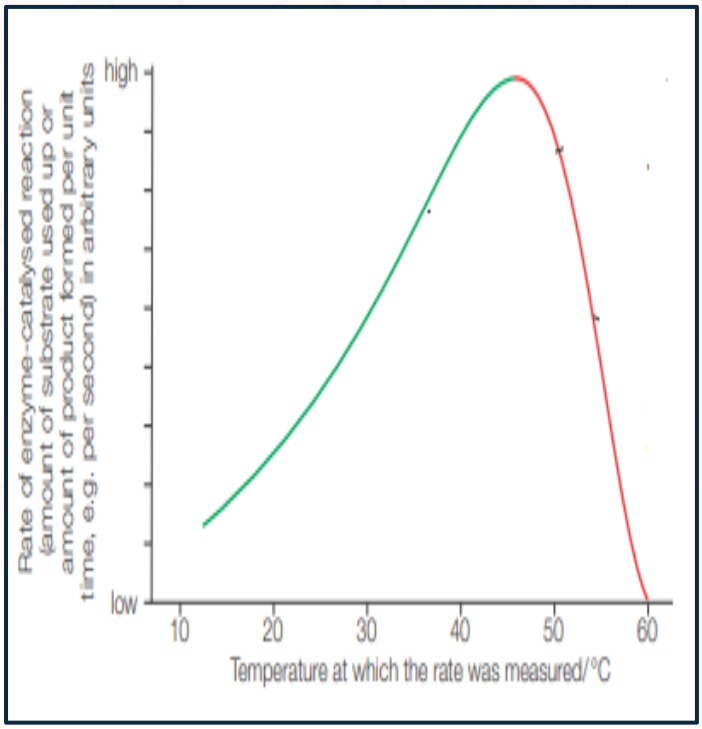
S.No.	Questions
70.	*[Biomolecules]* (a) Two students took the solution of same amino acid at different pH and applied potential difference to their solutions respectively.

Student A	
Student B	

(i) What do you think which student will observe a potential difference zero and why?

(ii) What would you do in order to get a positive observation?

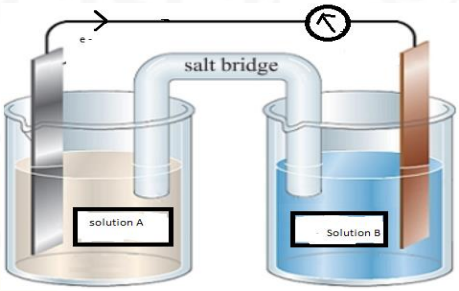
(b) The graph given below shows the rate of enzyme-catalysed reaction with temperature:

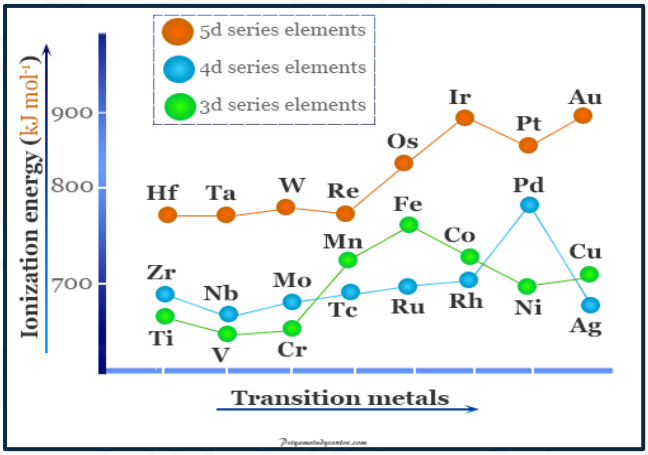


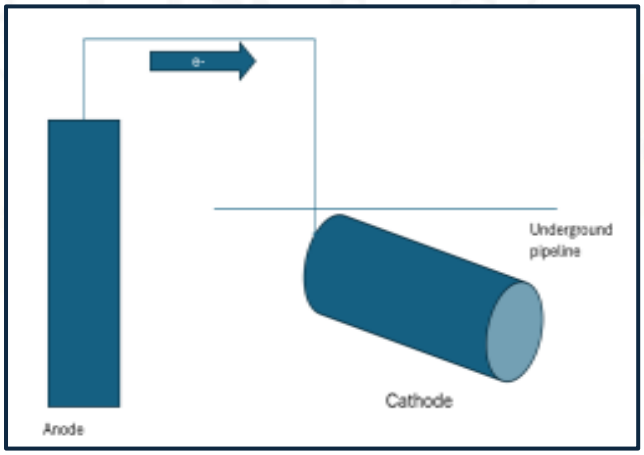
(i) Why does the rate of reaction decrease at high temperature?

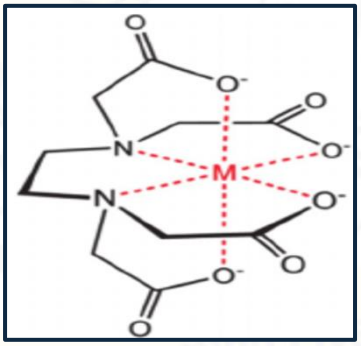
(Analysis & Application)

S.No.	Questions
71.	***[Coordination Compounds]*** The molecular shape of $[Ni(CO)_4]$ is tetrahedral while that of $[Ni(CN)_4]^{2-}$ is square planar. (a) Justify the shape of the *two* compounds. (b) Find the oxidation state of Ni in each complex. **(Application)**
72.	***[Electrochemistry]*** Nandini wants to electroplate her bracelet with silver. She gives the bracelet to an artist. (a) After electroplating she gets the information that 1.6117g of the metal is deposited when electric current of 0.2 ampere is passed for 2 hours. How will she make the confirmation that the metal deposited is silver by using the data? (b) Which law is applicable to solve the problem? **(Application)**
73.	***[Haloalkanes and Haloarenes]*** 3-bromo 3-methylhexane reacts with aq. KOH to give racemic mixture of products. (a) Identify the type of reaction mechanism. (b) Draw the structure of the transition state intermediate. (c) If Bromine is replaced by fluorine, will the reaction proceed faster or slowly? Give reason. **(Recall)**
74.	***[Haloalkanes and Haloarenes]*** Which compound in each of the following pairs will react faster by SN^2 mechanism with –OH and why? (a) CH_3Br or CH_3 I (b) $(CH_3)_3CCl$ or CH_3Cl **(Understanding)**
75.	***[Solutions]*** 50 mg of Na_2SO_4 is dissolved in 3 litres of water at 27^o Celsius. What would be the osmotic pressure for the solution? **(Application)**
76.	***[Solutions]*** During a study trip, students visited a lake and took out water sample which was rich in potassium chloride salt. They performed an experiment to calculate the boiling point of lake water which was found to be 100.025 degree Celsius. If 500 g of the water sample was used for calculation (K_b = 0.52 $Kkgmol^{-1}$) and there was 0.42 g KCl in the 500 ml sample, what is the observed molecular mass of KCl in the lake sample? **(Evaluate & Application)**

S.No.	Questions
77.	***[Solutions]*** A student X was doing an experiment by taking 0.15 g acetic acid in 40 g of benzene. He suddenly observed that the freezing point of the mixture is lowered by 0.40 degree Celsius. Do you think that association of acetic acid has taken place? If yes, what will be degree of association (ΔK_f of benzene = 5.12K $kgmol^{-1}$). **(Application & Evaluation)**
78.	***[Aldehydes, Ketones and Carboxylic Acids]*** Starting with acetic acid, discuss the role of one F and one Cl groups play on the acidity of the acid when they replace a hydrogen atom of CH_3 group of acetic acid. Answer by arranging the acids in increasing acid strength followed by explanation. **(Understanding)**
79.	***[Aldehydes, Ketones and Carboxylic Acids]*** A scientist while working in the lab accidently removed the labels from the carboxylic acid bottles and phenol. He had *three* bottles in which he had kept formic acid, acetic acid and phenol. Can you suggest a chemical test which he can perform to positively identify the acids so that he can label the bottles correctly? **(Recall & Understanding)**
80.	***[Electrochemistry]*** Geet has set-up the following galvanic cell by taking the electrolyte solution of $Pb(NO_3)_2$ and $CrCl_3$.  $E^o = -0.13$ V $E^o = -0.74$ V (a) How will you design the feasible cell by taking appropriate salt solution in place of solution A and B? (b) What is the applicability of the above cell? (c) Consider, salt bridge is filled with Potassium Chloride (KCl) solution. How does salt bridge maintain electrical neutrality? **(Create)**

S.No.	Questions
81.	***[Electrochemistry]*** (a) Graphical method fails to give the value of molar conductivity at infinite dilution of weak electrolyte. Explain. (b) To know the value of molar conductivity at infinite dilution for weak electrolyte, Kohlrausch's law is effective. Explain. (c) Draw the graph to show the variation of molar conductivity of a weak electrolyte with concentration. **(Evaluate)**
82.	***[Block Elements]*** Observe the following graph for ionisation enthalpies of first, second and third transition series.  Answer the following questions: (a) Why does the ionisation energy increase across a transition series? (b) The ionisation energies are nearly equal for first and second transition series but abruptly increases for third transition series. Explain. (c) Which element would have higher density, technetium or rhenium? Justify your answer. **(Analysis & Understanding)**
83.	***[Biomolecules]*** Vitamins are required in very small amount for the healthy growth of organisms. When a person does not get a particular vitamin in diet, she/he may suffer from certain diseases. Normal functioning of an organism can be greatly affected due to deficiency of vitamins in the body. (a) Which vitamin deficiency causes rickets and scurvy? (b) Do you think, all vitamins are soluble in water? Explain by giving an example. (c) Explain avitaminosis. **(Recall)**

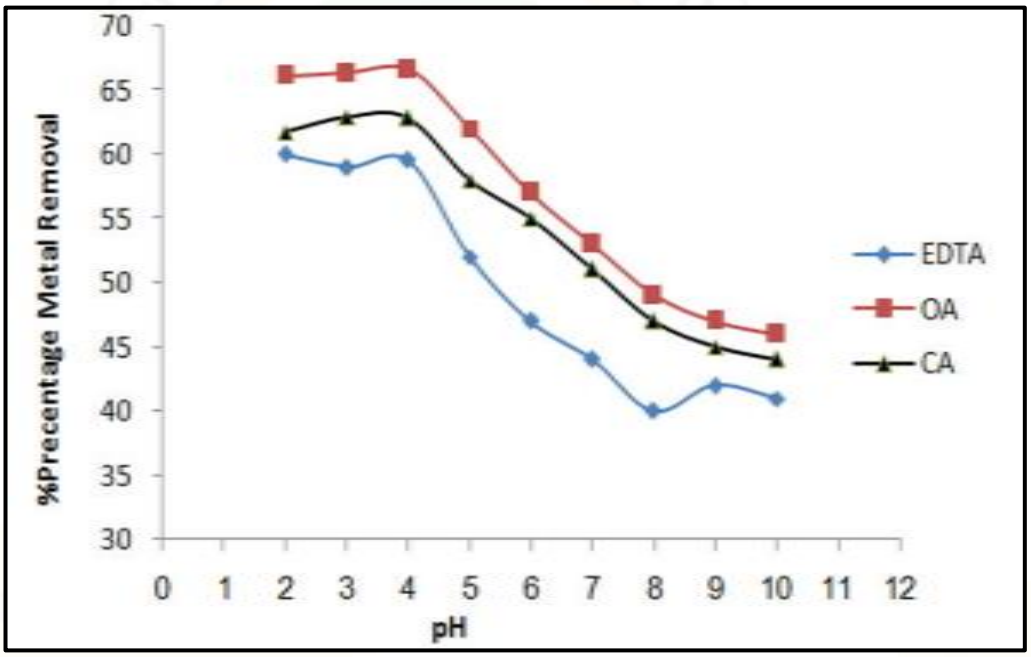
S.No.	Questions
84.	*[Solutions]* The concept of Osmosis is frequently used in medical field. On the other hand, reverse osmosis has also found application in desalination process. Both these processes play a very useful role in the growth and development of humankind. (a) Explain where in medical field the concept of osmosis is used. (b) The place close to the sea can use reverse osmosis (RO) for desalination. Explain how that can be done. (c) A saturated salt solution makes a boiled peeled egg shrink. Why? **(Recall & Understanding)**
85.	*[Haloalkanes and Haloarenes]* Chloroform was synthesised in the year 1847. It was mainly used in the medicine industry. When exposed to sunlight it forms a poisonous gas called phosgene. To prevent this, a small quantity of a compound which has a molecular formula C_2H_6O is added. (a) What is the chemical formula of phosgene? (b) Which chemical is added to prevent the formation of phosgene. (c) Where is chloroform used in the field of medicine? **(Recall)**
86.	*[Electrochemistry]* Ships, being exposed to saltwater and atmospheric conditions, are highly susceptible to rust and corrosion. This is one method used to prevent corrosion.  **Figure 1** (a) Give name of the method employed? (b) Name the cathode and anode in this process? (c) How is cathode protected? **(Understanding)**

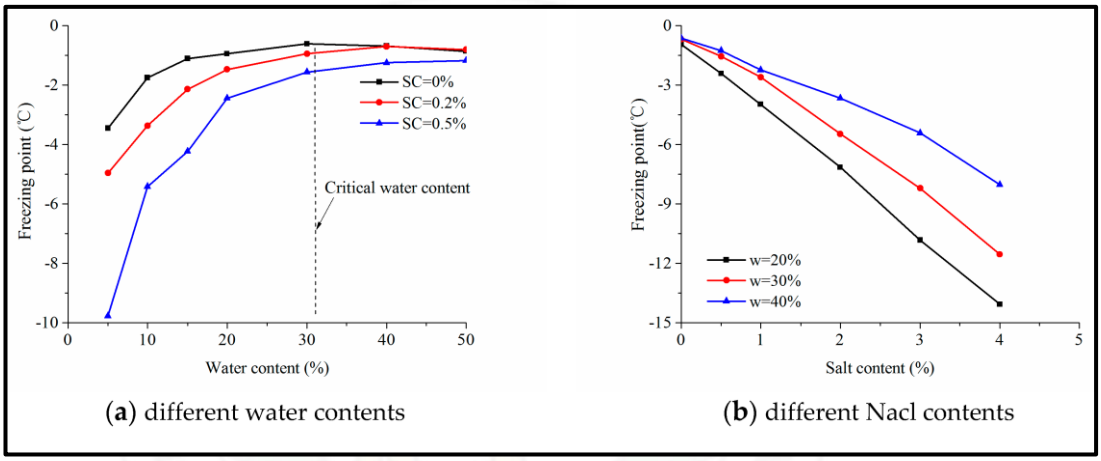
S.No.	Questions
87.	***[Coordination Compounds]*** Sodium ferrocyanide is used as anti-caking agent in salts and salt substitute. Due to contact with atmospheric moisture, table salt undergoes clumping. Adding certain amount of sodium ferrocyanide can prevent this from occurring. Consider the coordination compounds $Na_4[Fe(CN)_6]$ and $[Fe(H_2O)_6]Cl_2$ Based on above description, answer the following questions: (a) Though cyanide is poisonous, potassium ferrocyanide is used as food additive. Explain. (b) Which compound will be more stable $Na_4[Fe(CN)_6]$ or $[Fe(H_2O)_6]Cl_2$ Justify your answer. (c) Write the hydrate isomer of $[Fe(H_2O)_6]Cl_2$, which gives one mole of precipitate with $AgNO_3$ solution. **(Understanding & Application)**
88.	***[Coordination Compounds]*** Food and drug administration (FDA) has approved that Ethylenediamine tetra acetate (EDTA) is a medication in the treatment of lead poisoning. It is also used in the estimation of Ca^{2+} and Mg^{2+} during removal of hardness in water.  (a) Which type of a ligand is EDTA? (b) Why EDTA is used in the treatment of lead poisoning? (c) What is the geometry of EDTA complex? **(Recall)**

S.No.	Questions
89.	***[Alcohols, Phenols and Ethers]*** Alcohol and phenols are hydroxy derivatives of hydrocarbons. Both have the tendency to form intermolecular hydrogen bonding. Thus, they have higher boiling point and high solubility in water. As the O-H bond is polar in nature they also exhibit acidic property. Acidic characteristic depends upon inductive effect and resonance stabilization. The position and nature of substituents also affects the acidic strength. (a) Select from each pair as per the property mentioned in the bracket. (i) Ethanol, Methanol (most acidic) (ii) O-cresol and m-cresol (least acidic) **(Application)** (b) Correct the given statement and give a reason for your answer. *The solubility of phenol is higher than alcohol.* **(Understanding)** (c) Compounds **[X]** and **[Y]** are functional isomers of each other with molecular formula **C_3H_8O.** (i) Draw the isomers. (ii)Which compound will have a lower boiling point and why? **(Application)**
90.	***[Block Elements]*** Transition metals exhibit different oxidation states in their different types of compounds. Due to incompletely filled d-orbitals the transition metal shows variable oxidation states, magnetic property, and tendency to form complexes. The most stable oxidation state is the one that maximizes the charge without breaking the stable electronic configuration. The highest oxidation states of transition elements are observed in their fluorides and oxides. (a) In which compound *VO/ V_2O_4* vanadium has a stable oxidation state and why? **(Application)** (b) Manganese achieves its highest oxidation state with fluorine. Correct the statement with a valid reason. **(Understanding)** (c) Select the ion/s from the given ones that will show *maximum* and *minimum* response to the applied magnetic field: Zn^{2+}, Cu^{2+}, Mn^{2+} **(Application)**

S.No.	Questions
91.	***[Biomolecules]*** Nucleic acids are present in the nuclei of all living cells. DNA analysis is vital in crime scene situations. RNA is essential for most biological functions. In modern world the knowledge of RNA and DNA is vital for us. (a) Which nitrogenous bases constitute RNA and DNA? (b) Identify pyrimidine and purine from (a) part answer. (c) What are the structural differences in RNA and DNA? **(Recall)**
92.	***[Solutions]*** Vapour pressure plays an important role in calculating boiling point and the freezing point of solutions. In cold countries salt is sprinkled on the road whereas while boiling egg, salt is added in water. Both these processes help the cause. (a) Explain relative lowering of vapour pressure. (b) How adding salt to water help in boiling of egg? (c) Why is salt sprinkled on road during winters? **(Understanding)**

VI: Long Answer Questions (5 Marks Each)

S.No.	Questions
93.	***[Coordination Compounds]*** Water pollution caused by toxic elements is one of the most important environmental problems in the world. The objectives of this study were: the effects of chelating agents on heavy metals extraction from polluted water were carried out to examine Chelating agents like Ethylenediamine tetra acetate (EDTA), oxalic acid (OA) and citric acid (CA) were tested respectively. The effects of operating parameters, such as pH and extraction time were examined. Removal of metals was dependent on the concentration of extracting agent and raised with increasing concentration of chelating agents.  *Source: DOI : http://dx.doi.org/10.13005/ojc/330414* (a) What are chelating agents? (b) Name any *two* heavy metals which are considered toxic. (c) From the above graph, arrange the order of chelating agents with respect to the % removal of toxic metals. (d) Draw the structure of EDTA. (e) What is the main factor on which the removal of metals depends on contaminated water using Chelating Agents? **(Understanding)**

S.No.	Questions
94.	*[Solutions]* Water phase change in soil causes severe damage to roads, canals, airport runways and other buildings. The freezing point is an important indicator to judge whether the soil is frozen or not. It is found that the addition of salt can effectively reduce the frost heave of soil. The graphs given below show the change in freezing point with different concentrations of salt and water:  (**a**) different water contents (**b**) different Nacl contents *Source: https://www.mdpi.com/2073-4441/12/8/2232* It is clear from the graphs that as water content is high, depression is less and as the salt concentration is high, depression is more. (a) 2.1g CoCl3.6NH3 (molecular weight = 267.5) was dissolved in 100 g of water. The freezing point of the solution was -0.584°C. Assuming 100% ionization of the complex salt having coordination number 6, what will be the formula of the complex. Given that: K_f for water = 1.86 K. kg. mol^{-1}. (b) Which salt solution is the best for de-icing? 1% NaCl or 1% $CaCl_2$ [Atomic weight of Na= 23, Ca = 40, Cl = 35.5 a.m.u] (c) Equimolal concentration of two different solutes ***X and Y*** undergoes dimerization and trimerization respectively in their respective solutions. What will be the ratio of observed lowering of vapour pressure in two cases? **(Application & Analysis)**

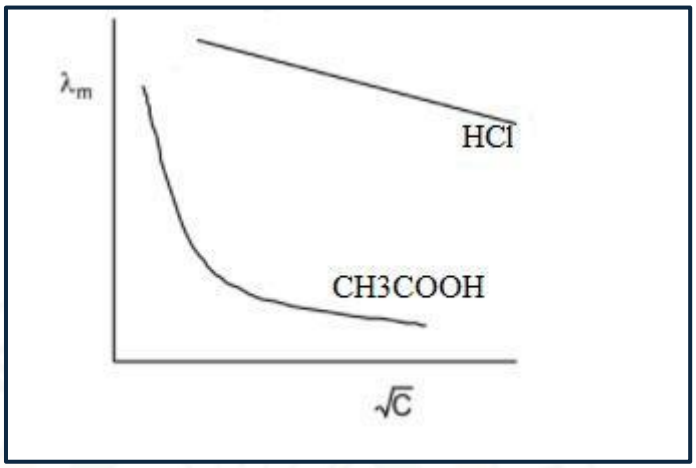
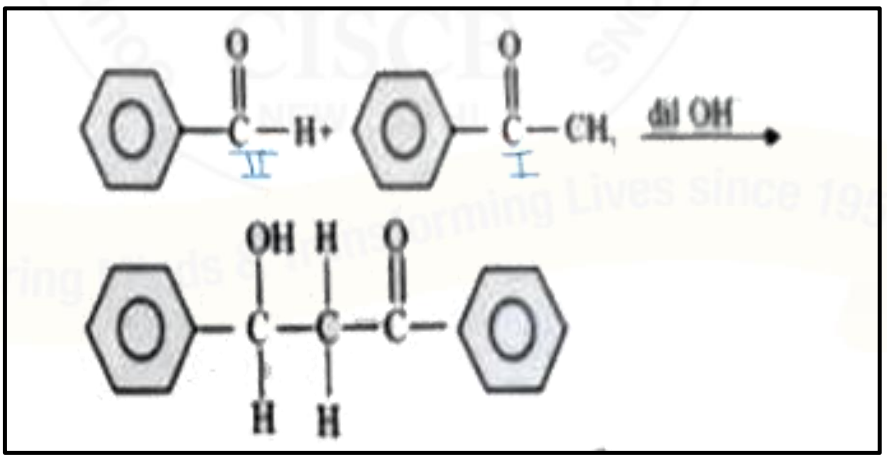
S.No.	Questions
95.	***[Aldehydes, Ketones and Carboxylic Acids]*** The aldol condensation takes its name from aldol (3-hydroxybutanal) a name introduced by Wurtz who first prepared the beta-hydroxy aldehyde from acetaldehyde in 1872. It is a base catalysed reaction, and the product of aldol condensation undergoes dehydration of intermediate beta-aldols or beta-ketals in presence of a dilute acid to form α, β unsaturated carbonyl compound. *Source:* *https://www.researchgate.net/publication/229950129_The_Aldol_Condensation* (a) Write the mechanism of aldol condensation starting with acetaldehyde. (b) Name the base used highlighting the role of the base catalyst in facilitating the reaction. (c) What is crossed aldol condensation? Name the product formed when benzaldehyde undergoes crossed aldol condensation with acetaldehyde. **(Application & Recall)**
96.	***[Aldehydes, Ketones and Carboxylic Acids]*** 'In 1915, a senior lecturer in Biochemistry at the University of Manchester named Dr. Chaim Weizmann invented a fermented process that converts starch into acetone and butanol by using Clostridium acetobutylicum. Acetone was the key component in the production of the smokeless gunpowder (cordite) used by the Allies in World War I. Acetone was previously made from calcium acetate imported from Germany, since Allies were in war with Germany, this was no longer possible.' *Source: https://www.weizmann.ac.il/WeizmannCompass/sections/people-behind-the-science/chaim-weizmann%E2%80%99s-acetone-patent-turns-100* (a) How will you prepare acetone from calcium acetate? (b) If butan-2-ol is oxidised by $K_2Cr_2O_7$, which ketone will be produced? Give the balanced chemical reaction. (c) How would you obtain acetone from acetyl chloride? **(Recall)**
97.	***[Electrochemistry]*** 'Freidrich Wilhelm Georg Kohlrausch was a German physicist who studied the electrical conductivity of electrolytic solutions. From 1875-1879 he performed numerous experiments with aqueous solutions of different salts, acids and other electrolytes. He concluded that each type of migrating ion has a specific conductivity, and it does not depend on the origin of the ion. In a simple way, his conclusions were applicable to strong electrolytes as well as more complex behaviour was observed for weak electrolytes.' *Source: https://doi.org/10.1002/elsa.202160008* (a) What did Kohlrausch mean when he said that each ion has specific conductivity which is independent of origin of ions? (b) Explain the law proposed by Kohlrausch with example. (c) How do you propose to calculate the molar conductivity of a weak electrolyte (acetic acid) by using his law? **(Application)**

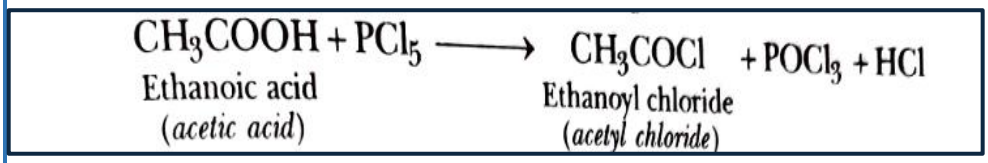
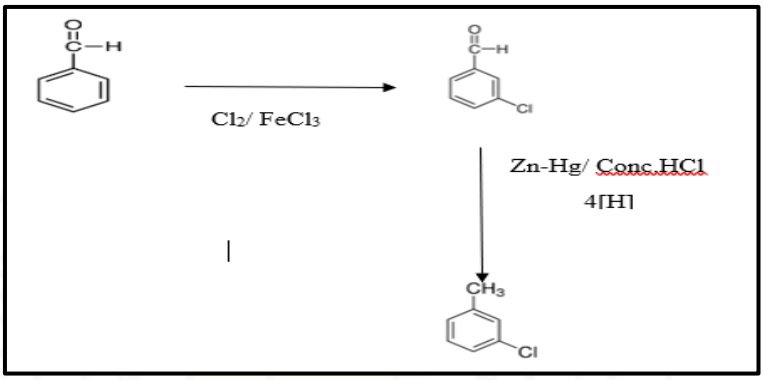
ANSWER KEY

Q.No.	Expected Answers
1.	(d) II and IV
2.	(c) Z> Y > X
3.	(d) X: Formaldehyde R: ethyl
4.	(d) +7, +2
5.	(b) Methyl isocyanide
6.	(b) Ethylamine
7.	(a) Na_3PO_4
8.	(b) Unchanged
9.	(a) 0.1860
10.	(c) $mol^{-2}L^2s^{-1}$
11.	(d) order = ½ molecularity = 3/2
12.	(c) Phenyl hydrazine
13.	(c) Peptide bond
14.	(d) C_6H_5Cl and $C_6H_5NH_2$
15.	(b) liberation of Cl_2, oxidation, chlorination, hydrolysis.
16.	(a) resonance with Benzene ring.
17.	(b) 193000C
18.	(c) III, II, and I
19.	(d) 1 chlorine atom is linked by primary valency.
20.	(d) Both (Q) and (S)
21.	(c) Silver mirror by Tollen's test.
22.	(a) (III) & (IV)
23.	(a) A parallel line with X axis.

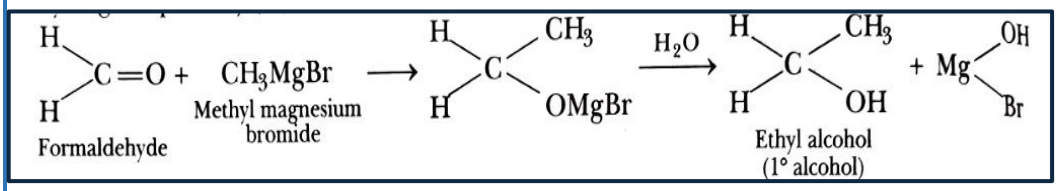
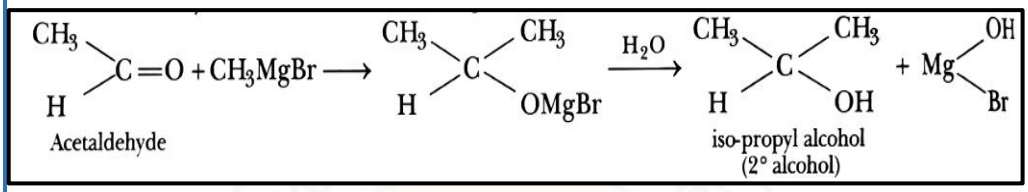
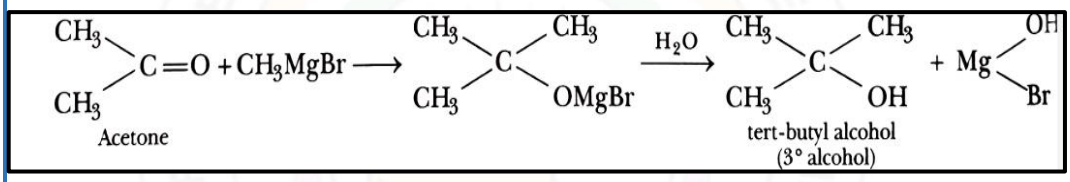
Q.No.	Expected Answers
24.	(c) Assertion (A) is true, but Reason (R) is false.
25.	(d) Assertion (A) is false, but Reason (R) is true.
26.	(c) The Assertion (A) is true, but Reason (R) is false.
27.	(a) Assertion (A) and Reason (R) both are correct statements and Reason (R) is the correct explanation for Assertion (A).
28.	(c) The Assertion (A) is true, but Reason (R) is false.
29.	yellow, Chromate
30.	greater, lower
31.	Tertiary, primary/secondary
32.	greater, lesser
33.	40, 60
34.	insoluble, soluble
35.	Alcoholic, β
36.	lowered, molar
37.	more, less
38.	more, linkage
39.	The boiling points are directly linked with H-bond. Greater is the extent of H-bond formation, higher is the boiling point (b.p.). Methylamine, CH_3NH_2, has two polar N-H bonds, due to which it forms intermolecular H-bond. In methanol, CH_3OH, H-bonding is through the oxygen atom which is more electronegative than N-atom of amines. Therefore, N-H---N bonds are much weaker than O-H---O bonds. Hydrocarbons, ethane, C_2H_6, does not have any electronegative atom.
40.	Yes, d and l forms to be drawn, d -tris(ethylenediamine)cobalt (III)ion and l-tris (ethylenediamine) cobalt (III) ion.
41.	Sp^3, tetrahedral, zero, yes, the charge will be zero.
42.	X is correct. Due to +I effect of methyl group, electron density at nitrogen atom increases. This increases the availability of N to potential acid thereby increasing the basicity.

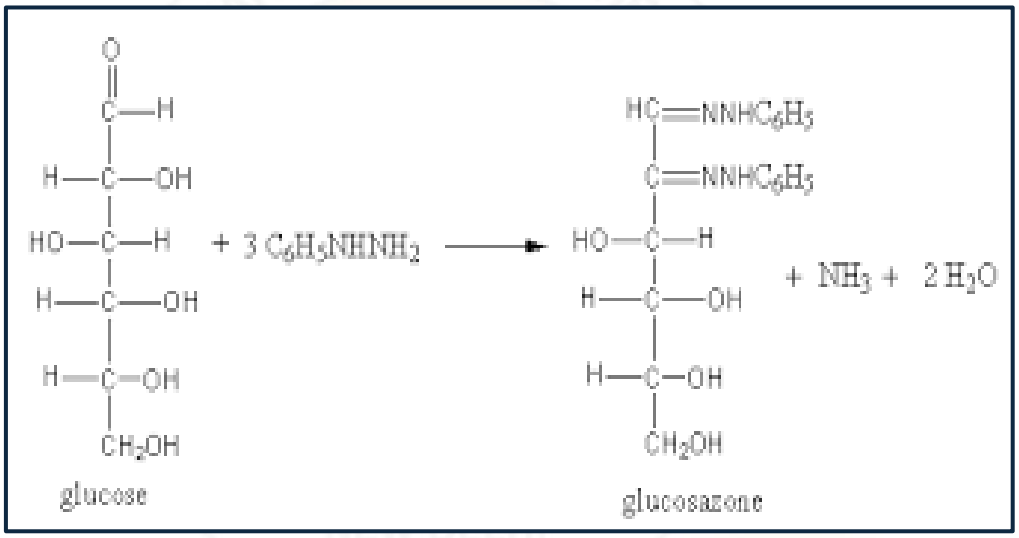
Q.No.	Expected Answers
43.	(a) Carbylamine test, -ethyl amine will give obnoxious smell of carbylamine when treated with $CHCl_3$ and alc. KOH, whereas the diethylamine would not give the test. (b) Ethanol gives iodoform test yellow ppt with I_2 and KOH, when heated ethyl amine will not give this test.
44.	(a) ȁ- Carbon atom present in them is asymmetric (except glycine). (b) It contains both a positive and a negative ion.
45.	(a) CH_3 | $(CH_2)_4$ | CH_3 (b) They are produced by the living cells.
46.	Order-First X-Rate of reaction. Y- Concentration of the reactant
47.	k=2.303/t loga/a-x 3/4th life a-x=a-3/4 a $t_{3/4} = \frac{2.303}{7.4\times10^{-5}} log \frac{a}{\frac{1}{4a}}$ $= \frac{2.303}{7.4\times10^{-5}} \log 4$ $= \frac{2.303}{7.4\times10^{-5}} \times 0.6020$ $=1.87\times 10^4$s.
48.	(1) Potential Energy (2) Reactants (3) Activation Energy (4) Products (5) Reaction Coordinate
49.	(a) 1: 1: 2 (b) 1 g-equivalent = 96500 C x g-equivalent = 4825C $= \frac{4825}{96500} =$ 0.05 g-equivalent.

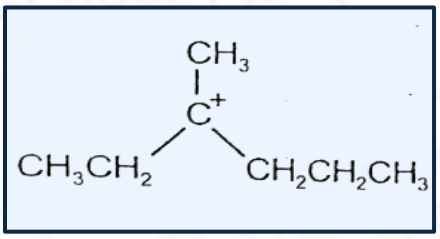
Q.No.	Expected Answers
50.	(a) No, the conductivity of 1 M HCl will be greater than 1M ethanoic acid. As it is a strong acid, complete ionization will occur so the number of ions will be more. (b) 
51.	(a) Ag^+/ Ag (b) Reaction II is spontaneous as E^o_{cell} = positive.
52.	(a) II > I > III (b) 

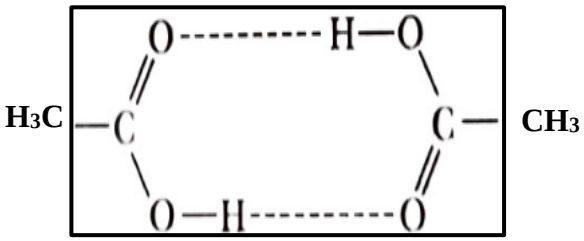
Q.No.	Expected Answers
53.	(a)  **$2\ CH_3COCl + (C_2H_5)_2Cd \rightarrow 2CH_3COC_2H_5 + CdCl_2$** (b) 
54.	(a) d- block elements exhibit more oxidation states as the energy gap is comparable and not much, while in f-block elements the energy gap between f and d subshell is comparatively higher. (b)With increase in atomic number in transition series, the nuclear charge increases which tends to decrease the size but addition of electron in d-subshell increases the screening effect. Therefore, the increased nuclear charge is partly balanced and hence, the atomic radii does not change much.
55.	This is because in higher oxidation states the size of the metal ion decreases/more vacant d-orbitals are available for bonding. Electronegativity difference between the transition metal and the halogen tends to decrease. This results in more equal sharing of electrons between the metal and the halogen.
56.	(a) $2KMnO_4 + 8H_2SO_4 + 10KI \rightarrow 2K_2SO4 + 2MnSO_4 + 8H_2O + 5I_2$ (b) $2KMnO_4 + 3H_2SO_4 + 5(COOH)_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$
57.	(a) It is indirect hydration of an alkene using diborane to form alcohol. $CH_3 - CH = CH_2 \xrightarrow[OH-]{\frac{B2H6}{H2O2}} CH_3CH_2 - CH_2OH$ (b) 4-methyl phenol< phenol <3-nitrophenol. **Reason:** +I group ($-CH_3$) in Phenols decreases its acidity while -I groups ($-NO_2$) increases it.

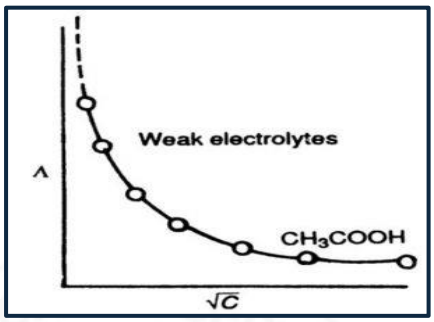
Q.No.	Expected Answers
58.	(a) $CH_3CH_2COOH \xrightarrow{NaOH} CH_3CH_2COONa \xrightarrow{Sodalime} C_2H_6 \xrightarrow{Cl2} CH_3CH_2Cl \xrightarrow{aq.KOH} CH_3CH_2OH$ (b) $CH_3CH_2CH_2Cl \xrightarrow{alc.KOH} CH_3CH_2{=}CH_2 \xrightarrow{HBr} CH_3CH(Br)CH_3 \xrightarrow{aq.KOH} CH_3CH(OH)CH_3$
59.	(a) Van't Hoff factor is useful in determination of correct molecular masses of the compounds undergoing association and dissociation. (b) $i = \frac{1-\propto+3\propto}{1}$ $= 1 + 2 \propto$
60.	(a) From compartment B to A. NaCl dissociates in aqueous solution, has a greater number of ions, shows higher osmotic pressure. (b) Compartment A. Osmotic pressure
61.	$\Delta T_b = K_b \, . m$ $\Delta T_b = K_b \times \frac{w \times 1000}{W \times M}$ $0.3 = 2.34 \times \frac{2.517 \times 1000}{150 \times M}$ M=130.8
62.	(a) Pathway A follows S_N1 mechanism in which attack of nucleophile on carbocation takes place from front and back side, gives racemic mixture which is optically inactive. (b) The product obtained in pathway B rotates the plane polarised light in opposite direction than that of substrate. Pathway A is faster than pathway B.

Q.No.	Expected Answers
63.	(a) 1° alcohol  (b) 2° alcohol  (c) 3° alcohol 
64.	(a) $-NO_2$ is an electron withdrawing group and it is equally dispersed in the p-position. (b) They do not form hydrogen bonds. (c) Due to the electronegativity of oxygen.
65.	(a) False: $(C_2H_5)_3N > (C_2H_5)_2NH > NH_3$ (b) False: +I effect is maximum for 3° amine than 1° amine. (c) True
66.	$R\text{-}NH_2 + CHCl_3 + 3KOH_{(alc)} \rightarrow RNC + 3KCl + 3H_2O$
67.	(a) No. of half-lives = 32/8 = 4 Amount left after 4 half-lives = $[A_0]/ 2^4$ $= 1/16 \times [A^0]$ (b) (i)Step 2 (ii) A to B is Faster.

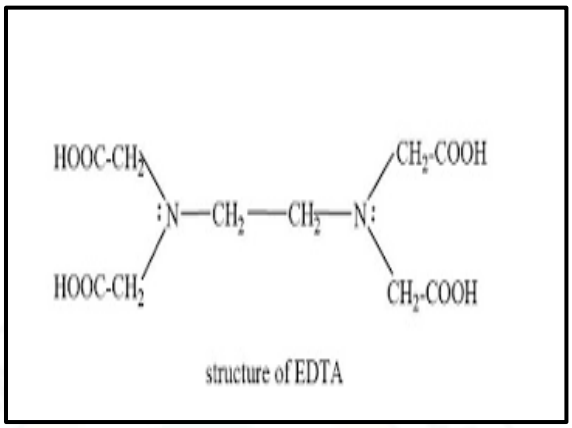
Q.No.	Expected Answers
68.	(a) (i) Rohan's hypothesis is correct as the rate does not change with the concentration of iodide ions. (ii) No, the half -life will not change as it is a first order reaction, and its half-life is independent of its initial concentration. (b) It's a zero-order reaction. Unit: mol. L^{-1} s^{-1}
69.	(a)(i) A = Secondary structure B = Quaternary structure (ii) Either by changing pH or temperature. (b) 
70.	(a) (i) Student B will observe zero potential difference as it forms zwitter ion and it does not migrate under the influence of applied electric field. (ii) Will change the pH of the solution. (b) (i) As enzymes are globular proteins and at high temperature denaturation takes place.
71.	(a) Oxidation state of Ni is zero in $[Ni(CO)_4]$. CO is a stronger field ligand, and it can pair the unpaired electrons. The 3d orbital is now totally filled, while the 4s and 4p orbitals remain open. Therefore, exhibits sp3 hybridization and tetrahedral geometry. The oxidation state of Ni in [Ni (CN)4]2- is +2. While in presence of CN- being a stronger field ligand all the electrons are paired up. The empty 3d, 3s and two 4p orbitals undergo dsp2 hybridization to make bonds with CN- ligands in square planar geometry. (b) Ni has 0 oxidation state in complex $[Ni(CO)_4]$ and +2 oxidation state in $[Ni(CN)_4]^{2-}$

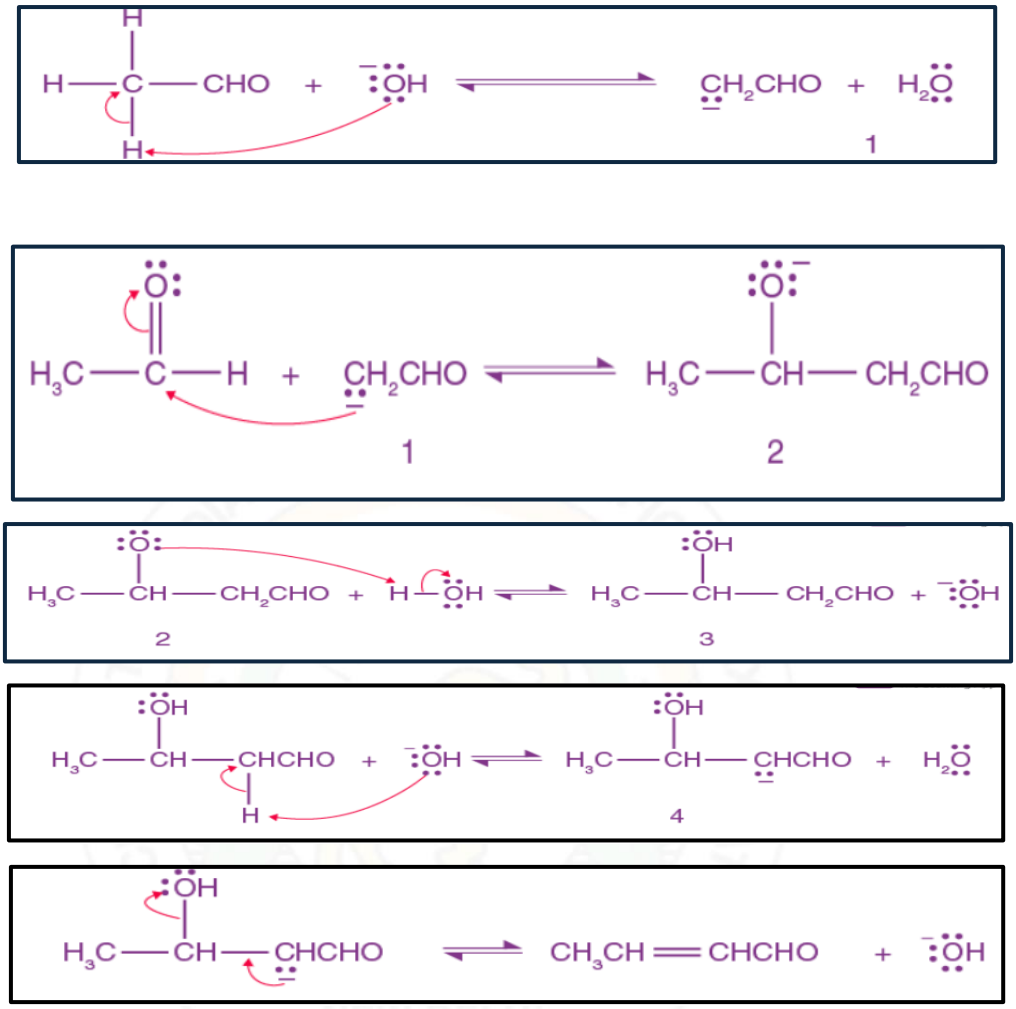
Q.No.	Expected Answers
72.	(a) $w = ZIt$ $1.6117 = \frac{At.mass}{Valency \times 96500} \times 0.2 \times 3600 \times 2$ $1.6117 = \frac{At.mass}{1 \times 96500} \times 0.2 \times 3600 \times 2$ Atomic mass = 108 g The deposited metal is silver. (b) Faraday's first law of electrolysis.
73.	(a) SN^1 (b)  (c) The reaction will become slow due to higher bond dissociation energy of C-F bond.
74.	(a) CH_3I will react faster because I^- is a better leaving group. It has lower bond dissociation energy. Halides show following order of reactivity: R-F < R-Cl < R-Br < R-I (b) CH_3Cl, lacks bulky substituents on the carbon atom that bears the leaving group. As a result, in the SN_2 reaction with OH^-, CH_3Cl has a faster reactivity than $(CH_3)_3Cl$.
75.	i= 3 as salt is completely dissociated. Molar mass of sodium sulphate $Na_2 So_4$=142 πV=inRT π= inRT/V = 3x.050/142x0.0821x300/3 = 1.23 atm
76.	M' = $\underline{i1000xK_bxw}$ $Wx\Delta T_b$ M' = 2x1000x0.52x0.42/ 500x0.025 = 34.94 g mol^{-1}

Q.No.	Expected Answers
77.	Yes, association has taken place.  n=2 M(obs)= ix1000x$K_f$xw/ WxΔT_f = 2x1000x5.12x0.15/40x0.40 = 96 α = M(obs)-M(cal)/M(obs) x n/n-1 α = 0.75
78.	$CH_3COOH < ClCH_2COOH < FCH_2COOH$ Discussion: due to +I of CH_3 group the -OH bond is strong hence weak acid Due to -I effect of both F and Cl groups (F has more -I effect) the bond between O-H of carboxylic acid becomes weaker. Hence, release of H+ is easier.
79.	Treat small amount of compound from all bottles with the Tollen's reagent and warm. The one which gives silver mirror is formic acid. Treat small amount of the other two compounds with neutral ferric chloride solution, the acid which gives wine red colouration is acetic acid. The one which gives violet/purple solution is phenol.
80.	(a) Solution A:$CrCl_3$ Solution B:$Pb(NO_3)_2$ (b) To convert chemical energy into electrical energy by redox reaction. (c) In anodic half-cell, concentration of Cr^{3+} increases, hence, Cl^{-1} ions are migrated from salt bridge to maintain electrical neutrality. In cathodic half-cell, the concentration of Pb^{2+} decreases, hence, K^{+1} ions are migrated from salt bridge to maintain electrical neutrality.

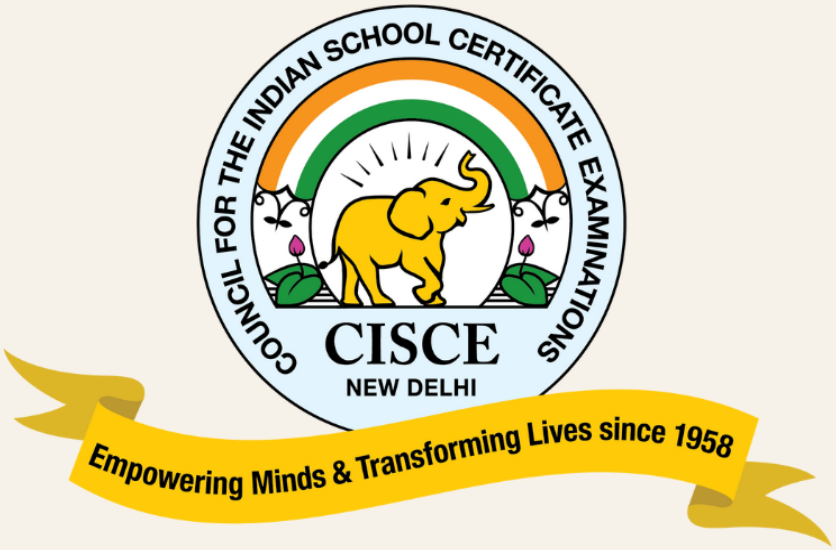
Q.No.	Expected Answers
81.	(a) The curve of weak electrolyte cannot be extrapolated to obtain the limiting value of molar conductivity at infinite dilution. (b) Each ion makes a definite contribution to the molar conductivity of an electrolyte at infinite dilution irrespective of the nature of the other ion present in the electrolyte. (c) 
82.	(a) Ionisation energy increases with increase in nuclear charge which increase with increase in atomic number. The added electron shields the added proton. The effect of increased nuclear charge is more than the shielding effect. (b) In the third transition series, after lanthanum, lanthanoids have electrons entered in 4f orbital, which shows poor shielding effect, hence atomic size decreases due to lanthanoid contraction, ionisation energy increases abruptly for decreased atomic size. (c) Rhenium has higher density due to decreased atomic size and increase in nuclear charge. Hence, the atomic volume decreases and electron density increases.
83.	(a) Rickets- Vit D Scurvy- Vit C (b) No, all vitamins are not water soluble. E.g. vitamin C is water soluble, but vitamin A is not soluble in water. (c) Multiple deficiencies caused by lack of more than one vitamin is known as avitaminosis.
84.	(a) In dialysis of kidneys the concept of osmosis is used. (b) The sea water contains different concentrations of many salts when they are separated from pure water through semipermeable membrane, the reverse osmosis (RO) takes place and water moves out from the sea water to pure water side. (c) As the salt concentration is less in egg than the saltwater solution, the water from egg moves towards saltwater solution and makes egg shrink.
85.	(a) $COCl_2$ (b) Ethanol (c) Anaesthesia
86.	(a) Electrical protection. (b) Anode-Magnesium and Cathode-Iron (c) Anode oxidises and electrons are transferred. NH^+ ions around the iron object and protects it from rusting.

Q.No.	Expected Answers
87.	(a) Cyanide in $Na_4[Fe(CN)_6]$ Is not ionisable in aqueous solution and hence does not show poisonous effect. (b) $Na_4[Fe(CN)_6]$ Will be more stable as cyanide is strong ligand and stabilise the compound by pairing the electron in low energy t_2g orbitals. (c) $[Fe(H_2O)_5Cl]Cl.H_20$
88.	(a) Chelating ligand (b) EDTA being chelating ligand forms more stable complex with heavy metal like lead. (c) Octahedral
89.	(a) (i)Methanol (ii) o-cresol (b)The solubility of phenol is lower than alcohol. The phenyl group being more hydrophobic in nature, the tendency to form intermolecular hydrogen bonding decreases. (c) (i) X=$CH_3CH_2CH_2OH$; Y=$CH_3CH_2OCH_3$ (ii) Compound [Y] will have lower boiling point as it is an ether which cannot form associated molecules by intermolecular hydrogen bond.
90.	(a) V_2O_4, vanadium has +4 oxidation state, and it achieves inert gas configuration. (b) Manganese can achieve it is highest oxidation state with oxygen. Oxygen can form multiple bonds with Manganese. (c) Maximum: Mn^{2+}; Minimum: Zn^{2+}
91.	(a) RNA-A, G, C, U DNA-A, G, C, T (b) Purines- A and G Pyrimidine- T, C, U (c) DNA- double stranded alpha-helix RNA- single stranded alpha helix
92.	(a) Pure solvent has a certain vapour pressure. When a non-volatile solute is added into pure solvent, less solvent evaporates and hence, vapour pressure decreases. The ratio between the Vapour Pressure (V.P) difference to V.P. of pure solvent is known as relative lowering of V.P. (b) Addition of salt increases the boiling point of aqueous solution and eggs get more heat for cooking. (c) It lowers the freezing point of ice.

Q.No.	Expected Answers
93.	(a) Chelating agents are agents which bind with the metal and form complexes. (b) Mercury/Copper/Lead (c) OA>CA>EDTA (d)  structure of EDTA (e) Concentration of the extracting agents.
94.	(a) $\Delta Tf = \frac{ixKfxw\ x1000}{M\ xW}$ Van't Hoff factor = $\frac{0.584 \times 267.5}{1.86\ x\ 2.1\ x10}$ = 3.99 = 4 Formula = $[Co(NH_3)_6]\ Cl_3$ (b) 1% NaCl is better for de-icing as its number of moles will be greater. (c) $\frac{\Delta TfX}{\Delta TfY}$= 3/2

Q.No.	Expected Answers
95.	**(a) Mechanism:**  (b) Dil. NaOH/Ba (OH)2 can be used as catalyst. OH- from the dilute alkali attacks on the first molecule of aldehyde and removes the α hydrogen present in it to form an enolate ion which is resonance stabilised. (c) When aldol condensation takes place between molecules of different aldehydes or different ketones or one aldehyde and one ketone. Cinnamaldehyde/ 3-phenylprop-2-enal.
96.	(a) By dry distillation of calcium acetate, we can obtain acetone $Ca(CH_3COO)_2 \rightarrow CH_3COCH_3 + CaCO_3$ (on heating) (b) $CH_3CH(OH)CH_2CH_3 + [O] \rightarrow CH_3COCH_2CH_3 + H_2O$ (c) $2CH_3COCl + (CH_3)_2Cd \rightarrow 2CH_3COCH_3 + CdCl_2$

Q.No.	Expected Answers
97.	(a) Na^+ ions have the same value of specific conductivity irrespective of their source being sodium sulphate or sodium nitrate. (b) Correct explanation of the law with example. $CH_3COONa+HCl \rightarrow CH_3COOH+NaCl$ (c) If molar conductivity at infinite dilution of HCl, NaCl and sodium acetate is known then Molar conductivity of acetic acid at infinite dilution can be calculated using this law.



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