CHEMISTRY (CODE – 043)

MARKING SCHEME

CLASS XII (2026-27)

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

GENERAL INSTRUCTIONS:

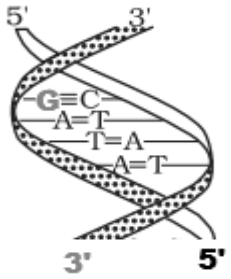
Read the following instructions carefully.

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		
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

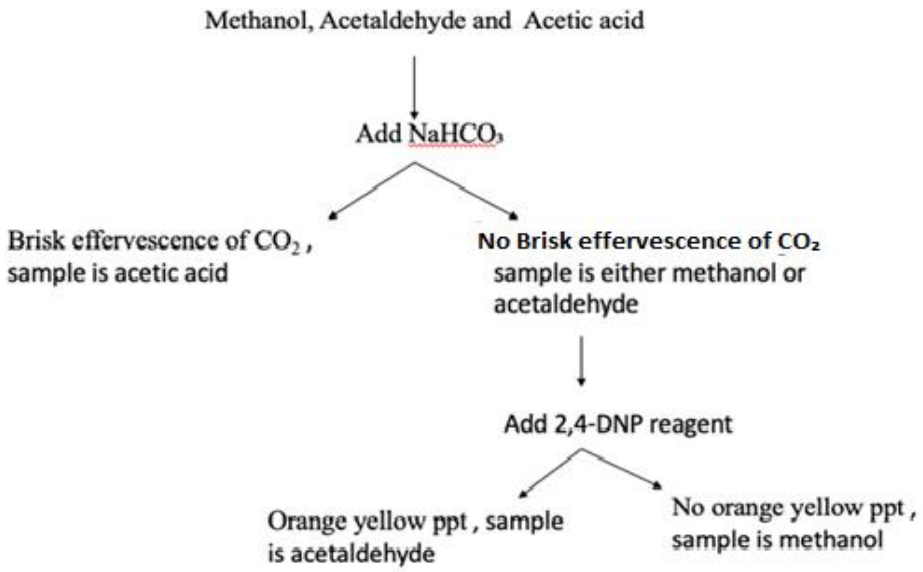
19	I.  II. Addition of lemon juice lowers the pH which breaks the hydrogen bonds, the globules of casein unfold and it gets denatured. **For Visually Challenged Learners** I. Adenine, Guanine, Cytosine and Thymine II. Addition of lemon juice lowers the pH which breaks the hydrogen bonds, the globules 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