B. ANALYSIS OF PERFORMANCE

CHEMISTRY PAPER 1 (THEORY)

PART I (20 Marks)

*Answer **all** questions.*

Question 1

(a) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: **[5]**

(zero, first, second, increased, decreased, anode, cathode, active, inactive, potassium cyanide, internal, external, dependent, independent, red, benzoic acid, benzoin, common ion effect, salt hydrolysis, alkali, potassium hydroxide.)

(i) In a galvanic cell, electrons flow from_____ to _____ through the connecting wires.

(ii) Racemic mixtures are optically _____ because of _____ compensation.

(iii) Half life period of a _____ order reaction is _____ of the concentration of the reactant.

(iv) Benzaldehyde when treated with an alcoholic solution of_____ forms _____.

(v) Solubility of calcium oxalate is _____ in the presence of ammonium oxalate because of _____.

(b) Complete the following statements by selecting the **correct alternative** from the choices given: **[5]**

(i) The compound which is optically active is:

(1) 1-butanol

(2) 2-butanol

(3) 1-propanol

(4) 2-methyl-1-propanol

(ii) The salt which will not hydrolyse in aqueous solution is:

(1) Copper sulphate

(2) Sodium sulphate

(3) Potassium cyanide

(4) Sodium carbonate

(iii) Copper has the face centred cubic structure. The coordination number of each ion is:

(1) 4

(2) 12

(3) 14

(4) 8

(iv) For the reaction $2SO_2 + O_2 \quad 2SO_3$, the unit of equilibrium constant is:

(1) L mol^{-1}

(2) J mol^{-1}

(3) mol L^{-1}

(4) $[L\ mol^{-1}]^2$

(v) The deficiency of vitamin D causes:

(1) Rickets

(2) Gout

(3) Scurvy

(4) Night blindness.

(c) Answer the following questions: **[5]**

(i) Two metallic elements A and B have the following standard oxidation potentials:

A = 0·40v B = – 0·80v. What would you expect if element A was added to an aqueous salt solution of element B? Give a reason for your answer.

(ii) Two moles of NH_3 are introduced into one litre flask in which it dissociates at high temperature as follows: $2NH_3(g) \quad N_2(g) + 3H_2(g)$. Determine Kc, if at equilibrium 1 mole of NH_3 remains.

(iii) Give balanced equation for the preparation of salicylaldehyde from phenol.

(iv) If the half life period for a first order reaction is 69·3 seconds, what is the value of its rate constant?

(v) Define cryoscopic constant.

(d) Match the following: **[5]**

(i)	Colligative property	(a)	Polysaccharide
(ii)	Nicol prism	(b)	Osmotic pressure
(iii)	Activation energy	(c)	Aldol condensation
(iv)	Starch	(d)	Polarimeter
(v)	Acetaldehyde	(e)	Arrhenius equation

Comments of Examiners

(a) (i) Some candidates wrote 'cathode to anode'.
(ii) Many candidates wrote 'active' and 'internal' in place of the correct words.
(iii) Some candidates wrote 'dependent' in place of 'independent'.
(iv) Many candidates wrote 'potassium hydroxide' and 'Benzoic acid' instead of the correct words.
(v) A few candidates wrote 'increased' in place of 'decreased'.

(b) (i) '1-butanal' or 2-methyl propanol was chosen by some candidates.
(ii) 'Potassium cyanide' or 'sodium carbonate' was chosen in some cases.
(iii) Some candidates wrote '4' in place of the correct option.
(iv) Many candidates chose the options (3) and (4).
(v) A few candidates chose 'scurvy' or 'night blindness'.

(c) (i) Candidates were confused with oxidation and reduction potential. Some wrote 'B displaced A' and various other wrong answers and incorrect reasons.
(ii) Most of the candidates calculated K_e for 2 moles of NH_3. Unit was wrong in many scripts.
(iii) Wrong reagents were used by many candidates. In some cases, the equation was unbalanced.
(iv) Several candidates used a wrong formula.
(v) Most of the candidates gave the mathematical expression and explained that.

(d) Most of the candidates were able to attempt this part correctly.

Suggestions for teachers

- The concept of production of current and flow of electrons in a galvanic cell should be explained clearly.
- The idea of 'internal 'and 'external' compensation should be taught with correct examples.
- Reactions should be practiced in class with correct names of the reactants and products.
- 'Common ion effect' should be taught in class with equations showing the shift of equilibrium.
- The concept of chiral carbon atom should be made clear. Isomerism should the practised with examples.
- The units of K_e should be derived in class taking examples.
- The use of electrochemical series should be taught in details giving its importance in determining the properties and nature of the elements.
- Reactions should be practiced with correct reactions and products in the balanced form.

MARKING SCHEME

Question 1.

(a) (i) anode, cathode
(ii) inactive, external
(iii) first \ 1^{st}, independent or zero, dependent or second dependent
(iv) potassium cyanide, benzion/ formula
(v) decreased, common ion effect

(b) (i) 2 butanol / formula
(ii) (1) Sodium sulphate / formula

(iii) (2) 12 /twelve

(iv) (1) L mol-1

(v) (1) Rickets

Answer the following questions:

(c) (i) A displaces B from its salt solution. Standard reduction potential of A is less than standard reduction potential of B or any other explanation.

(ii) $2\ NH_3 \quad N_2+3H_2$

Initial 2 0 0

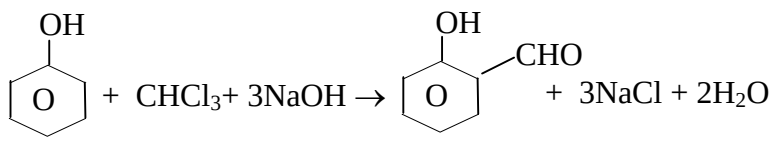
At eqn. 1 $\frac{1}{2}$ $\frac{3}{2}$

$[NH_3] = \frac{1}{1}$ moles per litre $[N_2] = \frac{\frac{1}{2}}{1}$ moles per litre

$[H_2] = \frac{\frac{3}{2}}{1}$ moles per litre

$$K_c = \frac{[N_2][H_2]^3}{[NH_3]^2} = \frac{\left(\frac{1}{2}\right)\left(\frac{3}{2}\right)^3 \text{ mole}^4/\text{litre}^4}{(1)^2 \text{ mole}^2/\text{litre}^2}$$

$$= \frac{27}{16}\text{mole}^2/\text{litre}^2 = 1{\cdot}687\ (\text{mol}/\text{lit})^2$$

(iii) 

(OR with KOH)

(iv) $K = \frac{0.693}{693} = 0.01\text{sec}^{-1}$

(v) Depression of freezing point when the molality of the solution is unity / any correct definition.

(d) Match the following:

(i) (b) Osmotic pressure

(ii) (d) Polarimeter

(iii) (e) Arrhenius equation

(iv) (a) Polysaccharide

(v) (c) Aldol condensation

PART II (50 Marks)

Answer **six** *questions choosing* **two** *from* ***Section A****,* **two** *from* ***Section B*** *and* **two** *from* ***Section C****.*

SECTION A

Answer any **two** *questions.*

Question 2

(a) (i) Ethylene glycol is used as an antifreeze agent. Calculate the amount of ethylene glycol to be added to 4 kg of water to prevent it from freezing at -6°C. (K_f for H_2O = 1ĕ85 K mole^{-1} kg) **[3]**

(ii) The freezing point of a solution containing 0·3gms of acetic acid in 30gms of benzene is lowered by 0ĕ45K. Calculate the Van't Hoff factor. **[2]**
(at. wt. of C = 12, H = 1, O = 16, K_f for benzene = 5·12K kg mole^{-1}).

(b) Name the law or principle confirmed by the following observations: **[2]**

(i) When water is added to 0·01M aqueous solution of acetic acid the number of hydrogen ions increase.

(ii) When 96500 coulombs of electricity is passed through acidulated water, 5·6 litres of oxygen at s.t.p. is liberated at the anode.

(c) Arrange Ag, Cr and Hg metals in the increasing order of reducing power. Given: **[1]**

$$E^{o}_{Ag^{+}/Ag} = +0 \cdot 80V$$

$$E^{o}_{cr^{+3}/cr} = -0 \cdot 74V$$

$$E^{o}_{Hg^{+2}/Hg} = +0 \cdot 79V$$

(d) In a first order reaction, 10% of the reactant is consumed in 25 minutes. Calculate: **[2]**

(i) The half life of the reaction.

(ii) The time required for completing 17% of the reaction.

Comments of Examiners

(a) (i) Incorrect formula and substitution was done by many candidates. Some candidates were unable to calculate the molecular weight of glycol.

(ii) Many candidates made wrong calculations due to wrong substitution.

(b) (i) Many candidates gave the answer as, 'dilution law' instead of Ostwald dilution Law.

(ii) Some candidates wrote only 'Faraday's law' but did not mention the '2nd law'.

Suggestions for teachers

- More practice should be given in numericals along with correct substitution.
- Important laws and their applications should be taught in class with correct examples.
- Elechochemical series should be taught with reference to the properties of the elements.

(c) Several candidates were confused between 'reduction' and 'reduction potential'. Many candidates arranged the metals in the reverse direction.

(d) (i) Some candidates made calculation errors in this part of the question.

(ii) Incorrect formula was taken by some candidates.

MARKING SCHEME

Question 2.

(a) (i) $\Delta T_f = K_f \times \frac{w \times 1000}{m \times W}$

$w = \frac{\Delta T_f \times m \times W}{K_f \times 1000}$ [Mol. wt. of $\begin{matrix} CH_2OH \\ | \\ CH_2OH \end{matrix}$ = 62]

$= \frac{6 \times 62 \times 4 \times 1000}{1 \cdot 85 \times 1000}$

$= 804 \cdot 32$ g

(ii) $\Delta T_f = iK_f \times \frac{w \times 1000}{m \times W}$ – or $\Delta T_f = ik_f \times m$

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

$= \frac{0 \cdot 45 \times 60 \times 30}{5 \cdot 12 \times 0 \cdot 3 \times 1000}$

$= 0 \cdot 527$

(b) (i) Ostwald's dilution law

(ii) Faraday's second law

(c) Ag, Hg, Cr

(d) $K = \frac{2 \cdot 303}{t} \log\left(\frac{a}{a-x}\right)$

$K = \frac{2 \cdot 303}{25} \log\left(\frac{100}{90}\right)$

$= 4.215 \times 10^{-3}\ min^{-1}$

Half life ($t_{½}$) $= \frac{0.693}{K} = \frac{0.693}{4.215 \times 10^{-3}} = 164.41$ minutes

$t = \frac{2 \cdot 303}{k} \log\left(\frac{a}{a-x}\right)$

$= \frac{2 \cdot 303}{4.215 \times 10^{-3}} \log\left(\frac{100}{83}\right)$ = 44.21 minutes

Question 3

(a) Explain giving reasons why (Give equations in support of your answer):

(i) A solution of NH_4Cl and NH_4OH acts as a buffer. **[2]**

(ii) Cu is precipitated as CuS while Zn is not precipitated when H_2S is passed through an acidic solution of $Cu(NO_3)_2$ and $Zn(NO_3)_2$ respectively. **[2]**

(b) (i) What is Schottky defect in a solid? **[1]**

(ii) A bcc element (atomic mass 65) has a cell edge of 420 pm. Calculate its density in gms/cm^3. **[3]**

(c) The rate of the reaction H_2+I_2 2HI is given by: **[2]**

$$\text{rate} = 1{\cdot}7 \times 10^{-19}[H_2][I_2] \text{ at } 25^oC.$$

The rate of decomposition of gaseous HI to H_2 and I_2 is given by:

$$\text{rate} = 2{\cdot}4 \times 10^{-21}[HI]^2 \text{ at } 25^oC.$$

Calculate the equilibrium constant for the formation of HI from H_2 and I_2 at 25^oC.

Comments of Examiners

(a) (i) The definition of Buffer solution was given by many candidates instead of explaining 'Buffer action'.

(ii) Many candidates did not mention the low K_{sp} for CuS and high K_{sp} for ZnS. Some candidates did not mention the suppression of concentration of Sulphide ion in acidic medium.

(b) (i) Many candidates did not mention the missing of both anion and cation in ionic crystals. Some candidates confused it with Frenkel defect.

(ii) Several candidates did not attempt this numerical, while some others did the problem with incorrect formula. In some cases, the value of 'Z' was taken wrongly.

(c) Value of K_c was taken as $rate_1$ / $rate_2$, giving wrong answers.

Suggestions for teachers

- The mechanism of buffer action should be explained with reference to the addition of acid, alkali and dilution. Explanation should be given taking correct equation.
- The use of solubility product in salt analysis should be taught with correct examples. Stress should be laid on key words.
- Defects in crystals should be explained diagrammatically.
- Adequate practice should be given in numericals.

MARKING SCHEME

Question 3.

(a) (i) NH_4Cl NH_4^+ (High) + Cl^- (High)

NH_4OH NH_4^+ (low) + OH^- (low)

Addition of HCl, HCl $H^+ + Cl^-$

H^+ (from HCl) + OH^- (from NH_4OH) $\rightarrow H_2O$

OH^- ions are removed from the solution.

In the absence of OH^-, NH_4OH, dissociates more in giving more OH^- ions. These OH^- ions combines with H^+ to form water. Process keeps on happening till all H^+ ions are consumed and pH remains constant.

Addition of NaOH:

$NaOH \quad Na^+ + OH^-$

NH_4^+ (from NH_4Cl) + OH^- (from NaOH) $\rightarrow NH_4OH$

NH_4OH being a weak base dissociates partially and whatever OH^- are released are not sufficient to increase the pH. OR any other explanation.

(ii) $HCl \quad H^+ + Cl^-$. $H_2S \quad 2H^+ + S^{2-}$

In the presence of HCl, the dissociation of H_2S is suppressed due to common H^+ ion and less S^{2-} ions are released in solution.

The K_{sp} of CuS is low and hence $[Cu^{+2}][S^2] > K_{sp}$.

ZnS has a high value of K_{sp} and hence, does not get precipitated with less S^{2-} ions.

(b) (i) Schottky defect – pair of holes exist in the crystal lattice due to one positive ion and one negative ion being absent from the crystal lattice. OR any other definition

(ii) Density (P) = $\dfrac{Z \times M}{N_A \times a^3}$

$= \dfrac{2 \times 65}{6.023 \times 10^{23} \times \left(420 \times 10^{-10}\right)^3}$

$= \dfrac{2 \times 65}{6.023 \times 10^{23} \times 7 \cdot 4 \times 10^{-23}}$

$= 2.91 \text{ gms/cm}^3$

(c) $H_2 + I_2 \quad 2HI$

$K_1 = 1 \cdot 7 \times 10^{-18}$

$K_2 = 2 \cdot 4 \times 10^{-21}$

$K_c = \dfrac{K_1}{K_2} = \dfrac{1 \cdot 7 \times 10^{-18}}{2 \cdot 4 \times 10^{-21}} = 708 \times 10^2$

Question 4

(a) (i) Give Lewis' definition for acids and bases. **[1]**

(ii) The solubility of Ag_2CrO_4 at 25°C is $8 \cdot 0 \times 10^{-5}$ moles/litre. Calculate its solubility product. **[1]**

(b) (i) Define molar conductance of a solution. State its unit. How is it related to the specific conductance of a solution? **[2]**

(ii) Calculate the value of E_{cell} at 298K for the following cell: **[3]**

Al / Al^{3+} (0·01M) // Sn^{2+} (0·015M) / Sn

$E^{o}_{Al^{3+}/Al} = -1 \cdot 66$ volt and $E^{o}_{Sn^{2+}/Sn} = -0 \cdot 14$ volt

(c) (i) Calculate the degree of hydrolysis of 0·2(M) sodium acetate solution. **[1]**
(Hydrolysis constant of sodium acetate = $5 \cdot 6 \times 10^{-10}$ and ionic product of $H_2O = 10^{-14}$ at 25^oC)

(ii) Explain why high pressure is used in the manufacture of ammonia by Haber's process. State the law or principle used. **[2]**

Comments of Examiners

(a) (i) Several candidates wrote 'electron acceptor' instead of stating 'electron pair acceptor'.
(ii) Wrong formula was used by some candidates.
(b) (i) Many candidates explained the formula of molar conductance in place of defining it. The unit was given wrongly in many scripts.
(ii) Several candidates calculated E^0_{cell} correctly but the calculation of E_{cell} was wrong. Some got the same values for both since they rounded up the value instead of calculating it up to the third place of decimal. Many candidates did wrong substitution in the 'Nernst' equation.
(c) (i) Incorrect formula was used by many candidates.
(ii) The explanation given by many candidates was not clear. In some cases, Le Chatelier's principle was only mentioned but not stated.

Suggestions for teachers:

- Lewis definition should be correctly taught with correct examples.
- Derivation of the K_{sp} values of different salts should be done in class.
- 'Nernst equation' should be taught with correct examples and correct substitution.
- Numericals should be practised with correct formula of substitution.
- Le Chaterliers principle should be explained with reference to the equations mentioned in the scope of syllabus.

MARKING SCHEME

Question 4.

(a) (i) Lewis acid is an electron pair acceptor.

Lewis base is an electron pair donor.

(ii) $Ag_2CrO_4 \quad 2Ag^+ + CrO_4^{2-=}$

S 2S S

$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$

$= (2S)^2 (S) = 4S^3$

$K_{sp} = 4 \times (8 \times 10^{-5})^3 = 2 \cdot 048 \times 10^{-12}$

(b) (i) Molar conductance is defined as the conducting power of all the ions produced by dissolving one gm mole of an electrolyte in solution/ any other definition

Its unit is $ohm^{-1}\ cm^2\ mole^{-1}$ or $ohm^{-1}\ m^2\ mole^{-1}$

$$\wedge_m = \frac{1000}{c} \times \wedge_{sp}$$

c = conc. in molarity

(ii) $E^o_{cell} = \left(E^o_{redn}\right)\text{cathode} - \left(E^o_{redn}\right)\text{anode}$

= (-0·14) – (1·66) volt

= 1·52 volt

$$E_{cell} = E^o_{cell} - \frac{0\cdot05912}{n}\log\frac{[\text{products}]}{[\text{Reactants}]}$$

$Al - 3e \rightarrow Al^{3+}$ — x (2)

$Sn^{2+} + 2e \rightarrow Sn$ — x (3)

$2Al - 6e \rightarrow 2Al^{3+}$

$3Sn^{2+} + 6e \rightarrow 3\ Sn$

$2Al + 3Sn^{2+} \rightarrow 2Al^{3+} + 3\ Sn$

$$E_{cell} = 1\cdot52 - \frac{0\cdot05912}{6}\log\frac{[Al^{3+}]^2[Sn]^3}{[Al]^2[Sn^{2+}]^3}\ volt$$

$$= 1\cdot52 - \frac{0\cdot05912}{6}\log\frac{(0\cdot01)^2(1)^3}{(1)^2(0015)^3}\ volt$$

= (1·52 - 0·0145) volt = 1·5055 volt

(c) (i) $$h = \sqrt{\frac{kw}{ka.c}} = \sqrt{\frac{Kh}{c}}$$

$$= \sqrt{\frac{5\cdot6\times10^{-10}}{0\cdot2}} = 5\cdot29\times10^{-5}$$

(ii) Formation of ammonia takes place with decrease in volume. Hence, the reaction is favoured with high pressure.

Le Chatelier's Principle – when a system at equilibrium is subjected to a stress, the equilibrium shifts in that direction to nullify the effect of the stress OR any other explanation.

SECTION B

Answer any **two** *questions.*

Question 5

(a) Give the IUPAC names of the following coordination compounds: **[2]**

(i) $K_2[Zn(OH)_4]$

(ii) $[Co(NH_3)_5(CO_3)]Cl$

(b) For the complex ion $[Fe(CN)_6]^{3-}$ state:

(i) The geometry of the ion. **[1]**

(ii) The magnetic property of the ion.

(c) What type of structural isomers are $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$? Give a chemical test to distinguish the isomers. **[2]**

Comments of Examiners

(a) (i) Several candidates wrote 'hydroxy' in place of 'hydroxo'. The valency of Zinc was not given correctly by a number of candidates.

(ii) Several candidates made mistakes in writing the correct name. 'Carbonate' was written instead of 'Carbonato'. The oxidation state of cobalt was given incorrectly by some candidates.

(b) (i) Many candidates wrote 'tetrahedral' or 'bipyramidal'.

(ii) Some candidates gave the answer as 'diamagnetic'.

(c) Many candidates wrote 'linkage isomerism'. Chemical test was not given but the ionisation of the two compounds was shown.

Suggestions for teachers

- Many examples of co-ordination complexes should be practised with correct spelling and correct oxidation state.
- Geometry of co-ordination compounds and ions should be explained by drawing the correct structure.
- The relation of the magnetic property with number of unpaired electrons should be explained by writing the electronic configuration in box diagrams.

MARKING SCHEME

Question 5.

(a) (i) potassiumtetrahydroxo zincate(II)

(ii) pentaamminecarbonatocobalt(III) chloride

(b) (i) Octahedral, Paramagnetic

(ii) Ionisation isomerism.

$[Co(NH_3)_5Br]SO_4$ gives white ppt with $BaCl_2$ solution, but $[Co(NH_3)_5\ SO_4]Br$ does not give white ppt. with $BaCl_2$ solution OR any other test.

(c) Type of structural isomers and correct chemical test.

Question 6

(a) For the molecule XeF_2 : **[2]**

(i) Draw the structure of the molecule indicating the lone pairs.

(ii) State the hybridisation of the central atom.

(iii) State the geometry of the molecule.

(b) Give balanced chemical equations for the following reactions: **[3]**

(i) Fluorine treated with dilute sodium hydroxide solution.

(ii) Hydrogen sulphide treated with concentrated sulphuric acid.

(iii) Potassium iodide treated with acidified potassium permanganate solution.

Comments of Examiners

(a) (i) Proper orientation of the orbitals around the Xenon atom was not shown by many candidates. Lone pair of electrons was missing in some cases.

(ii) The hybridisation was given incorrectly by many candidates.

(iii) Some candidates gave the answer as 'T' shaped. The word 'linear' was missing in many answers.

(b) In this part, many candidates wrote unbalanced and incorrect equations.

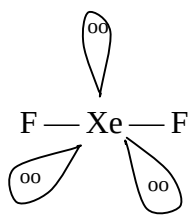
Suggestions for teachers

- Structures of the compounds should be explained by drawing and showing the lone pair of electrons.
- The correct hybridisation should be taught by writing the electronic configuration in box diagrams.
- The geometry of the molecules should be explained on the basis of hybridisation.
- Students should be given practice in writing correct balanced equations.

MARKING SCHEME

Question 6.

(a)



sp^3d, linear.

(b) (i) $2F_2 + 2NaOH \rightarrow F_2O + 2NaF + H_2O$

(ii) $H_2S + H_2SO_4 \rightarrow 2\ H_2O + SO_2 + S$

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

Question 7

(a) In the extraction of zinc from zinc blende: **[2]**

(i) Give an equation to show how zinc oxide is converted to zinc.

(ii) How is impure zinc finally electro-refined?

(b) Explain why: **[3]**

(i) Transition elements form coloured compounds.

(ii) Interhalogen compounds are more reactive than their constituent elements.

(iii) Cu^{+} is diamagnetic but Cu^{2+} is paramagnetic. (Z = 29)

Comments of Examiners

(a) (i) Some candidates wrote 'CO_2' in place of 'CO'.
(ii) The electrolyte was given wrongly by many candidates.

(b) (i) The presence of unpaired d-electrons was not mentioned by many candidates.
(ii) The polar nature of the x-y bonds or less overlapping of the orbitals was not mentioned by several candidates.
(iii) The diamagnetic nature of Cu^{+} was not mentioned by several candidates.

Suggestions for teachers

- Electrorefining should be taught with correct electrodes and electrolytes.
- The properties of transition metals should be explained with reference to the d-electrons.
- Magnetic nature should be explained in terms of electronic configuration.

MARKING SCHEME

Question 7.

(a) (i) $ZnO + C \xrightarrow{1673K} Zn + CO$

(ii) Anode – Impure Zn block

Cathode – Thin sheet of pure Zinc

Electrolyte – $ZnSO_4$ solution containing a little dilute H_2SO_4

Cathode – $Zn^{2+} + 2e \rightarrow Zn$

Anode – $Zn - 2e \rightarrow Zn^{+2}$

(b) (i) Presence of unpaired electrons in d orbitals/ d-d transition

Electrons absorb radiations of one colour from white light for excitation from one energy level to another within the same d subshell. Hence, transmitted light appears coloured. Or any correct explanation

(ii) x – y bonds are weaker than x – x or y – y bonds.

Polar nature of x-y bond.

Less overlapping of orbitals in x – y bond.

(iii) Cu^{+1} has no unpaired electrons, hence diamagnetic

Cu^{+2} has unpaired electrons, hence paramagnetic

SECTION C

Answer any **two** *questions.*

Question 8

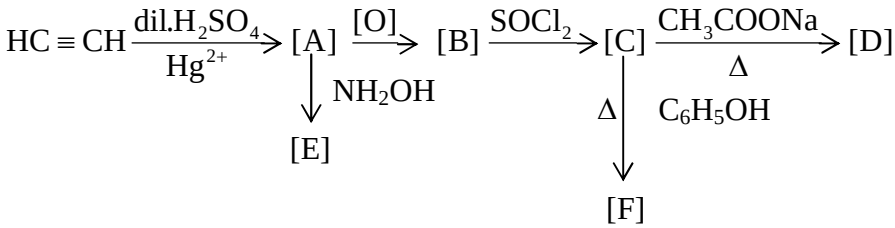
(a) How can the following conversions be brought about:

(i) Nitro benzene to benzene diazoniumchloride. **[3]**

(ii) Propanoic acid to ethylamine. **[2]**

(iii) Benzoic acid to benzaldehyde. **[2]**

(b) Identify the compounds A, B, C, D, E and F: **[3]**



Comments of Examiners

(a) (i) Many candidates used $LiAlH_4$ or H_2 /Ni for the reduction of nitrobenzene to aniline. In some cases, reagents and temperature were not mentioned for diazotization.

(ii) Several candidates started the conversion from ethanoic acid in place of propanoic acid. Conversion steps were incorrect in many cases.

(iii) Most of the candidates reduced benzoic acid to benzaldehyde directly by metal / acid.

(b) [E] was identified as methylamine and [F] as ethylacetate by many candidates.

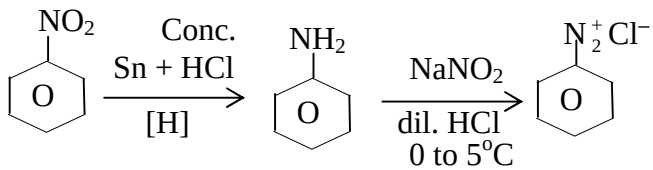
Suggestions for teachers

- Reduction of nitrobenzene should be taught with correct reducing agent. Diazotization should be taught with correct reagents and temperature (0^oC – 5^0C).
- Aliphatic and aromatic conversions should be practiced in class with correct reagents.
- Reactions should be practiced in class with correct reactants and products.

MARKING SCHEME

Question 8.

(a) (i)



(ii) $CH_3CH_2COOH \xrightarrow[\Delta]{NH_3} CH_3CH_2CONH_2 \xrightarrow{Br_2 / KOH} C_2H_5NH_2$

(iii) $C_6H_5COOH \xrightarrow[PCl_3/PCl_5^-]{SOCl_2} C_6H_5COCl \xrightarrow[BaSO_4]{H_2/Pd} C_6H_5CHO$

(b) [A] $\rightarrow$ Acetaldehyde or CH_3CHO

[B] $\rightarrow$ Acetic acid or CH_3COOH

[C] $\rightarrow$ Acetyl chloride or CH_3COCl

[D] $\rightarrow$ Acetic anhydride or $(CH_3CO)_2O$

[E] $\rightarrow$ Acetaldoxime or $CH_3CH=NOH$

[F] $\rightarrow$ Phenyl acetate or $C_6H_5OCOCH_3$

OR any common name

Question 9

(a) Write balanced chemical equations for the following reactions and name the reactions: **[3]**

(i) Acetamide is heated with bromine and sodium hydroxide solution.

(ii) Benzaldehyde is treated with 50% sodium hydroxide solution.

(b) Give one chemical test to distinguish between the following pairs of compounds: **[3]**

(i) Acetone and phenol.

(ii) Formic acid and Acetic acid.

(c) (i) Name the type of isomerism exhibited by the following pairs of compounds: **[2]**

(1) $(C_2H_5)_2NH$ and CH_3- NH-C_3H_7

(2) 1-butanol and 2 methyl-1-propanol

(ii) Name the type of isomerism that the compound with molecular formula $C_3H_6O_2$ exhibits. Represent the isomers. **[2]**

Comments of Examiners

(a) (i) Only the main product was written by many candidates while the by products were missing. In some cases, the equation was not balanced.

(ii) The name of the reaction was given incorrectly by a number of candidates.

(b) (i) Many candidates gave ferric chloride test for a acetone. Some only mentioned the name of the test without giving the observation.

(ii) Incorrect tests were given by many candidates.

(c) (i) Some candidates gave the answer as 'position isomers'.

(ii) Most of the candidates were able to attempt this part correctly.

Suggestions for teachers

- Name equations should be taught in balanced form. Reactants and products should be correctly taught.
- Identification of organic compounds should be done in class with correct tests.
- Isomerism should be explained by drawing the structural formulae of the isomers.

MARKING SCHEME

Question 9.

(a) (i)

Hoffmann's bromanide or Hofmann's degradation reaction.

(ii) $2C_6H_5 - CHO \xrightarrow{\text{dil. NaOH}} C_6H_5CH_2OH + C_6H_5COONa$

Cannizzaro's reaction

(b)(i) Acetone when treated with I_2 + NaOH gives yellow ppt. of CHI_3 but phenol with I_2 + NaOH gives no such ppt.

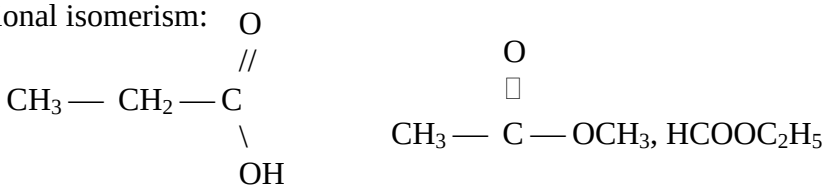
Phenol with neutral $FeCl_3$ solution gives violet colouration but Acetone gives no such observation (Or any correct test)

(ii) Formic acid gives white or grey ppt. with $HgCl_2$ solution but Acetic acid does not give such observation (Or any correct test)b

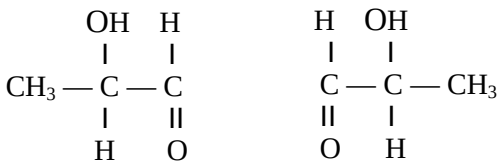
(c) (i) (1) Metamerism

(2) Chain isomerism

(ii) Functional isomerism:



Optical Isomerism:



Question 10

(a) Write balanced chemical equations for the following reactions: **[4]**

(i) Oxalic acid is treated with acidified potassium permanganate solution.

(ii) Benzoic acid is treated with a mixture of concentrated nitric acid and concentrated sulphuric acid.

(iii) Methyl magnesium iodide is treated with carbon dioxide and the product hydrolysed in acidic medium.

(iv) Ethylacetate is treated with ammonia.

(b) An organic compound [A] having molecular formula C_2H_7N on treatment with nitrous acid gives a compound [B] having molecular formula C_2H_6O. [B] on treatment with an organic compound [C] gives a carboxylic acid [D] and a sweet smelling compound [E]. Oxidation of [B] with acidified potassium dichromate also gives [D]. **[4]**

(i) Identify [A], [B], [C], [D] and [E].

(ii) Write balanced chemical equation of [D] with chlorine in the presence of red phosphorus and name the reaction.

(c) Acetamide is amphoteric in nature. Give two equations to support this statement. **[2]**

Comments of Examiners

(a) (i) A number of candidates wrote incorrect equations.

(ii) Ortho - para benzoic acid was written as the product by several candidates.

(iii) Some candidates wrote wrong products in this part.

(iv) This part was generally done correctly by candidates.

(b) (i) Identification of [C] was incorrectly done by several candidates.

(ii) A number of candidates wrote unbalanced equations.

(c) Many candidates did not attempt this part of the question. Some gave the reaction with NaOH to show the acidic nature of acetamide.

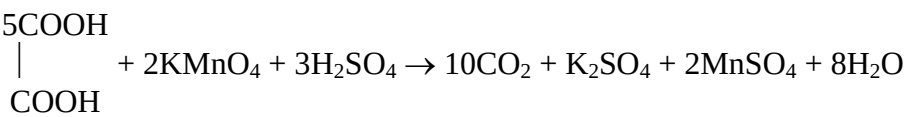
Suggestions for teachers

- Equation should be studied by writing the reactants and products with balanced form.
- Organic problems of identification should be given in class.
- The amphoteric nature of acetamide should be taught correctly with proper reactants and products.

MARKING SCHEME

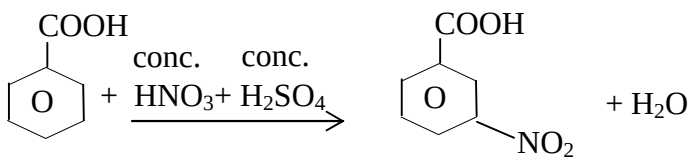
Question 10.

(a) (i)



$$\begin{matrix}5COOH\\|\\COOH\end{matrix} + 2KMnO_4 + 3H_2SO_4 \rightarrow 10CO_2 + K_2SO_4 + 2MnSO_4 + 8H_2O$$

(ii)



$$\text{C}_6\text{H}_5\text{COOH} + \text{HNO}_3 \xrightarrow[\text{conc.}]{\text{conc.}} \text{C}_6\text{H}_4(\text{NO}_2)\text{COOH} + \text{H}_2\text{O}$$

(iii) $CH_3MgI + O = C = O \rightarrow [IMgO - \overset{CH_3}{\underset{C}{|}} = O] \rightarrow CH_3COOH + MgI(OH)$

(iv) $CH_3COOC_2H_5 + NH_3 \rightarrow CH_3CONH_2 + C_2H_5OH$

(b) (i) [A] → $CH_3CH_2NH_2$ or Ethylamine

[B] → CH_3CH_2OH or Ethanol

[C] → $(CH_3CO)_2O$ or Ethanoic anhydride

[D] → CH_3COOH or Ethanoic acid.

[E] → $CH_3COOC_2H_5$ or Ethyl ethanoate.

(ii) $CH_3COOH + Cl_2 \xrightarrow{Red\ P} CH_2ClCOOH + HCl$

Hell Volhard Zelinsky reaction or

HVZ reaction.

(c) Basic : $CH_3CONH_2 + HCl \rightarrow CH_3CONH_2.HCl$ or $[CH_3CONH_3]^+Cl^-$

Acidic: $CH_3CONH_2 + HgO \rightarrow (CH_3CONH)_2Hg + H_2O$

GENERAL COMMENTS:

(a) Topics found difficult by candidates in the Question Paper:

- Co-ordination compounds.
- Definitions of different terms and units.
- Isomerism.
- Buffer solution
- Electrochemical cells.
- Geometry and hybridization.
- Inorganic equations.

(b) Concepts between which candidates got confused:

- Hydrolysis of salts.
- Catalysts in organic reactions.
- Conversion in Organic Chemistry.
- Numericals in Colligative properties with correct units.

(c) Suggestions for students:

- Practice organic conversions.
- Study chemical tests to distinguish between organic compounds.
- Study isomerism by drawing the structural formulae of the isomers.
- Avoid selective studies.
- Practice equations, both inorganic and organic with balanced form and correct condition.
- Practice numericals from all chapters with correct formulae and units.