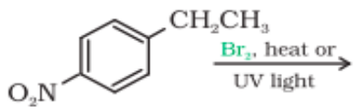
General Instructions:

(a) There are **33** questions in this question paper .
(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 mark each
(g) All questions are compulsory.
(h) 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.

Q.No	Questions	Marks
1	Which of the following homoleptic complexes will behave as a 1:3 electrolyte in aqueous solution? (a) $[Co(NH_3)_4(H_2O)_2]Cl_3$ (b) $[Co(NH_3)_6]Cl_3$ (c) $[CoCl_3(NH_3)_3]$ (d) $[Co(NH_3)_4Cl_2]Cl.\ H_2O$)	1
2	You want to measure the conductance of an electrolyte solution accurately without causing electrolysis at the electrodes. How is this difficulty usually overcome in practice? (a) By using direct current in the audio frequency range (b) By using alternating current at very low frequency (<100 Hz) (c) By using alternating current in the audio frequency range >550Hz (d) By using pulsed direct current at high voltage.	1
3	Why does the $–NO_2$ group activate the ortho and para positions ,but not the meta position toward nucleophilic substitution in haloarenes? (a) The $–NO_2$ group increases the electron density at the meta-position. (b) The $–NO_2$ group is electron donating and stabilizes the intermediate at meta-position. (c) The $–NO_2$ group is electron withdrawing and stabilizes the intermediate at ortho- and para-positions. (d) The $–NO_2$ group increases steric hindrance only at meta-position.	1
4	Identify the option showing the correct order of wavelengths of absorption in the visible region for the complexes; (a) $[Ni(NO_2)_6]^{4-} > [Ni(NH_3)_6]^{2+} > [Ni(H_2O)_6]^{2+}$ (b) $[Ni(H_2O)_6]^{2+} > [Ni(NH_3)_6]^{2+} > [Ni(NO_2)_6]^{4-}$ (c) $[Ni(NH_3)_6]^{2+} > [Ni(H_2O)_6]^{2+} > [Ni(NO_2)_6]^{4-}$ (d) $[Ni(NO_2)_6]^{4-} > [Ni(H_2O)_6]^{2+} > [Ni(NH_3)_6]^{2+}$	1
5	Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%. (a) 80 g (b) 14 g (c) 12 g (d) 10 g	1
6	Actinoids show a greater range of oxidation states than lanthanoids because: (a) 5f, 6d, and 7s orbitals in actinoids are close in energy. (b) 4f orbitals in lanthanoids are more available for bonding than 5f orbitals in actinoids (c) In actinoids, all the electrons in f orbitals participate in bonding. (d) 5f electrons experience relatively lower effective nuclear charge .	1

7	Identify the major monohalo product formed, in the reaction; (a) 4-Nitro-1-bromo-2-ethylbenzene (b) 4-Nitro-1-(1-bromoethyl)benzene (c) 4-Nitro-1-bromoethylbenzene (d) 4-Nitro-1-(2-bromoethyl)benzene 	1
8	A student has two test tubes ;one with ethylamine and the other with aniline. On adding reagent X, under suitable conditions, only one forms a yellow dye. Identify "X". Why is reagent X not stored in labs? (a) Nitrous acid – unstable and decomposes quickly. (b) Nitric acid – highly corrosive. (c) Sodium nitrite – hygroscopic. (d) Aryl Diazonium chloride – unstable in free form	1
9	For the decomposition of ammonia on a platinum surface, if $k = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}, what are the rates of production of N_2 and H_2? (a) Rate of $N_2 = 1.25 \times 10^{-4}$ mol L^{-1} s^{-1}; Rate of $H_2 = 3.75 \times 10^{-4}$ mol L^{-1} s^{-1} (b) Rate of $N_2 = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}; Rate of $H_2 = 7.5 \times 10^{-4}$ mol L^{-1} s^{-1} (c) Rate of $N_2 = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}; Rate of $H_2 = 1.25 \times 10^{-4}$ mol L^{-1} s^{-1} (d) Rate of $N_2 = 3.75 \times 10^{-4}$ mol L^{-1} s^{-1}; Rate of $H_2 = 1.25 \times 10^{-4}$ mol L^{-1} s^{-1}	1
10	Which of the following options best demonstrates the ability of oxygen to stabilise the highest oxidation state of transition metals? (a) Formation of MnO (b) Formation of Cr_2O_3 (c) Formation of Mn_2O_7 (d) Formation of FeO	1
11	Why is geometrical isomerism not shown by tetrahedral complexes with two types of unidentate ligands? (a) Because all positions are equivalent (b) Because rotation is restricted (c) Because ligands cannot donate lone pairs (d) Because bond angles are unequal	1
12	Give an example each of an amine whose basic strength is (i) greater than, and (ii) less than N-Methylmethanamine in the gaseous state. (a) Greater: Dimethylamine; Lesser: Ammonia (b) Greater: Aniline; Lesser: Ethylamine (c) Greater: Trimethylamine; Lesser: Methylamine (d) Greater: Ethylamine; Lesser: Aniline	1
A statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. (a)Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement.		
13	**Assertion (A):** Haloalkanes react with KNO_2 to form nitroalkanes as the main product, whereas $AgNO_2$ reacts with haloalkanes to give alkyl nitrites . **Reason (R):** In KNO_3, the nucleophilic attack occurs through the oxygen atom of NO_2^-, while in $AgNO_2$, the halide ion precipitates with Ag^+, leaving NO_2^- to attack via nitrogen.	1

14	**Assertion (A):** Monobromination of aniline can be achieved by first protecting the $-NH_2$ group through acetylation before bromination. **Reason (R):** When the amino group is acetylated to form acetanilide, its activating effect is reduced, allowing controlled monobromination.	1
15	**Assertion (A):** Change in optical rotation is observed when sucrose is hydrolysed. **Reason (R):** Hydrolysis of sucrose involves the breaking of a glycosidic bond between glucose and fructose molecules.	1
16	**Assertion (A):** A catalyst changes the Gibb's free energy of a reaction and alters the equilibrium constant. **Reason (R):** A catalyst provides an alternative pathway with lower activation energy .	1

Section-B

Question No. 17 to 21 are very short answer questions carrying 2 marks each

17 (1+1)

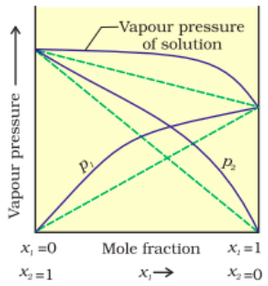
Explain the following

I It not possible to separate the components of an azeotropic mixture by fractional distillation.

II Sea water remain in liquid form at temperatures where pure water freezes.

OR

The graph shows the variation of vapour pressure of a binary liquid mixture



I Identify a liquid mixture that would show a similar vapour pressure–composition relationship.

II. Explain the molecular interactions between the components that leads to this type of behaviour.

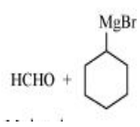
III Suggest another suitable liquid , which on replacing one component here, , would cause the vapour pressure curve to show the opposite trend.

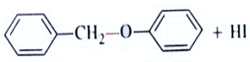
18 (2)

Explain the metal -ligand interactions in synergic bonding.

19 (1+1)

I Give the major products that are formed

(a) 

(b) 

II. Give reason for

(a) Propanol has higher boiling point than that of butane.

(b) The bond angle in alcohols is slightly less than the tetrahedral angle.

20 (1+1)

I Why cannot vitamin C be stored in our body?

II. Give the inference and the corresponding chemical equation for each; when D-glucose is treated with the following reagents, (i) Hydroxylamine (ii) Bromine water

21 (2)

I In a reaction between A and B, the initial rate of reaction (r_0) was measured for different initial concentrations of A . Observe the data and calculate the order w.r.t reactant A.

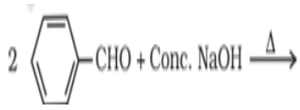
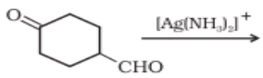
(log 2.4=0.3802, log 2.8=0.45, log 3=0.4771)

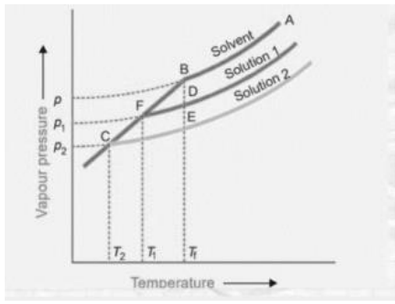
A/ mol L^{-1}	0.20	0.20	0.40
B/ mol L^{-1}	0.30	0.10	0.05
r_0/mol $L^{-1}s^{-1}$	5.07×10^{-5}	5.07×10^{-5}	1.43×10^{-4}

II. Define collision frequency.

Section C

Question No. 22 to 28 are short answer questions, carrying 3 marks each.

22	I Convert Propanamide to the following compounds in not more than two steps: (a) N- Ethylpropanamine (b) Ethanol II On nitration. aniline gives a substantial amount of m-Nitroaniline. Why?	(1+1+1)
23	I Calculate emf of the following cell at 298 K: $Pt(s)|Br^-$ (0.010 M)$|Br_2$ (l)$||H^+$ (0.030 M)$|$ H_2 (g) (1 bar)$|Pt(s)$. (log 1.11= 0.0453, log 9.02= 0.9542) II. Depict a Daniel cell having electrodes of zinc and copper dipping in the solutions of their respective salts, when E_{ext} > 1.1 V.	(1.5+1.5)
24	I Explain the hybridisation and geometry of the compound $[Ni(NH_3)_6]Cl_2$ as per valence bond theory[Z of Ni = 28] II Distinguish between ; coordination and hydrate isomerism	(2+1)
25	Various isomeric haloalkanes with the general formula C_4H_9Cl undergo hydrolysis reaction. I 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. II Another isomer "B" undergoes racemisation. Give complete equation for the same. OR II Give the reaction of "B" with (a) sodium metal and (ii) magnesium metal under suitable condition	(2+1)
26	I Give the structure of the products of the following reactions: (a)  (b)  II Though Carboxylic acids have >C=O group in their structure, but they are not prone to nucleophilic addition reactions. III. Which acid of each pair shown here would you expect to be stronger? Explain.$CH_2FCH_2CH_2CO_2H$ or $CH_3CHFCH_2CO_2H$	(1+1+1)
27	I Show the formation of the disaccharide with molecular formulae, $C_{12}H_{22}O_{11}$, which produces 2 moles of α-D(+) Glucose on hydrolysis. What will be the observation , such a disaccharide. undergoes Tollen's test? II Give two examples of fibrous protein.	(2+1)
28	I The rate constants of a reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the values of Ea and A. (log 7=0.8450 ,log2=0.3010 , log3.5=0.544) II Plot the distribution curve showing temperature dependence of rate of a reaction.	(2+1)
Section D Question No. 29 & 30 are case-based/data -based questions carrying 4 marks each.		

29	Chemical Transformations of Phenol Phenol undergoes enzymatic conversion in nature to form anisole, a compound contributing to the fragrance of essential oils . In industrial chemistry, phenol reacts with bromine, but the nature of the solvent dramatically affects the product distribution, which is crucial for synthesizing compounds like 2,4,6-Tribromophenol, widely used as a flame retardant. I Phenol can be converted to anisole by: (a) Treating with dimethyl chloride in the presence sodium metal (b) Treating with sodium hydroxide and methyl chloride (c) Treating with methyl alcohol in the presence of acid (d) Heating with sodium metal and aniline II Write two distinct equations showing phenol reacting with bromine in: (a) a polar solvent (b) a non-polar solvent **OR** II Give the Friedel craft's alkylation of both Phenol and Anisole. III Compare the acidity of Phenol and 2,4,6-Tribromophenol. Write the chemical equations for any two confirmatory tests used to identify phenols.	(1+1+2)
30	The Race To Freeze And Boil For an industrial cooling system, an experiment was carried out in the laboratory to study which aqueous solution is more effective in maintaining low operational temperatures without freezing. Two 1.0 m aqueous solutions were prepared — one of aluminium nitrate and one of glucose. The freezing points of the two solutions were recorded, and the given plot was observed. Given K_f(water)=1.86Kkg $mol^{-1.}$ I From the given figure identify solution 1 and solution 2 **OR** I Give a plausible reason for the difference in freezing point of solvent and solution 1 II Plot a graph showing the boiling point elevation for the two 1.0 m aqueous solutions given .  III If the observed difference in freezing point for 1.0 m aluminium nitrate solution is 4.50 °C, calculate its α. State whether this solute undergoes association / dissociation in the solution. .	(1+1+2)
	Section E Question No. 31 to 33 are long answer type questions carrying 5 marks each	
31	I The electrical resistance of a column of 0.05 mol L^{-1} sodium hydroxide solution of diameter 1 cm and length 4 cm is 5×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity. II Depict a H_2-O_2 fuel cell. Give the electrode reactions **OR** I Write the reactions that occur during electrolysis of aqueous sodium chloride using inert electrodes**.** How do the products differ when molten sodium chloride is electrolyzed instead? Explain the reason for this difference. II You decided to coat a metal key with nickel to prevent rust and improve its appearance. An electroplating bath is set using a solution of $Ni(NO_3)_2$	(3+2)

	and inert electrodes. If you pass a current of 5 amperes for 20 minutes , calculate the mass of nickel deposited on the key .(Molar mass of Nickel=58.7g/mol)	
32	I Account for the following: (a) The lowest oxide of transition metal is basic, and the highest is acidic. (b) Chromium is a hard metal while mercury is a liquid metal (c)The ionisation energy of elements of the 4d and 5d series are similar. II A compound 'X' is sparingly soluble in water and decomposes on heating at 513 K as follows: $2\ X \rightarrow Y + MnO_2 + O_2$ (a) Identify compounds 'X' and 'Y'. (b) Give the ionic equation of 'X' with thiosulphate in neutral medium . **OR** I Observe the thermochemical data (kJ mol^{-1}) for the first row Transition Elements and the Standard Electrode Potentials for the reduction of M^{2+} to M, and answer the questions that follow; (a)Identify the M^{2+} ion, which is highly stable. Give reason. (b)Compare the variation in hydration enthalpy of Mn^{2+} and Fe^{2+}. (c)Mention the factors influencing the $\Delta_a H^{\ominus}$ in 3d series. II. Give ionic equation for (a)Reaction of dichromate ion with iron(II) ion in acidic medium (b)Reaction between iodide and persulphate ions.	(3+1+1)
33	Answer the following questions: I Draw the structure of the ethylene ketal of hexan-3-one. II Give simple chemical tests to distinguish between Acetophenone and Benzophenone III An optically active organic compound 'A', with molecular formula, $C_5H_{10}O_2$ when treated with chlorine in the presence of red phosphorous forms compound 'B', whereas when it is treated with thionyl chloride forms compound 'C'. Compound C, on further hydrogenation with palladium on barium sulphate, forms compound D. (a) Identify A, B, C, D. (b) Give a chemical test to confirm the presence of 'D'. (c)How would you obtain 'A' from 'C'. **OR** I Explain (a)Acidity of α-hydrogens of aldehydes and ketones. (b)Role of alkaline medium in cyanohydrin formation. II An organic compound "A", with molecular formulae C_9H_{12} is oxidized to monocarboxylic acid "B", $C_7H_6O_2$ on vigorous oxidation with potassium permanganate, whereas when oxidized in presence of air and further	(1+1+3)

Element (M)	$\Delta_a H^{\ominus}$ (M)	$\Delta_i H_1^{\ominus}$	$\Delta_i H_2^{\ominus}$	$\Delta_{hyd} H^{\ominus}(M^{2+})$	$E^{\ominus}$/V
Ti	469	656	1309	-1866	-1.63
V	515	650	1414	-1895	-1.18
Cr	398	653	1592	-1925	-0.90
Mn	279	717	1509	-1862	-1.18
Fe	418	762	1561	-1998	-0.44

	treated with dilute acid forms phenol. Sodium salt of “B” finds use as a food preservative . (a) Identify “A” and “B” (b)How is “B” obtained using a Grignard’s reagent. (c)Compare the acidity of “A” and “B”.	
