CHEMISTRY
PAPER 1
(THEORY)

Maximum Marks: 70
Time Allotted: Three Hours
Reading Time: Additional Fifteen Minutes

Instructions to Candidates

1. You are allowed an **additional fifteen minutes** for **only** reading the question paper.
2. You must **NOT** start writing during the reading time.
3. This question paper has **9 printed pages**.
4. It is divided into **four sections** and has **twenty one questions** in all.
5. Answer **all** questions.
6. **Section A** has **fourteen subparts**. Each question carries 1 mark.
7. While attempting **Multiple Choice Questions** in Section A, you are required to **write only ONE option as the answer**.
8. **Section B** has **ten questions**. Each question carries 2 marks.
9. **Section C** has **seven questions**. Each question carries 3 marks.
10. **Section D** has **three questions**. Each question carries 5 marks.
11. ***Internal choices*** have been provided in ***one question each in Sections B, C and D.***
12. The intended marks for questions are given in brackets [ ].
13. All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
14. Balanced equations must be given wherever possible and diagrams where they are helpful.
15. When solving numerical problems, all essential workings must be shown.
16. In working out problems, use the following data:

Gas constant $R = 1{\cdot}987 cal\ deg^{-1} mol^{-1} = 8{\cdot}314 JK^{-1} mol^{-1}$
$= 0{\cdot}0821 dm^3 atm K^{-1} mol^{-1}$, *1 l atm* $= 1 dm^3 atm = 101{\cdot}3$ *J.*
1 Faraday=96500 coulombs. Avogadro's number= $6{\cdot}023 \times 10^{23}$.

Instruction to Supervising Examiner

1. Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

Note: The Specimen Question Paper in the subject provides a realistic format of the Board Examination Question Paper and should be used as a practice tool. The questions for the Board Examination can be set from any part of the syllabus, though the format of the Board Examination Question Paper will remain the same as that of the Specimen Question Paper. The weightage allocated to various topics, as given in the syllabus, will be strictly adhered to.

SECTION A - 14 MARKS

Question 1

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

[electrophilic, four, 4-bromophenol, first, alc. AgCN, decreases, 2,4,6-tribromophenol, nucleophilic, two, zero, alc. KCN, increases]

(i) The addition of a non-volatile solute to a pure solvent _____ its vapour pressure and _____ its boiling point. **(Understanding)**

(ii) When the concentration of a reactant of first order reaction is doubled, the rate becomes _____ times but for _____ order reaction the rate remains the same. **(Understanding)**

(iii) Phenol when treated with bromine water produces _____, which is an example of _____ substitution reaction. **(Recall)**

(iv) Methyl chloride on treatment with _____ gives methyl cyanide, whereas on treatment with _____, it gives methyl isocyanide. **(Understanding)**

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

(i) The sum of coordination number and oxidation number of metal 'M' in the complex $[M(en)_2Cl_2]$ is: **(Application)**

(a) 6

(b) 8

(c) 9

(d) 10

(ii) Which of the following orders is correct in spectrochemical series of ligands? **(Analysis)**

(P) $I^- < NH_3 < CN^- < CO$

(Q) $CO < I^- < NH_3 < CN^-$

(R) $NH_3 < CO < CN^- < I^-$

(S) $F^- < NH_3 < CN^- < CO$

(a) Only (Q) and (S) are correct.

(b) Only (P) and (S) are correct.

(c) Only (P) and (Q) are correct.

(d) Only (P) and (R) are correct.

(iii) When Chlorobenzene is heated with aq. ammonia in the presence of Cu_2O at high pressure, it gives: **(Recall)**

(a) aniline.

(b) phenyl isocyanide.

(c) diphenyl.

(d) diphenylamine.

(iv) Hydrolysis of sucrose is called: **(Recall)**

(a) esterification.

(b) saponification.

(c) hydration.

(d) inversion.

(v) An organic compound with molecular formula C_3H_6O does not give silver mirror test with Tollen's reagent but gives an oxime with hydroxylamine. The compound is: **(Understanding)**

(a) CH_3CH_2CHO

(b) CH_3-CO-CH_3

(c) CH_2=CH-CH_2OH

(d) CH_2=CH-O-CH_3

(vi) Given below are two statements marked Assertion and Reason. Read the two statements carefully and select the correct option. **(Analysis)**

Assertion: 0·1 M sucrose solution has higher depression in the freezing point than 0·1 M urea solution.

Reason: Depression in freezing point is not a colligative property.

(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 and Reason is false.

(d) Both Assertion and Reason are false.

(vii) Given below are two statements marked Assertion and Reason. Read the two statements carefully and select the correct option. **(Application)**

Assertion: Methoxy ethane reacts with HI at 373K to give ethanol and iodomethane.

Reason: Reaction of unsymmetrical ether with HI follows S_N2 mechanism.

(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 and Reason is false.

(d) Both Assertion and Reason are false.

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

Vishal set up an experiment to find the resistance of aqueous KCl solution for different concentrations at 298K using a conductivity cell connected to a Wheatstone bridge. He fed the Wheatstone bridge with A.C. power in the audio frequency range 550 to 5000 cycles per second. Once the resistance was calculated from null point, he also calculated the conductivity (κ) and molar conductivity (Λ_m) and recorded his readings in tabular form which is given below.

S.No.	Conc. (M)	κ (S cm^{-1})	Λ_m (S cm^2 mol^{-1})
1.	1·00	$111·3 \times 10^{-3}$	111·3
2.	0·10	$12·9 \times 10^{-3}$	129·0
3.	0·01	$1·41 \times 10^{-3}$	141·0

(i) Why did the molar conductivity increase though the conductivity decreased with dilution? **(Understanding)**

(ii) If molar conductivity at infinite dilution (Λ^o_m) of KCl is 150·0 S cm^2 mol^{-1}, calculate the degree of dissociation of 0·01 M KCl. **(Application)**

(iii) The conductivity of a 0·01M solution of acetic acid at 298 K is $1·65 \times 10^{-4}$ S cm^{-1}. Calculate the molar conductivity of the solution. **(Application)**

SECTION B – 20 MARKS

Question 2 **[2]**

Consider yourself a research scholar in the forensic science department studying the age of a dead biological sample. During one of the studies, you found that the sample decomposed by following first order kinetics.

If 50% of the sample is decomposed in 120 minutes, how long will it take for 90% of the sample to decompose? **(Application)**

Question 3 **[2]**

Write the chemical equations to convert each of the following: **(Recall)**

(i) Aniline to bromobenzene

(ii) Ethyl chloride to propanoic acid

Question 4 **[2]**

Using IUPAC nomenclature, write the formula for each of the following: **(Recall)**

(i) hexaamminecobalt (III) sulphate

(ii) tetraaquadichloridochromium (III) nitrate

Question 5 **[2]**

When 2g of benzoic acid (C_6H_5COOH) is dissolved in 25g of benzene, it shows a depression in freezing point equal to 1·62 K. Molal depression constant for benzene is 4·7 K kg mol^{-1}.

What is the percentage association of acid if it forms dimer in solution? **(Application)**

Question 6 **[2]**

How will you convert the following (write chemical equation): **(Understanding)**

(i) Phenol to salicylaldehyde

(ii) Formaldehyde to ethanol

Question 7 **[2]**

The molar conductivities at infinite dilution (Λ^{∞}_m) for NaI, CH_3COONa and $(CH_3COO)_2Mg$ are 126·9, 91·0 and 187·8 ohm^{-1} cm^2 mol^{-1} respectively at 25°C.

What is the molar conductivity of MgI_2 at infinite dilution? **(Application)**

Question 8 **[2]**

(i) Which divalent metal ion in weak field ligand has maximum paramagnetic character among the first transition metal series (3d series)? Why?

(Analysis)

(ii) The melting and boiling points of Zn, Cd and Hg are low. Why? **(Analysis)**

Question 9 **[2]**

(i) What happens when carbonyl compound is treated with zinc amalgam and concentrated hydrochloric acid? Give chemical equation and write the name of the reaction. **(Recall)**

OR

(ii) Write chemical equations to convert each of the following: **(Recall)**

(a) Acetic acid to acetaldehyde

(b) Formaldehyde to urotropine

Question 10 **[2]**

In general, it is observed that the rate of a chemical reaction becomes double with every 10°C rise in temperature. If this generalisation holds correct for a reaction, calculate the value of activation energy when temperature changes from 298 K to 308 K. ($R = 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$) **(Application)**

Question 11 **[2]**

Write the chemical equation for each of the following named organic reactions: **(Recall)**

(i) Hofmann's degradation reaction

(ii) Balz-Schiemann reaction

SECTION C – 21 MARKS

Question 12 **[3]**

How will you convert the following? (Write chemical equations) **(Understanding)**

(i) Phenol from benzene sulphonic acid

(ii) Ethyl alcohol from ethylamine

(iii) Diethyl ether from ethyl alcohol

Question 13 **[3]**

(i) Complete and balance the following equations: **(Understanding)**

(a) $K_2Cr_2O_7 + FeSO_4 + H_2SO_4 \longrightarrow$ _____ + _____ + _____ + _____

(b) $KMnO_4 + KI + H_2SO_4 \longrightarrow$ _____ + _____ + _____ + _____

(ii) Explain how the colour of $K_2Cr_2O_7$ solution depends on pH of the solution. **(Analysis)**

Question 14 **[3]**

Write the structural formula of the major product formed in each of the following reactions. **(Recall)**

(i) $C_6H_5ONa + C_2H_5Cl \longrightarrow$

(ii) $C_2H_5NH_2 + CHCl_3 + KOH_{(alc.)} \xrightarrow{warm}$

(iii) $CH_3CH_2CH_2Cl + NaI \xrightarrow{Aetone+heat}$

Question 15 **[3]**

(i) Which vitamin deficiency is responsible for xerophthalmia and night blindness? **(Recall)**

(ii) What are the products formed upon hydrolysis of lactose? **(Recall)**

(iii) When grapes are placed in a salt solution, they tend to shrink. Why? **(Analysis)**

Question 16 **[3]**

(i) (a) A 0·01 M solution of NaCl is diluted by adding water. What will happen to its specific conductivity and molar conductivity? **(Understanding)**

(b) Is it safe to stir 1M $AgNO_3$ solution with a copper spoon? Explain.
(Given: $E^o(Cu^{2+}/Cu) = +0·34V$, $E^o(Ag^+/Ag) = +0·80V$) **(Evaluate)**

(c) Two metals A and B have standard reduction potential values -2·37V and +0·80V respectively. Which of these will liberate H_2 gas from dil. HCl.? **(Analysis)**

OR

(ii) (a) Calculate the values of E_{cell} and ΔG for the following cell reaction at 25°C:
$Zn_{(s)}/Zn^{2+}_{(0.0004M)} \,||\, Cd^{2+}_{(0.2M)}/Cd_{(s)}$

(Given; $E^o_{(Zn^{2+}/Zn)} = -0·763V$; $E^o_{(Cd^{2+}/Cd)} = -0·403V$
1 Faraday = 96,500 coulombs, R = 8·314 $JK^{-1}\,mol^{-1}$) **(Application)**

(b) Calculate how long it will take to deposit 1·0 g of chromium when a current of 1·25 ampere flows through a solution of chromium (III) sulphate.
(Atomic weight of Cr = 52, 1 Faraday = 96,500 coulombs.) **(Application)**

Question 17 **[3]**

(i) The unit of rate constant of a reaction is same as that of its rate of reaction. Find the order of this reaction. **(Understanding)**

(ii) Give one example of pseudo first order reaction. **(Recall)**

(iii) How will the rate of reaction be affected when the surface area of the reactant is reduced? **(Understanding)**

Question 18 **[3]**

Identify the compounds [A], [B] and [C] in the following reactions: **(Analysis)**

(i) $C_6H_5CONH_2 \xrightarrow{Br_2 / aq.KOH} [A] \xrightarrow{NaNO_2+HCl\ (ice\ cold)} [B] \xrightarrow{Cu_2Cl_2+HCl} [C]$

(ii) $CH_3C{\equiv}N \xrightarrow{4[H]} [A] \xrightarrow{HNO_2\ (0^oC)} [B] \xrightarrow{SOCl_2\ (Pyridine)} [C]$

SECTION D – 15 MARKS

Question 19 **[5]**

(i) What happens when (Give chemical equations): **(Understanding)**

(a) Propanone is treated with CH_3MgBr and then hydrolysed.

(b) Formaldehyde undergoes Cannizzaro's reaction.

(c) Acetic acid reacts with $SOCl_2$ and the main product obtained is reduced with H_2 in the presence of $Pd/BaSO_4$.

(ii) An aromatic compound [A] gives a buff-coloured precipitate on treatment with neutral $FeCl_3$ solution. Compound [A] reacts with thionyl chloride to give compound [B], which on reacting with ammonia followed by heating gives compound [C]. Compound [C] on treatment with bromine in KOH forms [D] with molecular formula C_6H_7N and has a characteristic odour. Identify the compounds [A], [B], [C] and [D]. **(Analysis)**

Question 20 **[5]**

(i) An aqueous solution contains 0·63 g of protein in 300 cm^3 of water. The osmotic pressure of the solution at 300K is $1{\cdot}29 \times 10^{-3}$ atm. Calculate the molecular mass of protein.

(Given R = 0·0821 Lit atm K^{-1} mol^{-1}) **(Application)**

(ii) What mass of ethylene glycol must be added to 5·50 kg of water to lower the freezing point of water from 0 °C to -10·0 °C?

(K_f for water = 1·86 °C kg mol^{-1}, molecular weight of ethylene glycol = 62·0 g mol^{-1}) **(Application)**

(iii) Outer hard shells of two eggs are removed. One of the eggs is placed in saturated solution of sodium chloride and the other egg is placed in pure water. What change will be observed and why? **(Analysis)**

(iv) What would be the value of van't Hoff factor for a dilute solution of K_2SO_4 in water. Assume that K_2SO_4 is completely ionised. **(Analysis)**

Question 21 **[5]**

(i) Answer the following:

(a) When the coordination compound $CoCl_3.6NH_3$ is mixed with $AgNO_3$ solution, three moles of AgCl are precipitated per mole of the compound. Write the structural formula of the complex compound. **(Analysis)**

(b) Predict the number of unpaired electrons in $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$ based on crystal field theory. **(Evaluate)**

(c) Draw a diagram to show the splitting of d-orbitals in a tetrahedral crystal field. **(Recall)**

(d) Write the formulae for the following: **(Recall)**

(1) Linkage isomer of $[CoCl(en)_2(NO_2)]Cl_2$

(2) Ionisation isomer of $[CoBr(NH_3)_5]SO_4$

OR

(ii) (a) For the complex compound $[Fe(en)_2Cl_2]Cl$, identify the following: **(Application)**

(1) Oxidation state

(2) Hybridisation of the central metal atom

(3) Magnetic behaviour of the complex

(4) Geometry of the complex

(b) Draw the structures of geometrical isomers of complex $[Pt(en)_2Cl_2]^{2+}$. **(Recall)**

(c) On the basis of crystal field theory, write the electronic configuration for d^4 ion in octahedral crystal field, if $\Delta_o > P$. **(Application)**

CHEMISTRY PAPER 1
(THEORY)
ANSWER KEY

SECTION A - 14 MARKS

Question 1

(A) **[4×1]**

(i) decreases, increases

(ii) two, zero

(iii) 2,4,6 – tribromophenol, electrophilic

(iv) alc. KCN, alc. AgCN

(B) **[7×1]**

(i) (c) or 9

(ii) (b) or Only (P) and (S) are correct.

(iii) (a) or aniline

(iv) (d) or inversion

(v) (b) or CH_3-CO-CH_3

(vi) (d) or Both Assertion and Reason are false

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

(C) **[3×1]**

(i) The conductivity of a solution is the conductance of ions present in a unit volume of the solution. With dilution, the number of ions per unit volume decreases. Hence, conductivity decreases with dilution. The molar conductance (Λ_m) is the product of conductivity (κ) and the volume of the solution containing 1 mole of the electrolyte.

$\Lambda_m = \kappa \times V_m$

Hence, Λ_m increases on dilution.

(ii) Given; $\Lambda^o_m = 150.0$ S cm^2 mol^{-1}, $\Lambda^c_m = 141.0$ S cm^2 mol^{-1}

Molarity of KCl = 0.01 M

Degree of dissociation (α) = $\frac{\Lambda^c_m}{\Lambda^o_m}$ or $\alpha = \frac{141.0}{150.0}$

$\alpha = 0.94$ or 94%

(iii) Calculation of molar conductivity of solution.

$\Lambda_m = \frac{\kappa \times 1000}{\text{Molarity}}$ or

$\Lambda_m = \frac{1.65 \times 10^{-4} \times 1000}{0.01}$

= 16.5 S cm^2 mol^{-1}

SECTION B – 20 MARKS

Question 2 **[2]**

$t_{1/2}$ = 120 min, a = 100, (a-x) = (100-90) = 10

$k = \frac{0.693}{t_{1/2}}$ = 0.005775 min^{-1}

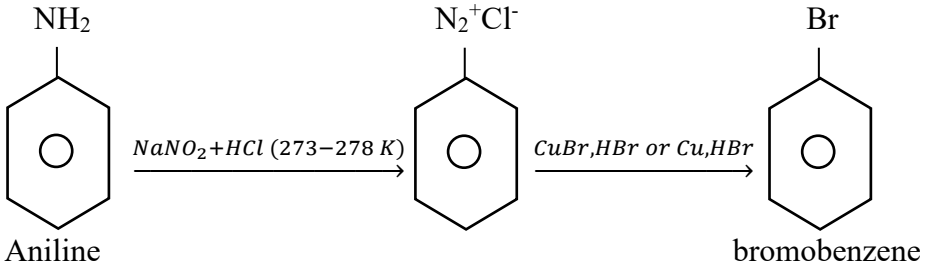
$t = \frac{2.303}{\kappa} \log \frac{a}{(a-x)}$ or

$t = \frac{2.303}{0.005775} \log \frac{100}{10}$

$t = \frac{2.303}{\kappa}$ x 1 = 398.79 minutes

Question 3 **[2]**

(i) Aniline to bromobenzene



(ii) Ethyl chloride to propanoic acid

$CH_3CH_2Cl \xrightarrow{alc.KCN} CH_3CH_2CN \xrightarrow{H^+; H_2O\ (Hydrolysis)} CH_3CH_2COOH$

Ethylchloride Propanoic acid

Question 4 **[2]**

(i) hexaammine cobalt (III) sulphate

Ans: $[Co(NH_3)_6]SO_4$

(ii) tetraaquadichloridochromium (III) nitrate

Ans: $[Cr(H_2O)_4Cl_2]NO_3$

Question 5 **[2]**

Given; wt. of solute = 2.0g, wt. of solvent = 25g

ΔT_f = 1.62 K, k_f = 4.7 K kg mol^{-1}

M_{normal} = 122 g mol^{-1}

$m_{obs} = \frac{1000 \times k_f \cdot w}{\Delta T_f \times w}$

$= \frac{1000 \times 4.7 \times 2}{1.62 \times 25}$

$= 241.98 \text{ g mol}^{-1}$

$i = \frac{\text{Normal mol. wt}}{\text{observed mol. wt}} = \frac{122.0}{241.98}$ or

$= 0.504$

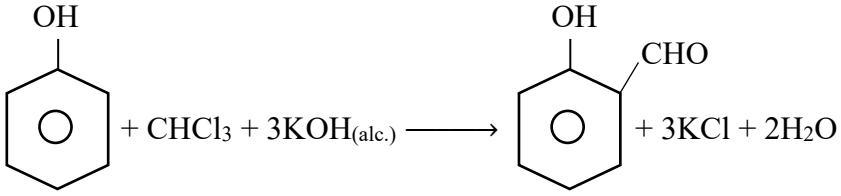
Degree of dissociation (α) $= \frac{1-i}{1-\frac{1}{h}} = \frac{1-0.504}{1-\frac{1}{2}} = \frac{0.496}{\frac{1}{2}}$

$(\alpha) = 0.496 \times 2$

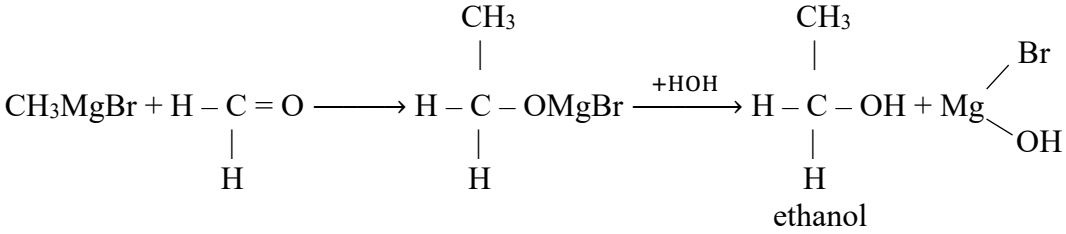
$= 0.992 = 99.2\%$

Question 6 **[2]**

(i) Phenol to salicylaldehyde



(ii) Formaldehyde to ethanol



Question 7 **[2]**

Molar conductivity at infinite dilution (Λ^o_m) for MgI_2 may be calculated as:

$\Lambda^o_m (MgI_2) = \Lambda^o_m(CH_3COO)_2Mg + 2\Lambda^o_m(NaI) - 2\Lambda^o_m(CH_3COONa)$

$= 187.8 + 2 \times 126.9 - 2 (91.0)$

$= 259.6 \text{ S cm}^2 \text{ mol}^{-1}$

Question 8 **[2]**

(i) Mn^{2+} show maximum paramagnetic character because it has maximum number of unpaired electrons.

(ii) All the electrons in d-subshell are paired. Hence the metallic bonds present in Zn, Cd and Hg are weak. Therefore, they have low melting and boiling points.

Question 9 **[2]**

(i)

$$CH_3 - \overset{\overset{O}{\|}}{C} - H + 4[H] \xrightarrow{Zn-Hg\ (HCl\ conc.)} CH_3CH_3 + H_2O$$

Ethane

(or any other correct example)

Clemmensen reduction

OR

(ii) (a) Acetic acid to acetaldehyde

$$CH_3COOH \xrightarrow{+SOCl_2} CH_3COCl \xrightarrow{H_2,Pd/BaSO_4} CH_3CHO$$

(b) Formaldehyde to urotropine

$$6HCHO + 4NH_3 \longrightarrow (CH_2)_6N_4 + 6H_2O$$

urotropine

Question 10 **[2]**

Given; $T_1 = 298K$, $T_2 = 308K$, $K_2/K_1 = 2$

$R = 8.314\ J\ K^{-1}\ mol^{-1}$

$\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ or

$\log 2 = \frac{E_a}{2.303 \times 8.314}\left[\frac{1}{298} - \frac{1}{308}\right]$

$0.3010 = \frac{E_a}{19.147}\left[\frac{10}{298 \times 308}\right]$ or

$E_a = \frac{0.3010 \times 19.147 \times 298 \times 308}{10}$

$E_a = 52898\ J\ mol^{-1}$

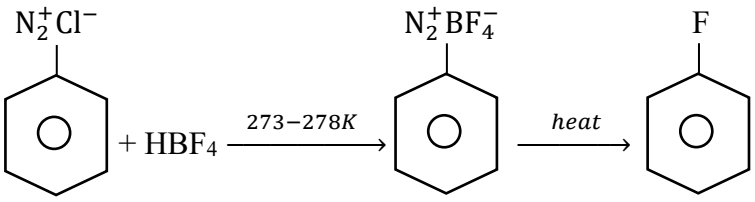
$E_a = 52.898\ kJ\ mol^{-1}$

Question 11 **[2]**

(i) Hofmann's degradation reaction

$$CH_3CONH_2 + Br_2 + 4KOH \longrightarrow CH_3NH_2 + K_2CO_3 + 2KBr + 2H_2O$$

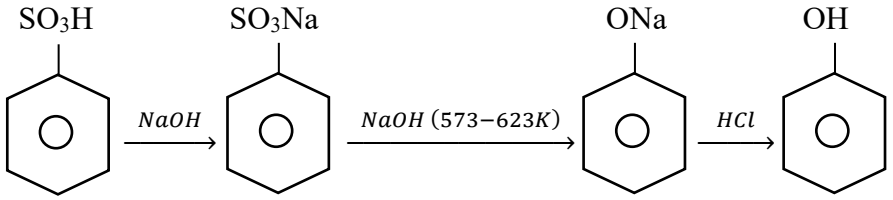
(ii) Balz-Scheimann reaction



SECTION C – 21 MARKS

Question 12 **[3]**

(i) Phenol from benzene sulphonic acid



(ii) Ethyl alcohol from ethylamine

$C_2H_5NH_2 + HNO_2 \longrightarrow C_2H_5OH + N_2 + H_2O$

(iii) Diethyl ether from ethyl alcohol

$2C_2H_5OH \xrightarrow{H_2SO_4 \text{ conc. } (413\ K)} C_2H_5\text{-}O\text{-}C_2H_5 + H_2O$

(or any other correct method)

Question 13 **[3]**

(i) (a) $K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 + 7H_2O$

(b) $2KMnO_4 + 10KI + 8H_2SO_4 \longrightarrow 6K_2SO_4 + 2MnSO_4 + 8H_2O + 5I_2$

(ii) $K_2Cr_2O_7 + 2KOH \longrightarrow 2K_2CrO_4 + H_2O$

orange yellow

$2K_2CrO_4 + H_2SO_4 \longrightarrow K_2Cr_2O_7 + K_2SO_4 + H_2O$

yellow orange

Or

The $Cr_2O_7^{2-}$ (dichromate ion) and CrO_4^{2-} (chromate ion) exist in equilibrium at pH = 4.

When alkali is added, the pH value will increase and $K_2Cr_2O_7$ solution will change from orange to yellow.

When acid is added, the pH value will decrease and the solution will change from yellow to orange.

Question 14 **[3]**

(i) $CH_3 – CH_2 – O – CH_2 – CH_3$

(ii) $CH_3CH_2 – N \equiv C$

(iii) $CH_3CH_2 – CH_2 – I$

Question 15 **[3]**

(i) Vitamin A

(ii) Glucose and Galactose

(iii) Salt solution is hypertonic solution as compared to grapes hence, exosmosis takes place and the grapes tend to shrink.

Question 16 **[3]**

(i) (a) Upon dilution the specific conductivity will decrease, and molar conductivity will increase.

(b) The following reaction takes place:

$Cu + 2Ag^{+}_{(aq.)} \longrightarrow Cu^{2+}_{(aq.)} + 2Ag$

$E^{o}_{cell} = E^{o}_{cathode} + E^{o}_{anode}$

$= + 0.80 - (+ 0.34)$

$E^{o}_{cell} = + 0.46$

Copper spoon will dissolve in 1M $AgNO_3$ solution therefore it is not safe to stir 1M $AgNO_3$ solution with copper spoon.

(c) Metal 'A' will liberate H_2 gas from dil. HCl solution.

Metal having lower reduction potential will liberate H_2 gas from dil. HCl solution.

OR

(ii) (a) Given:

$Zn_{(s)} + Zn^{2+}_{(0.0004M)} \parallel Cd^{2+}_{(0.2M)} / Cd_{(s)}$

$E^{o}_{Zn^{2+}/Zn} = - 0.763V$, $E^{o}_{Cd^{2+}/Cd} = - 0.403V$

Cell reaction: $Zn_{(s)} + Cd^{2+}_{(aq.)} \longrightarrow Zn^{2+}_{(aq.)} + Cd_{(s)}$

$E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$

$= -0.403V - (-0.763V)$

$= 0.36V$

$E_{cell} = E^{o}_{cell} - \frac{0.059}{2} \log \frac{[Zn^{2+}]}{[Cd^{2+}]}$

$= 0.36 - \frac{0.059}{2} \log \frac{[0.0004]}{[0.2]}$

$= 0.36 - \frac{0.059}{2} \log 2 \times 10^{-3}$

$= 0.36 - \frac{0.059}{2} (-2.6990)$

$= 0.36 + 0.08 = 0.44V$

E_{cell} = + 0.44V

ΔG = – nFE or

= – 2 x 96500 x 0.44

ΔG = – 84920 J or – 84.92 kJ

(b) $Cr^{3+} + 3e^- \longrightarrow Cr$

52g of chromium requires current = 3 x 96,500 coulombs

or 1g of chromium requires current = $\frac{3 \times 96500 \times 1}{52}$

Q = 5567.3 coulombs

Q = I x t or t = $\frac{Q}{I}$

Time required in seconds = $\frac{Q}{I} = \frac{5567.3}{1.25}$

= 4453.8 seconds

Question 17 **[3]**

(i) Zero order reaction

(ii) Pseudo first order reaction:

$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

$CH_3COOC_2H_5 + H_2O \longrightarrow CH_3COOH + C_2H_5OH$

(iii) The rate of reaction decreases.

Question 18 **[3]**

(i) (A) = $C_6H_5NH_2$

(B) = $C_6H_5N_2^+Cl^-$

(C) = C_6H_5Cl

(ii) (A) = $CH_3CH_2NH_2$

(B) = CH_3CH_2OH

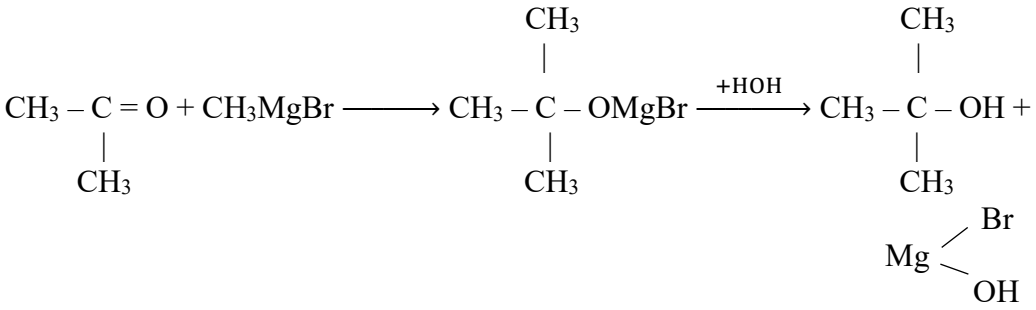
(C) = CH_3CH_2Cl

SECTION D – 15 MARKS

Question 19 **[5]**

(i)

(a)



(b) $2HCHO + NaOH_{(conc.)} \longrightarrow HCOONa + CH_3OH$

(c) $CH_3COOH + SOCl_2 \longrightarrow CH_3COCl \xrightarrow{H_2+Pd/BaSO_4} CH_3CHO$

(acetic acid) (acetaldehyde)

(ii) [A] = C_6H_5COOH or benzoic acid

[B] = C_6H_5COCl or benzoyl chloride

[C] = $C_6H_5CONH_2$ or benzamide

[D] = $C_6H_5NH_2$ or aniline

Question 20 **[5]**

(i) Given; w = 0.63g, V = 300 cm^3 or 0.3 litre

R = 0.0821 lit.atm K^{-1} mol^{-1}, T = 300K

$\pi = 1.29 \times 10^{-3}$ atm

$\pi V = \frac{w}{m}RT$

$1.29 \times 10^{-3} \times 0.3 = \frac{0.63}{m} \times 0.0821 \times 300$ or

$m = \frac{0.63 \times 0.0821 \times 300}{1.29 \times 10^{-3} \times 0.3}$

m = 40,095.35 g mol^{-1}

(ii) Given; W = 5.5kg = 5500g, ΔT_f = 10 °C

K_f = 1.86 K kg mol^{-1}, m = 62.0 g mol^{-1}

w = ?

$w = \frac{m \times \Delta T_f \times W}{1000 \times K_f}$ or

$$w = \frac{62 \times 10 \times 5500}{1000 \times 1.86}$$

w = 1833g = 1.833kg

(iii) In pure water, the egg will swell or increase in size due to endosmosis whereas in saturated sodium chloride solution, the egg will shrink due to exosmosis.

(iv) $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

The value of vant Hoff factor i = 3 (if K_2SO_4 is completely ionized).

Question 21 **[5]**

(i)

(a) $[Co(NH_3)_6]Cl_3 \longrightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$

$3AgNO_3 + 3Cl^- \longrightarrow 3AgCl + NO_3^-$

Structural formula of compound is $[Co(NH_3)_6]Cl_3$

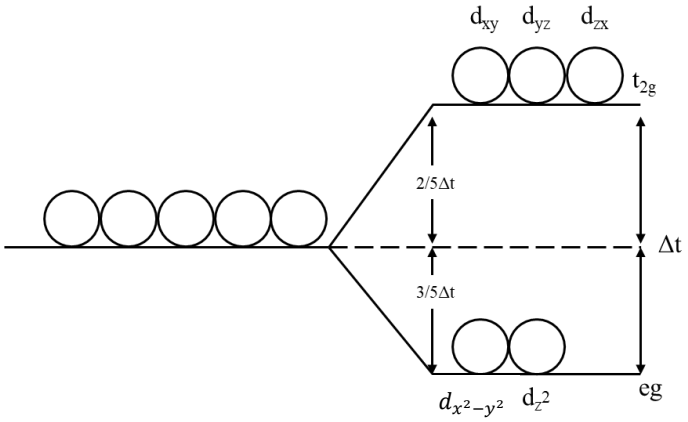
(b) For $[Fe(H_2O)_6]^{3+}$, $t_{2g}^3\ eg^2$

No. of unpaired electrons = 5

for $[Fe(CN)_6]^{3-}$, $t_{2g}^5\ eg^0$

No. of unpaired electrons = 1

(c)



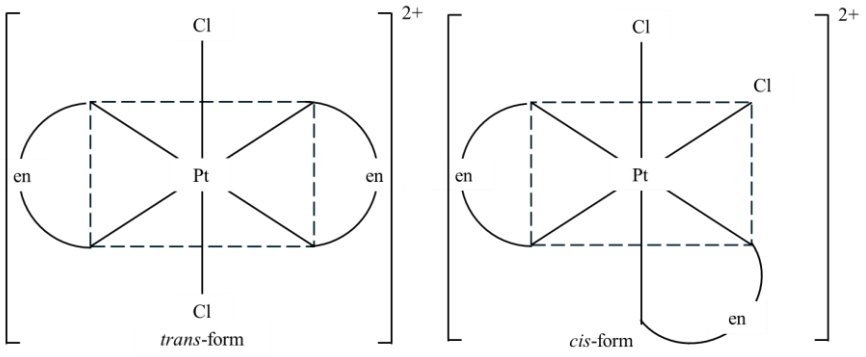
Splitting of d-orbitals Tetrahedral field

(d) (1) Linkage isomer of $[CoCl(en)_2NO_2]Cl_2$
Ans: $[CoCl(en)_2ONO]Cl_2$
(2) Ionisation isomer of $[CoBr(NH_3)_5]SO_4$
Ans: $[Co(NH_3)_5SO_4]Br$

OR

(ii) (a) For the complex compound $[Fe(en)_2Cl_2]Cl$:
(1) Oxidation state = +3
(2) Hybridisation = d^2sp^3
(3) Magnetic behaviour = paramagnetic
(4) Geometry = octahedral

(b) Geometrical isomers of $[Pt(en)_2Cl_2]^{2+}$ ion



(c) Electronic configuration for d^4 ion if $\Delta_o > P$ (strong field ligand)

$d^4 = t_{2g}^4\ eg^o$