SECTION A – 14 MARKS

Question 1

(A) Fill in the blanks by choosing the appropriate word(s) from those given below in the brackets. **[4×1]**

[lead poisoning, zero, phosgene, dependent, cancer, independent, diethyl ether, first, ethyl carbonate, ethene]

(i) For a particular reaction, the value of rate constant is $0{\cdot}05\ sec^{-1}$. The reaction is of _____order and will be _____ of the initial concentration.

(ii) EDTA is used in the treatment of _____ while Cisplatin is used in the treatment of _____.

(iii) The addition of small quantity of ethanol to chloroform prevents the formation of _____ and converts it into the harmless compound _____.

(iv) The dehydration of ethyl alcohol with conc. H_2SO_4 at 140°C mainly yields _____ while at 170°C the main product formed is _____.

(B) Select and write the correct alternative from the choices given below. **[7×1]**

(i) Which one of the following statements is correct regarding the dry cell?

(P) Zinc container acts as an anode in dry cell.

(Q) Zinc container touches the paste of MnO_2 and carbon.

(R) Dry cell can be charged easily.

(S) Graphite rod acts as a cathode in dry cell.

(a) Only (P) and (R)

(b) Only (Q) and (R)

(c) Only (P) and (S)

(d) Only (Q) and (S)

(ii) The metal complex ion that is paramagnetic is:

(Atomic number of Fe = 26, Cu = 29, Co = 27 and Ni = 28)

(a) $[Fe(CN)_4]^{2-}$

(b) $[Co(NH_3)_6]^{3+}$

(c) $[Ni(CN)_4]^{2-}$

(d) $[Cu(NH_3)_4]^{2+}$

(iii) When $KMnO_4$ is heated with acidified oxalic acid, gas bubbles are evolved. These gas bubbles are evolved due to the formation of:

(a) SO_2

(b) CO_2

(c) SO_3

(d) O_2

(iv) The reaction of ethanamide with alcoholic sodium hydroxide and bromine gives:

(a) ethylamine.

(b) methylamine.

(c) propylamine.

(d) aniline.

(v) An equimolar solution of non-volatile solutes A and B, shows a depression in freezing point in the ratio of 2:1. If A remains in its normal state in the solution, the state of B in the solution will be:

(a) normal.

(b) hydrolysed.

(c) associated.

(d) dissociated.

(vi) **Assertion**: Specific conductivity of all electrolytes decreases on dilution.

Reason: On dilution, the number of ions per unit volume decreases.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true but Reason is false.

(d) Assertion is false but Reason is true.

(vii) **Assertion**: Ammonolysis of alkyl halides involves the reaction between alkyl halides and alcoholic ammonia.

Reason: Ammonolysis of alkyl halides produces secondary amines only.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true but Reason is false.

(d) Assertion is false but Reason is true.

(C) Read the passage given below and answer the questions that follow. **[3×1]**

When two solutions are separated by a semi-permeable membrane, the solvent molecules move from a solution of lower molar concentration to a solution of higher molar concentration through osmosis.

(i) Samar removed the outer hard shell of two different eggs while cooking at home. He then placed one egg in pure water and the other egg in saturated solution of sucrose. What change is he likely to observe in the eggs after few hours?

(ii) Which solution, hypertonic or hypotonic, has a higher amount of solute in same quantity of solution?

(iii) A 5% aqueous solution of glucose (molar mass = 180 g mol^{-1}) is isotonic with 1·66% aqueous solution of urea. Calculate the molar mass of urea.

Comments of Examiners

(A)(i) Many of the candidates answered this question correctly. However, a few candidates wrote 'zero' instead of 'first' in the first blank and for the second blank, the correct answer was 'independent' but some candidates wrote 'dependent'.

(ii) A few candidates could answer this question correctly. Many candidates were confused and wrote 'cancer' instead of 'lead poisoning' in the first blank and in the second blank 'lead poisoning' instead of 'cancer'.

(iii) Most of the candidates answered it correctly as 'phosgene'. Some candidates wrote 'diethyl ether' instead of 'phosgene' in the first blank. A few candidates wrote 'ethene' instead of 'ethyl carbonate'.

(iv) Some of the candidates could answer this question correctly. Most of the candidates wrote 'ethene' instead of 'diethyl ether' in the first blank and 'diethyl ether' or 'ethyl carbonate' in the second blank instead of 'ethene'.

(B)(i) Some candidates could answer this question correctly. Most of the candidates gave the wrong options such as (a) i.e. only (P) and (R), instead of the correct option (c) i.e. only (P) and (S).

(ii) Many of the candidates could correctly answer this question. Most of the candidates answered with options (a) or $[Fe(CN)_4]^{2-}$ and (d) or $[Cu(NH_3)_4]^{2+}$ which were the correct options but some candidates opted for wrong options such as (b) or (c).

Suggestions for teachers

- Explain rate constant and the order of reaction clearly to the students.
- Teach in detail the uses of coordination compounds.
- Explain the preparation and properties of chloroform and the reason to add ethanol to chloroform during the storage of chloroform. Also, explain the reaction of chloroform with oxygen in presence of sunlight.
- Elucidate to the students dehydration reaction of ethanol in presence of concentrated H_2SO_4 or solid Al_2O_3 at different temperatures.
- Explain the manufacture of dry cell, and its working to the students with diagrams and reactions.
- Give emphasis on the explanation of the valence bond theory (VBT) for the bonding in coordination compounds.
- Teach in detail the oxidising properties of $KMnO_4$ in acidic, alkaline and neutral medium.
- Explain the degree of dissociation and degree of association along with the abnormal molecular weights to the students.
- Elucidate the link between the colligative properties and the Van't Hoff factor to the students.
- Make students practice questions related with assertion and reason. Discuss in detail specific, molar and equivalent conductivity in detail.

(iii)Most of the candidates could correctly answer this question. Some of the candidates erroneously wrote option 'a'.

(iv) Some of the candidates answered it correctly where the given reaction was Hofmann bromamide reduction in which ethanamide changes to methylamine. Most of the candidates provided the incorrect answer of ethylamine.

(v) Only few candidates could answer it correctly as option 'associated'. Most of the candidates answered erroneously with option (a) or (d).

(vi) Most of the candidates answered correctly as option (a) that both assertion and reason are true and the reason is the correct explanation for assertion. But, some candidates answered it incorrectly with option (c) that assertion is true and reason is false.

(vii) Majority of the candidates could answer this question correctly as option (c) that assertion is true but reason is false. However, few candidates answered it incorrectly as option (d) that assertion is false but reason is true.

Suggestions for teachers

- Teach in detail chemical reactions related with alkyl halides explaining ammonia formation.
- Explain the movement of particles through a semi-permeable membrane and conditions under which osmosis takes place.
- Give enough practice to the students on case-based questions.
- Teach with practical examples the difference between hypertonic and hypotonic solutions based on the concentration of solute in solution.
- Ensure sufficient practice of the numerical problems related to colligative properties and its use in the determination of molecular weight and help students develop a systematic approach in solving a numerical.

(C)(i) Many of the candidates could answer this question correctly. However, instead of writing, that the size of egg will increase when placed in pure water, some candidates wrote that there will be no change in size. When the egg is placed in saturated solution of sucrose, the size will decrease, or the egg will shrink.

(ii) Most of the candidates could answer this question correctly. Hypertonic solution is the correct answer but a few of the candidates answered this question with hypotonic solution which was wrong.

(iii)Majority of the candidates answered this part correctly clearly showing the steps in a sequential manner, applying the formula first and then adding values to it. However, some candidates also gave the answer correctly without showing steps and lost marks.

MARKING SCHEME

Question 1

(A)		
	(i)	first, independent
	(ii)	lead poisoning, cancer
	(iii)	phosgene, ethyl carbonate
	(iv)	diethyl ether, ethene
(B)		
	(i)	(c) or Only (P) and (S)

	(ii)	(a) or $[Fe(CN)_4]^{2-}$; (d) or $[Cu(NH_3)_4]^{2+}$
	(iii)	(b) or CO_2
	(iv)	(b) or methylamine.
	(v)	(c) or associated.
	(vi)	(a) or Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
	(vii)	(c) or Assertion is true but Reason is false.
(C)		
	(i)	In pure water, the size of the egg will increase due to endosmosis whereas in saturated solution of sucrose the egg will shrink (size will decrease) due to exosmosis.
	(ii)	Hypertonic solution has higher amount of solute than hypotonic solution in the same quantity of solution.
	(iii)	Glucose $\pi V = \frac{W}{M} RT$ Urea $\pi V = \frac{W}{M} RT$ $\frac{w_{(glucose)}}{m_{(glucose)}} = \frac{w_{(urea)}}{m_{(urea)}}$ $\frac{5}{180} = \frac{1{\cdot}66}{M_{urea}}$ $M_{urea} = \frac{180 \times 1{\cdot}66}{5} = 59{\cdot}76 \sim 60{\cdot}0$

SECTION B – 20 MARKS

Question 2

[2]

(i) Write a chemical test to distinguish between ethanol and phenol.

(ii) Give a chemical reaction to convert acetaldehyde into secondary propyl alcohol.

Comments of Examiners

(i) Some candidates only wrote the reagent name – for example – only iodoform or only neutral $FeCl_3$ solution while others only wrote correct observations for one compound. For example, Ethyl alcohol gives yellow precipitate for iodoform test (only correct observation for one compound) or phenol gives violet colour for neutral $FeCl_3$ reagent. A few of the candidates answered with wrong colour observation i.e. is Orange and Pink for reaction of Phenol with neutral $FeCl_3$, reaction.

(ii) The conversion of acetaldehyde to secondary propyl alcohol was shown correctly by most of the candidates. However, a few candidates failed to show hydrolysis of the addition product formed after the first step and few others failed to show the by-product.

Suggestions for teachers

- Perform the chemical test with the students in laboratory for helping them understand this better and with more clarity.
- Insist that the students use the proper reagent and correctly observe the distinguish between a pair of organic compounds.
- Instruct students to write a positive test for one compound, its observation and reagent, along-with a negative test for the other compound.
- Teach the reagents for oxidation, reduction and hydrolysis comprehensively.
- Intensify classroom practice for the organic conversions.
- Insist that the students write the complete and balanced equations.
- Stress upon writing name of the reactant and product also.

MARKING SCHEME

Question 2

(i)	Ethanol on heating with I_2 and aqueous alkali gives a yellow ppt of iodoform while phenol does not. Phenol with neutral $FeCl_3$ forms violet colouration while ethanol does not. *(or any other suitable chemical test,)*
(ii)	$CH_3-\overset{\overset{O}{\|\|}}{C}-CH + CH_3MgBr \longrightarrow H_3C-\overset{\overset{CH_3}{\|}}{\underset{\underset{CH}{\|}}{C}}-OMgBr \xrightarrow{H_2O}$ $CH_3-\overset{\overset{CH_3}{\|}}{\underset{\underset{CH}{\|}}{C}}-OH + Mg(OH)Br$

Question 3

[2]

Give a reason for each of the following.

(i) Zinc, cadmium and mercury are considered as d-block elements but not regarded as transition elements.

(ii) Transition metals possess a great tendency to form complex compounds.

Comments of Examiners

(i) This question was well answered by majority of the candidates. However, a few candidates did not use the term 'completely filled d orbital' and some candidates were confused between the terms 'partially filled' and 'completely filled'.

(ii) Some of the candidates gave wrong reasons such as variable valency or variable oxidation state of transition metals instead of writing small size/high nuclear charge/availability of vacant d-orbitals etc.

Suggestions for teachers

- Demonstrate 'd orbitals' with the help of a diagrams and explain the difference between completely filled and partly filled d orbitals. Also, explain difference between transition and d block element.
- Stress upon the important properties of transition elements and explain why transition metals form complex compounds or coloured compounds in class.

MARKING SCHEME

Question 3

(i)	Zn, Cd and Hg are not considered as transition elements because they do not have partially filled 'd' orbitals in their common ions/or they have $(n-1)d^{10}$ electronic configuration.
(ii)	Transition metals form a large number of complex compounds due to the following reasons: • Small size / high nuclear charge / availability of vacant d- orbitals of suitable energy for accommodating the lone pair of electrons donated by the ligands.

Question 4

[2]

Convert the following by giving chemical equations for each.

(i) Ethyl bromide to diethyl ether

(ii) Phenol to salicylaldehyde

Comments of Examiners

(i) The conversion of ethyl bromide to diethyl ether was shown correctly by most of the candidates. However, some of the candidates were unclear and used ethyl alcohol instead of sodium ethoxide.

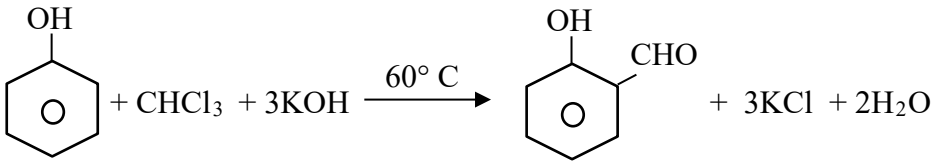
(ii) Most of the candidates gave correct answers to this question with the correct conversion of phenol to salicylaldehyde. However, a few candidates used CH_3Cl instead of $CHCl_3$ and few converted phenol to salicylic acid instead.

Suggestions for teachers

- Teach the general methods of conversions.
- Give sufficient practice of organic conversions and teach the named organic reactions with proper conditions.
- Lay emphasis on named organic reactions and train students to write balanced equations for all types of chemical reactions with appropriate conditions and reagents.

MARKING SCHEME

Question 4

(i)	Ethyl bromide to diethyl ether $C_2H_5Br + C_2H_5ONa \longrightarrow C_2H_5\text{-}O\text{-}C_2H_5 + NaBr$ *(or any other correct method.)*
(ii)	Phenol to salicylaldehyde 

Question 5

[2]

Account for the following.

(i) Zirconium (Zr) and Hafnium (Hf) are difficult to separate.

(ii) Salts of Cupric (Cu^{2+}) ion are coloured whereas salts of Cuprous(Cu^{+}) ion are colourless.

Comments of Examiners

(i) Majority of the candidates only wrote 'Lanthanoid contraction' but they missed another point i.e. similar property / similar size. Some candidates wrote 'actinoid contraction' instead of 'lanthanoid contraction'.

(ii) Most of the candidates did not mention the term d-d transition for explaining colour of Cu^{+} and Cu^{2+} ions. Some candidates were confused between the term empty, partly filled and incompletely filled d-orbitals.

Suggestions for teachers

- Explain in detail the property of f-block elements and causes of Lanthanoid contraction and consequences of Lanthanoid contraction as well.
- Illustrate diagrammatically the splitting of d orbital or crystal field theory.
- Explain and lay emphasis on how d-d transition takes place and what are the conditions necessary for d-d transition. Discuss how colour is produced due to d-d transitions and in which electronic configuration the salts remain colourless.

MARKING SCHEME

Question 5

(i)	Due to Lanthanoid contraction, Zr and Hf have almost similar size, therefore their properties are similar, hence it is difficult to separate them.
(ii)	A d-d transition causes the compounds to be coloured. As cuprous salts have a completely filled d orbital ($3d^{10}$) configuration, no d-d transition takes place in the 3rd Orbital and hence the compound is colourless / white. Whereas, in cupric salts incompletely filled d orbital ($3d^{9}$) configuration and d-d transition takes place, thus cupric salts are coloured.

Question 6

[2]

How will you bring the following conversions?

(i) Benzene to biphenyl

(ii) Iodoform to acetylene

Comments of Examiners

(i) Many candidates prepared biphenyl from chlorobenzene instead of benzene and some of the candidates missed anhydrous aluminum chloride while converting benzene to chlorobenzene.

(ii) Many candidates did not attempt this question. Of those who attempted, some of them used sodium 'Na' instead of Silver 'Ag' and a few of them missed conditions like heat.

Suggestions for teachers

- Give adequate practice in writing conversions of organic compounds step-wise with proper conditions.
- Give practice of organic reactions with proper reactants, condition, catalyst used, products and by-products.

MARKING SCHEME

Question 6

(i)	Benzene to biphenyl $C_6H_6 \xrightarrow{Br_2 / FeBr_3} C_6H_5Br \xrightarrow{Na/ether} C_6H_5 - C_6H_5$
(ii)	Iodoform to acetylene $CHI_3 + 6Ag + CHI_3 \xrightarrow{\Delta} HC \equiv CH + 6\ AgI$

Question 7

[2]

Calculate the maximum possible electrical work that can be obtained from a galvanic cell under standard conditions at 298 K.

$$Zn \mid \underset{(aq)}{Zn^{2+}} \parallel \underset{(aq)}{Ag^{+}} \mid Ag$$

Given $E^0_{(Zn^{2+}/Zn)} = -0{\cdot}76$ V ; $E^0_{(Ag^+/Ag)} = +0{\cdot}80$ V

Comments of Examiners

Most of the candidates only calculated E^o_{cell} and failed to get the answer for maximum possible electrical work. Some of the candidates calculated the value of ΔG^o but missed to mention the same in the answer with the negative sign. Only a few candidates gave the correct answer i.e. maximum possible electrical work as +301080J / 301.080kJ.

Suggestions for teachers

- Give practise to students with numericals on galvanic cell.
- Discuss the relation between maximum possible work and standard electromotive force 'emf' of the cell.

MARKING SCHEME

Question 7

$Zn_{(s)} \mid Zn^{2+}_{(aq)} \parallel 2Ag^{+}_{(aq)} \mid 2Ag_{(s)}$

$E^0_{cell} = E^0_{Cathode} - E^0_{Anode}$

$= 0{\cdot}80 - (-0{\cdot}76)$

$= 1{\cdot}56$ V

$\Delta G = -nFE^0$

$= -2 \times 96500 \times 1{\cdot}56$

$= -301080$ J or $-301{\cdot}080$ kJ

Question 8

[2]

(i) Give a reason for each of the following.

(a) Ethoxy ethane does not react with sodium, but ethanol does.

(b) Ethoxy ethane with conc. HI at 373K gives C_2H_5OH and CH_3I but not CH_3OH and C_2H_5I.

OR

(ii) An organic compound [A] having molecular formula $C_4H_{10}O$ forms a compound [B] with molecular formula C_4H_8O on oxidation. Compound [B] gives a positive iodoform test. The reaction of compound [B] with CH_3MgBr followed by hydrolysis gives compound [C] with molecular formula $C_5H_{12}O$.

Identify the compounds [A], [B] and [C]. Write the reaction for the conversion of compound [A] to compound [B].

Comments of Examiners

(i) (a) Many candidates failed to give the correct explanation of why ethanol reacts with sodium but do not react with ethoxy ethane. They failed to explain that ethanol has active hydrogen atoms which reacts with sodium to liberate hydrogen gas, whereas ethers do not have active hydrogen.

(b) One mark was awarded to the candidates who had attempted this question.

OR

(ii) Most of the candidates identified (B) and (C) incorrectly. The candidates wrote '1-Butanol' instead of '2-Butanol'. Also, many candidates did not write the correct equation for the conversion of (A) to (B).

Suggestions for teachers

- Explain the weakly acidic property of alcohol and reaction of alcohol with metals like Na, K etc.
- Discuss the structure of ethanol and ether with reference to their properties.
- Clarify that if there is unsymmetrical ether then on addition of HI, the halogen goes to the smaller alkyl group.
- Provide adequate practice of reactions where identification of compounds (A), (B) & (C) are carried out.

MARKING SCHEME

Question 8

(i)	(a)	Ethanol has active H – atom, hence they react evolving H_2 gas while ethers do not have active H.
	(b)	One mark was awarded to the candidates who had attempted to this question.
OR		
(ii)		$[A] - CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{\vert}{CH}} - CH_3$ or butan-2-ol

[B] - $CH_3 - CH_2 - \underset{\underset{O}{\|}}{C} - CH_3$ or butan-2-one

[C] – $CH_3 - CH_2 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3$ or 2-methyl butan-2-ol

$$CH_3 - CH_2 - \underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}} - CH_3 \ + [O] \xrightarrow[+ H_2SO_4]{K_2Cr_2O_7} CH_3 - CH_2 - \underset{\underset{O}{\|}}{C} - CH_3 + H_2O$$

[A] [B]

Question 9

[2]

If 200 cm^3 of an aqueous solution of a protein contains 1·26 g of protein, the osmotic pressure of the solution at 300K is found to be $2{\cdot}57 \times 10^{-3}$ atm.

Calculate the molar mass of protein.

(R = 0·0821 L atm K^{-1} mol^{-1})

Comments of Examiners

Many candidates were able to write the correct formula but most of them went wrong in substituting the correct values. The value of 200cm^3 to be converted to litres becomes 0.2L. Some candidates instead of writing 60,377g/ mol wrote 60.377g/mol which was incorrect.

Suggestions for teachers

- Train students to answer questions with numericals accurately and express using correct units.
- Devise lesson plans to explain the units and conversions of units with repeated revisions for clarity.

MARKING SCHEME

Question 9

Given, w = 1·26g ; V = $\frac{200}{1000}$ *or* $0 \cdot 2$ *litre* ; T = 300K ; $\pi = 2{\cdot}57 \times 10^{-3}$atm

π = CRT or $\pi = \frac{w}{mV}$ RT

$2{\cdot}57 \times 10^{-3} = \frac{1{\cdot}26}{0{\cdot}2 \times m} \times 0{\cdot}0821 \times 300$

$\therefore\ m = \frac{1{\cdot}26 \times 0{\cdot}0821 \times 300}{2{\cdot}57 \times 10^{-3} \times 0{\cdot}2} = 60{,}377$ g mol^{-1}

Question 10

[2]

(i) Benzaldehyde is less reactive than propionaldehyde. Why?

(ii) In the preparation of ethanal by the oxidation of ethanol, ethanal should be removed immediately as it is formed. Why?

Comments of Examiners

(i) Most of the candidates failed to answer accurately with key words like 'resonance in benzene ring'/'I effect'/'Electron withdrawing effect' etc.

(ii) Only a few candidates wrote the correct reason while many candidates wrote 'ethanal is poisonous' or 'explosive in nature' instead of writing 'ethanal undergoes further oxidation to form ethanoic acid / acetic acid'.

Suggestions for teachers

- Ensure that students understand the importance of usage of key words such as electron withdrawing effect, +M/-M effect, +I/-I effect or resonance stability, etc. for answering reasoning type questions.
- Explain with the help of reaction how ethanol is converted to ethanal using oxidising agent.
- Also, demonstrate the reaction of ethanal not being removed and how it converts to acetic acid/ethanoic acid.

MARKING SCHEME

Question 10

(i)	Benzaldehyde is less reactive than propanal due to e^- releasing (+I effect) or resonance of benzene ring, the positive charge on carbonyl group decreases and it becomes less susceptible to the nucleophilic attack.
(ii)	Ethanol first gets oxidised to form ethanal which further oxidises to form carboxylic acids. If ethanal is not removed immediately, it will form ethanoic acid.

Question 11

[2]

(i) Why is Mn^{+2} ion more stable than Fe^{+2} ion?

(Atomic number of Mn = 25 and Fe = 26)

(ii) Trivalent Lanthanoid ions such as La^{3+} (Z = 57) and Lu^{3+} (Z = 71) do not show any colour in their solution. Give a reason.

Comments of Examiners

(i) Many candidates could not answer the electronic configuration, an important aspect of the question despite the atomic number being given for Mn and Fe. A few candidates who answered electronic configuration failed to write that half-filled and completely filled orbitals are more stable than other sorts of configuration.

(ii) Most of the candidates found this question confusing, as they were confused between d-d and f-f transition. While, some of the other candidates were confused between vacant and partially filled f-orbitals. Many of them wrote d-d instead of f-f transition. And few of the candidates failed to explain that ions are colourless due to either empty f-orbitals or completely filled f-orbitals.

Suggestions for teachers

- Explain with the help of electronic configuration extra stability of half-filled and completely filled orbitals.
- Clarify that during oxidation of metals shell electrons are given out or lost.
- Explain with the help of electronic configuration that when an orbital is empty or completely filled, electronic transition is not possible.
- Eliminate the scope of confusion by clearly explaining that d-d transition takes place in d-block elements and f-f transition takes place in lanthanoids and actinoids.

MARKING SCHEME

Question 11

(i)	$Mn^{2+} = 1s^2 2s^2 2s^6\ 3s^2 3p^6\ 3d^5$ $Fe^{2+} = 1s^2 2s^2 2s^6\ 3s^2 3p^6\ 3d^6$ Half-filled orbitals are more stable, hence Mn^{2+} is more stable than Fe^{2+}.
(ii)	La^{3+} have $4f^0$ and Lu^{3+} have $4f^{14}$ configuration. Because of the absence of unpaired e^-, these ions impart no colour to the solution.

SECTION C – 21 MARKS

Question 12

[3]

For the reaction $A + B \rightleftharpoons$ Product, following data was obtained:

Experiment number	Initial concentration of [A] ($mol\ L^{-1}$)	Initial concentration of [B] ($mol\ L^{-1}$)	Initial Rate ($mol\ L^{-1}\ min^{-1}$)
1	0·15	0·15	$9 \cdot 6 \times 10^{-2}$
2	0·30	0·15	$3 \cdot 84 \times 10^{-1}$
3	0·15	0·30	$1 \cdot 92 \times 10^{-1}$
4	0·30	0·30	$7 \cdot 68 \times 10^{-1}$

Calculate the following:

(i) The overall order of the reaction

(ii) The rate law equation

(iii) The value of rate constant

Comments of Examiners

(i) Most of the candidates could answer this question correctly. However, some candidates were confused and found the overall order as second order reaction instead of third order reaction.

(ii) The majority of the candidates answered this question correctly. A few of the candidates did not mention 'k' in rate law equation and instead answered the rate law equation as $R = [A]^2\ [B]^1$ where 'k' was missing.

(iii) Some of the candidates could answer this correctly. As this question was linked with the previous question, candidates who answered part (ii) correctly (rate law equation) – could give the accurate value of k.

Suggestions for teachers

- Sufficient practice for numerical to find the order of the reaction should be given
- Explain the correct way to express rate law equation should be explained.
- Provide sufficient practice for rate law numericals along with finding 'k'.
- Emphasise that the units of k depends on order of reaction.

MARKING SCHEME

Question 12

(i)	Overall order of reaction = 2 + 1 = 3
(ii)	Rate law equation rate = k $[A]^2[B]^1$
(iii)	rate = k $[A]^2[B]^1$ $k = \frac{rate}{[A]^2[B]^1} = \frac{9{\cdot}6 \times 10^{-2}}{[0{\cdot}15]^2[0{\cdot}15]^1}$ k = 28·44 mol^{-2} L^2 min^{-1} *(Unit can be ignored.)*

Question 13

[3]

(i) Illustrate the following reactions by giving *one* suitable example in each case.

(a) Coupling reaction

(b) Acetylation of ethylamine

(ii) Aniline does not give Friedel – Crafts reaction. Give a reason.

Comments of Examiners

(i) (a) Most of the candidates answered this question correctly. However, some candidates did not mention the required medium or condition.

(b) Several candidates wrote the reaction correctly but few candidates showed alkylation instead of acetylation of ethyl amine. A few candidates did not mention the by-product.

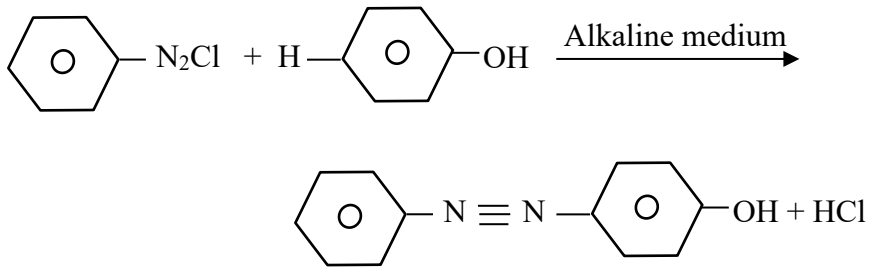
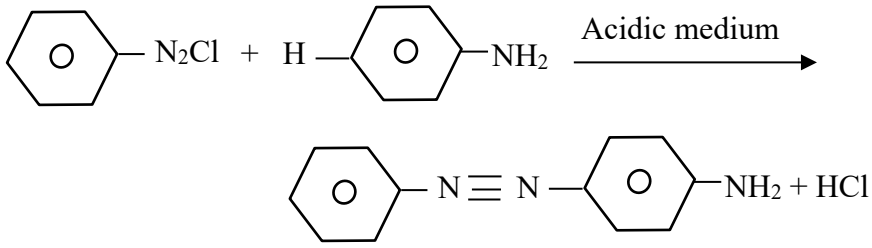
(ii) Most of the candidates missed the key words like 'Aniline is a Lewis base / it forms salt with Lewis acid' and thus lost marks while some of the candidates wrote the resonating structure of Aniline as the reason for not giving Friedel-Crafts reaction.

Suggestions for teachers

- Provide practice to the students to write named organic reactions with by-products and appropriate conditions.
- Give enough practice to write complete and balanced organic reactions.
- Emphasise that if the correct medium is not written then reaction will not take place.
- Explain reasoning type questions from different chapters of organic chemistry with correct key words such as aniline is Lewis base / Aniline forms salt with Lewis acid / it reacts with Anhy. $AlCl_3$ due to presence of lone pair on nitrogen atom etc.

MARKING SCHEME

Question 13

(i)	(a)	
	(b)	
(ii)	Aniline is a Lewis base and forms salt with Lewis acid. OR $C_6H_5NH_2 + AlCl_3 \longrightarrow C_6H_5NH_2AlCl_3^-$	

Question 14

[3]

(i) Aradhana visits a physician as she is suffering from rickets and joint pain. Which fat-soluble vitamin should the physician prescribe to her?

(ii) Somesh put few drops of vinegar in milk. What change do you think he observed in the milk after some time? What is this phenomenon known as?

(iii) Name the product of hydrolysis of sucrose. Is it a reducing sugar or a non-reducing sugar?

Comments of Examiners

(i) Most of the candidates could answer this question correctly. However, a few of the candidates responded with vitamin A or vitamin B.

(ii) Majority of the candidates gave explanation using incorrect terminologies like - the milk shall burst/crack rather than mentioning the proper observation such as curd/paneer. Some of the candidates mentioned the effects of denaturation of proteins – secondary, and tertiary structures getting destroyed but did not mention the term denaturation of proteins as the phenomena.

(iii) Most of the candidates got the first part correct and mentioned glucose or fructose correctly. However, many candidates wrote sucrose as reducing sugar instead or non-reducing sugar.

Suggestions for teachers

- Teach the various diseases caused by deficiency of various vitamins in the form of table including sources, symptoms and deficiency of diseases and facilitate discussion on the same.
- Stress upon the application of various concepts of biomolecules like denaturation and zwitter ion.
- Lay emphasis on the discussion of classification of carbohydrates in terms of hydrolysis and whether they are reducing /non reducing sugars based on the different functional groups.

MARKING SCHEME

Question 14

(i)	Vitamin D
(ii)	Milk gets converted into curd /cheese with the addition of Vinegar. The phenomenon is called denaturation of protein where globular milk protein becomes fibrous.
(iii)	Glucose or fructose $C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+ / \text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$ ($C_{12}H_{22}O_{11}$: sucrose) Sucrose is a non-reducing sugar.

Question 15

[3]

An aqueous solution containing 12·50 g of barium chloride in 1000g of water boils at 373·0834 K. Calculate the degree of dissociation of barium chloride.

Given K_b for H_2O = 0·52 K kg mol^{-1}; molecular mass of $BaCl_2$ = 208·34 g mol^{-1}

Comments of Examiners

Majority of the candidates wrote the formula correctly and most of them were able to find value of 'i' correctly. However, some candidates failed to find value of 'n' correctly, which was required to find degree of dissociation. Some of the candidates provided the correct formula to find degree of dissociation but substituted wrong values in it.

Suggestions for teachers

- Explain different methods of finding value of 'i'.
- Teach how to find value of 'n' with example of different reactions.

MARKING SCHEME

Question 15

Given; w = 12·50g, W = 1000g, Δ_{Tb} = 0.0834 K, K_b for H_2O = 0.52 K kg mol^{-1}

$M_{obs} = \frac{1000 \times k_b \times W}{\Delta T_b \times W} = \frac{1000 \times 0.52 \times 12{\cdot}50}{0{\cdot}0834 \times 1000} = 77{\cdot}94$ g mol^{-1}

$i = \frac{m_{normal}}{m_{observed}} = \frac{208.34}{77.94} = 2{\cdot}67$

for $BaCl_2 \longrightarrow Ba^{2+} + 2Cl^-$; n = 3

degree of dissociation $(\alpha) = \frac{i-1}{n-1} = \frac{2{\cdot}67-1}{3-1} = \frac{1{\cdot}67}{2} = 0{\cdot}835$ or 83·5%

Question 16 [3]

An organic compound C_2H_4O gives red precipitate when heated with Fehling solution. It also undergoes aldol condensation in the presence of dilute NaOH.

(i) Identify the organic compound and write its IUPAC name.

(ii) Which compound will be formed when this organic compound reacts with hydroxylamine?

(iii) What is observed when the compound, referred to in subpart (i), is heated with ammonical silver nitrate?

Comments of Examiners

(i) Majority of the candidates did not mention the IUPAC name of ethanal and wrote acetaldehyde or CH_3CHO.

(ii) Many of the candidates wrote wrong structural formula and name of the organic compound formed. Some candidates answered with 'oxine' or only 'oxime' instead of writing 'ethanal oxime'. A Few other candidates wrote the reaction with Benzaldehyde instead of ethanal.

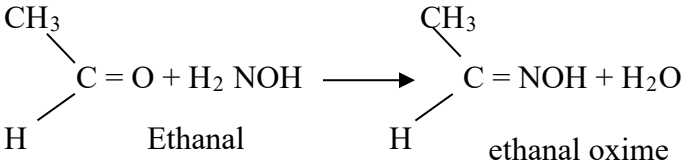
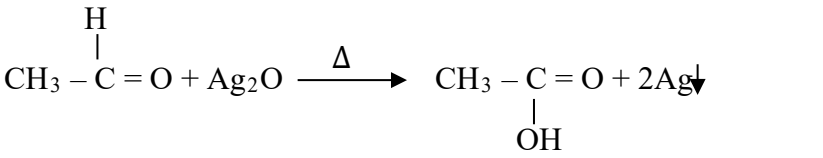
(iii) Most of the candidates wrote wrong observations and some candidates wrote wrong equations. A few of the candidates were confused and instead of 'silver mirror' answered with 'white ppt' or 'silvery white ppt'.

Suggestions for teachers

- Teach the students to read the IUPAC names of organic compounds in a tabular manner and take oral practice through class tests.
- Explain organic reactions with correct IUPAC names of reactants and products and give enough practice on writing correct organic reactions.
- Explain chemical tests of organic compounds with correct observation, reagent, and equations. Insist the students to always write correct observations.
- Elucidate to the students that silver mirror is formed on the walls of the test tube due to the 'silver ppt'.

MARKING SCHEME

Question 16

(i)	Ethanal or CH_3CHO
(ii)	
(iii)	 Ethanol Tollens reagent Ethanoic acid silver mirror

Question 17

[3]

(i) Identify the compounds [A], [B] and [C] in each of the following reactions.

(a) $C_2H_5OH \xrightarrow{PCl_5} [A] \xrightarrow{KCN} [B] \xrightarrow{H_3O^+} C_2H_5COOH \xrightarrow{NH_3} [C]$

(b) $C_6H_5OH \xrightarrow{Zn/dust} [A] \xrightarrow[\text{anhy. } AlCl_3]{CH_3Cl} [B] \xrightarrow[K_2Cr_2O_7+ H_2SO_4]{[O]} [C]$

OR

(ii) Give a chemical test to distinguish between the following pairs of compounds.

(a) Ethanol and methanol

(b) Ethanol and Ethanal

(c) Propan-2-ol and 2-methyl propan-2-ol

Comments of Examiners

(i) (a) Majority of the candidates identified [A] and [B] correctly but failed to identify compound [C]. Many candidates wrote $C_2H_5COONH_4$ instead of $C_2H_5CONH_2$ for the identification of compound [C]. Some candidates wrote molecular formula instead of writing correct structures or names of the organic compounds.

(b) Most of the candidates failed to identify [A], [B], and [C] correctly and some candidates identified [C] as C_6H_5CHO instead of C_6H_5COOH.

OR

(ii)(a) Some candidates wrote iodoform test to differentiate between ethanol and methanol and gave incomplete answers. They also mentioned that methanol gives negative iodoform test but did not write observation of yellow ppt for positive test with ethanol.

(b) Most of the candidates wrote iodoform test to differentiate between ethanal and ethanol but did not provide explanation to the observation for positive test and some of the candidates missed out to explain the negative test.

(c) Majority of the candidates could accurately answer the Lucas' test, but they were confused while writing observation.

Suggestions for teachers

- Give practice to students to identify organic compounds with their correct common names, IUPAC names, and structural formulae and ensure repeated revision of the same.
- Provide enough practice on the identification of organic compounds in class and teach the students named organic reactions, and oxidation reaction with correct equations.
- Instruct the students to write the correct name, structural formula or IUPAC name for identification of organic compounds.
- Instruct students to write reactions for differentiating tests along with observation like yellow ppt in this case.
- Give practise to write chemical reactions for differentiating tests along with writing a negative test is a must.
- Guide students to write what Lucas' reagent consists of along with correct observation for primary, secondary and tertiary alcohol.

MARKING SCHEME

Question 17

(i)	(a)	[A] = C_2H_5Cl [B] = $C_2H_5C{\equiv}N$ [C] = $C_2H_5-\overset{\overset{O}{\|}}{C}-NH_2$
	(b)	[A] = C_6H_6 [B] = $C_6H_5CH_3$ [C] = C_6H_5COOH
		OR
(ii)		
	(a)	Ethanol on heating with I_2 and aqueous alkali forms yellow ppt of iodoform while methanol does not. *(or any other suitable chemical test.)*
	(b)	Ethanal on heating with Tollen's reagent gives shining silver mirror on the walls of the test while ethanol does not. *(or any other suitable chemical test.)*
	(c)	With Lucas' reagent propan-2-ol will give turbidity after 5 minutes while 2-methyl propan-2-ol will give turbidity immediately. *(or any other suitable chemical test.)*

Question 18

[3]

(i) The rate constant of a reaction at 500K and 700K are 0·02 sec^{-1} and 0·07 sec^{-1} respectively. Calculate the value of E_a. (activation energy).

(ii) A radioactive substance which emits alpha particle follows first order reaction. The half-life period of this radioactive substance is 30 hours. Calculate the fraction in percent (%) of the radioactive substance which remains after 90 hours.

Comments of Examiners

(i) Most of the candidates answered this question correctly. However, A few candidates used the value of T_1 and T_2 in place of K_1 and K_2. A few candidates answered with incorrect formula or used the value of gas constant R as 0.0821 Lit-atm K^{-1} mol^{-1} instead of 8.314 J $K^{-1}mol^{-1}$.

(ii) Most of the candidates could calculate the value of rate constant (k) but could not calculate the fraction in percent of radioactive substance left.

Suggestions for teachers

- Provide students with practice on numerical problems based on Arrhenius equation and determination of activation energy with appropriate unit.
- Give adequate practice to the students in solving numerical problems based on order of reaction, rate constant, half-life period and fraction of substance left after certain time.

MARKING SCHEME

Question 18

(i)	Given, $K_1 = 0{\cdot}02$ sec^{-1} $K_2 = 0 \cdot 07\ sec^{-1}$ $T_1 = 500K$ $T_2 = 700$K $\log\frac{K_2}{K_1} = \frac{E_a}{2.303\ R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ or $\log\frac{0{\cdot}07}{0{\cdot}02} = \frac{E_a}{2.303 \times 8.314}\left[\frac{700-500}{700\times500}\right]$ $0{\cdot}544 = \frac{E_a}{2{\cdot}303 \times 8{\cdot}314}\left[\frac{200}{350000}\right]$ $E_a = 18228 \cdot 079\ Jor\ 18 \cdot 2281\ kJ$
(ii)	$k = \frac{0{\cdot}693}{t_{\frac{1}{2}}} = \frac{0.693}{30} = 0{\cdot}0231\ hour^{-1}$ $0 \cdot 0231 = \frac{2{\cdot}303}{90}\log\frac{100}{N}$ $N = 12{\cdot}5\ \%$

SECTION D – 15 MARKS

Question 19

[5]

(i) An organic compound [A], having a specific smell forms two compounds [B] and [C] by reacting with conc. sodium hydroxide. The molecular formula of compound [B] is C_7H_8O, which forms compound [A] again on oxidation. Compound [C] forms benzene on heating with soda lime.

Write the structures of compounds [A], [B] and [C]. Also, write the reactions involved.

(ii) Identify the compounds [A] and [B] in the reactions given below:

(a) $C_6H_6 \xrightarrow[AlCl_3(anhy.)]{CH_3Cl}$ [A] $\xrightarrow[K_2Cr_2O_7 + H_2SO_4]{[O]}$ [B]

(b) $CH_3\text{-}CHOH\text{-}CH_3 \xrightarrow[K_2Cr_2O_7 + H_2SO_4]{[O]}$ [A] $\xrightarrow{NH_2OH}$ [B]

Comments of Examiners

(i) Majority of the candidates identified compound [A] and compound [B] correctly, but they identified compound [C] incorrectly. Some candidates identified C_6H_5COOH as compound [C] instead of C_6H_5COONa. Many candidates could not answer the correct equations for Cannizzaro's reaction and some of them failed to answer the correct equation for formation of C_6H_6 from C_6H_5COONa.

(ii) (a) Some of the candidates correctly identified [A] which was the correct answer while a few were confused and answered with C_6H_5-C_2H_5/C_6H_5-CH_2OH instead of C_6H_5-CH_3 as compound [A].

(b) Most of the candidates identified the compound [A] correctly but many failed to identify the compound [B].

Suggestions for teachers

- Instruct students not to write molecular formula of compounds.
- Train students to write structural formula accurately.
- Acquaint students with correct IUPAC names and encourage them to write the correct names.
- Instruct students to write the conditions and biproducts and balance the reactions.
- Stress upon the importance of writing heat sign for decarboxylation reactions as without that reaction does not take place.
- Explain clearly the distinction between diluted and concentrated NaOH as the products are different for diluted and concentrated NaOH.
- Instruct students to write the final product for oxidation reactions and to avoid writing the intermediate products.
- Give students practice on the reaction of ammonia and its derivatives with addition or elimination and the products formed.

MARKING SCHEME

Question 19

(i)

$$2C_6H_5CHO + NaOH \longrightarrow \underset{[B]}{C_6H_5CH_2OH} + \underset{[C]}{C_6H_5COONa}$$
$$\underset{[A]}{\quad}$$

$$\underset{[B]}{C_6H_5CH_2OH} \xrightarrow{[O]} \underset{[A]}{C_6H_5CHO} + H_2O$$

$$C_6H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_6H_6 + Na_2CO_3$$

[A] = C_6H_5CHO or Benzaldehyde

[B] = $C_6H_5CH_2OH$ or Benzyl alcohol

[C] = C_6H_5COONa or Sodium benzoate

(ii) (a) [A] $C_6H_5CH_3$, Toluene
[B] C_6H_5COOH, Benzoic acid

(b) [A] CH_3COCH_3, Acetone

		[B] CH_3 \ C = NOH, Acetone oxime / CH_3

Question 20

[5]

(i) A coordination compound has a formula $CoCl_3.4NH_3$. It precipitates silver ions as AgCl and its molar conductance corresponds to a total of two ions.

Based on this information, answer the following questions.

(a) Deduce structural formula of the complex compound.

(b) Write the IUPAC name of the complex compound.

(c) Draw the geometrical isomers of the complex compound.

(ii) Give a chemical test to show that $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$ are ionisation isomers.

Comments of Examiners

(i) (a) Some of the candidates were unclear and answered with $[Co(NH_3)_4]Cl_3$ or $[Co(NH_3)Cl]Cl_2$ instead of $[Co(NH_3)_4Cl_2]$ Cl.

(b) Most of the candidates were unable to write IUPAC name of given complex correctly. They wrote tetraammine as tetramine. Also, many candidates were not able to find oxidation state of given metal ion and most of them after writing complex name wrote ion, which is not correct.

(c) Very few candidates were able to draw the cis and transform of complex. Majority of the candidates instead of taking 2 chlorine ligands in complex took 3 chlorine ligands. Many of the candidates were not well-versed with the meaning of cis and trans.

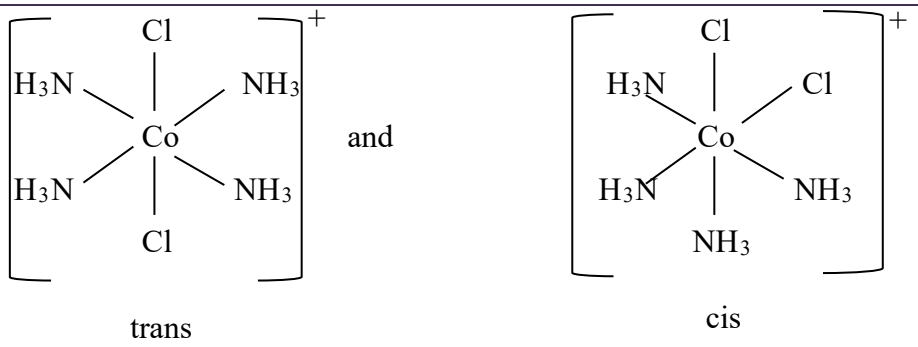
(ii) Many of the candidates gave incorrect reagent and their incorrect observations. For the first complex compound, instead of $BaCl_2$, some candidates wrote $BaSO_4$ as reagent. Similarly, for the second isomer some candidates wrote AgCl instead of $AgNO_3$. A few of the candidates wrote light yellow ppt. is observed with $AgNO_3$.

Suggestions for teachers

- Emphasise on Werner theory in terms of ionic sphere.
- Provide more practice to decide number of ions in ionic sphere based on precipitation and total number of ions formed and discuss the same.
- Lay emphasis on correct usage of nomenclature of complexes. Ensure that students are well-versed with the correct nomenclatures.
- Lay stress on where to write 'aa' and 'mm' in IUPAC name of complexes.
- Provide enough practice to find oxidation state of metal ion in complexes.
- Teach the difference between ion and complex, to overcome the common errors that students commit such as writing ion after IUPAC name.
- Give enough practice to draw isomers of a given complex.
- With due emphasis clarify that all ligands need not be in the complex part to avoid common errors. Such as in this particular example, only 2 Cl are present inside complex and one is present outside the complex which need not be drawn.
- Explain with the help of diagrams how to draw cis and trans isomers and give adequate practice of the same.
- Explain ionization isomer in class with suitable examples and instruct the students to write correct reagent and correct observations to distinguish chemically between two ionization isomers.

MARKING SCHEME

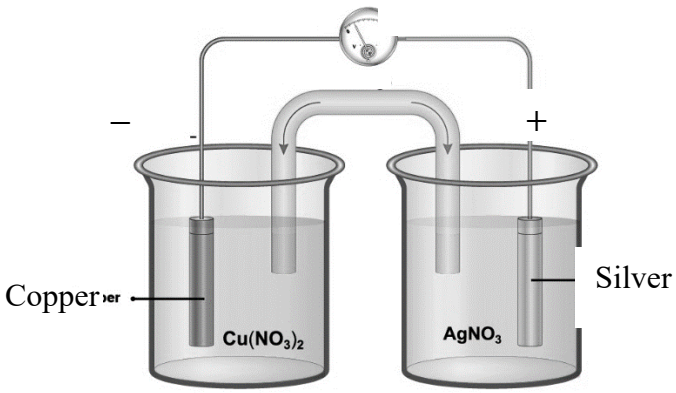
Question 20

(i)		
	(a)	$[Co(NH_3)_4Cl_2]Cl$
	(b)	tetraamminedichloridecobalt(III) chloride
	(c)	 trans and cis
(ii)	$[Co(NH_3)_5Cl]SO_4 + BaCl_2 \longrightarrow$ white ppt. $[Co(NH_3)_5SO_4]Cl + AgNO_3 \longrightarrow$ white ppt.	

Question 21

[5]

(i) (a) Study the diagram given below that represents Cu-Ag electrochemical cell and answer the questions that follow.



Given $E^0_{(Cu^{2+}/Cu)} = 0{\cdot}337$ V ; $E^0_{(Ag^+/Ag)} = 0{\cdot}799$ V

(1) Write the cell reaction for the above cell.

(2) Calculate the standard emf of the cell.

(3) If the concentration of $[Cu^{2+}]$ is 0·1 M and E_{cell} is 0·422 V, at 25^0 C, calculate the concentration of $[Ag^+]$.

(4) Calculate ΔG for the cell.

(b) Calculate $\wedge^0_m$ for $BaCl_2$ and $Al_2(SO_4)_3$ from the following data.

For $\wedge_m^0 Ba^{2+}$ = 127·2 S cm^2 mol^{-1} , $\wedge_m^0 Al^{3+}$ = 189 S cm^2 mol^{-1}

$\wedge_m^0 Cl^-$ = 76·3 S cm^2 mol^{-1} , $\wedge_m^0 SO_4^{2-}$ = 160 S cm^2 mol^{-1}

OR

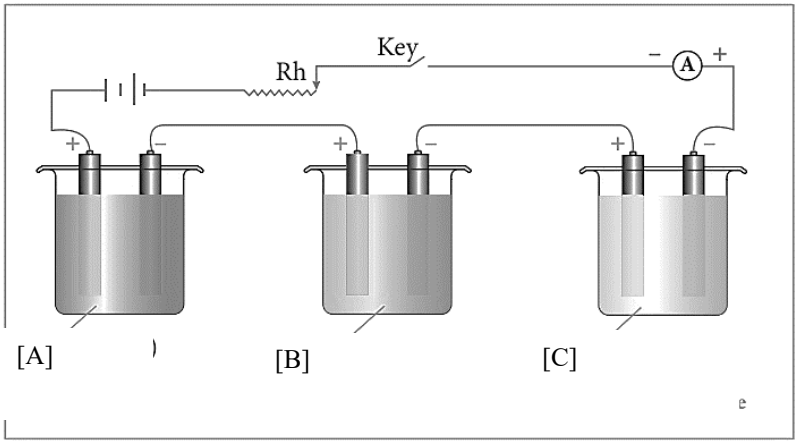
(ii) (a) A 0·05 M NH_4OH solution offers the resistance of 30·8 ohms to a conductivity cell at 298K. If the cell constant is 0·343 cm^{-1} and molar conductance of NH_4OH at infinite dilution is 471·4 S cm^{2}mol^{-1}, calculate the following:

(1) Specific conductance

(2) Molar conductance

(3) Degree of dissociation

(b) In the diagram of the electrolytic cell given below, A, B and C are connected in series having electrolytes of $ZnSO_4$, $AgNO_3$ and $CuSO_4$ respectively. A steady current of 1·5 A was passed until 1·45 g of Ag was deposited at the cathode of cell B.



(Atomic mass of Ag = 108, Cu = 63·5, Zn = 65·3)

Answer the following questions.

(1) How long did the current flow?

(2) What weight of Cu and Zn was deposited at cathode?

Comments of Examiners

(i)(a)(1) Majority of the candidates wrote incorrect and unbalanced cell reaction. Some candidates wrote cathode and anode reaction separately but did not write overall cell reaction.

(2) Most of the candidates gave the correct value of $E^0_{cell.}$ A few candidates wrote a negative value of E^0_{cell}, which was incorrect.

(3) The Nernst equation was written erroneously by most of the candidates. Also, some candidates made calculation errors.

(4) Some candidates instead of calculating ΔG calculated ΔG^0 which was not required. A few candidates wrote the wrong formula and did not express the answer with negative sign.

(b) Most of the candidates could correctly calculate the answer but a few of them did not use the respective number of ions in the formula to calculate the molar conductance at infinite dilution for $BaCl_2$ and $Al_2(SO_4)_3$.

OR

(ii)(a)(1) A large number of candidates who attempted this part answered correctly.

(2) Majority of the candidates attempted this part of the question correctly and only a few candidates who took approximate values got incorrect answers.

(3) Many candidates applied incorrect formula for the calculation of degree of dissociation.

(b) (1)Most of the candidates attempted this part correctly.

(2)A large number of the candidates attempted this part correctly.

Suggestions for teachers

- Explain the cell reactions taking place at reduction half-cell and oxidation half-cell and instruct them to write the overall cell reaction with balanced equation.
- Teach the students to calculate E^0_{cell} and E_{cell} correctly and stress on the fact that the value of E^o_{cell}/E_{cell} cannot be negative as if E^0_{cell} value is negative then the cell will not work.
- Make students practice numerical problems on 'Nernst equation' with correct formula, substitution and to answer with the correct unit.
- Advise the students to read the numerical problems carefully and ensure that they write the correct answer with right sign.
- Give enough practice in class on the numerical problems based on Kohlrausch's law.
- Provide practise to students on numerical problems.
- Instruct the students to take four places after decimal.
- Give practice of numericals on the degree of dissociation.
- Explain Faraday's first and second law of electrolysis with numericals.

MARKING SCHEME

Question 21

(i)

(a)

(1) Cell reaction

$Cu_{(s)} + 2Ag^{+}_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$

(2) $E^0_{cell} = E^0_C - E^0_A$

$= 0{\cdot}799 - 0{\cdot}337 = 0{\cdot}462$ V

(3) $E_{cell} = E^0_{cell} - \frac{0{\cdot}0591}{n} \log \frac{[Cu^{+2}]}{[Ag^{+}]^2}$ or

$0{\cdot}422 = 0{\cdot}462 - \frac{0{\cdot}0591}{2} \log \frac{[0{\cdot}1]}{[Ag^{+}]^2}$

$[Ag^{+}] = 0{\cdot}0666$ m

(4) $\Delta G = -nfE$

$= -2 \times 96500 \times 0{\cdot}422$

$= -81{,}446$ J or $81{\cdot}446$ kJ

(b) $\wedge^0_{BaCl_2} = \wedge^0_m(Ba^{2+}) + 2\wedge^0_m(Cl^{-})$

$= 127 + 2 \times 76{\cdot}3 = 279{\cdot}6$ S cm^2 mol^{-1}

$\wedge^0_m = \wedge^0_m(Al^{3+}) + \wedge^0_m(SO_4^{2-})$

$= 2 \times 189 + 3 \times 160$

$= 858$ S cm^2 mol^{-1}

OR

(ii)

(a) Given, C = 0·05 M, R = 30·8ohm , $\frac{l}{a} = 0{\cdot}343 cm^{-1}$

$\wedge^0_m = 471{\cdot}4$ S cm^2 mol^{-1}

(1) Specific conductance $(\kappa) = \frac{1}{R} \times \frac{1}{a}$

$= \frac{1}{30.8} \times 0 \cdot 343 = 0{\cdot}011136$ S cm^{-1}

(2) Molar conductance $(\wedge_m) = \kappa \times \frac{1000}{C}$

$= 0{\cdot}011136 \times \frac{1000}{0{\cdot}05}$

$= 222.72$ S cm^2 mol^{-1}

		(3)	Degree of dissociation $(\alpha) = \frac{\wedge_m^c}{\wedge_m^0}$ $= \frac{222.72}{471{\cdot}4} = 0{\cdot}472$ or $47{\cdot}2\%$
	(b)		
		(1)	Given weight of Ag= 1·45 g $i = 1{\cdot}5$A W = zit or W= $\frac{E}{96500}$ it or $1 \cdot 45 = \frac{108}{1 \times 96500} \times 1{\cdot}5 \times t$ $\therefore t = 863{\cdot}73$ seconds or 14·39 min.
		(2)	$\frac{Weight of Cu}{Weight of Ag} = \frac{Equivalent weight of Cu}{Equivalent weight of Ag}$ $\frac{Weight of Cu}{1{\cdot}45} = \frac{\frac{63{\cdot}5}{2}}{\frac{108}{1}}$ $\therefore Cu = 0{\cdot}426$ g $\frac{Weight of Zn}{Weight of Ag} = \frac{Equivalent weight of Zn}{Equivalent weight of Ag}$ $\frac{Weight of Zn}{1{\cdot}45} = \frac{\frac{65{\cdot}3}{2}}{\frac{108}{1}}$ $\therefore Zn = 0{\cdot}438$ g

Note: For questions having more than one correct answer/solution, alternate correct answers/solutions, apart from those given in the marking scheme, have also been accepted.