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]**

(acetaldehyde, salt solution, 0.68, R, formaldehyde, buffer solution, 0.524, i, calcium formate, 50 minutes, below, 45 minutes, 0.74, van't Hoff factor, Raoult's Law, weak, strong, increases, decreases, positive, negative, above.)

(i) The solution obtained by mixing appropriate amount of _____base and its salt with strong acid is called _____.

(ii) An aqueous solution of glucose boils _____ 100^{o}C and freezes _____ 0^{o}C.

(iii) The ratio of the observed value of a colligative property to the normal value of the same property is termed as _____ and is represented by letter _____.

(iv) When a mixture of calcium acetate and _____ is subjected to dry distillation _____ is obtained.

(v) A _____ catalyst increases the rate of a chemical reaction while a negative catalyst _____ the rate of the reaction.

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

(i) A saturated solution of Ag_2CrO_4 is 2×10^{-4} moles/litre. Its solubility product is:

(1) $4{\cdot}4\times10^{-8}$

(2) $3{\cdot}2\times10^{-11}$

(3) $2{\cdot}8\times10^{-9}$

(4) $5{\cdot}6\times10^{-12}$

(ii) A molecule contains atoms x and y so that x occurs at the corners of the cube while y at the face centres. The formula of the molecule can be:

(1) xy_3

(2) Xy

(3) x_2y

(4) xy_2

(iii) 15 moles of hydrogen (H_2) and 5.2 moles of iodine (I_2) are mixed and allowed to attain equilibrium at 500^oC. At equilibrium, the concentration of HI is found to be 10 moles. The equilibrium constant for the formation HI is:

(1) 50

(2) 15

(3) 100

(4) 25

(iv) Glucose gives silver mirror test with Tollen's reagent. It shows the presence of:

(1) Alcoholic group

(2) Ketonic group

(3) Aldehydic group

(4) Acidic group

(v) In the formation of $K_4[Fe(CN)_6]$, the hybridisation involved is:

(1) dsp^2

(2) d^2sp^3

(3) sp^3d^2

(4) sp^3

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

(i) Why, Fe^{2+} has smaller radius than Mn^{2+} ?

(ii) Write the Nernst equation for the following cell reaction:

$$Zn(s)\left|Zn^{2+}(aq)\right|\left|Cu^{2+}(aq)\right|Cu(s)$$

(iii) Draw the structure of isomers for molecular formula $C_3H_6Cl_2$ which can exhibit optical isomerism.

(iv) What are the products formed when phenol and nitrobenzene are treated separately with a mixture of conc. sulphuric acid and conc.niric acid?

(v) How will you prepare 2-methyl propan – 2 ol from methyl magnesium bromide. Give balanced equations.

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

(i)	Specific conductivity	(a)	Argentite
(ii)	Froth floatation process	(b)	Thermosetting plastics
(iii)	Aniline	(c)	Bidentate Ligand
(iv)	Bakelite	(d)	$Ohm^{-1}\ cm^{-1}$
(v)	Ethylene diamine	(e)	Diazotisation

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 is the molarity of a solution which freezes at -0.192^oC assuming no change in the solute by raising the temperature, at what temperature will the same solution boil? (K_f for water is $1{\cdot}86^oC\ kg\ mol^{-1}$ and K_b for water is $0{\cdot}515^oC\ kg\ mol^{-1}$) **[3]**

(ii) Phenol (M.W. = 94) associates in benzene to a certain extent to form dimer. A solution containing 20g of phenol in 1000 gms of benzene has its freezing point decreased by 0·69 K. Calculate the observed molecular weight and the degree of association of phenol. (K_f for benzene is $5{\cdot}12\ K\ kg\ mol^{-1}$). **[2]**

(b) If three elements P, Q and R crystallise in a cubic solid lattic with P atoms at the corners, Q atoms at the cube centre and R atoms at the centre of faces of the cube, then write the **[2]**

formula of the compound.

(c) State the Le Chatelier's principle. What are the conditions for getting maximum yield of ammonia by Haber's process? **[3]**

$$N_2(g) + 3H_2(g) \underset{445^oC}{\overset{200\ atm}{\rightleftharpoons}} 2NH_3(g) + heat$$

Question 3

(a) (i) An element having bcc geometry has atomic mass 50. Calculate the density of unit cell, if its edge length is 290 pm. **[2]**

(ii) What is the effect of dilution on the strength of weak acids? Explain. **[2]**

(b) The following electrochemical cell is set up at 25°C: **[3]**

$$Zn\left|Zn^{2+}(aq)(1M)\right|\left|Cd^{2+}(aq)(1M)\right|Cd$$

Given: $E^o_{Zn^{2+}/Zn} = -0\cdot763V; E^o_{Cd^{2+}/Cd} = -0\cdot403V$

(i) Write the cell reaction.

(ii) Calculate the emf of the cell.

(iii) Calculate the value ΔG^o for the cell reaction at 25°C.

(iv) Is the reaction spontaneous or non-spontaneous?

(c) For the following reaction: **[3]**

$$2H_2(g) + 2NO(g) \rightleftharpoons 2H_2O(l) + N_2(g)$$

the following rate data was obtained.

Experiment	[NO](mol L^{-1})	[H_2] (mol L^{-1})	Rate (mol L^{-1} sec^{-1}
1	0·40	0·40	$4\cdot8\times10^{-3}$
2	0·80	0·40	19.2×10^{-3}
3	0·40	0·80	9.6×10^{-3}

Determine the following:

(i) The order of reaction with respect to NO and H_2 .

(ii) The rate law.

(iii) The value of rate constant.

Question 4

(a) (i) Define the terms specific conductance and equivalent conductance. What is the relationship between specific and equivalent conductance? **[2]**

(ii) A solution containing 2 g of anhydrous barium chloride in 400 ml of water has a conductivity of 0·0058 $ohm^{-1}cm^{-1}$. Calculate the molar and equivalent conductivities of this solution (at wt. Ba = 137, Cl = 35·5) **[3]**

(b) Explain the following: **[3]**

(i) An aqueous solution of $AlCl_3$ is acidic and that of Na_2CO_3 is basic.

(ii) The hydrolysis of esters begins slowly but becomes fast after some time.

(iii) The concentration of hydroxyl ions in aqueous ammonia decreases on the addition of a little solid ammonium chloride.

(c) What is the effect of temperature on ionic product of water and why? What happens to the ionic product of water if some acid is added to it? **[2]**

SECTION B

Answer any **two** *questions*

Question 5

(a) Write the IUPAC name of the following coordination compounds: **[2]**

(i) $[Fe\ (H_2O)_6]\ Cl_3$

(ii) $[Co\ Br\ (NO_2)\ (NH_3)_4]$

(iii) $K_3\ [Fe\ (C_2O_4)]$

(iv) $[Cr\ (NH_3)_6]\ [CO(CN)_6]$

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

(i) $[Cr\ (H_2O)_5\ Cl]Cl_2{\cdot}H_2O$ and $[Cr(H_2O)_4\ Cl_2]Cl{\cdot}2H_2O$

(ii) $[Co\ Br\ (NH_3)_5]SO_4$ and $[Co(SO_4)\ (\ NH_3)_5]Br$

(iii) $[Cr\ (SCN)\ (H_2O)_5]^{2+}$ and $[Cr\ (NCS)\ (H_2O)_5]^{2+}$

(iv) $[Cu\ (NH_3)_4]\ [Pt\ Cl_4]$ and $[Pt\ (NH_3)_4]\ [Cu\ Cl_4]$

(c) $K_2\ [Pt\ Cl_4]$ is ionised to give three ions, when dissolved in water. Will it form white precipitate with $AgNO_3$? Give a reason. **[1]**

Question 6

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

(i) Sulphur dioxide gas is passed through acidified potassium permanganate solution.

(ii) Potassium dichromate is treated with acidified ferrous sulphate solution.

(iii) Silver nitrate is added to dilute solution of sodium thiosulphate.

(b) What is meant by Lanthanoid contraction? Write the general electronic configuration of inner transition elements. **[2]**

Question 7

(a) Sulphur dioxide acts both as an oxidising and a reducing agent. Give one reaction each to show its oxidising and reducing nature. **[2]**

(b) How will you obtain pure copper from its most important ore? Write all the steps and reactions involved in it. **[3]**

SECTION C

Answer any **two** *questions.*

Question 8

(a) Carry out the following conversions: **[6]**

(i) Acetaldehyde to Acetone.

(ii) Phenol to Benzoic acid.

(iii) Acetic acid to Methylamine.

(iv) Nitrobenzene to *p*-aminoazobenzene.

(b) Complete the following reactions and name the reactions. **[2]**

(i) $C_6H_5NH_2 + \_\_\_\_\_ + KOH \rightarrow C_6H_5NC + KBr + H_2O$

(ii) $CH_3-\overset{\overset{O}{\|}}{C}-H + CH_3CHO \xrightarrow{\text{dil NaOH}} \_\_\_\_\_$

(c) Give one good chemical test to distinguish between the following pairs of compounds: **[2]**

(i) Acetaldehyde and acetone.

(ii) Phenal and ethanal.

Question 9

(a) An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula C_6H_7N. Identify the compounds A, B and C. **[3]**

(b) (i) Give one example of a polyester and name the monomers from which it is formed. **[3]**

(ii) Write the monomers of the following polymers:

(1) Teflon

(2) Bakelite

(3) Nylon – 66

(4) Polystyrene

(c) (i) Do the compounds having $-\overset{|}{C}= N -$ and $-N = N -$ bonds show geometrical isomerism? If yes, give one example of each and name the isomers. **[4]**

(ii) How can you chemically convert methylamine to ethylamine?

Question 10

(a) Identify the products A, B and C. **[3]**

(i) $C_6H_5COOH \xrightarrow{SOCl_2} [A] \xrightarrow{NH_3} [B] \xrightarrow{Br_2 / KOH} [C]$

(ii) $CH_3CH_2OH \xrightarrow[K_2Cr_2O_7 + H_2SO_4]{[O]} [A] \xrightarrow{+HCN} [B] \xrightarrow[\text{Hydrolysis}]{H^+ / H_2O} [C]$

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

(i) Benzoic acid is treated with phosphorous pentachloride.

(ii) Formaldehyde is treated with hydrazine.

(iii) Aniline is heated with chloroform and alcoholic caustic potash.

(iv) Benzoyl chloride is heated with hydrogen in the presence of palladium and barium sulphate.

(c) (i) Write three possible isomers having molecular formula $C_3H_6O_2$. **[3]**

(ii) How will you distinguish between primary, secondary and tertiary aliphatic amines?