SECOND YEAR HIGHER SECONDARY MODEL EXAMINATION 2024 – ANSWER KEY

SUBJECT: CHEMISTRY

Qn. Code: 225

Qn. No.	Sub Qns	Answer Key/Value Points	Scor e	Total		
	Answer any 4 questions from 1 to 5. Each carries 1 score					
1.		(b) 3	1	1		
2.		Dry cell/Mercury cell (Button cell)	1	1		
3.		Linkage isomerism	1	1		
4.		(d) SOCl ₂	1	1		
5.		Vitamin C	1	1		
		Answer any 8 questions from 6 to 15. Each carries 2 scores	1			
6.	(i)	van't Hoff factor (i) is defined as:				
		i = Normal molar mass Abnormal molar mass OR, i = Observed colligative property Calculated colligative property OR, i = Total number of moles of particles after association/dissociation Number of moles of particles before association/dissociation	1	2		
	(ii)	i = 2	1			
7.	. ,	Galvanic cells are devices that convert chemical energy of some redox reactions to	1			
	(i) (ii)	electrical energy. OR , these are cells which produce electricity by some chemical reactions. Zn(s) Zn ²⁺ (aq) Cu ²⁺ (aq) Cu(s) OR , Zn Zn ²⁺ Cu ²⁺ Cu	1	2		
8.		These are reactions which appear to follow higher order but actually follow first order kinetics. E.g.: Hydrolysis of ester OR , Inversion of cane sugar OR , Any hydrolysis reaction	1	2		
9.	(i) (ii)	The factors affecting rate of a chemical reaction are nature of the reactants, concentration of the reactants, temperature, pressure, catalyst and radiation or light. [Any 2 required] $r = k[NH_3]^0 \text{ OR}, r = k$	1	2		
10.	(i) (ii)	Finkelstein reaction: Alkyl chlorides or bromides when treated with Nal in dry acetone, alkyl iodides are formed. This reaction is known as Finkelstein reaction. $R-X + Nal \longrightarrow R-I + NaX$ (where X = Cl or Br) Fittig Reaction: Aryl halides when treated with sodium in dry ether, we get diaryls (diphenyls). OR, Chlorobenzene when treated with sodium in dry ether, we get diphenyl. $2 \longrightarrow X + Na \xrightarrow{Ether} \longrightarrow + 2NaX$	1	2		

Proceeds in 2 stepsProceeds in a single stepAn intermediate (carbocation) is formedNo intermediate is formedOrder of the reaction is 1Order is 2For optically active compounds, the reaction proceeds through retention of configuration.For optically active compounds, the reaction proceeds through retention of configuration.2 x 1 = 212.Chloroform is stored in closed dark coloured bottles filled up to the neck in order to prevent its oxidation to the poisonous gas carbonyl chloride (COCl.) or phosgene. OR, the equation: 2CHCl.s + 0.2Import 1000000000000000000000000000000000000	11.		S _N 1 Reaction	S _N 2 Reaction		
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on solution side.				e larger than osmotic pressure is applied		
			on solution side.			

		Application: Desalination of sea water OR , Purification of water.	1	
17.	(i) (ii)	Molar conductivity is the conductivity of 1 mole of an electrolytic solution kept between two electrodes of a conductivity cell with unit area of cross section and at a distance of unit length. OR, Molar conductivity of a solution at a given concentration is the conductance of 'V' volume of a solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length. OR, Molar conductivity, $\Lambda_m = \hat{k}.V$ OR, $\Lambda_m = \frac{\hat{k}}{c}$ (where \hat{k} is the conductivity and c is the concentration of the electrolytic solution in mol/m ³). OR, Molar conductivity, $\Lambda_m = \frac{1000 \ \hat{k}}{M}$ [Where M is the molarity of the solution].	1	3
	(iii)	$\Lambda_{\rm m} = \Lambda^0_{\rm m} - A\sqrt{c}$	1	
18.	(ii)	Here k = $5.5 \times 10^{-14} \text{ s}^{-1}$		
		$t\frac{1}{2} = \frac{0.693}{k}$	1	
		$k = \frac{0.693}{5.5 x 10^{-14}} = 1.26 \times 10^{13} \mathrm{s}$	1	3
	(ii)	mol ⁻¹ L s ⁻¹ OR, M ⁻¹ s ⁻¹ OR, mol ⁻¹ L min ⁻¹ OR, M ⁻¹ min ⁻¹	1	
19.	(i) (ii)	Because of the presence of partially filled d-orbitals OR, due to d-d transition. Electronic configuration of element with atomic number 25 is: [Ar] 3d ⁵ 4s ² For divalent ion, the configuration becomes [Ar] 3d ⁵	1	2
		So there are 5 unpaired electrons (i.e. n = 5)	1/2 1/2	3
		Magnetic moment (μ_s) = $\sqrt{n(n+2)} = \sqrt{5(5+2)} = \sqrt{35} = 5.91$ BM	1	
20.		 Potassium dichromate is prepared from chromite ore (FeCr₂O₄). The preparation involves the following three steps: 1. Conversion of chromite ore to sodium chromate by fusing it with sodium carbonate in presence of air. 4 FeCr₂O₄ + 8 Na₂CO₃ + 7 O₂ → 8 Na₂CrO₄ + 2 Fe₂O₃ + 8 CO₂ 2. Acidification of sodium chromate with sulphuric acid to sodium dichromate. 2Na₂CrO₄ + 2 H⁺ → Na₂Cr₂O₇ + 2 Na⁺ + H₂O 3. Conversion of sodium dichromate to potassium dichromate by treating with potassium chloride. 	1 1 1	3
		Na ₂ Cr ₂ O ₇ + 2 KCl \rightarrow K ₂ Cr ₂ O ₇ + 2 NaCl [Explanation or equation required]		

21.	(i)	Tetraamminedichloridocobalt(III) chloride	1		
	(ii)	Geometrical isomers of [Co(NH ₃) ₄ Cl ₂] ⁺ are:			
		$\begin{array}{cccc} & Cl & & & \\ & H_{3}N & & & \\ & H_{3}N & & \\ & H_{3}N & & \\ & NH_{3} & & \\ & NH_{3} & & \\ & & Cl & \\ & & H_{3}N & \\ & & Cl & \\ & & & \\ $	1	3	
		cis isomer $[Co(NH_3)_4Cl_2]$ trans $[Co(NH_3)_4Cl_2]$			
	(iii)	None of the geometrical isomers of this complex can show optical activity. [Both cis and trans isomers of [Co(NH ₃) ₄ Cl ₂] ⁺ have plane of symmetry. So they are optically inactive. Also, optical isomerism is commonly shown by octahedral complexes containing didentate ligands].	1		
22.	(i)	A co-ordination compound or complex salt keeps its identity both in solid and solution states. While a double salt keeps its identity only in solid state.	1		
	(ii)	OR, A complex ion does not get ionized in solution, while a double salt gets ionized. Chelating ligands are ligands which can bind to the central atom in more than one position and form ring complexes.	1	3	
		OR, Di- or polydentate ligands can bind to the central atom through two or more			
		donor atoms and form ring complexes. Such ligands are called chelating ligands.			
	(iii)	Ethane-1,2-diamine OR , ethylene diamine (en) and Oxalate ion ($C_2O_4^{2-}$ or Ox^{2-}).	1		
23.	(i)	Due to the presence of inter molecular hydrogen bonding in alcohols OR, due to the	1		
		absence of hydrogen bonding in haloalkanes.	_		
	(ii)	Phenols are acidic, due to the greater electronegativity of sp ² hybridized carbon			
		atom to which -OH group is bonded OR , due to the greater stability of phenoxide ion compared to phenol.	1	3	
	(iii)	Because the alkoxy group is ortho-para directing OR , due to greater electron density at ortho and para positions, the electrophile enters at these positions.	1		
24.	(i)	Aldehydes are more reactive than ketones in nucleophilic addition reactions due to steric reason and electronic reason. OR , due to the presence of + I effect (electron donating inductive effect) and steric hindrance of 2 alkyl groups in ketones.	1		
	(ii)	Clemmensen reduction OR , Wolff-Kishner reduction.	1		
	(iii)	Esterification: Carboxylic acids (or, acid chlorides or acid anhydrides) when heated			
		with alcohols or phenols in the presence of a mineral acid like concentrated H_2SO_4 or HCl gas, we get esters.	1	3	
		OR, R-COOH + R'-OH $\xleftarrow{H^+}$ R-COOR' + H ₂ O			
		OR, R-COOH + R'-OH $^{H^+}$ R-COOR' + H ₂ O OR, CH ₃ -COOH + CH ₃ -OH $^{H^+}$ CH ₃ -COO-CH ₃ + H ₂ O Acetic acid Methanol Methyl acetate			
25.	(i)	Aniline when treated with NaNO $_2$ and HCl to form Benzenediazonium salt, which on			
		treating with Cuprous chloride or copper powder to give chlorobenzene.	2		

		OR, diazotization of Aniline followed by Sandmeyer's reaction or Gattermann's		
		reaction.		
		OR, Cl		3
		$\underbrace{NH_2}_{273-278 \text{ K}} \xrightarrow{NaNO_2 + HX} \underbrace{V}_2 \xrightarrow{N_2 X}_{273-278 \text{ K}} \underbrace{Cu_2 Cl_2 \text{ OR } Cu \text{ powder}}_{273-278 \text{ K}}$		•
		$\begin{bmatrix} 1 \\ -272 & 078$		
		$\checkmark 273-278 \text{ K} \checkmark \longrightarrow \checkmark$		
	(ii)	Hoffmann Bromamide degradation reaction: When an amide is treated with bromine	1	
		and alcoholic NaOH, we get a primary amine with one carbon atom less than that		
		present in the amide.		
		OR, $R-CO-NH_2 + Br_2 + 4 NaOH \longrightarrow R-NH_2 + Na_2CO_3 + 2 NaBr + 2 H_2O$		
		OR, $CH_3-CO-NH_2 + Br_2 + 4 NaOH \longrightarrow CH_3-NH_2 + Na_2CO_3 + 2 NaBr + 2 H_2O$		
		Ethanamide Methanamine		
	(.)	OR, any other example		
26.	(i)	The amino acids which cannot be synthesized in the body and must be obtained	1	
		through diet, are known as essential amino acids .		
		E.g.: Valine, Leucine, Isoleucine, Arginine, Lysine, Threonine, Methionine,	1	3
	(ii)	Phenylalanine, Tryptophan and Histidine. [Any 2 examples required]		0
	(1)	E.g. for fibrous protein: Keratin and myosin	1/2	
		E.g. of globular proteins Insulin and albumins [Any 1 example for each is required]	1⁄2	
		Answer any 4 questions from 27 to 31. Each carries 4 scores		
27.	(i)	Non-ideal solutions: Solutions which do not obey ideal gas equation at all	1	
		concentrations.		
		OR, solutions for which $p_1 \neq p_1^0 \cdot \chi_1$ and $p_2 \neq p_2^0 \cdot \chi_2$ are known as non-ideal solutions.		
		OR, these are solutions for which vapour pressure is either higher or lower than that		
		predicted by Raoult's law.		
	(ii)	For solutions which show negative deviation from Raoult's law, $p_1 < p_1^0$, χ_1 , $p_2 < p_2^0$, χ_2 ,		
		$\Delta_{mix}H < 0$ and $\Delta_{mix}V < 0$		
		Here the solute-solvent interactions (A-B interactions) are stronger than solute-		
		solute interaction (A-A interaction) and solvent-solvent interaction (B-B interaction).		4
		The vapour pressure – composition graph for such a solution is:	1½	4
		↑Vapour pressure		
		of solution		
		I I I I I I I I I I I I I I I I I I I		
		essu		
		Id IT		
		Vapour pressure		
		$x_{i=0}$ Mole fraction $x_{i}=1$		
		$x_{2=1}$ $x_{1} \rightarrow x_{2=0}$		
		$\leftarrow x_2$		

		E.g. solution of phenol and aniline, chloroform and acetone. [Any one example is required]	1/2	
	(iii)	The solutions which show a large positive deviation from Raoult's law form minimum boiling azeotrope at a particular composition. E.g. 95% aqueous ethanol solution by volume.	1	
28.	(i)	Kohlrausch's law states that the limiting molar conductivity of an electrolyte is the sum of the individual contributions of the anion and the cation of the electrolyte. OR, For an electrolyte like $A_x B_y$ which dissociates as: $A_x B_y \rightarrow xA^{y+} + yB^{x-}$ $\Lambda^0_{m_{(A_x B_y)}} = x. \lambda^0_{(A^{y+})} + y. \lambda^0_{(B^{x-})}$	1	
		$M(A_x B_y)$ (A^0) <	1	4
	(ii)	$\Lambda_m = \frac{1000 \ x \ \text{k}}{M}$	1	4
		Here $\hat{k} = 0.01148 \text{ S cm}^{-1}$ and M = 0.05 mol L ⁻¹		
		So, $\Lambda_m = \frac{1000 \ x \ 0.01148}{0.05}$ = 229.6 S cm ² mol ⁻¹	1	
29.	(i)	In [Ni(CN) ₄] ²⁻ , in presence of CN ⁻ ligands, electron pairing in d-orbitals of Ni ²⁺ occurs. So, Ni ²⁺ is in dsp² hybridisation . So it has a square planar structure . Due to the	1½	
		absence of unpaired electrons, it is diamagnetic. But in [NiCl ₄] ²⁻ , in presence of Cl ⁻ ligands, electron pairing in d-orbitals of Ni ²⁺ does not occur. So, Ni ²⁺ is in sp³ hybridisation . So it has a tetrahedral structure . Due to the presence of unpaired electrons , it is paramagnetic .	1½	
		OR, [Ni(CN) ₄] ²⁻ : Here the central atom Ni is in +2 oxidation state. The electronic configuration of Ni ²⁺ is: Ni ²⁺ - [Ar]3d ⁸ 4s ⁰ 4p ⁰ Here the co-ordination number of Ni is 4 and hence the no. of vacant orbitals required = 4. In presence of the ligand CN ⁻ , the electrons in 3d level get paired. Now one 3d orbital, one 4s orbital and two 4p orbitals undergo dsp ² hybridization to form 4 new orbitals. Thus, the complex has square planar geometry and is diamagnetic, due to the absence of unpaired electron. [NiCl ₄] ²⁻ : Here also the central atom Ni is in +2 oxidation state. Ni ²⁺ - [Ar]3d ⁸ 4s ⁰ 4p ⁰ Here the co-ordination number of Ni is 4 and hence the no. of vacant orbitals	(1½)	4
		required = 4. In presence of the ligand Cl ⁻ , the electrons in 3d level do not get paired. Now one 4s orbitals and three 4p orbitals undergo sp³ hybridization to form 4 new orbitals. Thus, the complex has <i>tetrahedral</i> geometry and is <i>paramagnetic</i> because of the presence of unpaired electron.	(1½)	

	(ii)	$d_{x^{2}-y^{2}} d_{z}^{2} d_{z} d_{xy} d_{xz} d_{yz}$ $d_{x^{2}-y^{2}} d_{z}^{2} d_{z} d_{xy} d_{xz} d_{yz}$ $d_{xy} d_{yz}$ $d_{xy} d_{yz}$ $d_{xy} d_{yz}$ $d_{yz} d_{yz}$	1	
30.	(i) (ii)	Lucas Test: Lucas reagent is a mixture of conc. HCl and anhydrous ZnCl ₂ . Tertiary alcohols react with Lucas reagent to form immediate turbidity; secondary alcohols form turbidity within 5 minutes, while primary alcohols do not produce turbidity at room temperature. They give turbidity only on heating. Reimer-Tiemann Reaction: When Phenol is treated with chloroform in the presence of sodium hydroxide, followed by acidification, we get Salicylaldehyde (o- hydroxybenzaldehyde). OR, OR, OH O	1½	4
	(iii)	Benzoquinone OR,	1	
31.	(i)	CH ₃ -CH-COOH OR, 2-chloropropanoic acid OR, α-chloropropionic acid	1	
	(ii)	CI CH ₃ -CHCl-COOH is more acidic than CH ₃ -CH ₂ -COOH.	1	
	(iii)	By treating acetaldehyde (ethanal) with methyl magnesium bromide followed by hydrolysis, we get propan-2-ol. OR ,	2	4
		$CH_3 - CHO + CH_3MgBr \longrightarrow CH_3 - CHOMgBr \xrightarrow{H_2O} CH_3 - CHOH - CH_3$ $\dot{C}H_3$		