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 $R = 1{\cdot}987\ cal\ deg^{-1}\ mol^{-1} = 8{\cdot}314\ JK^{-1}\ mol^{-1} = 0{\cdot}0821\ dm^3\ atm\ K^{-1}mol^{-1}$
$1\ l\ atm = 1\ dm^3\ atm = 101{\cdot}3\ J.$ *1 Faraday* $= 96500$ *Coulombs.*
Avogadro's number $= 6.023 \times 10^{23}$.

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]**

(increases, formic acid, decreases, less, zero, small, paired, atoms, unpaired, ions, pentagonal bipyramidal, electrical, more, ethylamine, molecules, propanoic acid, methylamine, chemical)

(i) An electrochemical cell converts _____ energy to _____ energy.

(ii) The crystal of graphite is made up of _____ while that of sodium chloride is made up of _____.

(iii) Ethyl isocyanide, on hydrolysis with dilute sulphuric acid, gives _____ and _____ .

(iv) The molar conductance of a solution _____ with dilution, while its specific conductance _____ with dilution.

(v) The Van't Hoff factor of acetic acid solution is _____than one and the value of normal colligative property is _____ than the observed colligative property of this solution.

This Paper consists of 7 printed pages and 1 blank page.

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

(i) Of the following terms used for denoting concentration of a solution, the one which does not get affected by temperature is:

(1) Molarity

(2) Molality

(3) Normality

(4) Formality

(ii) The solubility of calcium hydroxide is s mol litre^{-1}. The solubility product under the same condition will be:

(1) $4s^3$

(2) $2s^3$

(3) $2s^2$

(4) s^3

(iii) A current liberates 0·50g of hydrogen in 2 hours. The weight of copper (at.wt.= 63·5) deposited at the same time by the same current through copper sulphate solution is:

(1) 63·5 g

(2) 31·8 g

(3) 15·9 g

(4) 15·5 g

(iv) Natural rubber is a:

(1) Polyester

(2) Polyamide

(3) Polyisoprene

(4) Polysaccharide

(v) Among the following halogens, the one which does not form an oxyacid is:

(1) Fluorine

(2) Chlorine

(3) Bromine

(4) Iodine

(c) Answer the following questions: [5]

(i) What is the $[OH^-]$ concentration of an acid whose pH is 5 at 25°C?

(ii) What happens when a nickel rod is dipped into a copper sulphate solution? Justify your answer.

$$\left[E^{0}_{Ni^{+2}/Ni} = -0 \cdot 25v \text{ and } E^{0}_{Cu^{+2}/Cu} = +0 \cdot 34v \right]$$

(iii) Write the equation for the preparation of acidanilide from aniline.

(iv) Define Raoult's law for the elevation of boiling point of a solution.

(v) An ionic compound is made up of A cations and B anions. If A cations are present at the alternate corners and B anion is present on the body of the diagonal, what is the formula of the ionic compound?

(d) Match the following: [5]

(i)	Molal depression constant	(a)	Infinite dilution
(ii)	Acetaldehyde	(b)	mol l^{-1} sec^{-1}
(iii)	Rate of reaction	(c)	Iodoform
(iv)	Optical activity	(d)	K Kg mol^{-1}
(v)	Kohlrausch's law	(e)	Lactic acid

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) What will be the vapour pressure of a solution containing 5 moles of sucrose ($C_{12}H_{22}O_{11}$) in 1 kg of water, if the vapour pressure of pure water is 4·57 mm of Hg? [C = 12, H = 1, O = 16] [3]

(ii) A 2 molal solution of sodium chloride in water causes an elevation in the boiling point of water by 1·88 K. What is the value of Van't Hoff factor? What does it signify? [K_b = 0·52 K kg mol^{-1}] [2]

(b) (i) Write the mathematical expression relating the variation of rate constant of a reaction with temperature. [4]

(ii) How can you graphically find the activation energy of the reaction from the above expression?

(iii) The slope of the line in the graph of log k (k = rate constant) versus $\frac{1}{T}$ is – 5841.

Calculate the activation energy of the reaction.

(c) Define Frenkel defect in solid crystal. [1]

Question 3

(a) Explain giving reasons why: [4]

(i) Ionic solids conduct electricity in molten state, but not in solid state.

(ii) Solution of sodium chloride has no effect on litmus, but a solution of zinc chloride turns blue litmus red.

(b) In a crystal of diamond: [2]

(i) How many carbon atoms are present per unit cell?

(ii) What type of lattice does diamond crystallize in?

(iii) How many carbon atoms surround each carbon atom?

(iv) How are they arranged?

(c) (i) What is standard hydrogen electrode? [1]

(ii) 0·05 M NaOH solution offered a resistance of 31·6 ohm in a conductivity cell at 298 K. If the cell constant of the cell is 0·367 cm^{-1}, calculate the molar conductivity of the NaOH solution. [3]

Question 4

(a) (i) K_c for the reaction $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$ is 61·7 at 60°C. What is its unit? Calculate K_p for the reaction and write its unit. [3]

(ii) What happens to the equilibrium in a reversible reaction if a catalyst is added to it? [1]

(b) State the effect of the following on the reaction $2SO_{2(g)}+O_{2(g)} \rightleftharpoons 2SO_{3(g)}+189{\cdot}4$ kJ at equilibrium: [2]

(i) Temperature is increased.

(ii) Concentration of SO_2 is increased.

(iii) Pressure is decreased.

(iv) Helium is added at constant pressure.

c) (i) 0·3605 g of a metal is deposited on the electrode by passing 1·2 amperes of current for 15 minutes through its salt solution. The atomic weight of the metal is 96. What is the valency of the metal? [3

(ii) Explain why phenolphthalein is used as an indicator in acid-base titration. [1

SECTION B

Answer any **two** *questions*

Question 5

(a) Write the formula of the following compounds: [2]

(i) Triamminetriaquachromium(III)chloride

(ii) Potassiumhexacyanoferrate(III)

(b) Name the types of isomerism shown by the following pairs of compounds: [2]

(i) $[CoCl(H_2O)(NH_3)_4]Cl_2$ and $[CoCl_2(NH_3)_4]Cl.H_2O$

(ii) $[Pt(NH_3)_4][PtCl_6]$ and $[Pt(NH_3)_4Cl_2][PtCl_4]$

(c) For the complex ion of $[Co(NH_3)_6]^{3+}$: [1]

(i) State the hybridisation of the complex.

(ii) State the magnetic nature of the complex.

Question 6

(a) Write balanced chemical equations for the following reactions: [3

(i) Ozone and lead sulphide.

(ii) Chlorine is passed through hot concentrated NaOH solution.

(iii) Sulphuric acid is treated with phosphorous.

(b) Give reasons for the following: [2

(i) Zn^{+2} salts are white but Cu^{2+} salts are blue in colour.

(ii) Fluorine gives only one oxide but chlorine gives a series of oxides.

Question 7

(a) How is potassium dichromate prepared from a sample of chromite ore? Give balanced equations for the chemical reactions involved. [3]

(b) For the molecule IF_7: [2]

(i) Draw the structure of the molecule.

(ii) State the hybridisation of the central atom.

(iii) State the geometry of the molecule.

SECTION C

Answer any **two** *questions.*

Question 8

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

(i) Acetic acid to methyl cyanide. [2]

(ii) Acetaldehyde to formaldehyde. [3]

(iii) Nitrobenzene to 2, 4, 6 tribromoaniline. [2]

(b) Identify the reagents A, B, C, D, E and F required for the following conversion: [3]

$$C_6H_5NO_2 \xrightarrow{A} C_6H_5NH_2 \xrightarrow{B} C_6H_5N_2^+Cl^- \xrightarrow{C} C_6H_5Cl \xrightarrow{D} C_6H_5OH \xrightarrow{H_2SO_4} E + F$$

Question 9

(a) The deficiency of which vitamin will cause the following diseases: [2]

(i) Scurvy

(ii) Haemorrhages

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

(i) Ethanol and 2 propanol.

(ii) Aniline and ethylamine.

(c) Write the structures of all enantiomers possible for lactic acid. [1]

(d) Give balanced equations for the following reactions: [4]

(i) Acetaldehyde is heated with hydroiodic acid in the presence of red phosphorous.

(ii) Calcium acetate is subjected to dry distillation.

(iii) Sodium ethoxide is treated with ethyl bromide.

(iv) Benzaldehyde is treated with sodium bisulphite.

Question 10

(a) An organic compound A with molecular formula C_7H_8 on oxidation by chromylchloride in the presence of CCl_4 gives a compound **B** which gives positive tollen's test. The compound **B** on treatment with NaOH followed by acid hydrolysis gives two products C and **D**. C on oxidation gives **B** which on further oxidation gives **D**. The compound **D** on distillation with sodalime gives a hydrocarbon E. Below 60°C, concentrated nitric acid reacts with E in the presence of concentrated sulphuric acid forming a compound F. Identify the compounds **A**, **B**, C, **D**, E and F. [3]

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

(i) Clemmensen's reduction.

(ii) Kolbe's electrolytic reaction.

(iii) Balz-Schiemann's reaction.

(c) (i) What do you observe when glucose is treated with bromine water? [2]

(ii) What is isoelectric point?

(d) Answer the following: [2]

(i) What is biuret test?

(ii) Write balanced equation for the formation of biuret.