CHEMISTRY (CODE - 043)

SAMPLE QUESTION PAPER*

CLASS XII (2026-27)

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

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. In addition to this, a separate question has been provided for visually impaired candidates in lieu of questions having visual inputs.
9. Use of log tables and calculators is not allowed.

Section-A

Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

1	The boiling points and K_b values of isomeric amines are given in table 1. **Table 1** Which one of the following statement is correct? A. Amine P is more volatile than amine R, but less basic B. Amine R will give white precipitate with Hinsberg reagent, which is soluble in NaOH C. Amine Q is more soluble in water as compared to R. D. Amine P and Q can be prepared by Gabriel Phthalimide process.	1
2	Which of the following complex is tetrahedral in shape? A. $[Ni(CN)_4]^{2-}$ B. $[Cu(NH_3)_4]^{2+}$ C. $[NiCl_4]^{2-}$ D. $[Co(en)_3]^{3+}$	1

Amine	Boiling point/K	pK_b (approx)
P	329.3	3.00
Q	310.5	9.83
R	350.8	3.22

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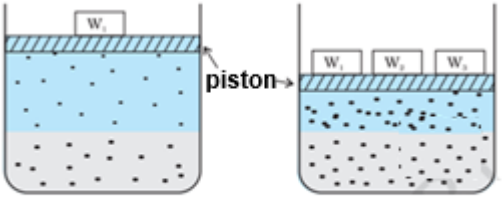
3	The quantity of charge required to obtain one mole of metal "M" from M_2O_3 is: A. 1F B. 6F C. 3F D. 2F	1
4	An organic compound "X" on reaction with chloroform and alcoholic KOH gives foul smelling product. In which of the following case compound X would be produced: A. Chloromethane is treated with AgCN. B. Nitrobenzene is reduced. C. Benzene diazonium chloride is treated with Cu/KCN D. Aniline reacts with Acetyl chloride.	1
5	Consider a system in a state of dynamic equilibrium, as shown in Fig. 1(a). The lower part is solution and the upper part is gaseous system at pressure p and temperature T. If the pressure is increased over the solution phase by compressing the gas to a smaller volume as shown in Fig 1(b).  Figure 1 Which of the following statements is true about figure 1(b) A. solubility of gas will increase until dynamic equilibrium is reached B. solubility of gas will decrease until dynamic equilibrium is reached C. solubility of gas will increase until static equilibrium is reached D. solubility of gas will decrease until static equilibrium is reached ***(For Visually Challenged Learners)*** According to Henry's law partial pressure P of a gas above the liquid at constant temperature is directly proportional to A. volume of the gas B. mole fraction of the gas in the solution C. atmospheric pressure D. vapour pressure of the solution	1
6	Aavya carries out hydrolysis of acetyl chloride. The reaction is represented by the following equation: $CH_3COCl + H_2O \longrightarrow CH_3COOH + HCl$ She carries out the reaction with (i) equimolar amounts of acetyl chloride and water (ii) excess of water. The rate law obeyed in the two cases will be: A. (i) First order (ii) Second Order B. (i) First order (ii) First order C. (i) Second order (ii) Second order D. (i) Second order (ii) First order	1

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7	The amino acid HOOC-CH_2-CH_2-CH (NH_2) COOH, can be synthesised within our body. Which of the following is true about this amino acid? HOOC-CH_2-CH_2-CH(NH_2) COOH is: A. an acidic and non-essential amino acid. B. a neutral and non- essential amino acid. C. an acidic and essential amino acid D. a neutral and essential amino acid	1
8	Identify the Grignard reagent and carbonyl compound which on reaction followed by hydrolysis will give 3-methyl pentan-3-ol. (i) $C_2H_5COC_2H_5 + CH_3MgCl$ (ii) $C_2H_5COCH_3 + C_2H_5MgCl$ (iii) $CH_3CHO + C_2H_5 - \underset{\displaystyle MgCl}{\overset{\displaystyle H}{\overset{|}{C}}} - C_2H_5$ (iv) $C_2H_5CHO + CH_3 - \underset{\displaystyle MgCl}{\overset{\displaystyle H}{\overset{|}{C}}} - C_2H_5$ A. (i) and (iii) B. (ii) and (iv) C. (iii) and (iv) D. (i) and (ii)	1
9	Which one of the following element will be strong oxidising agent in their +3 oxidation state? (Atomic no. Cr=24, Mn=25, Ti=22, Fe=26) A. Cr B. Mn C. Ti D. Fe	1
10	When (–)-2-bromohexane reacts with sodium hydroxide, (+)-hexan-2-ol is formed. Which one of the following observation would be correct? A. The reaction follows S_N2 mechanism and is accompanied by inversion of configuration. B. The reaction follows S_N1 mechanism and is accompanied by inversion of configuration. C. The reaction follows S_N2 mechanism and is accompanied by retention of configuration. D. The reaction follows S_N1 mechanism and is accompanied by retention of configuration.	1
11	If half-life of a first order reaction is 16 minutes, how much time does it take to complete 75% of the reaction? A. 16 min B. 32 min C. 48 min D. 64 min	1
12	Which solution has the highest conductivity? A. 0.1 M HCl B. 0.1 M CH_3COOH C. 0.1 M glucose D. 0.1 M NH_4OH	1

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13	**Assertion (A):** Nitration of aniline gives significant amount of meta derivative. **Reason (R):** -NH_2 is ortho and para directing and highly activating group. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true.	1
14	**Assertion (A):** Permanganate and manganate ions have tetrahedral structure **Reason (R):** In permanganate and manganate ions, pi bonding takes place which is due to overlap of p orbitals of oxygen with p orbitals of manganese. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true.	1
15	**Assertion (A)**: Miscibility of ethers with water resembles those of alcohols of the same molecular mass. **Reason (R)**: The oxygen of ether can also form hydrogen bonds with water. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
16	**Assertion (A):** $[Co(NH_3)_6]^{3+}$ is diamagnetic. **Reason (R):** NH_3 is a strong field ligand and causes pairing of electrons. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
	Section-B Question No. 17 to 21 are very short answer questions carrying 2 marks each.	
17(A)	**Attempt either A or B** (I) Complete and balance the following reaction $SO_3^{2-} + MnO_4^- + H^+ \rightarrow$ (II) Why does titanium melt at a lower temperature than chromium? **OR**	1 1

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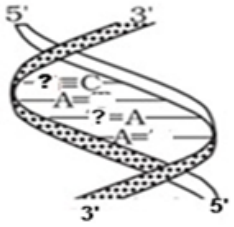
17(B)	(I) Why do titanium and scandium forms complex compounds, whereas potassium and calcium do not, although they belong to same period? (II) Complete and balance the following reaction $Fe^{2+} + Cr_2O_7^{2-} + H^+ \rightarrow$	1 1
18	"The rate of reaction remains constant during the course of reaction." Is this statement always true or is true under certain conditions? Reflect on the statement.	2
19	(I) Complete the sequence of nitrogenous bases in the given DNA strand (Figure 2) (II) Milk contains a protein called casein. How does the structure of casein change on addition of a few drops of lemon juice to milk?  Figure 2 ***(For Visually Challenged Learners)*** (I) Name the nitrogenous bases in DNA (II) Milk contains a protein called casein. How does the structure of casein change on addition of a few drops of lemon juice to milk?	1 1 1 1
20	Chlorobenzene can be converted into phenol by heating in aqueous sodium hydroxide solution at a temperature of 623K and 300 atm, however presence of a substituent group effects its activity towards this nucleophilic substitution reaction. Which substituent (i) nitro or (ii) methoxy will increase the reactivity of chlorobenzene and why?	2
21	**Account for the following:** (I) Underground iron pipelines are often protected by connecting them to a more reactive metal like magnesium. (II) Write the reactions occurring at cathode and anode during the electrolysis of molten magnesium chloride.	2x1
	Section-C Question No. 22 to 28 are short answer questions, carrying 3 marks each.	
22	(I) Which of the following has the highest magnetic moment? Justify your answer. Ti^{2+} ,Co^{2+} , Fe^{2+} . [Atomic No. Ti = 22 Co = 27 , Fe = 26] (II) Which characteristic of iron make it suitable to: a) act as catalyst in Haber's process. b) form interstitial compound with oxygen.	1 2

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23	The values of log k and 1/T for a reaction are given-	3

S.No.	Log k	1/T (/K)
1.	-4.46	0.00333
2.	-3.91	0.00323
3.	-3.37	0.00313
4.	-2.82	0.00303
5.	-2.31	0.00294

The plot of log k vs 1/T obtained for the above data is as shown in Figure 3.

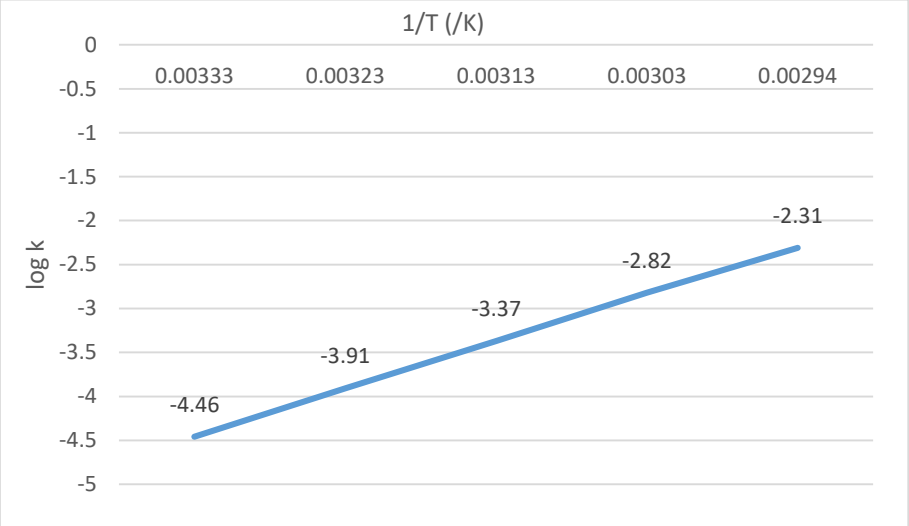

Figure 3

Here k is the rate constant and T is the absolute temperature.

Calculate E_a for the reaction. (Given R= 8.314 $JK^{-1}mol^{-1}$)

(For Visually Challenged Learners)

Rate constant k of a reaction varies with temperature 'T' according to the equation

$$\log k = \log A - \frac{Ea}{2.303RT}$$

where E*a* is the activation energy. When a graph is plotted for log k vs 1/T, a straight line with a slope of − 4250 K is obtained. Calculate E*a* for the reaction. (Given R= 8.314 $JK^{-1}mol^{-1}$).

24	Identify each name reaction and complete the missing reactant/ product in the given reaction sequence.	3x1

(I) $2CH_3CHO \xrightarrow{?} CH_3CH(OH)CH_2CHO$

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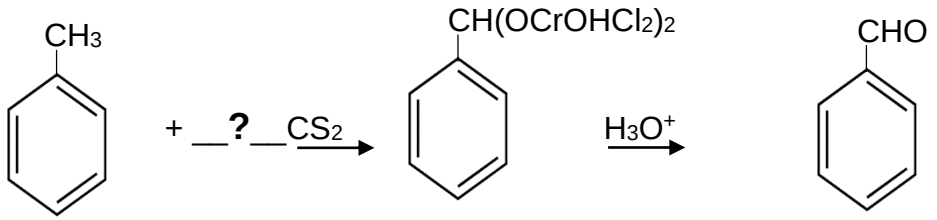
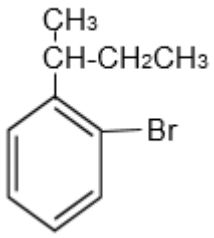
	(II)  (III) >C=O $\xrightarrow[-H_2O]{NH_2NH_2}$ __?_____ $\xrightarrow[\text{Heat}]{KOH/\text{ethylene glycol}}$ $>CH_2 + N_2$	
25	(I) Aman prepared a solution by dissolving 10 ml of Acetone and 10 ml of Carbon disulphide. The net volume of resulting solution was not found to be 20 mL. a) What would be the observation in this case? Comment. b) In case carbon disulphide is replaced by chloroform in the above case, what would be the expected changes in volume of the resulting solution? Support your answer with appropriate reason. (II) Calculate the concentration of oxygen (in ppm) present in 1 litre of sea water. Given that a litre of sea water weighs 1030 g and contains about 6×10^{-3} g of dissolved oxygen.	1+1 1
26	(I) Convert the following; a) Nitrobenzene to flourobenzene b) Benzoic acid to benzylamine (II) Aniline undergoes electrophilic substitution reactions readily. However, acetylation of aniline is required to obtain monosubstituted products. Give reason for your answer	2 1
	Attempt either A or B	
27(A)	(I) Write the IUPAC name of the following compound  (II) When $CH_3CH_2CH_2Cl$ reacts with AgCN and KCN, Compound "X" and "Y" respectively are formed. Identify "X" and "Y". Support your answer with appropriate reason.	1 2
	OR	
27(B)	(I) What is the IUPAC nomenclature of the compound: $(CH_3)_3C$-$C(CH_3)Br$-CH_2CH_3	1

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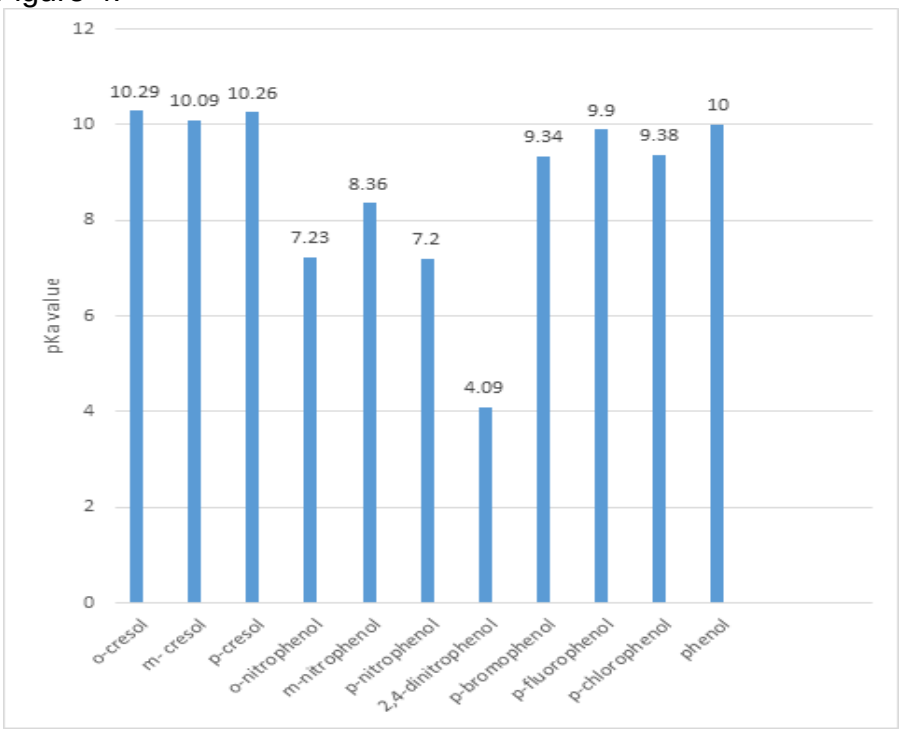
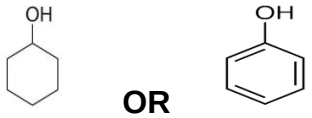
	(II) Which of the following will be hydrolysed more readily? $CH_2=CH-CH_2Cl$ or $(CH_3)_2CHCl$ Support your answer with reason.	2
28	(I) On adding 100 g of non-volatile solute A in 1000 g of water, the vapour gets reduced by 50 percent. Calculate the molar mass of solute A. (II) It has been observed that nitric acid solution containing 32% of water by mass, cannot be separated into its components through fractional distillation. Why?	2 1
	Section D Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.	
29	**Acidity of substituted phenols** Phenol and substituted phenols are relatively more acidic than aliphatic alcohols. The pKa value is a quantitative measure of the acidic strength. The effect of substituents on acidity of phenols (pKa values) is given in Figure 4.  **Figure 4** **Study the graph and answer the following questions** (I) The pKa value of 2,4,6- trinitrophenol will be: A. more than 8.36 B. between 7.2 and 8.3 C. between 4.09 and 2.3 D. less than 4.09 (II) The order of acidity of p-halophenols is : A. p-bromophenol > p-chlorophenol > p-flourophenol > phenol B. phenol > p-flourophenol > p-chlorophenol > p-bromophenol C. p-chlorophenol > p-bromophenol > p-flourophenol > phenol	 <

	D. phenol > p-flourophenol > p-bromophenol > p-chlorophenol **Attempt either (IIIA) or (IIIB).** (IIIA) Predict which one of the following two compounds will have lower value of pKa .	2
	 **OR** Give reason in support of your reason.	
	OR (IIIB) Predict whether 4 chloro-2, 6- dintirophenol is more or less acidic than 2,4,6-trinitrophenol? Use the values in the graph to support your answer.	2
	(For Visually Challenged Learners) **Read the passage and answer the questions that follow** The presence of electron withdrawing groups such as nitro group, enhances the acidic strength of phenol. It is due to the effective delocalisation of negative charge in phenoxide ion. On the other hand, electron releasing groups, such as alkyl groups, in general, do not favour the formation of phenoxide ion resulting in decrease in acid strength. Cresols, for example, are less acidic than phenol. The pKa value is a quantitative measure of the acidic strength. Higher the pKa value lower is the acidic strength. (I) Which of the following will form least stable phenoxide ion? A. phenol B. o-cresol C. o-nitrophenol D. o-chlorophenol	1
	(II) Which group causes the maximum increase in pKa value of phenol: A. – CH_3 B. – OCH_3 C. – NO_2 D. – Cl	1
	Attempt either (IIIA) or (IIIB) (IIIA). Which of the following will be more acidic? Nitrophenol or 2,4-Dinitrophenol. Support your answer with appropriate reason?	2
	OR (IIIB). Predict whether pka value of p-cresol or p-nitrophenol will be higher or lower than phenol. Give reason to support your answer.	2

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30	**Identification of carbohydrate** Students of class 12 are given a sample of carbohydrate obtained from a plant extract. They conducted the following tests to identify the carbohydrate. The students find that the given carbohydrate is soluble in water. They take about 1-2 mL of aqueous solution of the carbohydrate in a test tube and add 2 mL of Benedict's reagent. The test tube is heated in water bath for 3-5 minutes. A brick red precipitate is obtained. The sample of the given carbohydrate on hydrolysis with dilute acid, gives only one type of monosaccharide. Read the passage and answer the following questions: (I) The sample gives a positive Benedict's test. We can conclude that the given carbohydrate is a A. monosaccharide B. reducing sugar C. non-reducing sugar D. polysaccharide (II) Which of the following is plant based carbohydrate? (i) sucrose (ii)lactose (iii) starch (iv) glycogen A. (i) and (ii) B. (i) and (iii) C. (iii) and (iv) D. (i) and (iv) **Attempt either (IIIA) or (IIIB)** (IIIA) Considering all observations reported in the passage the sample is most likely (i) glucose (ii) fructose (iii) sucrose (iv) lactose (v) maltose. Justify your answer. **OR** (IIIB) Ravi reports that the given sample is starch. What could be his justification, based on the observations in the passage? Do you agree with Ravi? Why or why not?	1 1 2 2
Section-E Question No. 31 to 33 are long answer type questions carrying 5 marks each.		
31(A)	**Attempt either A or B** (I) Account for the following a. The pH should be around 3.5 during the addition of ammonia derivative compounds to aldehyde/ ketone. b. Alcohols are added to carbonyl compounds in the presence of dry HCl gas. c. The reaction of aldehydes with sodium hydrogen sulphite is commonly used for the separation and purification of aldehydes. (II) A student has three colourless samples: methanol, acetaldehyde, and acetic acid. They have only $NaHCO_3$, and 2,4-DNP reagent	3x1 2

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		Devise a flowchart to identify each compound using only these two reagents.	
		OR	
31(B)	(I)	Arrange the following according to the property indicated a) CH_3CHO, $HCHO$, C_6H_5CHO (decreasing order of the ease of oxidation) b) CH_3COCl, CH_3COOH, CH_3CONH_2, CH_3COOCH_3 (increasing order of nucleophilic acyl substitution) c) CH_3CHO, CH_3COCH_3, CF_3CHO (increasing order of electrophilicity of carbonyl carbon)	3x1
	(II)	Write any two possible isomers of the compound having molecular formula C_3H_6O. Identify which of these isomer/s will give a positive Tollen's test and explain the reason.	2
	Attempt either A or B		
32(A)	**Answer the following questions:**		5x1
	(I)	Two test tubes, X and Y, contain solutions of the complexes $[Cr(H_2O)_3Cl_3]$ and $[Cr(en)_3]^{3+}$ respectively. If plane-polarized light is passed through these solutions, which solution will rotate the plane of polarization and why?	
	(II)	$[Ni(CO)_4]$ and $[Ni(H_2O)_6]^{2+}$ are two complexes of Ni. Which complex will have higher crystal field splitting energy, and which factor determines this difference?	
	(III)	A solution of the coordination compound $PdCl_2 .4NH_3$ is treated with $AgNO_3$, and 2 mole of AgCl precipitate form. Determine the primary valency and secondary valency of Pd in the compound.	
	(IV)	The complex $[Fe(CN)_6]^{4-}$ exhibits d^2sp^3 hybridisation. Based on this, comment on the strength of the ligand CN^- and its effect on the geometry of the complex.	
	(V)	Why is anhydrous $CuSO_4$ white, but $CuSO_4 .5H_2O$ blue in colour?	
		OR	
32(B)	**Answer the following questions:**		5x1
	(I)	Three coordination compounds of cobalt(III) are given: Compound A: $[Co(NH_3)_6]Cl_3$ Compound B: $[Co(NH_3)_5Cl]Cl_2$ Compound C: $[Co(NH_3)_4Cl_2]Cl$ Which of the three compounds will show maximum electrolytic conductivity and why?	
	(II)	On the basis of crystal field theory, write the electronic configuration for d^5 ion if $\Delta_0 > P$.	
	(III)	Using IUPAC norms, write the formulae of Diaquadiammine (oxalato) chromium(III) chloride.	
	(IV)	Compare the optical activity of $[Co(NH_3)_2Cl_2(en)]Cl$ and $[Co(NH_3)_4Cl_2]Cl$. Which one is optically active and why?	
	(V)	Explain why $[Cu(NH_3)_4]^{2+}$ shows a blue colour while $[Cu(H_2O)_4]^{2+}$ shows a greenish colour. Which factor influences the colour difference?	

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Attempt either A or B

33(A) (I) A student investigates the effect of concentration on the cell potential of a Zn–Cu galvanic cell at 298 K. 1+2

The cell is: $Zn(s) \mid Zn^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$

standard electrode potentials:

$E^0(Zn^{2+}/Zn) = -0.76$ V, $E^0Cu^{2+}/Cu = +0.34$ V, $E^o cell = 1.10$ V

The following experimental data were collected:

Experiment	$[Zn^{2+}]$ (M)	$[Cu^{2+}]$ (M)	Measured EMF (V)
1	1.00	1.00	1.10
2	0.1	1.00	1.16
3	1.00	0.10	1.04
4	0.01	1.00	1.22
5	1.00	0.01	0.98

a) Why does experiment 4 show the maximum EMF?

b) For experiment 3, calculate the theoretical EMF using the Nernst equation. Suggest one possible reason why the measured EMF differs slightly from the calculated value.

(II) If k is expressed in Sm^{-1} and the concentration, c in mol m^{-3} then the units of molar conductivity are in Sm^2mol^{-1}. However, if we use Scm^{-1} as the units for k and $molcm^{-3}$, the units of concentration, then the units of molar conductivity are in Scm^2mol^{-1}. Show how 1 Sm^2mol^{-1} is related to 1S cm^2mol^{-1} 1

(III) What happens to the specific gravity of electrolyte in lead storage battery during charging and discharging of battery? 1

OR

33(B) I. For aqueous NaCl at 25 °C the molar conductivities at two concentrations are measured as: 3

$\Lambda_m(0.010\ M) = 123.9\ S\ cm^2\ mol^{-1}$

$\Lambda_m(0.040\ M) = 120.7\ S\ cm^2\ mol^{-1}$

Molar conductivity for strong electrolytes can be represented as $\Lambda_m = \Lambda^\circ_m - A\sqrt{c}$. Determine Λ°(molar conductivity at infinite dilution) and the constant A for NaCl solution.

II. Write the electrode reactions that occur in a hydrogen–oxygen fuel cell. Also, state two advantages of fuel cells compared to conventional batteries. 2

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CHEMISTRY (CODE – 043)

MARKING SCHEME

CLASS XII (2026-27)

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

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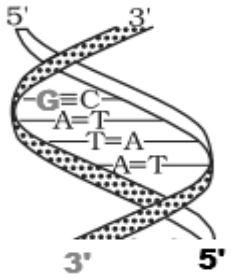
7. All questions are compulsory.
8. In addition to this, a separate question has been provided for visually impaired candidates in lieu of questions having visual inputs.
9. Use of log tables and calculators is not allowed.

Section-A		
1	B. Amine R will give white precipitate with Hinsberg reagent, which is soluble in NaOH. On the basis of information, P is secondary, Q is tertiary and R is primary amine. Primary amine gives white precipitate with Hinsberg reagent , which is soluble in NaOH.	1
2	C. $[NiCl_4]^{2-}$ $[NiCl_4]^{2-}$is tetrahedral because Cl^- is a weak field ligand, so it does not cause pairing of electrons. The other complexes are square planar or octahedral.	1
3	C. 3F M^{3+} + 3e- → M Quantity of charge = 3F	1
4	B. Nitrobenzene is reduced. In the above case, aniline is formed. The foul smell is given by the isocyanides produced, when aliphatic and aromatic primary amine compound undergoes carbylamine reaction. Out of the following, option B provides aromatic amine which will undergo carbylamine reaction. Hence (B) will give foul smell.	1

5	A. Solubility of gas will increase until dynamic equilibrium is reached Henry's law ***(for visually challenged learners)*** B. mole fraction of the gas in the solution	1
6	D. (i) second order (ii) first order The rate of reaction will depend on both the reactants in case (i) In case (ii), when water is in excess, the rate of reaction is independent of concentration of water. Such reactions are called pseudounimolecular reactions.	1
7	A. an acidic, non-essential amino acid. The amino acid can be synthesised in our bodies so it is non-essential. It has two –COOH groups and one -NH_2 group, therefore it is acidic.	1
8	D. (i) and (ii) (i) $C_2H_5COC_2H_5 + CH_3MgCl \rightarrow C_2H_5C(OMgCl)(CH_3)C_2H_5 \xrightarrow{\text{hydrolysis}} C_2H_5C(OH)(CH_3)C_2H_5$ (ii) $C_2H_5COCH_3 + C_2H_5MgCl \rightarrow C_2H_5C(OMgCl)(C_2H_5)CH_3 \xrightarrow{\text{hydrolysis}} C_2H_5C(OH)(C_2H_5)CH_3$ (iii) $C_2H_5CH(MgCl)C_2H_5 + CH_3CHO \rightarrow CH_3CH(OMgCl)C_2H_5C_2H_5 \xrightarrow{\text{hydrolysis}} CH_3CH(OH)C_2H_5CHC_2H_5$ (iv) $C_2H_5CH(MgCl)CH_3 + C_2H_5CHO \rightarrow C_2H_5CH(OMgCl)C_2H_5CHCH_3 \xrightarrow{\text{hydrolysis}} C_2H_5CH(OH)C_2H_5CHCH_3$	1
9	B: Mn Mn^{3+} act as strong oxidising agent.	1
10	A. The reaction follows S_N2 mechanism and is accompanied by inversion of configuration.	1
11	B. 32 min 50% reaction is completed in 16 min. For remaining 50% of the substance to reduce to its half (25%) time required will be 16 min. Therefore 50% +25% = 75% of the reaction will be completed in 32 min	1

12	A. HCl is a strong acid and fully dissociates into H^+ and Cl^- ions. More ions lead to higher conductivity. CH_3COOH and NH_3 are weak electrolytes and are partially ionized having lower conductivity. Glucose is a non-electrolyte, no ions and hence no conductivity.	1
13	B. A and R are true, and R is not the correct explanation of A	1
14	C. A is true but R is false. Reason is false, the correct statement - The pi bonding takes place by overlapping of p orbitals of oxygen with d orbitals of manganese.	1
15	A. A and R are true, and R is the correct explanation of A	1
16	A. A and R are true, and R is the correct explanation of A $[Co(NH_3)_6]^{3+}$ is diamagnetic because all electrons are paired. NH_3 is a strong field ligand, so it causes electron pairing in the d-orbitals. Hence, the reason correctly explains the assertion.	1
Section-B Question No. 17 to 21 are very short answer questions carrying 2 marks each		
17A 17B	I. $2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O,$ II. Chromium has more number of unpaired electrons than Titanium leading to stronger interatomic attractions holding its atoms together requiring more energy to break as compared to titanium. **OR** I. The transition metals form a large number of complex compounds. This is due to the comparatively smaller sizes of the metal ions, their high ionic charges and the availability of d orbitals for bond formation. Hence Titanium forms complex compounds, whereas Potassium and calcium do not. II. $Cr_2O_7^{2-} + 14\ H^+ + 6\ Fe^{2+} \rightarrow 2\ Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$	1 1 1 1
18	The statement is true for a zero order reaction as the rate is independent of concentration of reactants. For reactions of order other than zero, like order 1, 2 etc. the rate of reaction decreases with the decrease in concentration of reactants.	1 1

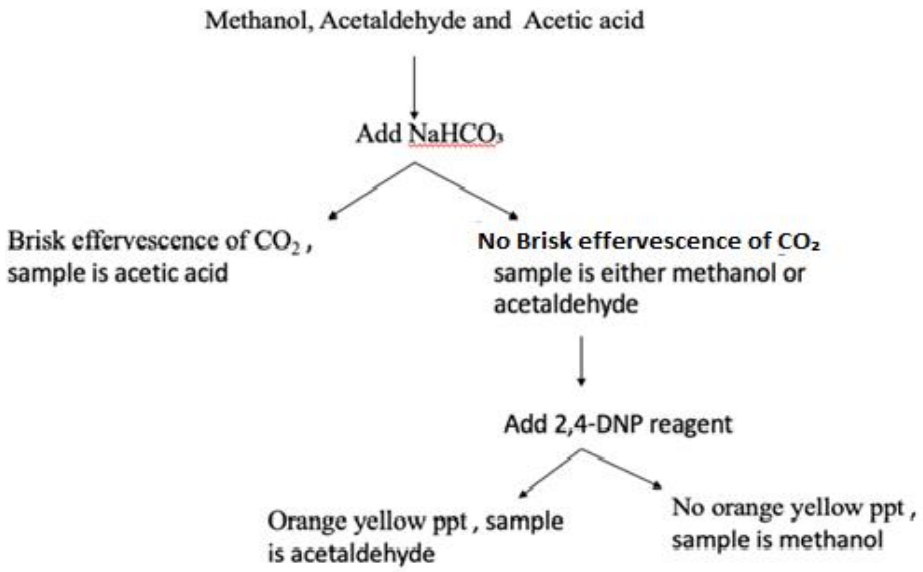
19	I.  II. Addition of lemon juice lowers the pH which breaks the hydrogen bonds, the globules of casein unfold and it gets denatured. **For Visually Challenged Learners** I. Adenine, Guanine, Cytosine and Thymine II. Addition of lemon juice lowers the pH which breaks the hydrogen bonds, the globules of casein unfold and it gets denatured.	1 1 1 1
20	Nitro group will increase the reactivity. The nitro group is a strong electron-withdrawing group (EWG) due to both its inductive (-I) and resonance (-M) effects whereas methoxy group is electron donating in nature. In chlorobenzene when nitro group is present at the *ortho* or *para* position, it withdraws electron density from the ring and stabilizes this negative charge through resonance. Hence increases its reactivity towards nucleophilic	1 ½ ½
21	I. Magnesium being more reactive than iron acts as a sacrificial anode and undergoes oxidation ($Mg \rightarrow Mg^{2+} + 2e^-$), supplying electrons to the iron pipe, which behaves like cathode, thus preventing corrosion. II. Cathode: $Mg^{2+} + 2e^- \rightarrow Mg$ (l) Anode: $2Cl^- \rightarrow Cl_2$ (g) + 2e-	1 ½ ½
	Section-C Question No. 22 to 28 are short answer questions, carrying 3 marks each.	
22	I. Fe^{2+} (4 unpaired electrons) has higher magnetic moment, as it contains more unpaired electrons as compared to other two. II. a) It provides large surface area and variable oxidation state. b) Iron has large crystal lattices containing interstitial sites large enough to accommodate small non-metal atoms like oxygen, carbon, nitrogen.	½, ½ 1 1
23	log K= log A - $\frac{Ea}{2.303RT}$ Slope = - $\frac{Ea}{2.303R}$	½ ½

	Slope = $\frac{y_2-y_1}{x_2-x_1}$ = $\frac{-4.46-(-3.91)}{.00333-.00323}$ = - 5500 J/K/mol (value of slope may vary slightly if different values of y_2,y_1, x_2 and x_1 are chosen) Equating the value of slope to the expression – $-\frac{Ea}{2.303R}$ = − 5500 where R= 8.314 $JK^{-1}mol^{-1}$ Ea = 5500 X 2.303 X 8.314 Ea = 105.31 $kJmol^{-1}$ **For Visually challenged learners** log k= log A - $\frac{Ea}{2.303RT}$ Slope = - $\frac{Ea}{2.303R}$ $-\frac{Ea}{2.303R}$ = − 4500 where R= 8.314 $JK^{-1}mol^{-1}$ Ea = 4500 X 2.303 X 8.314 Ea = 86.16 $kJmol^{-1}$	1 (Correct answer and correct unit) ½ , ½ 1 1 ½ , ½ (Correct answer and correct unit)
24	I. Aldol condensation, dil NaOH II. Etard Reaction, CrO_2Cl_2 III. Wolf -kishner reduction, >C=N.NH_2	½ + ½ ½ + ½ ½ + ½
25	I. a) The net volume of resulting solution was found to be slightly more than 20 mL. Carbon disulphide and acetone have weak intermolecular interactions which leads to increase in the volume of the solution. b) When solution is replaced with chloroform, net volume shows slight decrease from 20 mL, as chloroform and acetone have strong intermolecular interactions owing to hydrogen bonding.	½ ½ ½ ½

	II. Parts per million = $\frac{\text{Number of parts of the component} \times 10^6}{\text{Total number of parts of all components}}$ $= \frac{6 \times 10^{-3} \times 10^6}{1030 + 0.006}$ $= \frac{6 \times 10^{-3} \times 10^6}{1030}$ = 5.8 ppm	½ ½
26	I. a) Nitrobenzene to flurobenzene $C_6H_5NO_2 \xrightarrow{Sn/HCl} C_6H_5NH_2 \xrightarrow{NaNO2/HCl} C_6H_5N^{2+}Cl^- \xrightarrow{NaBF4} C_6H_5F$ b) Benzoic acid to benzylamine $C_6H_5COOH + NH_3 \xrightarrow{heat} C_6H_5CONH_2 \xrightarrow{LiAlH4} C_6H_5CH_2NH_2$ II. $-NH_2$ group in aniline is strongly activating in electrophilic substitutions, hence giving 2,4,6 trisubstituted products. Acetylation converts $-NH_2$ *to* $-NHCOCH_3$ which is less activating due to resonance with the carbonyl group, hence controlling and enabling the substitution at para position .	1 1 ½ ½
27(A)	I. 1-Bromo-2(1-methylpropyl) benzene II. When $CH_3CH_2CH_2Cl$ reacts with AgCN Compound X = $CH_3CH_2CH_2NC$ When $CH_3CH_2CH_2Cl$ reacts with KCN Compound Y = $CH_3CH_2CH_2CN$ KCN is predominantly an **ionic** compound, which it dissociates in solution to produce free cyanide ions which is an ambident nucleophile and attacks through C- side. AgCN is a covalent compound, in this case, the bond formation occurs through the nitrogen atom of the cyanide group, leading to the formation of the isocyanide.	1 ½ ½ ½ ½
	OR	
27(B)	I. **3-bromo-2,2,3-trimethylpentane** II. **CH_2=CH-CH_2Cl** (allyl chloride) will be hydrolysed more readily than **$(CH_3)_2CHCl$**	1 1

		allyl carbocation (CH_2=CH-CH_2^+) is more stabilised than secondary carbocation formed(**$(CH_3)_2CH^+$.** Due to resonance in allyl carbocation, where positive charge is delocalised on two carbons, makes it more stable.	1
28	I.	The relative lowering of vapour pressure is given by: $$\frac{P^\circ - P_S}{P^\circ} = \chi_B = \frac{n_B}{n_A + n_B}$$	½
		n_A= number of moles of water = 1000/18= 55.56 mol	
		n_B= number of moles of solute = W_B/M_B	
		$\frac{P^\circ - P_S}{P^\circ}$= 0.5 (as 50 % reduction is there)	½
		Substituting the value:	
		0.5= n_B/ (n_B +55.56)	
		0.5 n_B + 0.5 X 55.56 = n_B	
		Or	
		0.5 n_B= 0.5 X55.56	½
		n_B= **55.56 mol =** W_B/M_B	
		On calculation:	
		M_B =100/55.56 = 1.8 g/mol	½
	II.	Nitric acid solution containing 32% of water by mass forms an azeotropic solution. It has the *same composition* in both the liquid and vapor phases. Hence cannot be separated into its components through fractional distillation.	1
29	I.	D. less than 4.09	1
	II.	A. p-bromophenol > p-chlorophenol > p-flourophenol > phenol	1
	III.	A. Phenol is more stronger acid than the cyclohexanol so will have less pKa value than cyclohexanol.	1
		Phenol loses hydrogen ion to form its conjugate base - phenoxide ion, which is stabilised by resonance.	1
		Where as in the Cyclohexanol, conjugate base formed is less stable due to localisation of negative charge on oxygen atom.	
		OR	
	III.	B. pKa of p-nitrophenol is 7.2 while p-chlorophenol is 9.38. Following this trend, more the nitro groups, lower will be the pKa value. Therefore, pKa value of 4 chloro-2,6- dintirophenol is higher than	1

	2,4,6-trinitrophenol. More the pKa values, lower is the acidic strength, therefore 4 chloro-2,6- dintirophenol is less acidic than 2,4,6 trinitrophenol. **For visually challenged learners** **I.** B. o-cresol **II.** B. – OCH_3 **III.** A. 2,4 Dintirophenol is more acidic in nature. The nitro group is a strong electron withdrawing group. It exerts both –I effect and –M effect, hence withdraws electrondensity from the ring. Phenoxide ion formed is stabilised. Presence of two nitro groups make the phenoxide ion formed more stable as compared to the presence of one nitro group. **OR** **III.** B. pKa of cresol will be higher than phenol. The pKa values increases due to presence of electron donating groups. pKa of p-nitrophenol will be lower than phenol. The pKa values decreases due to presence of electron withdrawing groups	1 1 1 1+1 ½+½ ½+½
30	**I.** B. reducing sugars give a brick red ppt. with Benedict's solution **II.** B. sucrose and starch are plant based carbohydrates. lactose is milk sugar (animal milk) and glycogen is animal starch **III.** A. Sample is maltose. The sugar is reducing in nature as it gives positive Benedict's test – it is not sucrose. The sugar undergoes hydrolysis so it is not a monosaccharide –i.e not glucose or fructose. The sugar gives same monosaccharide on hydrolysis lactose gives glucose and galactose while maltose gives 2 glucose molecules. Therefore, it is maltose. **OR** **III.** B. The carbohydrate gives only one monosaccharide on hydrolysis. Starch on hydrolysis gives glucose. No, the carbohydrate is not starch. The carbohydrate is soluble in water while starch is insoluble. Moreover starch is not a reducing sugar.	1 1 1+1 1+1
31(A)	I. a) A highly acidic medium protonates the ammonia derivatives, reducing their nucleophilicity. In a basic medium, the carbonyl compound is not protonated. reducing its electrophilicity for nucleophilic attack. Hence, a mildly acidic pH of about 3.5 gives the best rate for derivative formation.	1

	b) Dry hydrogen chloride protonates the oxygen of the carbonyl compounds and therefore, increases the electrophilicity of the carbonyl carbon facilitating the nucleophilic attack of alcohol.	1
	c) The hydrogen sulphite addition compound is water soluble and can be converted back to the original carbonyl compound by treating it with dilute mineral acid or alkali. Therefore, these are useful for separation and purification of aldehydes.	1
	II. 	½ +½ ½ + ½
31(B)	**OR**	
	I. a) $HCHO > CH_3CHO > C_6H_5CHO$ b) $CH_3CONH_2 < CH_3COOH < CH_3COOCH_3 < CH_3COCl$ c) $CH_3COCH_3 < CH_3CHO < CF_3CHO$	1 1 1
	II. The possible isomers of compound with molecular formula C_3H_6O are: Propan-1-al: $CH_3–CH_2–CHO$ Propanone: $CH_3–CO–CH_3$ (a ketone)	½ ½
	Propanal (CH_3CH_2CHO) gives a positive Tollens' test (silver mirror). Tollens' reagent oxidises aldehydes to carboxylates, reducing Ag^+ to metallic Ag. Ketones and alcohols do not give this test.	½ + ½

32(A)	I.	$[Cr(en)_3]^{3+}$ contains three bidentate ethylenediamine ligands arranged in a chiral octahedral geometry, so it is optically active and will rotate the plane of polarization whereas $[Cr(H_2O)_3Cl_3]$ exists as a fac and mer isomers but is not optically active because it is symmetrical (has a plane of symmetry).	1
	II.	$[Ni(CO)_4]$ has higher crystal field splitting due to the strong field ligand CO as compared to $[Ni(H_2O)_6]^{2+}$ which has weak ligand H_2O. The ligand nature (strong vs weak field) determines the difference.	½+½
	III.	Primary valency is oxidation number of the metal which is 2 and secondary valency is coordination number which is 4 and is satisfied by all ligands coordinated to the metal.	½ +½
	IV.	CN^- is a strong field ligand, causing low-spin octahedral geometry with d^2sp^3 hybridisation.	½ +½
	V.	$[Cu(H_2O)_4]SO_4 \cdot H_2O$) is a complex, the blue colour is due to water that acts as ligand. In absence of ligand, crystal field splitting does not occur, hence on losing water of crystallisation copper sulphate becomes colourless.	1
		OR	
32(B)	I.	Compound A shows maximum conductivity. On dissociation A → $[Co(NH_3)_6]^{3+} + 3Cl^-$ (total 4 ions), B → $[Co(NH_3)_5Cl]^{2+} + 2Cl^-$ (3 ions), C → $[Co(NH_3)_4Cl_2]^+ + Cl^-$ (2 ions). The more the number of ions in solution, the higher is its conductivity.	1
	II.	$t_{2g}^5e_g^o$ Strong field causes pairing in t2g, only one unpaired electron remains.	1
	III.	$[Cr(NH_3)_2(H_2O)_2(C_2O_4)]Cl$	1
	IV.	$[Co(NH_3)_2Cl_2(en)]Cl$ is optically active; $[Co(NH_3)_4Cl_2]Cl$ is not. The bidentate ligand en can produce a chiral (non-superimposable) octahedral arrangement (no internal mirror plane), giving optical isomerism. Complexes with only monodentate ligands like MA_4B_2 are symmetric and achiral.	1
	V.	The different ligands (NH_3 vs H_2O) produce different crystal field splitting (Δ), so they absorb different wavelengths of light which gives different observed colours. Ligand nature ie strength of ligand determines crystal field splitting and thus the energy (wavelength) of d–d transitions, affecting colour.	½+½

33(A)	I. a) Cell potential from the Nernst equation increases when the reaction quotient Q=$[Zn^{2+}][Cu^{2+}]$ decreases. In experiment 4, $[Zn^{2+}]$=0.01 M (very low) and $[Cu^{2+}]$=1.00 M (high), so Qc is very small , log Qc is very negative , the −0.0591/2 log Q term is positive and large, giving the highest E. b) $E=E^{o}-0.059/2 \log Qc$ $E=E^{o}-0.059/2 \log [Zn^{2+}]/[Cu^{2+}]$ $= 1.1-0.059/2 \log [1/0.10]$ $=1.1-0.02955 \log 10$ $= 1.1 - 0.02955$ $= 1.07045$ V The measured EMF differs because when current flows through a cell, it faces some internal resistance (r) due to resistance of electrolyte, electrodes or salt bridge which lowers the observed cell voltage. II. $\Lambda_m(\text{S cm}^2\text{ mol}^{-1}) = \frac{\kappa\ (\text{S cm}^{-1}) \times 1000\ (\text{cm}^3/\text{L})}{\text{molarity (mol/L)}}$ Both type of units are used in literature and are related to each other by the equations: 1 S m^2mol^{-1} = 10^4 S cm^2mol^{-1} or 1 S cm^2mol^{-1} = 10^{-4} S m^2mol^{-1}. III. During charging, the specific gravity of electrolyte in a lead storage battery increases, while discharging it decreases. **OR**	1 ½ ½ ½ ½ 1 ½ + ½
33(B)	I. For c_1=0.010 $123.9=\Lambda^{\circ}_m - A\sqrt{0.0100}$ $123.9= \Lambda^{\circ}_m - A(0.100)$ ……(1) For c_2=0.040 M $120.7= \Lambda^{\circ}_m - A\sqrt{0.040}$ $120.7= \Lambda^{\circ}_m - A(0.2)$……..(2) Subtract (2) from (1): $123.9-120.7=[\Lambda^{\circ}_m-\Lambda^{\circ}_m]+[-0.100A-(-0.200A)]$ 3.2=0.100A A= 3.2/0.100 A = 32.0 $Scm^2\ mol^{-1}M^{-1/2}$ Now substitute A into (1) to get Λ°_m $123.9= \Lambda^{\circ}_m - 32\ (0.100)$ Λ°_m =123.9 + 3.2 Λ°_m = 127.1 Scm^2mol^{-1}	½ ½ ½ ½ ½ ½

	II. Electrode Reactions in a Hydrogen–Oxygen Fuel Cell: Anode: $2H_2 \rightarrow 4H^+ + 4e^-$ Cathode : $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ Overall Reaction: $2H_2 + O_2 \rightarrow 2H_2O$ The two advantages of fuel cells compared to conventional batteries are: • Higher efficiency: Fuel cells can convert chemical energy to electrical energy more efficiently than many conventional batteries. • Continuous operation: As long as fuel (hydrogen) and oxidant (oxygen) are supplied, fuel cells can operate indefinitely, unlike batteries which need recharging.	½ ½ ½ ½

CHEMISTRY (CODE - 043)

SAMPLE QUESTION PAPER*

CLASS XII (2025-26)

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

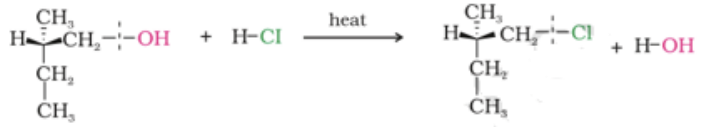
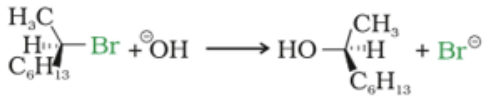
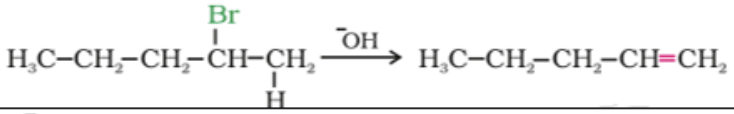
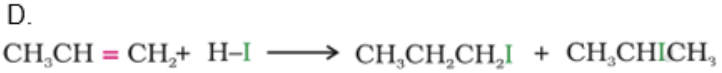
GENERAL INSTRUCTIONS:

Read the following instructions carefully.

1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

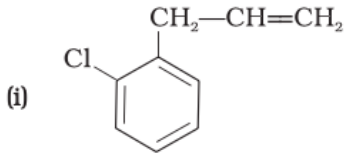
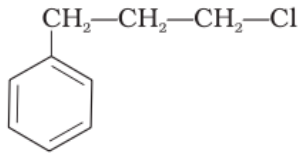
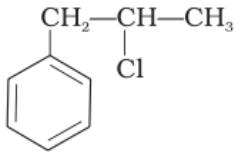
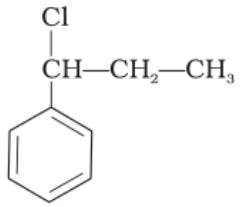
	Section-A Question 1 to 16 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.	
1	Which of the following reaction will lead to formation of ethyl methyl ketone: A. heating $CH_3CH(CH_3)CH_2OH$ with acidified $Na_2Cr_2O_7$ B. passing $CH_3C(OH)CH_3$ over heated copper C. ozonolysis of $CH_3CH_2C(CH_3)=CHCH_3$ D. acetylene on reaction with $HgSO_4/H_2SO_4$	1
2	Consider the reaction and identify B and C $CH_3CH_2CH_2CH_2Cl \xrightarrow{NaOH + Ethanol} A$ $A \xrightarrow{H_2O,\ H^+} B$ and $A \xrightarrow{(i)\ B_2H_6,\ (ii)H_2O_2,\ OH^-} C$ A. B=C= Butanol B. B= Butanol, C=Butene C. B= Butan-2-ol, C= Butanol D. B= Butene, C=Butan-2-ol	1
3	The counter ion in the coordination compound $[Co(NH_3)_5(NO_2)]Cl_2$ is A. Ammine B. Cobalt	1

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

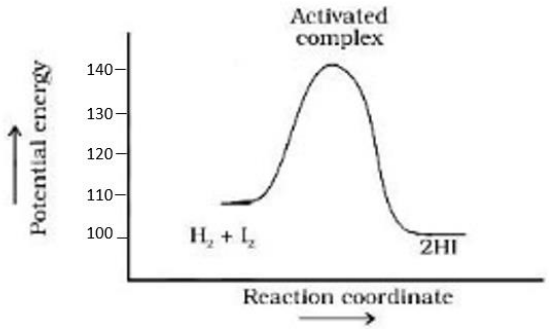
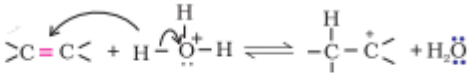
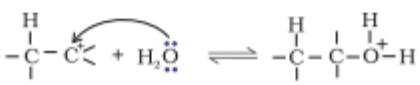
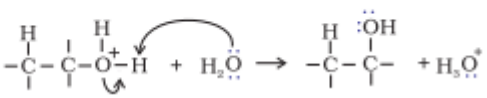
	C. Chloride D. Nitro	
4	The organic compounds A, B and C are amines having equivalent molecular weight. A and B on reaction with benzene sulphonyl chloride give white precipitate, however white precipitate obtained from compound B remains insoluble in NaOH. The variation in the boiling point of A, B and C can be seen as : A. A> B>C B. B>A>C C. A=B > C D. C>B>A	1
5	70 gm solute is dissolved in 700 gm solvent to prepare a solution having density 1.5 g/ml. The ratio of its molality and molarity will be: A. 0.77 B. 1.4 C. 0.73 D. 1.3	1
6	Match the column I and column II: Column I / Column II A.  (i) Addition reaction B.  (ii) Elimination reaction C.  (iii) S_N^2 reaction D.  (iv) S_N^1 reaction A. A-(i), B-(ii), C-(iii), D-(iv) B. A-(iv), B-(ii), C-(iii), D-(i) C. A-(i), B-(iii), C-(ii), D-(iv) D. A-(iv), B-(iii), C-(ii), D-(i)	1

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

7	In o-cresol, the –OH group is attached to the carbon that is: A. sp^3 hybrid B. sp^2 hybrid C. sp hybrid D. dsp^2 hybrid	1
8	Which of the following is laevorotatory in nature : A. alpha D – glucose B. beta -D- glucose C. beta-D- fructose D. sucrose	1
9	The name inner transition metals is often used to refer to the A. lanthanoids B. actinoids C. both lanthanoids and actinoids D. d block elements	1
10	Λ_m^o CH_3COOH can be calculated if the values of the following are given: 1. Λ_m^oHCl, Λ_m^oKCl and Λ_m^o CH_3COOK 2. Λ_m^oNaCl, Λ_m^oKCl and Λ_m^o CH_3COONa 3. $\Lambda_m^o$$H_2SO_4$, $\Lambda_m^o$$Na_2SO_4$ and Λ_m^o CH_3COONa A. Only 1 B. Either 1 or 2 C. Either 1 or 3 D. Either 2 or 3	1
11	Which of the following will give a yellow or orange ppt. with 2,4 DNP? (i) Porpanal (ii) Propanone (iii) Propanoic acid A. (i) and (ii) B. (ii) and (iii) C. (i) and (iii) D. (i), (ii) and (iii)	1

12	Identify the secondary benzylic halide and primary alkyl halide from the following:  (i)  (ii)  (iii)  (iv) A. (i) and (iii) B. (iv) and (ii) C. (iii) and (iv) D. (i) and (ii)	1
13	**Assertion (A):** Secondary aliphatic amines react with nitrous acid to form aliphatic diazonium salts which being unstable, liberate nitrogen gas quantitatively. **Reason**: Nitrogen gas evolved on reaction with nitrous acid can be used for the estimation of proteins and amino acids. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
14	**Assertion (A):** Care should always be taken to ensure that solutions that flow in the blood stream are of the same osmotic pressure as that of the blood. **Reason(R):** Sodium ion and potassium ions are responsible for maintaining proper osmotic pressure balance inside and outside of the cells of organism. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1

15	**Assertion (A)**: Starch forms colloidal solution with water. **Reason (R)**: Starch contains 80-85% of amylopectin which is insoluble in water. Select the most appropriate answer from the options given below: A**.** Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
16	**Assertion (A):** Secondary cells are used in invertors. **Reason (R):** A primary cell can be recharged by passing current through it in the opposite direction after it has been used. Select the most appropriate answer from the options given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true	1
	Section-B Question No. 17 to 21 are very short answer questions carrying 2 marks each.	
17	**Attempt either option A or B** A. Answer the following: I. When 50 mL of phenol and 50 mL of aniline are mixed, predict whether the volume of the solution is equal to, greater than or less than 100 mL. Give reason to support your answer. II. Ritesh suggested adding salt to the box containing ice. He said this would keep the cold drink bottles cold for a longer time. How will Ritesh justify his suggestion? **OR** B. Answer the following: I. $BaCl_2$ on reaction with Na_2SO_4 in aqueous solution gives white precipitate. If the two solutions are separated by a semi-permeable membrane, will there be appearance of a white precipitate due to osmosis? II. Why does water stops boiling when sugar is added to boiling water.	2x1 2x1

18	Consider the graph for the reaction $H_2 + I_2 \rightleftharpoons 2HI$  I. Calculate enthalpy of reaction and activation energy for the backward reaction. II. How will the catalyst affect the rate of this reaction? Explain. ***(for visually challenged learners)*** I. Define activation energy. What will happen to activation energy if we increase the temperature? II. How will the catalyst affect the rate of an endothermic reaction?	2x1 2x1
19	Carry out following conversions : I. Nitrobenzene to 4- bromobenzenamine II. Chlorophenylmethane to 2-phenyl-ethanamine	2x1
20	Write the formula of the following coordination complex: I. diaquasilver(I) dichloridoargentate(I) II. dihydroxidobis(triphenylphosphine)nickel(II)	2x1
21	The mechanism of formation of alcohols from alkenes is given below. Rectify the errors in the mechanism and rewrite the corrected steps STEP 1  STEP 2  STEP 3 	2

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

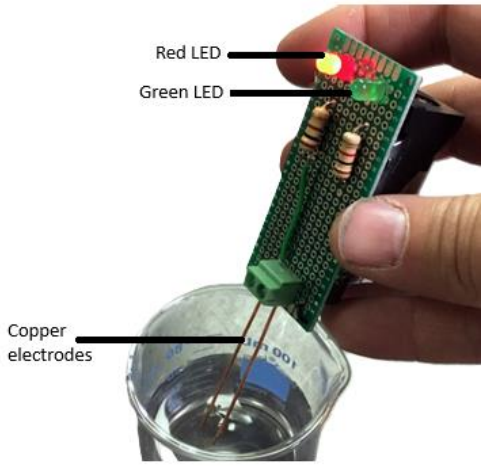
	Section-C Question No. 22 to 28 are short answer questions, carrying 3 marks each.	
22	What will be the vapour pressure of a 1 molal aqueous solution of $MgCl_2$, assuming dissociation of $MgCl_2$ to be 70 mole percent? (Vapor pressure of pure water at 25 ^oC is 23.8 mmHg)	3
23	Write the Nernst equation for the following: I. Ni (s) + Cu^{2+} (aq) → Ni^{2+} (aq) + Cu (s) II. Al (s) + $FeSO_4$ (aq) → $Al_2(SO_4)_3$ (aq) + Fe (s) III. Mg (s)/Mg^{2+} (aq)//Ag^+ (aq)/Ag(s)	3x1
24	Explain the following: I. Toluene on treatment with Cl_2 in sunlight gives benzyl chloride whereas when treated with Cl_2 in dark gives o-chlorobenzene and p-chlorobenzene. II. Finkelstein reaction is carried out in the presence of dry acetone. III. neo pentylchloride has lower boiling point than isopentylchloride.	3x1
25	Which of the following elements will: I. exhibit similar magnetic behaviour and why? Magnesium (Atomic No. 12), Chromium (Atomic No. 24), Iron (Atomic No. 26) and Molybdenum (Atomic No. 42). II. form white salts and why? Zinc (Atomic No. 30), Scandium (Atomic No. 21), Nickel (Atomic No. 28) and Vanadium (Atomic No. 23)	2x1.5
26	Arrange the products obtained in the following cases in the increasing order of their pKa values: A. Oxidation of ethanol in presence of acidified potassium dichromate B. Reaction of propanoic acid with Br_2 in the presence of red Phosphorus C. Reaction of isopropyl magnesium bromide with carbon dioxide, followed by hydrolysis. D. Reaction of propanoic acid with Cl_2 in the presence of red Phosphorous.	3

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

27	Carry out the following conversions. (**Attempt any 3)** I. Butan-2-one to 3-Methylpentan-3-ol II. Anisole to 4-Methoxytoluene III. Phenol to Benzene IV. Chloroethane to Ethoxy ethane	3x1
28	Answer the following questions: I. Are the enthalpies of atomisation of Zinc and Copper matched correctly? Justify your answer. Element | Enthalpy of atomisation/ $kJmol^{-1}$ Zinc | 339 Copper | 130 II. Out of sulphuric acid and hydrochloric acid, which acid will you prefer for permanganate titrations and why? III. $5NO_2^- + 2MnO_4^- + 6H^+ \rightarrow$	3x1

Section D

Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.

29	**Conductivity of Aqueous Solutions** Electrical conductivity is based on the flow of ions. Slightly ionized substances are *weak electrolytes*. Weak acids and bases would be categorized as weak electrolytes because they do not completely dissociate in solution. Highly ionized substances are *strong electrolytes*. Strong acids and salts are strong electrolytes because they completely ionize in solution. The ions carry the electric charge through the solution thus creating an electric current. The current, if sufficient enough, will light one or both LEDs on a *conductivity meter*, shown at right.  The meter has a 9V battery, two parallel copper electrodes and	

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two LED's – one green and one red. The conductivity of a solution can be tested by switching the meter on and dipping the copper electrodes in the solution to be tested.

Substances that do not conduct an electric current are called *non-electrolytes*. Non-electrolytes do not ionize; they do not contain moveable ions. The LEDs of a conductivity meter will not light because there are no ions to carry the electric current.

The table given below is a guide to the possible conductivity measurements

Scale	Red LED	Green LED	Conductivity
0	off	off	low or none
1	dim	off	low
2	medium	off	medium
3	bright	dim	high
4	very bright	medium	very high

source: https://chem.libretexts.org

Based on the information provided above, answer the following questions: 1+1+2

I. Is it possible to identify whether the given solution is 1 M NaOH or 1 M HCl using the conductivity meter? Justify your answer.

II. What is the possible pH value of solution if the glow of green LED is medium and the red LED glows very brightly?

(i) 1 (ii) 13 (iii) 5 (iv) 8

(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iv)
(d) (iii) and (iv)

OR

Write down the observations if the conductivity meter is dipped in distilled water.

III. Refer to the table given below and draw the molar conductivity vs. concentration curve for solution A and B.

Solution	Red LED	Green LED
A	bright	dim
B	dim	off

(For Visually Challenged students)

Conductivity of Aqueous Solutions

Conductivity meter is a device which is used to identify whether the given solution is a strong, weak or non-electrolyte. The meter has a 9V battery, and two parallel copper electrodes and a 5 point scale (0 to 4) to measure conductivity of a solution. The conductivity of a solution can be tested by switching the meter on and dipping the copper electrodes in the solution to be tested.

Electrical conductivity is based on the flow of ions. Highly ionized substances are *strong electrolytes*. Strong acids and salts are strong electrolytes because they completely ionize in solution. The ions carry the electric charge through the solution thus creating an electric current. The current, if sufficient enough, will show a value of 3 or 4 on the conductivity *meter*.

Slightly ionized substances are *weak electrolytes*. Weak acids and bases would be categorized as weak electrolytes because they do not completely dissociate in solution. The values for weak electrolytes are 1 or 2 on the conductivity scale.

Substances that do not conduct an electric current are called *non-electrolytes*. Non-electrolytes do not ionize; they do not contain moveable ions. The conductivity meter shows a value of 0 in such a case as there are no ions to carry the electric current.

The following table is a guide to the possible conductivity values:

Scale	Conductivity
0	low or none
1	low
2	medium
3	high
4	very high

Based on the information provided above, answer the following questions: 1+1+2

I. Is it possible to identify whether the given solution is 1 M NaOH or 1 M HCl using the conductivity meter? Justify your answer.

II. What is the possible pH value of solution if the scale shows the value "4"

(i) 1 (ii) 13 (iii) 5 (iv) 8

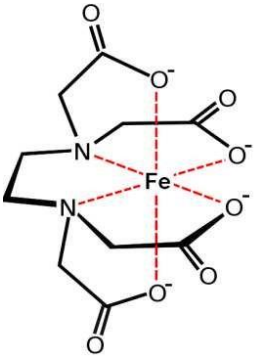
(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iv)
(d) (iii) and (iv)

OR

What will be value on the scale if the conductivity meter is dipped in distilled water?

III. Predict the electrolyte is a strong or weak electrolyte on the basis of the following observation:

Solution	Scale
A	3
B	2

30	**Iron-EDTA complex in food fortification** Food fortification is defined as the practice of adding vitamins and minerals to commonly consumed foods during processing to increase their nutritional value. It is a proven, safe and cost-effective strategy for improving diets and for the prevention and control of micronutrient deficiencies. A food product (such as rice, wheat flour, edible oil) that is fortified through the addition of fortificants is called a "vehicle".  In African and south Asian countries 40% of the population suffers from anaemia. Average human needs nearly 10mg of iron daily. Iron fortification may be useful in fighting iron deficiencies in humans. Reduced iron and several iron salts have been used in the past as iron fortification, however, not all are suitable for this purpose, in terms of iron absorption. Recent studies have shown that beverages containing sugar fortified with either Ferrous sulphate or Fe(III)- EDTA complex have high rate of absorption of iron. Ferrous sulphate as well as Fe(III)- EDTA is suitable to enrich sugar, but while iron from ferrous sulphate is precipitated and poorly absorbed when fortified sugar is added to beverages such as tea, Fe(III)- EDTA reacts slowly with tea and iron is not precipitated for at least 24 hr. Fe(III)-EDTA as iron fortification, has demonstrated so far, more advantages than that observed from other iron salts, including ferrous sulphate. But, EDTA is a chelating agent and its use in food technology to prevent oxidative damage of food has been restricted. Excessive consumption of EDTA can cause abdominal cramps, nausea, low blood pressure and damage to kidneys. According to National Institute of Health, it is unsafe to consume more than 3 g of EDTA per day or continuously for more than 5 to 7 days. The amount of EDTA necessary for 10 mg of iron fortification, is about 60 mg. This is within the safe limits and is comparable to the usual amount added to the diet. (source: Layrisse, M., & MartInez-Torres, C. (1977). Fe (III)-EDTA complex as iron fortification. *The American Journal of Clinical Nutrition*, *30*(7), 1166-1174.) **Based on the information provided above, answer the following questions:** I. Why is Fe(III)-EDTA complex stable as compared to Ferrous sulphate? **OR**	1+1+2

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

What happens when hard water is titrated against Na_2EDTA?

II. You are a doctor, working in Somalia. Will you recommend iron fortified food to your patients? Support your answer with references from the passage.

III. What is the denticity of the ligand in the Fe(III) EDTA complex. Name the atom(s) through which it can bind to the central metal ion.

Write the structure of EDTA. (Refer to figure 1)

For Visually challenged candidates

Iron-EDTA complex in food fortification

Food fortification is defined as the practice of adding vitamins and minerals to commonly consumed foods during processing to increase their nutritional value. It is a proven, safe and cost-effective strategy for improving diets and for the prevention and control of micronutrient deficiencies. A food product (such as rice, wheat flour, edible oil) that is fortified through the addition of fortificants is called a “vehicle”.

Reduced iron and several iron salts have been used in the past as iron fortification, however, not all are suitable for this purpose, in terms of iron absorption. Recent studies have shown that beverages containing sugar fortified with either Ferrous sulphate or Fe(III)- EDTA complex have high rate of absorption of iron.

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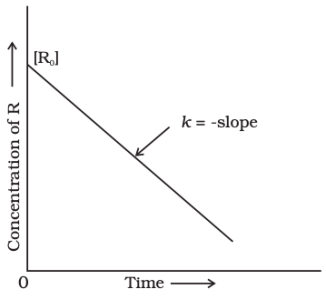
Fe(III)-EDTA as iron fortification, has demonstrated so far, more advantages than that observed from other iron salts, including ferrous sulphate. But, EDTA is a chelating agent and its use in food technology to prevent oxidative damage of food has been restricted. Excessive consumption of EDTA can cause abdominal cramps, nausea, low blood pressure and damage to kidneys. According to National Institute of Health, it is unsafe to consume more than 3 g of EDTA per day or continuously for more than 5 to 7 days.

The amount of EDTA necessary for 10 mg of iron fortification, is about 60 mg. This is within the safe limits and is comparable to the usual amount added to the diet.

(source: Layrisse, M., & MartInez-Torres, C. (1977). Fe (III)-EDTA complex as iron fortification. *The American Journal of Clinical Nutrition*, *30*(7), 1166-1174.)

	Based on the information provided above, answer the following questions: I. Why is Fe(III)-EDTA complex stable as compared to Ferrous sulphate? **OR** What happens when hard water is titrated against Na_2EDTA? II. You are a doctor, working in Somalia. Will you recommend iron fortified food to your patients? Support your answer with references from the passage. III. (a)What is the denticity of the ligand in the Fe(III) EDTA complex. Name the atom(s) through which it can bind to the central metal ion. (b) EDTA is an electron acceptor or an electron donor?	1+1+2
	Section-E Question No. 31 to 33 are long answer type questions carrying 5 marks each.	
31	**Attempt either A or B** A. Answer the following questions: I. Write the structure of expected product of Cannizarro reaction of 2-chlorobenzaldehyde. II. How would the presence of $-SO_3H$ group effect the basic strength of aniline. III. Convert acetic acid to ethanamine. IV. Write the steps to prepare Benzoic acid from Benzoyl chloride. V. Give a chemical test to distinguish between: propanal and propanone **OR** B. Answer the following questions: I. Write the structure of expected product of Wolf-Kishner reduction of 2 –methylbutanal. II. How would the presence of $-SO_3H$ group effect the acidic strength of benzoic acid III. Prepare acetic acid from ethanamine. IV. Convert Aniline to benzoic acid. V. Give a chemical test to distinguish between: propanal and ethanal.	5x1

32	**Attempt either A or B** A. Answer the following questions: I. Identify and give any one point of difference between the protein present in the hair and protein present in egg albumin. II. Both glucose and sucrose have aldehydic group, then why does only glucose reduces Fehling's Reagent.and not sucrose? III. Why do amino acids behave as salts? IV. What chemical change takes place during curdling of milk? V. Doctor advised a 50 year old woman enough exposure to sunlight and addition of fish and egg yolk to her diet. What is the possible disease diagnosed by the doctor? **OR** B. Answer the following questions: I. Identify and give any one point of difference between the carbohydrate present in cane sugar and carbohydrate present in milk. II. Glucose is an aldohexose and a monosaccharide. Which oxidising agent should be used to bring about oxidation of only the aldehydic group present in glucose? III. Amino acid $HOOC\text{-}CH_2CH(NH_2)CH_2COOH$.Predict whether the pH of this amino acid will be >7, 7 or <7. IV. Name the two major molecular shapes formed due to the folding of secondary structure of proteins. V. Ashish's gums bleed frequently. The doctor's prescription mentioned that Ashish is suffering from scurvy. Help him to identify two food sources to help him recover faster. .	5x1
33	**Attempt either A or B** A. I. The rate of a reaction triples when the temperature changes from 298 K to 318 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature. (Given R = 8.314 $JK^{-1}mol^{-1}$, log 3 = 0.4771) II. Identify the order of reaction and write its integrated rate equation mentioning what each term in the equation represents.  **OR**	3+2

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

	B. I. Consider the following first order thermal decomposition of SO_2Cl_2 at a constant volume SO_2Cl_2 (g) → SO_2(g) + Cl_2 (g) If the total pressure of the gases is found to be 200 torr after 10 seconds and 300 torr upon the complete decomposition of SO_2Cl_2. Calculate the rate constant. (Given log 3 = 0.4771, log 2= 0.3010) II. For a bimolecular elementary reaction A + B → Products. Write the expression for the rate of reaction relating temperature and activation energy for the reaction and also mention what each term represents in the equation.	3+2

*Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.

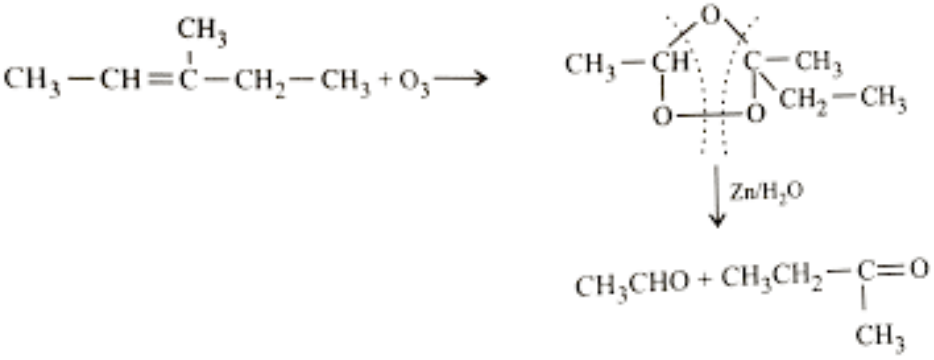
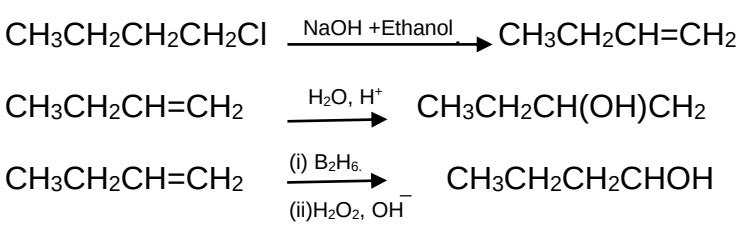
CHEMISTRY CODE - 043
MARKING SCHEME
CLASS XII (2025-26)

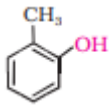
Time: 3 hours **Max. Marks: 70**

GENERAL INSTRUCTIONS:

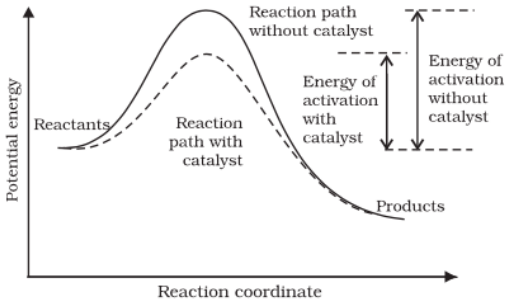
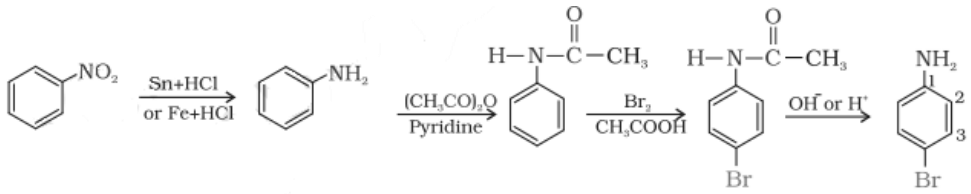
Read the following instructions carefully.

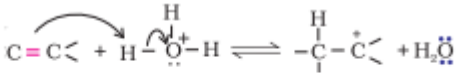
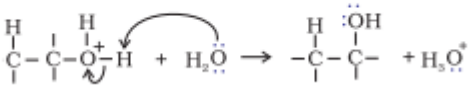
1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

	Section-A	
1	C. Ozonolysis of $CH_3CH_2C(CH_3)=CHCH_3$ 	1
2	C. B= Butan-2-ol, C= Butanol 	1
3	C. chloride	1

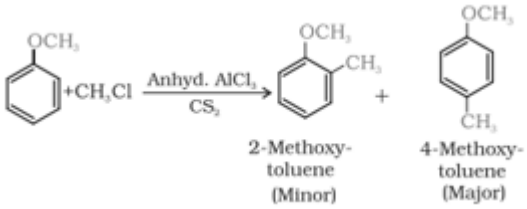
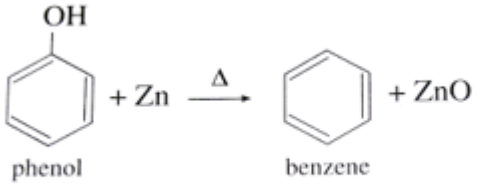
	The formula of coordination complex, the ions outside the square bracket are called counter ions.	
4	A. A> B>C A is primary, B is secondary amine, C is tertiary amine.Primary amines are having higher boiling point as compared to secondary and tertiary amines.	1
5	C. 0.73 m = $\frac{m_2}{MM_2}$ x $\frac{1000}{m_1}$ m = $\frac{70}{MM_2}$ x $\frac{1000}{700}$ M = $\frac{m_2}{MM_2}$ x $\frac{1000}{V}$ Here, V = $\frac{m_1+m_2}{d}$ = $\frac{770}{1.5}$ M = $\frac{70}{MM_2}$ x $\frac{1000\ x\ 1.5}{770}$ $\frac{m}{M}$ = $\frac{770}{700\ x\ 1.5}$ = 0.73	1
6	D. A-(iv), B-(iii), C-(ii), D-(i)	1
7	B. sp^2 hybrid. The –OH group has replaced –H of benzene ring. All carbons of benzene are sp^2 hybrid. 	1
8	C. Beta D – fructose	1
9	C. both lanthanoids and actinoids	1
10	C. Either 1 or 3 Λ_m^o CH_3COOH = $\Lambda_m^o HCl$ + Λ_m^o CH_3COOK - $\Lambda_m^o KCl$	1

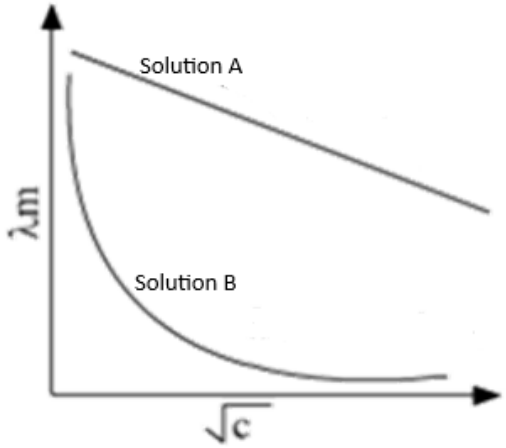
	Λ_m^o CH_3COOH = 1/2 $\Lambda_m^o H_2SO_4$ + Λ_m^o CH_3COONa – 1/2 $\Lambda_m^o Na_2SO_4$	
11	A. (i) and (ii) Aldehydes and ketones react with 2,4 dinitrophenylhydrazine to give a yellow/orange ppt of 2,4 dintirophenylhydrazone	1
12	B. (iv) and (ii)	1
13	D. A is false but R is true Primary aliphatic amines react with nitrous acid to form aliphatic diazonium salts which being unstable, liberate nitrogen gas	1
14	B. Both A and R are true, and R is not the correct explanation of A. If osmotic pressure of the solutions that flow in the blood stream is not same as that of the blood, exosmosis or endosmosis will take place.	1
15	A. Both A and R are true, and R is the correct explanation of A. In starch, the major component is 80-85% of amylopectin is insoluble in water. Hence starch is not completely soluble in water and form colloidal solution.	1
16	C. A is true but R is false. A primary cell becomes dead after use, it cannot be recharged.	1
17	**Option A** I. The volume will be less than 100 ml. The intermolecular forces between phenol and aniline is stronger than phenol-phenol and aniline-aniline which results in decrease in volume. II. Salt lowers the freezing point of water ie. it leads to depression in freezing point. This will delay the melting of ice. **OR** **Option B** I. Precipitate of $BaSO_4$ will not appear as osmosis involves movement of solvent molecules and not solute.	1 1 1

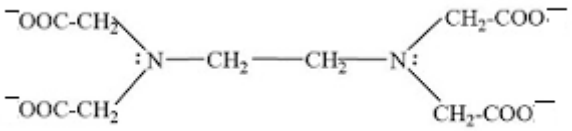
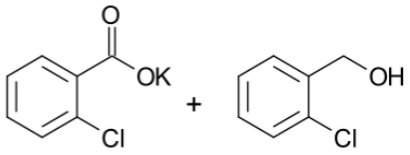
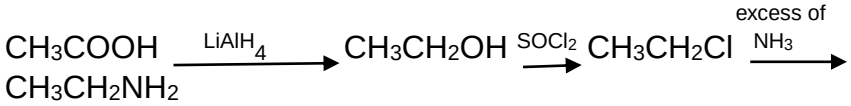
	II. Sugar being non-volatile solute, lowers the vapour pressure above the solution. This leads to elevation in boiling point.	1
18	I. Ea for backward reaction = 40 kJ/mol, ΔH= 10 kJ/mol II. Catalyst will increase the rate of reaction as the activation energy required to form intermediate activated complex between reactant and catalyst is lower than the activation energy required for forming complex without catalyst.  ***(for visually challenged learners)*** I. The minimum energy required to form the intermediate activated complex, is known as activation energy (Ea). Activation energy is the least possible energy required to start a chemical reaction. The activation energy doesn't change with change in temperature. II. Catalyst will increase the rate of reaction as the activation energy required to form intermediate activated complex between reactant and catalyst is lower than the activation energy required for forming complex without catalyst.	1 1 1 1
19	I  II. $C_6H_5CH_2Cl + KCN \longrightarrow C_6H_5CH_2CN \xrightarrow{LiAlH_4} C_6H_5CH_2CH_2NH_2$	1 1
20	I. $[Ag(H_2O)_2][Ag(Cl)_2]$ II. $[Ni(OH)_2(PPh_3)_2]$	1 1

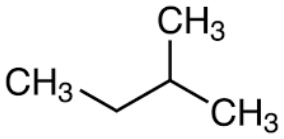
21	STEP 1  STEP 2 No error STEP 3 	1 1
22	P_A^o = 23.8 mm of Hg m = 1molal ,1mol of solute in1000g of water $n_B = 1$ mol $n_A = \frac{1000}{18} = 55.5$mol $MgCl_2 \rightarrow Mg^{2+} + 2Cl^-$ 1 0 0 $1-0.7$ 0.7 1.4 $\alpha = (i-1)/(n-1)$ n=3 $i = 0.7(2)+1$ $= 1.4 + 1 = 2.4$ $\frac{P_A^o - P_s}{P_A^o} = i\frac{n_B}{n_A + n_B}$ $\frac{23.8 - Ps}{23.8} = 2.4\ \frac{1}{56.5}$ $23.8\left(1-\frac{2.4}{56.5}\right) = Ps$ 22.9mm of Hg $= Ps$	½ ½ ½ ½ ½
23	I. $E_{cell} = E^o_{cell} - \frac{2.303\ RT}{2F}$ log $\frac{[Ni^{2+}]}{[Cu^{2+}]}$	1

	II. $E_{cell} = E^{o}_{cell} - \frac{2.303\ RT}{6F} \log \frac{[Al^{3+}]^2}{[Fe^{2+}]^3}$ III. $E_{cell} = E^{o}_{cell} - \frac{2.303\ RT}{2F} \log \frac{[Mg^{2+}]}{[Ag^{+}]^2}$	1 1
24	I. Cl_2 in presence of sunlight forms free radical as an intermediate and hence toluene undergoes free radical substitution of the alky group to form benzyl alcohol whereas Cl_2 in dark forms Cl^+, an electrophile as an intermediate, making toluene undergo electrophilic substitution and form o-chlorobenzene and p-chlororbenzene. II. NaI is soluble in dry acetone but NaCl is insoluble. NaCl precipitates out of the reaction mixture and shifts the equilibrium towards the right accoding to Le Chatelier's principle. III. The branching of the chain in neo pentylchloride is more than iso pentylchloride, which makes the molecule more compact and decreases its surface area. This decrease the magnitude of the Van der Waal's forces of attraction existing between the two molecules of neopentyl chloride. and consequently the boiling point decreases and is less than isopentyl chloride	1 1 1
25	I. Chromium and Molybdenum Cr – $[Ar]3d^5 4s^1$ Mo- $[Kr]4d^5 5s^1$ have similar electronic configuration and same number of unpaired electrons (6). Therefore, both show similar magnetic behaviour. II. Zinc and Scandium Zinc shows +2 oxidation state in its salts and Zn^{2+} – $[Ar]3d^{10}$ has no unpaired electrons as it has completely filled d subshell, so it forms white salts and Sc shows +3 oxidation state in its salts and Sc^{3+} [Ar] and no unpaired electron, so it forms white salts. Nickel and Vanadium salts are coloured as their ions have unpaired electrons.	½ 1 ½ 1
26	A. $CH_3CH_2OH \xrightarrow{\text{Acidified } K_2Cr_2O_7} CH_3COOH$ B. $CH_3CH_2COOH \xrightarrow{Br_2/\text{ Red P}} CH_3CHBrCOOH$ C. $(CH_3)_2CHMgCl \xrightarrow{(i)CO_2\ (ii)H^+,H_2O} (CH_3)_2CHCOOH$ D. $CH_3CH_2COOH \xrightarrow{Cl_2/\text{ Red P}} CH_3CHClCOOH$ Order of acidity : $CH_3CHClCOOH > CH_3CHBrCOOH > CH_3COOH > (CH_3)_2CHCOOH$	½ ½ ½ ½

	Order of pKa values: $CH_3CHClCOOH < CH_3CHBrCOOH < CH_3COOH < (CH_3)_2CHCOOH$	1
27	**Attempt any 3** I. $CH_3CH_2COCH_3 + CH_3CH_2MgCl \xrightarrow{\text{dry ether}} (CH_3CH_2)_2C(OMgCl)CH_3 \xrightarrow{H_2O} (CH_3CH_2)_2C(OH)CH_3$ II.  2-Methoxy-toluene (Minor) 4-Methoxy-toluene (Major) III.  phenol benzene IV. $CH_3CH_2Cl + CH_3CH_2ONa \longrightarrow CH_3CH_2OCH_2CH_3 + NaCl$	1 1 1
28	I. No. Enthapy of atomisation of Zinc is 130kJ/mol because it has no unpaired electrons in d subshell so the interatomic interaction is weaker than Cu. II. Sulphuric acid because hydrochloric acid is oxidised to chlorine. III. $5NO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$	1 1 1
29	I. No. Both are strong electrolytes so both the LEDs will glow. Red will be very bright and green will be medium in both cases. II. (a) (i) and (ii) **OR** **Scale** | **Red LED** | **Green LED** | **Conductivity** 0 | off | off | low or none	1 1

	III. A is strong electrolyte while B is a weak electrolyte. (marks allotted for correct curve)  **For Visually challenged** I. No. Both are strong electrolytes so both will have value of 3 or 4 on the scale II. (a) (i) and (ii) **OR** The value will be 0. III. A is a strong electrolyte and B is a weak electrolyte	1 + 1 1 1 1+1
30	I. EDTA is a chelating agent, it forms ringed complex with the central metal ion and makes the complex stable. **OR** Hardness of water is estimated by simple titration with Na_2EDTA. The Ca^{2+} and Mg^{2+} ions form stable complexes with EDTA. II. Yes, 40% of the population in Africa suffers from anaemia. Most of the patients in Somalia are likely to be anaemic. Iron fortified food will have increased the nutritional value. In the same amount of food product the patient will get higher amount of the micronutrient than present in natural product. This will help reduce cases of iron deficiency in Somalia. However, patients will be advised to consume the food product according to the recommended safe limits of the fortificant. **OR** No, though 40% of the population suffers from anaemia, iron fortified food will be recommended to patients whose reports	1 1

	suggest iron deficiency. Iron fortified food will have increased the nutritional value. In the same amount of food product the patient will get higher amount of the micronutrient than present in natural product. This fortificant can cause other ill effects to the non- anaemic population as well as could lead to higher levels of iron in the body than required. **III.** (a)6 2 Nitrogen and 4 oxygen are electron donors (b)  **For Visually challenged** I. Same as above II. Same as above III. (a) 6 2 Nitrogen and 4 oxygen are electron donors. (b) EDTA is an electron donor.	½ ½ 1
31	**Option A** I. The structures of expected products of Cannizarro reaction of 2-chloro -benzaldehyde  II. $-SO_3H$ is electron withdrawing in nature, hence it decreases the availability of lone pair for donation, hence basic nature of aniline decrease due to the presence of sulphonic group. III. Following are the steps to convert acetic acid to ethanamine.  IV. Benzoic acid from Benzoyl chloride: 	1 1 1 1

	V. The chemical test to distinguish between propanal and propanone is Tollen test (Silver Mirror) Propanal on heating in a water bath with ammonical silver nitrate (Tollen's reagent) forms a silver mirror on the sides of the test tube. Propanone on heating in a water bath with Tollen's reagent does not show any reaction. **OR** **Option B** I. Product formed on Wolf-Kishner reduction of 2 –methylbutanal is  II. The strength of benzoic acid depends on its ability to donate the proton and stability of the conjugate base formed .Sulphonic acid is an electron withdrawing group , it presence increases the ability to release proton . Hence the acidic strength will be increased . III. To convert acetic acid from ethanamine following are the steps involved : $CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH \xrightarrow{\text{acidified } KMnO_4} CH_3COOH$ IV. Aniline to benzoic acid: $C_6H_5NH_2 \xrightarrow{NaNO_2/\ HCl} C_6H_5N_2^+Cl^- \xrightarrow{KCN} C_6H_5CN \xrightarrow{\text{complete hydrolysis}} C_6H_5COOH$ V. a chemical test to distinguish between: propanal and ethanal Ethanal gives yellow precipitate on heating with iodine in the presence of sodium hydroxide (positive Iodoform test) Propanal will not give any reaction on heating with iodine in the presence of sodium hydroxide (negative Iodoform test)	1 1 1 1 1 1 1
32	**Option A** I. Protein present in the hair are fibrous while in egg are globular.	1

	Fibrous proteins are long fibre like and usually insoluble in water whereas globular proteins are globular and usually soluble in water.	
	II. Glucose reduces Fehling's Reagent however sucrose cannot though both have aldehydic group because glucose contains free aldehydic group whereas sucrose is a disaccharide and does not have free aldehydic group.	1
	III. Alpha -Amino acids behave as salts. This behaviour is due to the presence of both acidic (carboxyl group) and basic (amino group) groups in the same molecule.	1
	IV. The chemical change takes place during curdling of milk caused due to the formation of lactic acid from the lactose sugar by the bacteria present in milk.	1
	V. The possible disease is Osteoporosis, which can be cured by taking Vitamin D rich diet.	1
	OR	
	Option B	
	I. Carbohydrate present in cane sugar is sucrose which is a disaccharide composed of glucose and fructose while the carbohydrate present in milk is lactose which is a disaccharide composed of glucose and galactose	1
	II. Glucose is an aldohexose and a monosaccharide. Bromine water is a mild oxidising agent which can be used to bring about oxidation of only the aldehydic group present in glucose.	1
	III. Amino acid P is with structural formula given as – $HOOC\text{-}CH_2CH(NH_2)CH_2COOH$ The presence of two carboxylic acids shows that it is an acidic amino acid The pH will be less than 7	1
	IV. The two major molecular shapes formed due to the folding of secondary structure of proteins are alpha helix and beta pleated sheets	1
	V. Ashish is suffering from scurvy, which occurs due to deficiency of Vitamin C The sources of food are – Citrus fruits, amla and green leafy vegetables	1
33	**Option A**	
	I. Here, $T_1 = 298\,K, T_2 = 318\,K$	
	$\frac{K_2}{K_1} = 3$	
	$\log \frac{K_2}{K_1} = \frac{E_\alpha}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$	½
	$\log 3 = \frac{E_\alpha}{2.303 \times 8.314}\left[\frac{1}{298} - \frac{1}{318}\right]$	½

$$0.4771 = \frac{E_\alpha}{2.303 \times 8.314}\left[\frac{10}{298 \times 318}\right]$$ ½

$$E_\alpha = \frac{0.4771 \times 2.303 \times 8.314 \times 298 \times 318}{10}$$ ½

$$= 86567.87 \text{ J mol}^{-1}$$ 1

E_a =86.567 KJ mol^{-1} (½ mark for anwer anmd ½ for correct unit)

II. It is zero order reaction. ½

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

Here, k is rate constant, [R] – concentration of reactant at time t, [Ro] initial concentration of reactant. ½

OR

Option B

I. $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

$t = 0$	P_i	0	0
on completion	0	P_i	P_i
$t = 10$ sec	$P_i - x$	x	x

½

On completion

$P_T = P_i + P_i$

$P_T = 2P_i$

$P_i = \frac{300}{2}$

$= 150$ torr

After 10 seconds

$P_T = P_i - x + x + x$

$x = P_T - P_i$

$x = 200 - 150$

$x = 50$ torr ½

First order integrated rate equation

$$k = \frac{2.303}{t} \log \frac{P_i}{P_i - x}$$ ½

$$k = \frac{2.303}{10} \log \frac{150}{150 - 50}$$

	$k = \frac{2.303}{10} \log \frac{150}{100}$ $k = \frac{2.303}{10} \log \frac{3}{2}$ $k = \frac{2.303}{10} (\log 3 - \log 2)$ $k = \frac{2.303}{10} \times (0.4771 - 0.3010)$ $k = \frac{2.303}{10} \times 0.1761$ $k = 0.040\ s^{-1}$	1 ½
	II. Rate of reaction can be expressed as Rate = $Z_{AB}e^{-Ea/RT}$	1
	where Z_{AB} represents the collision frequency of reactants, A and B and $e^{-Ea/RT}$ represents the fraction of molecules with energies equal to or greater than Ea.	1

SAMPLE PAPER (2024 -25)

CHEMISTRY THEORY (043)

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

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

(a) There are **33** questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 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 calculators is 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 Ammonolysis of ethyl chloride followed by reaction of the amine so formed with 1 mole of methyl chloride gives an amine that 1

a. reacts with Hinsberg reagent to form a product soluble in an alkali.
b. on reaction with Nitrous acid, produced nitrogen gas.
c. reacts with Benzenesulphonyl chloride to form a product that is insoluble in alkali.
d. does not react with Hinsberg reagent.

2 Which one of the following has the highest dipole moment? 1

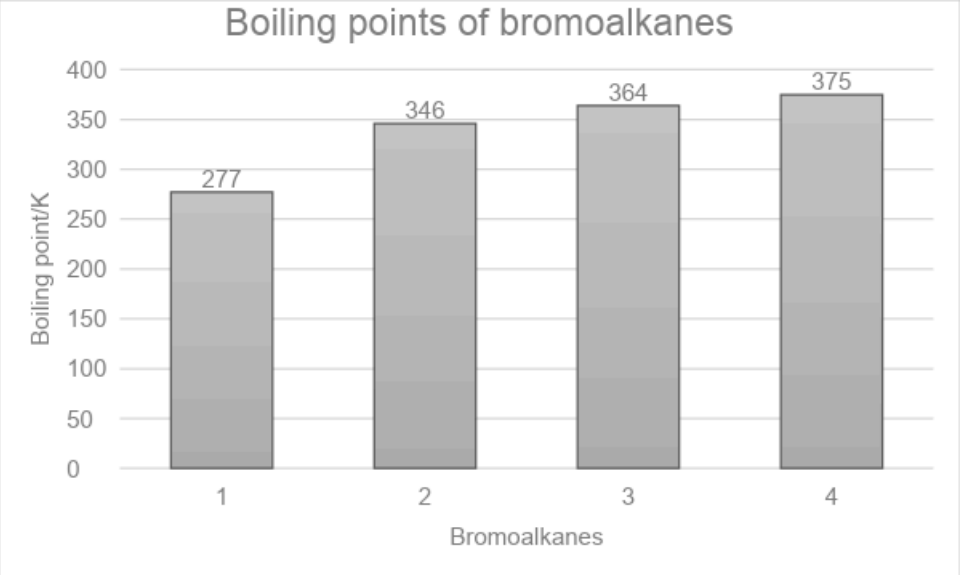
a. CH_3F
b. CH_3Cl
c. CH_3I
d. CH_3Br

3 Match the properties given in column I with the metals in column II 1

Column I	Column II
(i) Actinoid having configuration [Rn] $5f^7 6d^1 7s^2$	(A) Ce
(ii) Lanthanoid which has $4f^{14}$ electronic configuration in +3 oxidation state.	(B) Lu
(iii) Lanthanoid which show +4 Oxidation state	(C) Cm

a. (i)-(C), (ii)-(B), (iii)-(A)
b. (i)-(C), (ii)-(A), (iii)-(B)
c. (i)-(A), (ii)-(B), (iii)-(C)
d. (i)-(B), (ii)-(A), (iii)-(C)

4 Study the graph showing the boiling points of bromoalkanes and identify the compounds. 1



a. 1 = Bromomethane, 2= 2-Bromobutane, 3= 1-Bromobutane, 4= 2-Bromo-2-methylpropane

b. 1 =1-Bromobutane, 2= 2-Bromo-2-methylpropane, 3= 2-Bromobutane, 4= Bromomethane

c. 1 = Bromomethane, 2=1-Bromobutane, 3= 2-Bromo-2-methylpropane, 4= 2-Bromobutane,

d. 1 =Bromomethane, 2= 2-Bromo-2-methylpropane, 3=2- Bromobutane, 4= 1-Bromobutane

(for visually challenged learners)
Which of the following haloalkanes has the highest boiling point?
a. 2-Bromo-2-methylpropane
b. 2-Bromobutane
c. Bromomethane
d. 1-Bromobutane

5 The initial concentration of R in the reaction R□P is 4.62 x 10^{-2} mol/L. What is the half life for the reaction if k = 2.31x 10^{-2} $molL^{-1}s^{-1}$ 1

a. 30 s
b. 3 s
c. 1 s
d. 10 s

6 When $C_6H_5COOCOCH_3$ is treated with H_2O , the product obtained is : 1

a. Benzoic acid and ethanol
b. Benzoic acid and ethanoic acid
c. Acetic Acid and phenol
d. Benzoic anhydride and methanol

7 1

Formulation of Cobalt(III) Chloride-Ammonia Complexes

Colour	Formula	Solution conductivity corresponds to
Yellow	$[Co(NH_3)_6]^{3+}3Cl^-$	Y
Purple	$[CoCl(NH_3)_5]^{2+}2Cl^-$	1:2 electrolyte
Green	X	1:1 electrolyte

'X' and 'Y' in the above table are:

a. X=$[Co(NH_3)_6]^{2+}3Cl^-$, Y= 1:3
b. X= $[Co(NH_3)_4Cl_2]^+Cl^-$, Y= 1:3
c. X=$[Co(NH_3)_4Cl_2]^+Cl^-$, Y= 1:1
d. X=$[Co(NH_3)_4Cl_2]^{3+}3Cl^-$, Y= 1:1

8 Which of the following contains only β-D- glucose as its monosaccharide unit: 1

a. Sucrose
b. Cellulose
c. Starch
d. Maltose

9 Which one of the following sets correctly represents the increase in the paramagnetic property of the ions? 1

a. $Ti^{3+} < Fe^{2+} < Cr^{3+} < Mn^{2+}$
b. $Ti^{3+} < Mn^{2+} < Fe^{2+} < Cr^{3+}$
c. $Mn^{2+} < Fe^{2+} < Cr^{3+} < Ti^{3+}$
d. $Ti^{3+} < Cr^{3+} < Fe^{2+} < Mn^{2+}$

10 A first-order reaction is found to have a rate constant, $k = 5.5 \times 10^{-1}4\ s^{-1}$. The time taken for completion of the reaction is: 1

a. 1.26×10^{13} s
b. 2.52×10^{13} s
c. 0.63×10^{13} s
d. It never goes to completion

11 A student was preparing aniline in the lab. She took a compound "X" and reduced it in the presence of Ni as a catalyst. What could be the compound "X" 1

a. Nitrobenzene
b. 1-Nitrohexane
c. Benzonitrile
d. 1-Hexanenitrile

12 Which of the following compound gives an oxime with hydroxylamine: 1

a. CH_3COCH_3
b. CH_3COOH
c. $(CH_3CO)_2O$
d. CH_3COCl

13 **Assertion (A):** $[Mn(CN)_6]^{3-}$ has a magnetic moment of two unpaired electrons while $[MnCl_6]^{3-}$ has a paramagnetic moment of four unpaired electrons. 1
Reason (R): $[Mn(CN)_6]^{3-}$ is inner orbital complexes involving d^2sp^3 hybridisation,on the other hand, $[MnCl_6]^{3-}$ is outer orbital complexes involving sp^3d^2 hybridisation.

Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

14 **Assertion (A)**: For strong electrolytes, there is a slow increase in molar conductivity with dilution and can be represented by the equation 1

$$\Lambda_m^\circ = \Lambda_m - A\ c^{½}$$

Reason (R): The value of the constant '*A*' for NaCl, $CaCl_2$, and $MgSO_4$ in a given solvent and at a given temperature is different.

Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

15 **Assertion (A)** Glucose does not form the hydrogensulphite addition product with $NaHSO_3$. 1
Reason (R): Glucose exists in a six-membered cyclic structure called pyranose structure.

Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

16 **Assertion (A):** The half- life for a zero order reaction is independent of the initial concentration of the reactant. 1
Reason (R): For a zero order reaction, Rate = k

Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17 a. Nitrogen gas is soluble in water. At temperature 293 K, the value of K_H is 76.48 kbar . How would the solubility of nitrogen vary (increase, decrease or remain the same) at a temperature above 293 K , if the value of K_H rises to 88.8 kbar. 1

b. Chloroform (b.p. 61.2°C) and acetone (b.p. 56°C) are mixed to form an azeotrope. The mole fraction of acetone in this mixture is 0.339. Predict whether the boiling point of the azeotrope formed will be (i) 60°C (ii)64.5 °C or (iii)54 °C. Defend your answer with reason. 1

OR

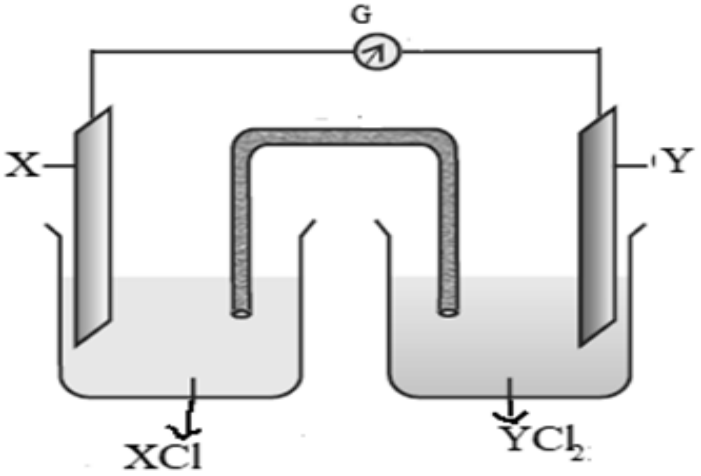
a. A soda bottle will go flat (loose its fizz) faster in Srinagar than in Delhi. Is this statement correct? Why or why not? 1

b. How does sugar help in increasing the shelf life of the product? 1

18 a. Write the IUPAC name of the following complex: $K[Cr(H_2O)_2(C_2O_4)_2]H_2O$ 1

b. Name the metal present in the complex compound of
(i) Haemoglobin (ii) Vitamin B-12 ½+½

19 Observe the following cell and answer the questions that follow:



a. Represent the cell shown in the figure. 1
b. Name the carriers of the current in the salt bridge ½
c. Write the reaction taking place at the anode. ½

(for visually challenged learners)
For the cell represented as:

$Mg(s)/Mg^{2+}(aq)//Ag^{+}(aq)/Ag(s)$
a. Identify the cathode and the anode 1
b. Write the overall reaction 1

20 Complete the following reactions by writing the major and minor product in each case (any 2)

a. $CH_3CH_2Br + KCN \rightarrow$ 1

b. $CH_3CH_2CH = CH_2 + HBr$ □ 1

c. $(CH_3)_2CHCHClCH_3$ + alc KOH → 1

21 The presence of Carbonyl group in glucose is confirmed by its reaction with hydroxylamine. Identify the type of carbonyl group present and its position. Give a chemical reaction in support of your answer. 1 1

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22 a. Write down the reaction occurring on two inert electrodes when electrolysis of copper chloride is done. What will happen if a concentrated solution of copper sulphate is replaced with copper chloride? 2

b. Write an expression for the molar conductivity of aluminium sulphate at infinite dilution according to Kohlrausch law. 1

23 Account for the following:

a. The lowest oxide of transition metal is basic, and the highest is acidic. 1
b. Chromium is a hard metal while mercury is a liquid metal 1
c. The ionisation energy of elements of the 3d series does not vary much with increasing atomic number. 1

24 a. Give the chemical reaction involved when p-nitrotoluene undergoes Etard reaction. 1
b. Why does Benzoic acid exist as a dimer in an aprotic solvent? 1
c. Benzene on reaction with methylchloride in the presence of anhydrous $AlCl_3$ forms toluene. What is the expected outcome if benzene is replaced by benzoic acid? Give a reason for your answer. 1

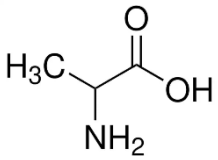
OR

An organic compound 'X', does not undergo aldol condensation. However 'X' with compound 'Y' in the presence of a strong base react to give the compound 1,3-diphenylprop-2-en-1-one.

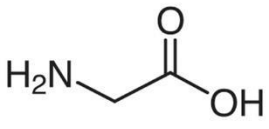
a. Identify 'X' and 'Y' 1
b. Write the chemical reaction involved. 1
c.Give one chemical test to distinguish between X and Y. 1

25 a. Give the structure of all the possible dipeptides formed when the following two amino acids form a peptide bond. 2

Alanine



Glycine



b. Keratin, insulin, and myosin are a few examples of proteins present in the human body. Identify which type of protein is keratin and insulin and differentiate between them based on their physical properties. 1

26 Neeta was experimenting in the lab to study the chemical reactivity of alcohols. She carried out a dehydration reaction of propanol at 140°C to 180°C. Different products were obtained at these two temperatures.

a. Identify the major product formed at 140°C and the mechanism followed in this case. 1+½ 1+½

b. Identify the major product formed at 180°C

27 Various isomeric haloalkanes with the general formula C_4H_9Cl undergo hydrolysis reaction. Among them, compound "A" is the most reactive through S_N1 mechanism. Identify "A" citing the reason for your choice. Write the mechanism for the reaction. 3

28 The equilibrium constant of cell reaction :

$Sn^{4+}(.aq) + Al(s) \rightarrow Al^{3+} + Sn^{2+}(aq)$ is 4.617×10^{184}, at 25 °C

a. Calculate the standard emf of the cell. 2
(Given: log 4.617×10^{184} = 184.6644)

b. What will be the E^o of the half cell Al^{3+}/Al , if E^o of half cell Sn^{4+}/Sn^{2+} is 0.15 V. 1

SECTION D

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

29 Dependence of the rate of reaction on the concentration of reactants, temperature, and other factors is the most general method for weeding out unsuitable reaction mechanisms. The term mechanism means all the individual collisional or elementary processes involving molecules (atoms, radicals, and ions included) that take place simultaneously or consecutively to produce the observed overall reaction. For example, when hydrogen gas reacts with bromine, the rate of the reaction was found to be proportional to the concentration of H_2 and to the square root of the concentration of Br_2. Furthermore, the rate was inhibited by increasing the concentration of HBr as the reaction proceeded. These observations are not consistent with a mechanism involving bimolecular collisions of a single molecule of each kind. The currently accepted mechanism is considerably more complicated, involving the dissociation of bromine molecules into atoms followed by reactions between atoms and molecules:

It is clear from this example that the mechanism cannot be predicted from the

overall stoichiometry.

(source: Moore, J. W., & Pearson, R. G. (1981). *Kinetics and mechanism*. John Wiley & Sons.)

a. Predict the expression for the rate of reaction and order for the following:

$H_2 + Br_2 \square 2\ HBr$ 1

What are the units of rate constant for the above reaction? 1

b. How will the rate of reaction be affected if the concentration of Br_2 is tripled? 1

OR

What change in the concentration of H_2 will triple the rate of reaction?

c. Suppose a reaction between A and B, was experimentally found to be first order with respect to both A and B. So the rate equation is: 1

Rate = k[A][B]

Which of these two mechanisms is consistent with this experimental finding? Why?

Mechanism 1

A → C + D (slow)

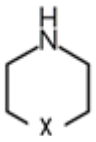
B + C → E (fast)

Mechanism 2

A + B → C + D (slow)

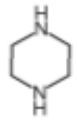
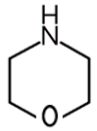
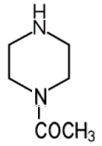
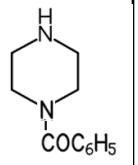
C → E (fast)

30 Amines are basic in nature. The pK_b value is a measure of the basic strength of an amine. Lower the value of pK_b, more basic is the amine. The effect of substituent on the basic strength of amines in aqueous solution was determined using titrations. The substituent "X" replaced "-CH_2" group in piperidine (compound 1) and propylamine $CH_3CH_2CH_2NH_2$, (compound 2).

Compound 1: 

Compound 2: $HXCH_2CH_2NH_2$

The experimental data is tabulated below:

Substituent "X"	**Electro-negativity of X**	**substituted piperidine compound**	**pK_a**	**Substituted propylamine compound**	**pK_a**
CH_2	2.55		11.13	$CH_3CH_2CH_2NH_2$	10.67
NH	3.12		9.81	$NH_2CH_2CH_2NH_2$	10.08
O	3.44		8.36	$HOCH_2CH_2NH_2$	9.45
CH_3CON	3.6		7.94	$CH_3CONHCH_2CH_2NH_2$	9.28
C_6H_5CON	3.7		7.78	$C_6H_5CONHCH_2CH_2NH_2$	___

(source: Hall Jr, H. K. (1956). Field and inductive effects on the base strengths of amines. *Journal of the American Chemical Society*, *78*(11), 2570-2572.)

Study the above data and answer the following questions:

a. Plot a graph between the electronegativity of the substituent vs pK_b value of the corresponding substituted propyl amine (given that $pK_a + pK_b = 14$). Is there any relation between the electronegativity of the substituent and its basic strength? 2

b. The electronegativity of the substituent "C_6H_5CON" is 3.7, what is the expected pKa value of compound $C_6H_5CONHCH_2CH_2NH_2$? 1

10

(i) 9.9 (ii) 9.5 (iii) 9.3 (iv) 9.1

c. The pKa value of the substituted piperidine formed with substituent "X" is found to be 8.28. What is the expected electronegativity of "X" 1

(i)3.5 (ii)3.4 (iii)3.8 (iv) 3.1

OR

What is the most suitable pKa value of the substituted propylamine formed with substituent "X" with electronegativity 3.0

(i)10.67 (ii)10.08 (iii)10.15 (iv)11.10

(for visually challenged learners)

a.How does the electronegativity of the substituent affect the pK_b value and the basic strength of the substituted propyl amine (given that $pK_a + pK_b = 14$).? Give a reason to support your answer. 2

b. The electronegativity of the substituent "C_6H_5CON" is 3.7, what is the expected pKa value of compound $C_6H_5CONHCH_2CH_2NH_2$? 1

(i) 9.9 (ii) 9.5 (iii) 9.3 (iv) 9.1

c. The pKa value of the substituted piperidine (compound 1) formed with substituent "X" is found to be 8.28. What is the expected electronegativity of "X" 1

(i)3.5 (ii)3.4 (iii)3.8 (iv) 3.1

OR

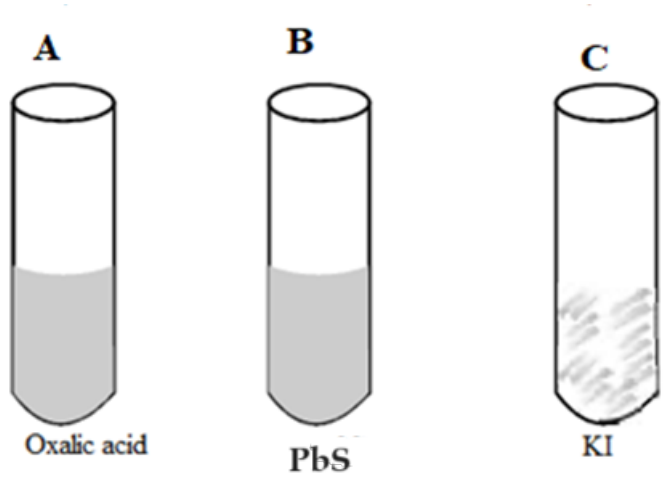
What is the most suitable pKa value of the substituted propylamine formed with substituent "X" with electronegativity 3.0

(i)10.67 (ii)10.08 (iii)10.15 (iv)11.10

SECTION E

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

31 a. A purple colour compound A, which is a strong oxidising agent and used for bleaching of wool, cotton, silk and other textile fibres was added to each of the three test tubes along with H_2SO_4. It was followed by strong heating.



In which of the above test tubes; A,B or C:

(i) Violet vapours will be formed 1

(ii) The bubbles of gas evolved will extinguish a burning matchstick. Write an equation for each of the above observations. 1

b. A metal ion M^{n+} of the first transition series having d^5 configuration combines with three didentate ligands. Assuming $\Delta_0 < P$:

(i) Draw the crystal field energy level diagram for the 3d orbital of this complex. 1

(ii) What is the hybridisation of M^{n+} in this complex and why? 1

(iii) Name the type of isomerism exhibited by this complex. 1

OR

a. Using, Valence Bond Theory identify A, B, C, D, E and F in the following table

S.No	Complex	central metal ion	configuration of metal ion	Hybridization of Metal ion	Geometry of the Complex	Number Of Unpaired Electron	Magnetic Behaviour
i	$[CoF_4]^{2-}$	**A**	$3d^7$	sp^3	tetrahedral	**B**	Paramagnetic
ii	$[Cr(H_2O)_2C_2O_4)_2]$	Cr^{3+}	$3d^3$	**C**	octahedral	3	**D**
iii	$[Ni(CO)_4]$	Ni	$3d^84s^2$	**E**	**F**	0	Diamagnetic

3

b. Write the ionic equations for the reaction of acidified $K_2Cr_2O_7$ with (i)H_2S and (ii)$FeSO_4$ 2

32 a. Give reasons for the following:

(i)The reaction of ethanol with acetyl chloride is carried out in the presence of pyridine . 1

(ii) Cresols are less acidic than phenol. 1

b. Williamson's process is used for the preparation of ethers from alkyl halide. Identify the alkyl bromide and sodium alkoxide used for the preparation of 2- Ethoxy-3-methylpentane 1

c. Convert:

(i) Toluene to 3-nitrobenzoic acid. 1

(ii) Benzene to m-nitroacetophenone. 1

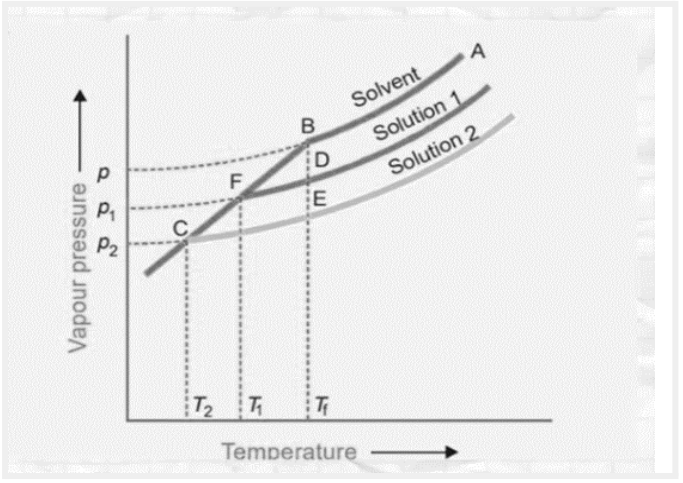
OR

a. Out of formic acid and acetic acid, which one will give the HVZ reaction? Give a suitable reason in support of your answer and write the chemical reaction involved. 2

b. Alcohols are acidic but they are weaker acids than water. Arrange various isomers of butanol in the increasing order of their acidic nature. Give a reason for the same. 1

c. An organic compound A which is a Grignard reagent is used to obtain 2-methylbutan-2-ol on reaction with a carbonyl compound 'B' . Identify A' and 'B'. Write the equation for the reaction between A and B. 2

33 a. An experiment was carried out in the laboratory, to study depression in freezing point. 1M aqueous solution of $Al(NO_3)_3$ and 1 M aqueous solution of glucose were taken. From the given figure identify solution 1 and solution 2. Give a plausible reason for your answer. 2



b. The osmotic pressure of a solution of cane sugar was found to be 2.46 atm at 300 K. If the solution was diluted five times, calculate the osmotic pressure at the same temperature. 3

How can the osmotic pressure of the given cane sugar solution be decreased without changing its volume? Give a reason for your answer.

OR

a. While giving intravenous injections to the patients, the doctors take utmost care of the concentration of the solution used. Why is it necessary to check the concentration of the solution? 2

b. A solution of phenol was obtained by dissolving 2X 10^{-2} kg of phenol in 1 kg of benzene. Experimentally it was found to be 73 % associated. Calculate the depression in the freezing point recorded. 3

(for visually challenged learners)

a. Which of the two solutions : 1M aqueous solution of $Al(NO_3)_3$ or 1M aqueous solution of glucose will show a greater depression in freezing point? Give a plausible reason for your answer. 2

b. The osmotic pressure of a solution of cane sugar was found to be 2.46 atm at 300 K. If the solution was diluted five times, calculate the osmotic pressure at the same temperature. 3

How can the osmotic pressure of the given cane sugar solution be decreased without changing its volume? Give a reason for your answer.

OR

a. While giving intravenous injections to the patients, the doctors take utmost care of the concentration of the solution used. Why is it necessary to check the concentration of the solution? 2

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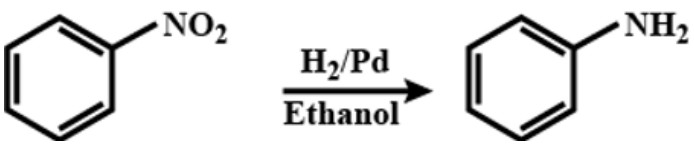
MARKING SCHEME

SAMPLE PAPER (2024 -25)

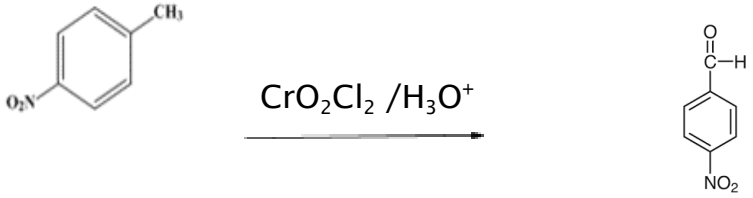
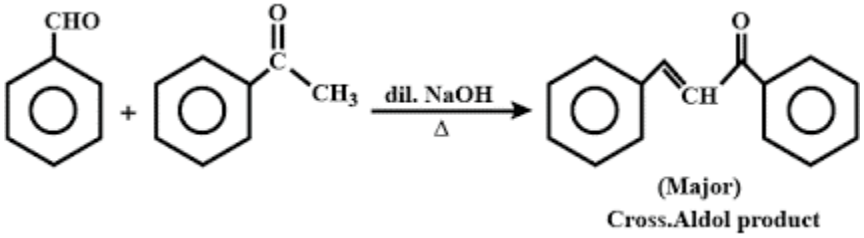
CHEMISTRY THEORY

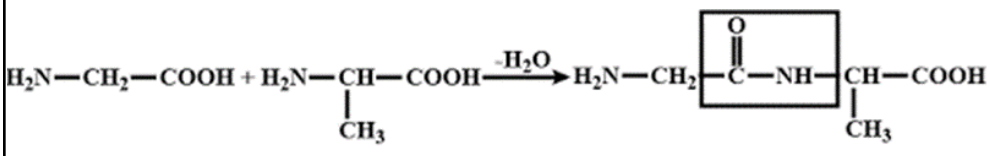
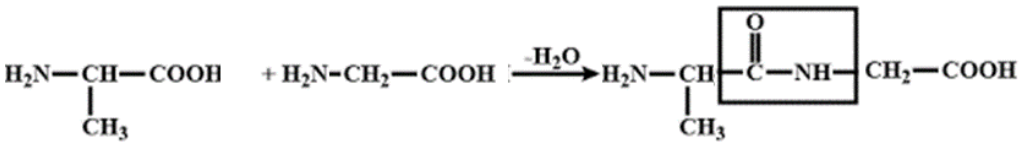
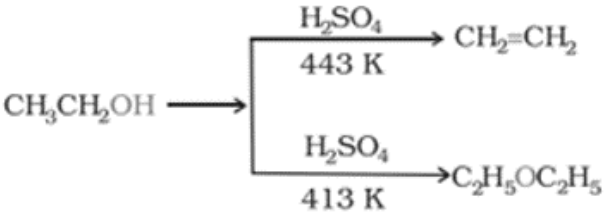
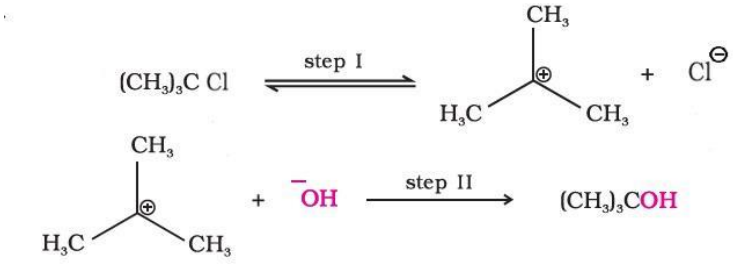
(043)

SECTION A		
1	(c) reacts with Benzenesulphonyl chloride to form a product that is insoluble in alkali	1
2	(b)CH_3Cl The order followed is this $CH_3I<CH_3Br<CH_3F< CH_3Cl$, though F is most electronegative, the bond length is small as compared to C-Cl. Dipole moment is the product of the charge and the bond length.	1
3	(a) (i)-(C), (ii)-(B), (iii)-(A)	1
4	(d) 1 =Bromomethane, 2= 2-Bromo-2-methylpropane, 3=2-Bromobutane, 4= 1-Bromobutane ***(for visually challenged learners)*** d. 1-Bromobutane	1 1
5	(c) the order of reaction is zero as the unit of k is $molL^{-1}s^{-1}$. Thus half life = $[R]_o$ / 2k = 4.62 x 10^{-2} /2 x 2.31 x 10^{-2}	1
6	(b) Benzoic acid and ethanoic acid $C_6H_5COOCOCH_3 \xrightarrow{H_2O} C_6H_5COOH + CH_3COOH$	1
7	(b) X=$[Co(NH_3)_4Cl_2]^+Cl^-$, Y= 1:3	1
8	(b) Cellulose Starch contains only α glucose, sucrose contains α-D-glucose and β-D-fructose glucose, maltose contains α-D-glucose and cellulose is a polymer of β-D-glucose.	1
9	(d) $Ti^{3+}< Cr^{3+}< Fe^{2+} < Mn^{2+}$ No. of unpaired electrons : Ti^{3+} (1), Cr^{3+} (3), Fe^{2+} (4) and Mn^{2+} (5) Paramagnetism depends on the number of unpaired electrons	1
10	(d) It never goes to completion First order reaction [R] = [Ro] e^{-kt} If [R]=0 then	1

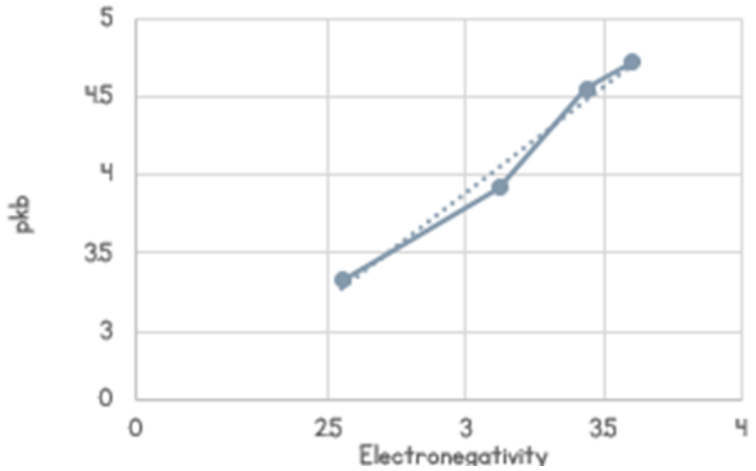
	e^{-kt} = 0, which is not possible for any finite value of t. Here, t is ∞.	
11	(a) Nitrobenzene 	1
12	(a)CH_3COCH_3 Aldehyde and ketones give nucleophilic addition reactions. Other carbonyl compounds do not give nucleophilic addition reactions.	1
13	(a) Both A and R are true and R is the correct explanation of A	1
14	(d) A is false but R is true. $\Lambda_m^\circ = \Lambda_m - A\ c^{½}$ is an incorrect equation, the correct equation is $\Lambda_m = \Lambda_m^\circ - A\ c^{½}$	1
15	(b) Both A and R are true but R is not the correct explanation of A. Due to the absence of a free aldehydic group, it does not give a reaction with $NaHSO_3$.	1
16	(d)A is false but R is true. The half- life for a zero order reaction $t_{1/2}$ = [Ro]/2k where [Ro] is the initial concentration of the reactant.	1
	SECTION B	
17	(a) Solubility of gas is inversely proportional to the value of Henry's constant K_H. On increasing temperature nitrogen gas becomes less soluble because its K_H value increases. (b) (ii)64.5 °C Chloroform and acetone mixture show negative deviation from Raoult's law therefore, they form maximum boiling azeotrope at a specific composition. The boiling point of the mixture so obtained will be higher than the individual components. **OR** (a) At higher altitudes i.e. in Srinagar the atmospheric pressure is	½ ½ ½ ½ 1

	lower. The solubility of a gas in a liquid is directly proportional to the partial pressure of the gas over the solution, therefore, the carbon dioxide dissolved in water will be lesser at Srinagar making the soda go flat faster. (b)Preservation of fruits by adding sugar/salt protects against bacterial action. Through osmosis, a bacterium on canned fruit loses water, shrivels and dies.	 1
18	(a) Potassium diaquadioxalatochromate(III) hydrate (b) (i) Haemoglobin: Iron (ii) Vitamin B-12: Cobalt	1 1
19	(a) $Y(s)\|Y^{2+(}aq) \| \| X^{+}(aq)\| X(s)$ (b) ions are carrier of current in salt bridge (c) $Y(s) \rightarrow Y^{2+(}aq) + 2e^{-}$ ***(for visually challenged learners)*** a. Cathode: silver , Anode: Magnesium b. $Mg + 2Ag^{+} \square Mg^{2+} + 2Ag$	1 ½ ½
20	(a)CH_3CH_2CN (major), CH_3CH_2NC (minor) (b) $CH_3CH_2CHBrCH_3$ (major) $CH_3CH_2CH_2CH_2Br$ (minor) (c) $(CH_3)_2C{=}CHCH_3$ (major) $(CH_3)_2CHCHCH_2$ (minor)	½+½ ½+½ ½+½
21	The carbonyl group present in glucose is aldehyde and the C_1 atom . Glucose gets oxidised to six-carbon carboxylic acid (gluconic acid) with COOH group at the C1 atom on reaction with a mild oxidising agent like bromine water. This indicates that the carbonyl group is present as an aldehydic group	½ ,½ 1
SECTION C		
22	<u>(a) Product of electrolysis of Copper Chloride</u> Cathode(-) $Cu^{2+} + 2e^{-} \rightarrow Cu(s)$ anode(+) $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ <u>Product of electrolysis of concentrated Copper Sulphate</u> Anode(+) $SO_4^{2-} \rightarrow S_2O_8 + 2e^{-}$ Cathode (-) $Cu^{2+} + 2e^{-} \rightarrow Cu(s)$ (b) $\Lambda^0_m[Al_2(SO_4)_3] = 2\,\lambda^0_m(Al^{3+}) + 3\,\lambda^0_m(SO_4^{2-})$	 1 1 1
23	(a) In the case of a lower oxide of a transition metal, the metal atom has some electrons present in the valence shell of the metal atom that are not involved in bonding. As a result, it can donate electrons and behave as a base whereas in higher oxide of a transition metal,	1

	the metal atom does not have an electron in the valence shell for donation. As a result, it can accept electrons and behave as an acid. (b) Chromium has unpaired electrons which result in strong metallic bonding which results in it being a hard solid and the absence of unpaired electrons in Hg results in it being a liquid. (c) The increase in effective nuclear charge responsible for steady increase in ionisation energy is counterbalanced by shielding effect of (n-1)d electrons	1 1
24	(a)  (b) Benzoic acid undergoes extensive intermolecular hydrogen bonding , leading to the formation of dimer . (c) Benzoic acid does not undergo reaction with CH_3Cl i.e Friedel Craft reaction because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group **OR** Compound 'X' = Benzaldehyde , Compound Y = Acetophenone  **(Major)** **Cross.Aldol product** Chemical test to distinguish between X and Y is the Tollen Test . Benzaldehyde undergoes SIlver mirror test with Tollen reagent and forms silver mirror . However Acetophenone does not react with Tollen Reagent .	1 1 1 ½,½ 1 1

25	(a)  (Glycine) (Alanine)  (Alanine) (Glycine) (b) (i) Keratin is a fibrous protein. fibre- like structure is formed. Such proteins are generally insoluble in water. (ii)Insulin is a globular protein . This structure results when the chains of polypeptides coil around to give a spherical shape. These are usually soluble in water.	1 1 ½ ½
26	(a) Ethanol undergoes a dehydration reaction. At 140°C, diethyl ether is formed. The formation of ether is a nucleophilic substitution bimolecular reaction S_N2 (b) When the temperature exceeds 170°C, ethene is the major product. Elimination, E1 reaction 	1+½ 1+½
27	"A" is $(CH_3)_3CCl$, the carbocation intermediate obtained in tertiary alkyl halide is most stable, making A most reactive of all possible isomers. 	½ +½ 1 1

28	$E_{Cell} = E^{o}_{Cell} - \frac{2.303RT}{nF} \log Kc$ At 298 K $E_{Cell} = E^{o}_{Cell} - \frac{0.0591}{n} \log Kc$	½
	At equilibrium Ecell =0, n= 6	½
	$E^{o}_{Cell} = \frac{0.0591}{n} \log Kc$	½
	=0.059/6 log 4.617×10^{184} = 0.00983 x 184.6644 = 1.8152	½
	(ii) $E^{o}_{cell} = E^{0}_{Sn4+/Sn2+} - E^{0}_{Al3+/Al}$ 1.81 = -0.15- $E^{0}_{Al3+/Al}$ $E^{0}_{Al3+/Al}$ = -1.66 V	½ ½
	SECTION D	
29	a. Rate = k $[H_2]$ $[Br_2]^{1/2}$ order = 3/2	½ ½
	units of k = $\frac{molL^{-1}s^{-1}}{mol^{3/2}L^{-3/2}}$ = $mol^{-1/2}L^{1/2}s^{-1}$	1
	b. Rate = k $[H_2]$ $[Br_2]^{1/2}$ If conc of Br_2 is tripled Rate' = k $[H_2]$ $[3Br_2]^{1/2}$ Rate' = √3 k $[H_2]$ $[Br_2]^{1/2}$ Rate' = √3 Rate	1
	OR	
	Rate = k $[H_2]$ $[Br_2]^{1/2}$ If conc of Br_2 is tripled Rate' = 3 Rate= k $[xH_2]$ $[Br_2]^{1/2}$ 3 Rate = k $[x\ H_2]$ $[Br_2]^{1/2}$ x = 3, the concentration of H_2 is tripled	1

	c. The slowest step is the rate-determining step. From mechanism 2, Rate = k [A] [B] while from mechanism 1 Rate = k [A] Therefore mechanism 2, is consistent with the experimental finding	1
30	a  ……. Is the line of best fit The pKb increases with an increase in the electronegativity of the substituent, therefore the basic strength decreases with an increase in the electronegativity of the substituent b. (iv) 9.1 c. (i) 3.5 **OR** (iii) 10.15 ***(for visually challenged learners)*** The pKb increases with an increase in the electronegativity of the substituent, therefore the basic strength decreases with an increase in the electronegativity of the substituent	1½ ½ 1 1 1 1

Substituent "X"	**Electro-negativity of X**	**Compound**	**pKa**	**pKb**

CH_2	2.55	$CH_3CH_2CH_2NH_2$	10.67	3.33	
NH	3.12	$NH_2CH_2CH_2NH_2$	10.08	3.2	1
O	3.44	$HOCH_2CH_2NH_2$	9.45	4.55	
CH_3CON	3.6	$CH_3CONHCH_2CH_2NH_2$	9.28	4.72	

b. (iv) 9.1 — 1

c. (i) 3.5 — 1

OR

(iii) 10.15 — 1

SECTION E

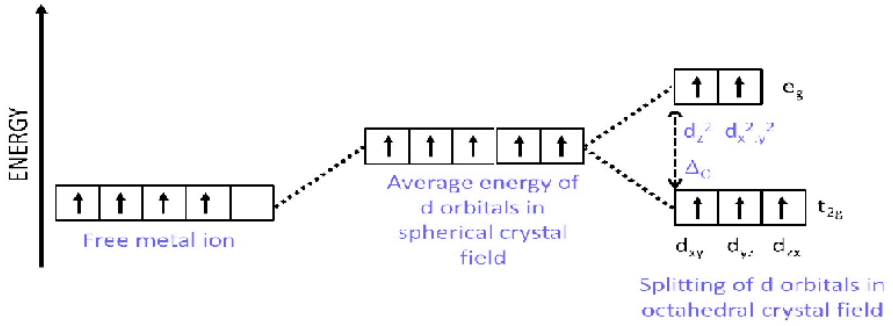
31 (a) (i) Test tube C — 1

$10I^- + MnO_4^- + 16\ H^+ \rightarrow 5I_2 + 2Mn^{2+} + 8\ H_2O$

(ii) Test tube A — 1

$C_2O_4^{2-} + 2MnO_4^- + 16\ H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8\ H_2O$

(b) (i)



2

(ii) Sp^3d^2 , Since Δ_0 > P it will form an outer orbital complex as the electrons in the 3d orbital will not pair up. — ½

(iii) Optical isomerism. — ½

OR

a. A = Co^{2+} — ½

B = 3 — ½

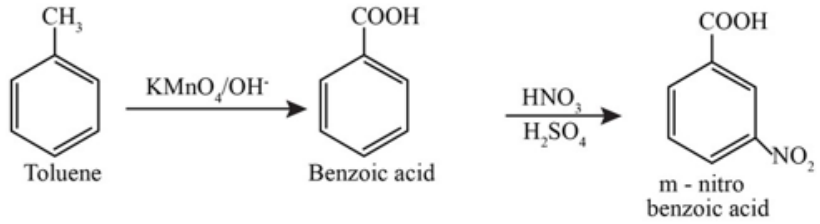
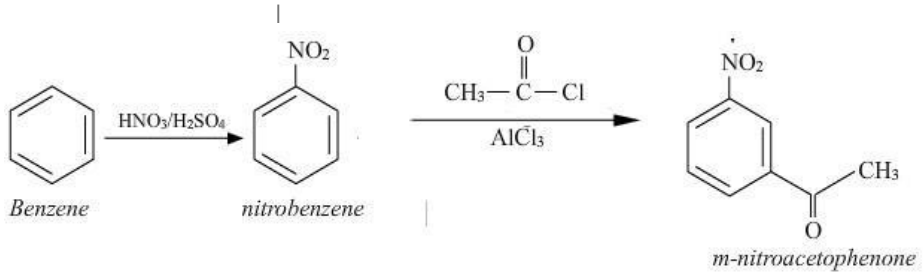
C = d^2sp^3 — ½

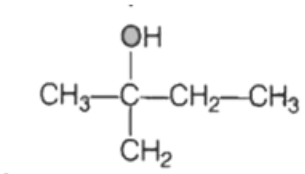
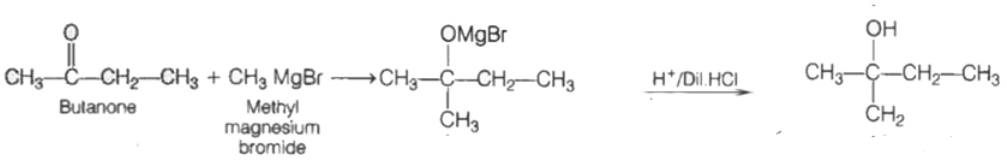
D = Paramagnetic — ½

E= sp^3 — ½

F = tetrahedral — ½

b.

	(i) $Cr_2O_7^{2-} + 8\,H^+ + 3\,H_2S \rightarrow 2\,Cr^{3+} + 3S + 7\,H_2O$ (ii) $Cr_2O_7^{2-} + 14\,H^+ + 6\,Fe^{2+} \rightarrow 2\,Cr^{3+} + 6\,Fe^{3+} + 7\,H_2O$.	1 1
32	a. (i) The reaction of ethanol with acetyl chloride is carried out in the presence of pyridine . Pyridine is a strong organic base .The function of pyridine is to remove HCl formed in the reaction. (ii) The electron releasing groups, such as alkyl groups, in general, do not favour the formation of phenoxide ion resulting in decrease in acid strength. Cresols, for example, are less acidic than phenol. b. C_2H_5Br and $CH_3CH_2CH(CH_3)CH_2CH_2ONa$ yields 2-ethoxy-3-methylpentane c. (i)  (ii)  **OR** a. Acetic acid will give HVZ reaction. Carboxylic acids having an α-hydrogen are halogenated at the α-position on treatment with chlorine or bromine in the presence of a small amount of red phosphorus to give α-halo carboxylic acids. $CH_3COOH \xrightarrow{Br_2/red\ P} CH_2BrCOOH$ b. Isomers of butanol are: Butan-1-ol , butan-2-ol , 2-methylpropanol , 2-methylpropan-2-ol . Acidic strength in isomeric alcohols varies as follows : R R	1 1 1 1 ½ 1 ½

		½
	The acidic character of alcohols is due to the polar nature of O–H bond. An electron-releasing group (–CH_3 , –C_2H_5) increases electron density on oxygen tending to decrease the polarity of O-H bond 2-methylpropan-2-ol< 2-methylpropanol < butan-2-ol <Butan-1-ol	½
	c. An organic compound A is a Grignard reagent : RMgX B is a ketone RCOR'	
	A + B □  (2-methylbutan-2-ol)	
	Ketones lead to the formation of tertiary alcohol ,so the compound B is a ketone B – Butan-2-one and A ' is CH_3 MgBr	½ + ½
	 Butanone Methyl magnesium bromide	1
33	a. Depression in the freezing point is a colligative property. In dilute solutions the depression of freezing point (ΔTf) is directly proportional to the molal concentration of the solute in a solution. From the graph it is interpreted that Solution 2 shows more depression in freezing point	1 ½
	1 M $Al(NO)_3$ has higher i value (i=3) than 1 M glucose (i=1) 1 M $Al(NO)_3$ will have higher depression , hence solution 2 is $Al(NO)_3$ solution and solution 1 is glucose solution.	½
	(for visually challenged learners) a. 1 M $Al(NO)_3$ shows greater depression in freezing point 1 M $Al(NO)_3$ has higher i value (i=3) than 1 M glucose (i=1) and we know that $\Delta T_f = iK_f m$	1 1
	b. $\pi = (n_2/V) RT$ Given π = 2.64 atm	½

	Let V_1= V V_2= 5V (On dilution by 5 times) $\frac{\pi 1}{\pi 2} = \frac{(n/V_1)}{(n/V_2)}$ $\frac{2.64}{\pi 2} = \frac{(n/V)}{(n/5V)}$ $\pi 2 = 0.528$ atm Osmotic pressure is directly proportional to temperature. The osmotic pressure of cane sugar can be decreased by decreasing the temperature. **OR** a. While giving intravenous injection to the patients , utmost care of concentration of the solution is to be taken . The solution must have same concentration as that of blood cells . If the solution becomes more concentrated than the concentration of the blood it will lead to the shrinking of blood cells and fluid will start flowing out because of endosmosis. If concentration is less concentrated than the concentration of the blood it will lead to swelling of blood cells will take place. Both situations are life-threatening. b. $2C_6H_5OH \longrightarrow (C_6H_5OH)_2$ Initial concentration : C 0 Final concentration C (1-α) Cα/n, where α is degree of association . Experimentally, phenol is 73 % associated . Hence α = 0.73 . Relation between i (vant hoff factor) and α is given as : α=(1-i)/ (1-n) , where n for phenol = ½ as phenol acts as dimer , association is taking place Substituting the values : 0.73=(1-i)/(-0.5)	1 ½ ½ ½ 1 1 ½ ½

	i=1- 0.73/2 i= 0.635	½
	Depression in freezing point can be calculated as: $\Delta T_f = iK_f\, m$ $= iK_f\, (w_b / M_b \times w_a)$ $K_f = 5.12$ K Kg/mol, $w_b = 2 \times 10^{-2}$ kg = 20 g, $w_a = 1$ kg $M_b = 94$ $\Delta T_f = (0.635 \times 5.12 \times 20 / (94)$ = 0.691 K	1 ½
	_____	