CHEMISTRY

PAPER – 1

(THEORY)

(Maximum marks: 70)

(Time allowed: Three hours)

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

All questions are compulsory

Question 1 is of 20 marks having four sub parts, all of which are compulsory.

*Question numbers 2 to 8 carry 2 marks each, with **any two** questions having internal choice.*

*Question numbers 9 to 15 carry 3 marks each, with **any two** questions having an internal choice.*

Question numbers 16 to 18 carry 5 marks each, with an internal choice.

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 Faraday = 96500 coulombs.

Avogadro's number = 6·023 $\times 10^{23}$.

Question 1

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

(Ketones, aldehydes, CaC_2, cationic, acidic, Al_4C_3, anionic, alkaline, -I, -M, normality, molality, mole fraction, + I, +M, molarity, less, more)

(i) _____and_____ are temperature independent mode of concentration representation.

(ii) Trichloroacetic acid is _____ acidic than acetic acid due to _____ effect.

(iii) Aqueous solution of NH_4Cl will be _____ due to _____ hydrolysis.

(iv) _____ on hydrolysis gives ethyne while _____ on hydrolysis gives methane.

(b) Complete the following statements by selecting the **correct alternative from the choices given:** **[4×1]**

(i) The electronic configuration of outer most shell of the most electronegative element is:

(1) ns^2np^3

(2) ns^2np^4

(3) ns^2np^5

(4) ns^2np^6

(ii) Which of the following species is diamagnetic in nature?

(1) He_2^-

(2) H_2

(3) H_2^+

(4) H_2^-

(iii) The volume of '10 vol' H_2O_2 required to liberate 500 ml of O_2 at NTP is:

(1) 50 ml

(2) 25 ml

(3) 100 ml

(4) 125 ml

(iv) The compound which is not isomeric with diethyl ether is:

(1) methyl n-propyl ether

(2) 1 – butanol

(3) 2 – methyl propan – 2 – ol

(4) butanone

(c) Match the following**:** **[4×1]**

(i)	Magnetic quantum number	(a)	Optical isomerism
(ii)	Boron halides	(b)	Sodium carbonate
(iii)	Lactic acid	(c)	Orientation of the orbital
(iv)	Solvay's process	(d)	Lewis acid.

(d) Answer the following questions: **[4×2]**

(i) (1) For a molecule $N_b = N_a$ will the molecule be stable? Explain why.

(2) What type of bond is formed when two p-orbitals overlap sidewise?

(ii) (1) Which alkyne on reductive ozonolysis will produce glyoxal only?

(2) Which gas is produced on dehydrohalogenation of ethyl iodide?

(iii) (1) At what temperature is the entropy of a perfectly crystalline substance taken as zero?

(2) Predict the sign of ΔG for a reaction that is exothermic and accompanied by an increase in entropy.

(iv) (1) Why are alkali metals used as reducing agents?

(2) Name the alkaline earth metal which shows diagonal relationship with aluminium.

Question 2 **[2]**

(a) In the Carius method of estimation of halogens, 0.250g of an organic compound gives 0.141g of AgBr. Calculate the percentage of bromine in the compound.

(at.wt. of Ag = 108, Br = 80).

OR

(b) In the Carius determination 0.234 g of an organic compound gave 0.334 g of Barium Sulphate. Calculate the percentage of Sulphur in the given compound.

(at.wt. of Ba=137, S = 32, O = 16)

Question 3 **[2]**

Complete and balance the following equations:

(i) $FeSO_4 + H_2O_2 + H_2SO_4 \rightarrow$ _____ + _____

(ii) $H_2O_2 + Ag_2O \rightarrow$ _____ + _____ + _____

Question 4 **[2]**

A dry gas measuring 280 ml at 305 K and 750 mm of Hg, weighs 0.344 g. Calculate the molecular weight of the gas.

Question 5 **[2]**

Write the structural formula of the compounds having the following IUPAC names.

(i) 5 – methyl hept – 3 – enal

(ii) 3 – hydroxy 6, 6 dimethyl hept – 4 – ene – 1 – oic acid.

Question 6 **[2]**

The first ionisation enthalpy of nitrogen (Z = 7) is greater than that of oxygen (Z = 8) but the reverse is true for the second ionisation enthalpy. Explain why.

Question 7 **[2]**

(a) Which alkene on reductive ozonolysis gives only:

(i) Ethanal

(ii) Propanone

OR

(b) How will you convert the following:

(i) Ethyl alchohol to ethene

(ii) Propene to 2 - bromopropane.

Question 8 **[2]**

Discuss the structure of diamond and graphite and explain the hardness of these allotropes on the basis of their structures.

Question 9 **[3]**

(i) Which one of the following is more paramagnetic Fe^{2+} or Fe^{3+}? Explain.

(ii) What is the number of unpaired electrons in Mn^{2+} ion? (at.no. Mn = 25)

Question 10 **[3]**

(a) In a Victor Meyer's determination, 0.36g of volatile substance displaces air which measures 140 ml at STP. Calculate the vapour density and molecular weight of the substance.

(1 litre of H_2 gas at STP weights 0.09g)

OR

(b) 750 ml of N_2 gas when taken in a vessel has pressure equal to 900 mm of Hg, 1200 ml of O_2 gas when taken in another vessel has pressure equal to 1450 mm of Hg. If both the gases are taken in 1000 ml vessel, what will be the total pressure exerted by the mixture of above gases? Assume that the gases are non-reacting.

Question 11 **[3]**

Write the balance equations for the following:

(i) Dilute hydrochloric acid is added to sodium thiosulphate solution.

(ii) Silver nitrate solution is treated with sodium thiosulphate solution.

(iii) Iodine solution is treated with sodium thiosulphate solution.

Question 12 **[3]**

(a) Calculate the standard heat of formation ($\Delta H°_f$) of $C_6H_{12}O_{6(s)}$ from the following data:

(i) ΔHc of $C_6H_{12}O_{6(s)}$ = - 2816 k.J mole $^{-1}$

(ii) $\Delta H°_f$ of $CO_{2(g)}$ = - 395.5 k.J mole $^{-1}$

(iii) $\Delta H°_f$ of $H_2O_{(l)}$ = - 285.9 k.J mole $^{-1}$

OR

(b) Answer the following questions in brief:

(i) Define *heat of neutralisation*.

(ii) What is the criteria for spontaneity in terms of free energy change?

(iii) Which of the following possesses higher entropy:

1. Gaseous substance

2. Liquid substance

Question 13 **[3]**

Answer the following questions:

(i) Name the gas that had leaked from the storage tank of the Union Carbide plant in the Bhopal gas tragedy.

(ii) What is acid rain and how it is formed?

(iii) What are the two effects of ozone layer depletion?

Question 14 **[3]**

(i) Discuss the optical isomerism of Lactic acid.

(ii) Can a compound of the type *aaC* = *Cab* show geometrical isomerism? Explain why.

Question 15 **[3]**

Write the molecular orbital configuration of N_2 . Calculate the bond order and predict its magnetic behaviour.

Question 16 **[5]**

(a) (i) Balance the following equations by ion-electron method:

(1) $MnO_4^- + Fe^{2+} + H^+ \rightarrow Mn^{2+} + Fe^{3+} + H_2O$ (acidic medium)

(2) $MnO_4^- + SnO_2^{2-} + H_2O \rightarrow MnO_2 + SnO_3^{2-} + OH^-$ (alkaline medium)

(ii) Find the oxidation number of:

(1) S in $Na_2S_4O_6$

(2) Cr in $K_2Cr_2O_7$

(3) Mn in K_2MnO_4

(4) Fe in Fe_3O_4

OR

(b) (i) Balance the following equations by oxidation number method:

(1) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2 + H_2O$)

(2) $K_2Cr_2O_7 + HCl \rightarrow KCl + CrCl_3 + H_2O + Cl_2$

(ii) Give reasons for the following:

(1) HNO_3 acts only as an oxidising agent while HNO_2 can act both as a reducing agent and an oxidising agent.

(2) Chlorine liberates iodine from KI solution.

Question 17 **[5]**

(a) (i) Explain why:

(1) The colour of Baeyer's reagent gets discharged when treated with an alkene.

(2) Alkanes and alkynes do not give geometrical isomerism.

(ii) How will you convert the following? (Give balanced equation.)

(1) Sodium acetate to methane

(2) Ethane to butane

(3) Benzene to toluene

OR

(b) (i) Identify the compounds A and B.

(1) $`C_6H_5COONa + NaOH \xrightarrow{CaO} A \xrightarrow[Conc\ H_2SO_4]{Conc\ HNO_3} B$

(2) $C_2H_6 \xrightarrow[hv]{Br_2} A \xrightarrow[heat]{Alc\ koH} B$

(ii) State an appropriate chemical test used to distinguish between the following pairs of compounds:

(1) Ethene and Ethyne

(2) But – 1 – ene and but – 2 - ene

Question 18 **[5]**

(a) (i) 15 moles of N_2 is mixed with 20 moles of H_2 in an 8 litre vessel. 5.6 moles of ammonia is formed. Calculate *Kc* for the equation;

$N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2NH_{3(g)} + heat$

(ii) The solubility product of silver chloride is $1x10^{-10}$ at 25°C. Calculate the solubility of silver chloride in 0.1 M sodium chloride.

OR

(b) (i) State and explain Le Chatelier's principle. On the basis of this principle discuss the conditions for obtaining the maximum yield of SO_3 in the following reaction.

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g);}\ \Delta H = -42\ k.cal.$

(ii) Calculate the *p*H value of 0.01M CH_3COOH if it is 5% dissociated.