CHEMISTRY

PAPER – 1

(THEORY)

(Three Hours)

(Candidates are allowed additional 15 minutes for **only** reading the paper**.**

They must NOT start writing during this time.)

Answer **all** *questions in* ***Part I*** *and* ***six*** *questions from* ***Part II****, choosing* **two** *questions from Section* ***A****,* ***two*** *from Section* ***B*** *and* ***two*** *from Section* ***C****.*

All working, including rough work, should be done on the same sheet as, and adjacent to, the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems use the following data:

Gas constant $R = 1.987\ cal\ deg^{-1}\ mol^{-1} = 8.314\ JK^{-1}\ mol^{-1} = 0.0821\ dm^3\ atm\ K^{-1}mol^{-1}$

$1\ l\ atm = 1\ dm^3\ atm = 101.3\ J.$ *1 Farday = 96500 Coulombs.*

Avagadro's number $= 6.023 \times 10^{23}$.

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]**

(hydrolysis, reduction, oxidation, vacant, osmotic, above, benzoic acid, phenol, aniline, below, can, decreases, increases, cannot, crystal, ionization, rate, rate constant.)

(i) A catalyst _____ start a reaction but it can increase the _____ of the reaction.

(ii) Electrons trapped in the _____ sites of the _____ lattice are called F-centres.

(iii) An aqueous solution of sugar boils _____ 100^oC and freezes _____ 0^oC.

(iv) Toluene on _____ with alkaline potassium permanganate gives_____.

(v) The degree of _____ of ammonium hydroxide _____ on addition of ammonium chloride.

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

(i) For reaction $2N_2O_5 \rightarrow 2\ NO_2 + O_2$, the rate and rate constants are 1.02×10^{-4} mole litre^{-1} sec^{-1} and 3.4×10^{-5} sec^{-1} respectively. The concentration of N_2O_5 at that time will be:

(1) 1.732 mol lit^{-1}

(2) 3 mol lit^{-1}

(3) 1.02×10^{-4} mol lit^{-1}

(4) 3.2×10^{5} mol lit^{-1}

(ii) Ethanoic acid dimerises in solution. Its molecular mass determined from its depression of freezing point of the solution will be:

(1) Same as the theoretical value

(2) Half its theoretical value

(3) Double its theoretical value

(4) One third of its theoretical value.

(iii) Magnesium displaces hydrogen from dilute acid solution because:

(1) The oxidation potential of magnesium is less than that of hydrogen.

(2) The reduction potential of magnesium is less than that of hydrogen.

(3) Both magnesium and hydrogen have same oxidation potential.

(4) Both magnesium and hydrogen have same reduction potential .

(iv) In the series of reactions $CH_3COOH \xrightarrow{NH_3} A \xrightarrow{heat} B \xrightarrow{P_2O_5} C$, the product C is:

(1) Acetyl chloride

(2) Ammonium acetate

(3) Acetic anhydride

(4) Methyl cyanide.

(v) In the reaction $PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$, the equilibrium will shift in the opposite direction, if:

(1) Chlorine is added.

(2) PCl_3 is added

(3) Pressure is increased

(4) Pressure is reduced.

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

(i) Among equimolal aqueous solutions of $MgCl_2$, NaCl, $FeCl_3$ and $C_{12}H_{22}O_{11}$, which will show minimum osmotic pressure? Why?

(ii) If K_c for the reaction $N_2 + 3H_2 \rightarrow 2NH_3$ is 1.5×10^{-5} $(mol/lit)^{-2,}$ write the value of K_{c1} for the reaction $\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightarrow NH_3$

(iii) *The pH of acetic acid decreases on dilution*. State the Law governing this statement.

(iv) Xenon gives a series of flourides, but Helium and Neon do not. Why?

(At. No: Xe = 54, Ne = 10, He = 2)

(v) Calculate the number of coulombs required to deposite 20.25 g of aluminium (at. mass = 27) from a solution containing Al^{+3}.

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

(i)	$CHCl_3 + NaOH$	(a)	Fluorine
(ii)	Proteins	(b)	Starch
(iii)	Carbohydrate	(c)	Ammonia
(iv)	Lewis base	(d)	Peptide linkage
(v)	KHF_2	(e)	Isocyanide test

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) A certain aqueous solution boils at 100.303°C. What is its freezing point? K_b for water = 0.5 K mol^{-1} and K_f = 1.87 K mol^{-1}. **[2]**

(ii) A solution containing 1g of sodium chloride in 100g of water freezes at 0.604°C. Calculate the degree of dissociation of sodium chloride. (Na = 23, Cl = 35.5, K_f for water = 1.87 k mol^{-1} **[4]**

(b) (i) Explain graphically how the rate of a reaction changes with every 10°C rise in temperature. **[2]**

(ii) How is the activation energy of a reaction related to its rate constant? **[1]**

(iii) The half life period for the decomposition of a substance is 2.5 hours. If the initial weight of the substance is 160 g, how much of the substance will be left after 10 hours? **[1]**

Question 3

(a) (i) Define Frenkel defects of an ionic crystal. **[1]**

(ii) Iron has an edge length 288 pm. Its density is 7.86 gm cm^{-1}. Find the type of cubic lattice to which the crystal belongs. (at. mass of iron = 56) **[3]**

(b) Explain giving reasons why:

(i) $Mg(OH)_2$ is sparingly soluble in water but highly soluble in ammonium chloride solution. **[2]**

(ii) When H_2S is passed through acidified zinc sulphate solution, white precipitate of zinc sulphide is not formed. **[2]**

(c) The equilibrium constant for the reaction $H_2(g)+I_2(g) \rightarrow 2HI(g)$ is 49.5 at 440°C. If 0.2 mole of H_2 and 0.2 mole of I_2 are allowed to react in a 10 litre flask at this temperature, calculate the concentration of each at equilibrium. **[2]**

Question 4

(a) (i) What is specific conductance of a solution and what is its unit? How is it related to the equivalent conductance of the solution? **[2]**

(ii) 2.5 amperes of current is passed through copper sulphate solution for 30 minutes. Calculate the number of copper atoms deposited at the cathode (Cu = 63.54). **[2]**

(iii) Four metals W, X, Y and Z have the following values of $E^{o}_{red.}$: **[2]**

E^{o}_{red}

W = -0.140 V

X = - 2.93 V

Y = +0.80 V

Z = +1.50 V

Arrange them in the increasing order of reducing power.

(b) (i) On adding sodium acetate to aqueous solution of acetic acid, what happens to the pH of the solution? Give a reason for your answer. **[2]**

(ii) Calculate the pH of an aqueous solution of ammonium formate assuming complete dissociation. pka for formic acid = 3.8 and pkb of ammonia = 4.8 **[1]**

(c) Explain auto catalysis with one example. **[1]**

SECTION B

Answer any **two** *questions*

Question 5

(a) (i) State the geometry and magnetic property of tetracarbonyl nickel according to the valence bond theory. **[1]**

(ii) What type of structural isomers are $[Pt(OH)_2(NH_3)_4]SO_4$ and $[Pt\ SO_4(NH_3)_4]\ (OH)_2$? How will you identify the isomers with a chemical test? **[2]**

(b) Name the co-ordination compound used for the following: **[2]**

(i) Treatment of cancer.

(ii) Treatment of lead poisoning.

Question 6

(a) Explain giving reasons why:

(i) The halogens are coloured and the colour deepens from fluorine to iodine. **[2]**

(ii) In a given transition series, the atomic radius does not change very much with increasing atomic number. **[2]**

(b) Draw the resonating structures of ozone molecule. **[1]**

Question 7

(a) (i) Give equations to show the use of aqua regia in dissolving platinum. **[1]**

(ii) Draw the structure of Xenon hexafluoride molecule and state the hybridisation of the central atom and the structure of the molecule. **[2]**

(b) Write balanced equations for the following reactions: **[2]**

(i) Ozone and alkaline potassium iodide.

(ii) Sodium sulphite and acidified potassium permanganate.

SECTION C

Answer any **two** *questions.*

Question 8

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

(i) Benzene diazonium chloride is treated with copper and hydrochloric acid.

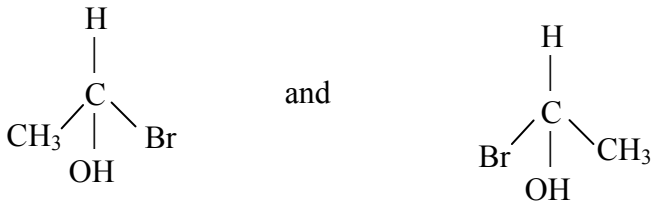
(ii) Formaldehyde is treated with 50% caustic soda solution.

(b) (i) Write the structures of the isomers of 3 phenyl prop-2-enoic acid. **[1]**

(ii) What type of isomerism is exhibited by the following pairs of compounds: **[2]**

(1) $CH(CH_2)_3\ CH_2OH$ and $(C_2H_5)_2\ CHOH$

(2)



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

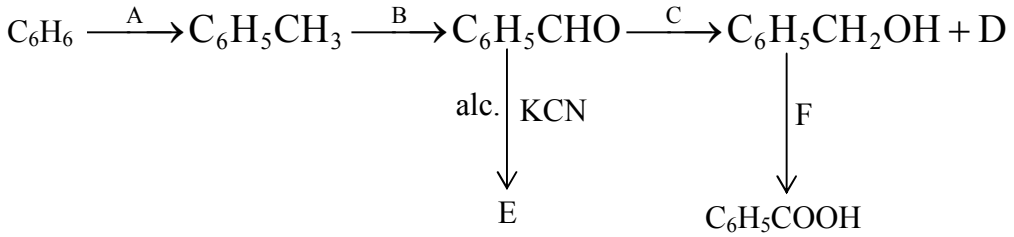
(i) Urea and acetamide

(ii) 1-propanol and 2 methyl 2-propanol.

(d) Name the monomeric units of Nylon 66. **[1]**

Question 9

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



(b) How can the following conversions be brought about?

(i) Ethanoic acid to ethylamine. **[3]**

(ii) Aniline to benzoic acid. **[3]**

(c) What is a zwitter ion? Represent the zwitter ion of glycine. **[1]**

Question 10

(a) An organic compound A on treatment with ethanol gives a carboxylic acid B and a compound C. Hydrolysis of C under acidic condition gives B and D. Oxidation of D with acidified potassium permanganate also gives B. B on heating with calcium hydroxide gives E with molecular formula C_3H_6O. E does not give Tollen's test but reacts with iodine and caustic potash to give a yellow precipitate. **[4]**

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

(ii) Write balanced equation of E with iodine and caustic potash and name the reaction.

(b) (i) Name the functional groups that distinguish glucose and fructose. How will you distinguish between the two compounds? **[2]**

(ii) What are polyesters? Give one example of polyester and the monomers. **[2]**

(c) Give balanced equations for the following reactions: **[2]**

(i) Aniline and benzoyl chloride.

(ii) Diethyl ether and hydroiodic acid (cold).

SPECIMEN PAPER **I** OF **II**
FOR PAPER 2

CHEMISTRY

PAPER – 2

(PRACTICAL)

(Three hours)

(*Candidates are allowed additional 15 minutes for* ***only*** *reading the paper.*
They must NOT start writing during this time.)

ALL ANSWERS MUST BE WRITTEN IN THE ANSWER BOOKLET PROVIDED SEPARATELY.

Question 1 *is an* ***oxidation-reduction titration*** *in which sufficient working details are given. All essential working must be shown.*

Question 2 *is an experiment on the* ***rate of reaction****.*
Sufficient working must be shown.

Question 3 *is an exercise in* ***qualitative analysis****.*

Mathematical Tables and graph paper are provided.

Read the questions carefully and follow the given instructions.

Attempt ***all*** *questions.*

All working, including rough work, should be done on the same sheet as the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

Attempt ***all*** *questions.*

Question 1 **[8]**

You are provided with two solutions as follows:

- **C-10** is a solution prepared by dissolving 1.04 gms of potassium manganate (VII) $KMnO_4$ per litre.
- **C-11** is a solution prepared by dissolving 13.4 gms of hydrated ammonium iron (II) sulphate crystals, $(NH_4)_2SO_4.FeSO_4.xH_2O$ per litre.

PROCEDURE:

Rinse and fill the burette with the solution **C-10** ($KMnO_4$). Pipette out 20 ml or 25 ml of **C-11** (hydrated ammonium iron(II) sulphate) into a clean conical flask. To this, add 20ml of dilute sulphuric acid **C-12**, specially provided for titration.

Titrate the solution with **C-10** ($KMnO_4$) till one drop of this gives a light permanent pink colour to the solution in the conical flask. Ensure that the pink colour does not disappear on shaking the contents of the conical flask.

Repeat the experiment to get at least two concordant readings.

Tabulate your readings.

State:

(A) The capacity of the pipette used.

(B) The titre value you intend to use in your calculations.

Show the titre value to the Visiting Examiner.

The equations for the above reactions are as follows:

$2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

$10(NH_4)_2SO_4.FeSO_4.xH_2O + 5H_2SO_4 + 5[O] \rightarrow 10(NH_4)_2SO_4 + 5Fe_3(SO_4)_{3+} \ 10\ xH_2O + 5H_2O$

Relative atomic masses:

K = 39 Fe = 56 S = 32 N = 14 H = 1 Mn = 55 O = 16

Calculate the following:

(i) The **molarity** of potassium manganate (VII) solution **C-10**.

(ii) The **molarity** of hydrated ammonium iron(II) sulphate solution **C-11**.

(iii) The **molecular mass** of hydrated ammonium iron(II) sulphate deduced from the experimental data.

(iv) The **numerical value** of *x*.

***Question 2** **[5]**

You are provided with two solutions as follows:

(a) **C-13** is a solution of sodium thiosulphate of strength 0.05 M

(b) **C-14** is a solution of hydrochloric acid of strength 0.05 M.

PROCEDURE:

Take the beakers labelled **1** to **5**. Put 0.05 M sodium thiosulphate solution and distilled water according to the following table:

Beaker Number	**1**	**2**	**3**	**4**	**5**
Volume of 0.05 M sodium thiosulphate (ml)	50	40	30	20	10
Volume of distilled water added (ml)	0	10	20	30	40

Now place the beaker labelled **1** on a white paper with a cross mark in black. View the cross-mark through the solution. Now pipette out 10 ml of 0.05 M hydrochloric acid **C-14** into it and immediately start a stop-watch. View the solution from the top and stop the stop-watch as soon as the cross on the paper becomes invisible. Note the time in the stop-watch.

Repeat the experiment by adding 10 ml of 0.05 M hydrochloric acid **C-14,** to the beakers labelled **2, 3, 4** and **5** and note the time taken in each case for the cross mark on the paper to become invisible.

Tabulate your results.

Sodium thiosulphate reacts with hydrochloric acid to produce colloidal sulphur which makes the cross-mark invisible.

The reaction is given by:

$Na_2S_2O_3$ (aq) + 2HCl(aq) $\rightarrow$ 2NaCl(aq) + SO_2(g) + H_2O(aq) + S (colloidal)

From your results:

(i) Plot a graph between the concentration of sodium thiosulphate and the time taken for the cross-mark on the paper to become just invisible.

(ii) Predict the effect of change in concentration of sodium thiosulphate on the rate of the above reaction from the nature of your graph.

Note:** ***Question 2 will be set from either Rate of Reaction or Identification of Organic Compounds.

Question 3 **[7]**

Analyse qualitatively the substance **C-15** which contains *two* anions and *two* cations. Identify these ions.

(a) While testing for **anions** you must mention:

(i) How the solution/soda extract was prepared.

(ii) How the gases were identified.

(iii) The confirmatory test for anions.

Show the results as required to the Visiting Examiner.

(b) While testing for **cations** you must mention:

(i) How the original solution for group analysis was prepared.

(ii) The formal group analysis with pertinent group reagents.

(iii) The confirmatory test for each cation.

Show the results as required to the Visiting Examiner.

Note: *Use of qualitative analysis booklet/table is not allowed.*

Question 4

Show the following to the Visiting Examiner for assessment:

(a) Project **[7]**

(b) Chemistry Practical File. **[3]**

SPECIMEN PAPER **II** OF **II**
FOR PAPER 2

CHEMISTRY

PAPER – 2

(PRACTICAL)

(Three hours)

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Question 1 *is an* ***oxidation-reduction titration*** *in which sufficient working details are given. All essential working must be shown.*

Question 2 *is an exercise dealing with the* ***identification of organic compounds****.*

Credit will be given for precise observations recorded and for well drawn deductions.

Question 3 *is an exercise in* ***qualitative analysis****.*

Mathematical Tables are provided.

Read the questions carefully and follow the given instructions.

Attempt ***all*** *questions.*

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Tabulate your readings.

State:

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Relative atomic masses:

K = 39 Fe = 56 S = 32 N = 14 H = 1 Mn = 55 O = 16

Calculate the following:

(i) The **molarity** of potassium manganate (VII) solution **C-10**.

(ii) The **molarity** of hydrated ammonium iron(II) sulphate solution **C-11**.

(iii) The **molecular mass** of hydrated ammonium iron(II) sulphate deduced from the experimental data.

(iv) The **numerical value** of *x*.

***Question 2** **[5]**

Substances **C-13** and **C-14** are organic compounds. Carry out the following experiment and note all the changes taking place at each step of the experiments.

Note the smell of the substance formed, colour of the substance obtained, colour of the precipitate formed, and solubility in excess of the reagent and any other observations you may have. State the identity of each compound on the basis of the experiments and observational changes.

PROCEDURE:

(a) Substance **C-13:**

1. Take 3 – 4 drops of **C-13** in a test tube, add about 0.5 grams of potassium hydrogen sulphate and heat strongly.
2. Take 0.2 grams of borax in a test tube and add 5 ml of water to it, and shake well to get a clear solution. To this, add 2 drops of phenolphthalein solution. Now add 2- 3 drops of **C-13** to this, shake well, warm and cool.
3. Take about 4 – 5 drops of **C-13** in a test tube. Add about 1 ml of copper sulphate solution followed by a few drops of Sodium Hydroxide solution.

Show the results as required to the Visiting Examiner.

(b) Substance **C-14:**

1. Take 2 ml freshly prepared Sodium Nitroprusside solution. To this, add 2 ml of **C-14** followed by Sodium Hydroxide solution drop by drop, and warm.
2. Take 2 ml of **C-14** and to this add 2 ml of saturated Sodium Bisulphite solution. Shake.
3. Take 1 ml of **C-14.** To this, add 2 ml of Iodine solution followed by 10% Sodium Hydroxide solution. Warm on a water bath and cool.
4. Take 2 ml of **C-14** in a test tube, add 1 ml of Mercuric chloride solution. Now, add Sodium Hydroxide solution drop-wise and shake.

Show the results as required to the Visiting Examiner.

Note:** ***Question 2 will be set from either Rate of Reaction or Identification of Organic Compounds.

Question 3 **[7]**

Analyse qualitatively the substance **C-15** which contains *two* anions and *two* cations. Identify these ions.

(a) While testing for **anions** you must mention:

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Note: *Use of qualitative analysis booklet/table is not allowed.*

Question 4

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(a) Project **[7]**

(b) Chemistry Practical File. **[3]**