PART I (40 marks)

Answer **all** *questions.*

Question 1.

(a) For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than one circled, NO score will be awarded. **[10]**

(i) The hybridization of carbon in ethyne, graphite and diamond is

A sp, sp^2, sp^3.

B sp^2, sp, sp^3.

C sp^3, sp, sp^2.

D sp^3, sp^2, sp.

(ii) After the emission of one α-particle and two β-particles from the atom ${}_{92}X^{238}$, the number of protons in the atom will be

A 93.

B 92.

C 91.

D 90.

(iii) Which of the following statements is correct for an ideal solution?

I. The change in volume of mixing is equal to zero.

II. The change in enthalpy is zero but change in volume is not equal to zero.

III. The change in enthalpy of mixing is equal to zero.

A I and II

B I and III

C II and III

D II only

(iv) The movement of colloidal particles under an applied electric potential is known as

A Brownian movement.

B electro-dialysis.

C electrophorosis.

D peptization.

(v) The coordination compound formed when potassium ferrocyanide solution is added to an aqueous solution of copper sulpahte is

A $Cu_2[Fe(CN)_6]$.

B $Cu_2[Fe(CN)_5]$.

C $Cu_2[Fe(CN)_4]$.

D $Cu_2[Fe(CN)_3]$.

(vi) Solder is an alloy composed of

A lead and tin.

B lead and copper.

C tin and cadmium.

D tin and antimony.

(vii) Which of the following is the correct order of +I-effect?

A $-CH_3 > -CH_2R > -CHR_2 > -CR_3$

B $-CH_2R > -CHR_2 > -CR_3 > -CH_3$

C $-CHR_2 > -CH_2R > -CH_3 > -CR_3$

D $-CR_3 > -CHR_2 > -CH_2R > -CH_3$

(viii) The following reactions are given by all the amines ***EXCEPT***

A $RNH_2 + HCl \longrightarrow [RNH_3]^+Cl^-$

B $RNH_2 + H_2O$ [illegible] $RNH_3.OH$

C $R_2NH + H_2SO_4$ [illegible] $[R_2NH_2]HSO_4$

D $RNH_2 + CHCl_3 + 3KOH \longrightarrow RNC + 3KCl + 3H_2O$

(ix) Williamson's synthesis is used for the preparation of

A ether.

B alcohol.

C ketones.

D aldehydes.

(x) The test which can differentiate benzaldehyde from acetone is

A iodoform test.

B carbylamine test.

C ferric chloride test.

D sodium bicarbonate test.

(b) ***Correct the following statements by changing only the underlined words. Rewrite ONLY the correct answer. DO NOT copy the whole sentences.*** **[5]**

(i) Some of the polar crystals on heating produce a small electric current called <u>piezoelectricity</u>.

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(ii) Effective collisions are those in which colliding molecules must have energy equal or greater than the <u>activation</u> energy.

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(iii) In a cyclic process the net change of internal energy is <u>maximum</u>.

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(iv) In fibers, the chains are held together by <u>covalent</u> bonds.

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(v) Fructose is a carbohydrate containing <u>carboxyl</u> group.

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(c) ***Match the items in Column A with the items in Column B. Rewrite the correct pairs by writing the number and the corresponding alphabet in the spaces provided. For example: (vi) – (h)*** **[5]**

Column A	**Column B**
(i) Adiabatic process	(a) $dT = 0$
(ii) Isobaric process	(b) $dV = 0$
(iii) Isochoric process	(c) $dq = 0$
(iv) Electrophilic addition	(d) $dp = 0$
(v) Nucleophilic addition	(e) C_2H_6
	(f) C_2H_4
	(g) CH_3COCH_3

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(d) ***Fill in the blanks choosing appropriate word/s given in the brackets.***

Write the correct answers in the space provided. **[5]**

[anode, greater, cathode, lower, mannitol, one, sorbitol, two]

(i) Van't Hoff factor, '*i*' for KCl is ……

(ii) The pH of an aqueous solution of sodium acetate is ……. than seven.

(iii) Dextrose on reduction with sodium amalgam and water forms …….

(iv) Fats have ……. percentage of unsaturated acids than oils.

(v) When electricity is passed through an acidic medium of glycine it moves towards ……..……..

(e) ***Answer the following questions.***

(i) Name the type of bond present in ortho-nitrophenol. **[1]**

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(ii) Write down ***two*** advantages of Thin Layer Chromatography (TLC) over paper chromatography. **[1]**

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(iii) What is the function of HCl in the analysis of group II cations? **[1]**

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(iv) On dilution, the equivalent conductance increases and the specific conductance decreases. Why? **[2]**

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(v) Why is white phosphorus always kept under water? **[1]**

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(vi) Write down the chemical equation for the reaction of H_2O_2 with ethylene. **[1]**

(vii) Draw the isomers of $C_2H_2Cl_2$ and name the isomers. **[2]**

(viii) Name the following chemical reactions. **[2]**

1. $CH_3COCl + H_2 \xrightarrow{Pd} CH_3 - \overset{\overset{O}{\|}}{C} - H + HCl$

2. $CH_3CONH_2 \xrightarrow[\Delta]{Br_2 / NaOH} CH_3NH_2$

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(ix) Write down the balanced equation for the preparation of nitroethane from ethane. **[1]**

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(x) Differentiate between the following pairs of compounds: **[2]**

1. phenol and lower aliphatic alcohol
2. aniline and aliphatic amines

Phenol	**Lower aliphatic alcohol**

Aniline	**Aliphatic amines**

(xi) Write the structure of monomer unit of polystyrene. **[1]**

PART II
SECTION A (28 marks)

Answer any **four** *questions.*

Question 2.

(a) 92 g of ethanol is dissolved in 54 g of water. Calculate the mole fraction of each. **[2]**

(b) Write the nuclear reaction and identify the projectile for the following conversions: **[2]**

(i) ${}_{7}N^{14}$ to ${}_{8}O^{17}$

(ii) ${}_{11}Na^{23}$ to ${}_{11}Na^{24}$

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(c) (i) Why is physisorption called physical adsorption and chemisorption as chemical adsorption? **[2]**

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(ii) Define true equilibrium state of a system under a given set of conditions. **[1]**

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Question 3.

(a) If the ionic product of water at 305 K is 2.7×10^{-14}, what is the pH of neutral water? **[2]**

(b) Explain why ionic crystals **[2]**

(i) are highly brittle?

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(ii) have high density?

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(c) Draw the molecular orbital diagram for N_2^+ and answer the following questions. **[3]**

(i) Calculate its bond order.

(ii) Predict its magnetic properties.

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Question 4.

(a) On passing 1.34 amperes of current in a solution of copper sulphate for 10 hours, 15.885 g of Cu was deposited on the electrode. The reaction is shown as: $Cu^{2+} + 2e^- \rightarrow Cu$ **[3]**

(i) Calculate the amount of electricity passed through the solution.

(ii) How many moles of Cu were deposited?

(iii) If the charge on an electron is 1.6×10^{-19} coulomb, calculate the value of Avogadro's number.

(b) List down and explain briefly ***four*** factors which influence the adsorption of a gas on the surface of a solid. **[2]**

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(c) Distinguish between the rate of reaction and the rate constant. **[2]**

Rate of reaction	**Rate constant**

Question 5.

(a) A solution containing 8 g of a non-volatile solute in 500 g of water freezes at 273.087 K. Calculate the molecular weight of the non-volatile solute. (k_f = 1.856 deg mol^{-1}) **[2]**

(b) (i) What are the roles of cadmium rods and graphite rods in a nuclear reactor? **[1]**

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(ii) Why is fusion energy superior to fission energy? **[1]**

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(c) Draw a well labelled phase diagram of the lead-silver system and calculate the degree of freedom at eutectic point. **[3]**

Question 6.

(a) Write short notes on: **[2]**

(i) Lewis concept of acids and bases

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(ii) Validity of Ostwald's dilution law

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(b) (i) What is a metallic bond? **[1]**

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(ii) Conductivity of metal decreases with the increase in temperature. Why? **[1]**

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(c) (i) When do we get a lower molecular mass of a substance as compared to a normal molecular mass? **[1]**

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(ii) A voltaic cell consist of a metallic zinc plate immersed in 0.1 M zinc nitrate solution and a lead plate in 0.02 M lead nitrate solution. Calculate the emf of the cell at 25°C. **[2]**

$E^0_{Zn^{2+}/Zn} = -0.76\,V$ $\quad$ $E^0_{Pb^{2+}/Pb} = -0.13\,V$

Question 7.

(a) The pH value for CH_3COONH_4 remains constant even after adding a base or an acid. Give reasons. **[2]**

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(b) The rate law for the reaction $H_2 + I_2 \rightarrow 2HI$ is found to be rate = $K[H_2]\,[I_2]$. How will the rate of reaction change when concentration of **[2]**

(i) iodine is doubled?

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(ii) hydrogen is halved?

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(c) (i) What do you understand by the term F-centers? **[1]**

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(ii) What are the differences between ferromagnetic and antiferromagnetic substances? **[1]**

Ferromagnetic	**Antiferromagnetic**

(iii) State group displacement law. **[1]**

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SECTION B (18 marks)

Answer any **three** *questions.*

Question 8.

(a) (i) What is Joule-Thomson effect? **[1]**

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(ii) ΔH and ΔS for vapourisation of H_2O at 1 atm. pressure are 81260 $Jmole^{-1}$ and 0.2176 $kJmole^{-1}$ respectively. Calculate the temperature at which the free energy change for transformation is zero. **[2]**

(b) Write down the IUPAC name of the following compounds. **[2]**

(i) $K_3[Al(C_2O_4)_3]$ = ……

(ii) $[Cr(NH_3)_6]$ $[Co(CN)_6]$ = ……..

(iii) $[Cu(NH_3)_4]SO_4$ = …….

(iv) $[Fe(H_2O)_6]SO_4$=……

(c) What kind of property is exhibited by copper when copper reacts with ferric sulphate? Write down the reaction. **[1]**

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Question 9.

(a) Complete the following reactions. **[2]**

(i) $SiO_2 + Mg \rightarrow$ ……

(ii) $2NaI + MnO_2 + 3H_2SO_4 \rightarrow$ ……

(b) What is ozonolysis? Write the chemical reaction. **[2]**

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(c) Classify the following reactions as electrophilic, nucleophilic, addition, elimination, substitution or free radical reaction. Write the balanced equations for the reactions. **[2]**

(i) Chlorination of methane in presence of UV light

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(ii) Reaction of ethylbromide with alcoholic KOH

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Question 10.

(a) Explain the entropy change when **[2]**

(i) a rubber band is stretched,

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(ii) ice melts to liquid.

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(b) Define linkage isomerism and give ***one*** example? **[1]**

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(c) Describe the extraction of lead by carbon reduction process. **[3]**

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Question 11.

(a) State ***two*** ways in which the internal energy of a system can be changed. **[1]**

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(b) Write down ***two*** uses each of **[2]**

(i) iodine and

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(ii) silver nitrate.

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(c) What are the differences between **[3]**

(i) homolytic fission and heterolytic fission,

(ii) mesomeric effect and inductive effect,

(iii) SN_1 reaction and SN_2 reaction.

Homolytic fission	**Heterolytic fission**

Mesomeric effect	**Inductive effect**

SN_1 reaction	**SN_2 reaction**

SECTION C (14 marks)

Answer any **two** *questions.*

Question 12.

(a) (i) Give ***one*** characteristic required by an organic compound to exhibit an optical isomerism. **[1]**

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(ii) What type of isomerism is exhibited by But-2-ene-1, 4 dioic acid? Draw the structures for all the isomers. **[1]**

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(b) Compound A (C_2H_4O) on oxidation gives compound B ($C_2H_4O_2$). Compound A undergoes aldol condensation. **[3]**

(i) What is aldol condensation?

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(ii) Give the balanced equation of the reaction mentioned above.

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(iii) Write the esterification reaction of compound B.

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(c) How will you distinguish between cyanides and isocyanides? **[2]**

Cyanides	**Isocyanides**

Question 13.

(a) Complete the following reactions and balance them. **[3]**

(i) $2C_6H_5Cl + CCl_3CHO \xrightarrow{Conc.H_2SO_4}$ ……

(ii) $C_6H_5NO_2 + 6[H] \xrightarrow{Sn+HCl}$ ……

(iii) $C_6H_5COOH + NH_3 \xrightarrow{Heat}$ ……

(b) What do you observe when **[2]**

(i) grape sugar is treated with an excess of phenyl hydrazine?

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(ii) sucrose is boiled with mineral acids?

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(c) What do you understand by the following terms? **[2]**

(i) Racemic mixture

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(ii) Elastomers

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Question 14.

(a) How will you carry out the following conversions? **[3]**

(i) Urea to biuret

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(ii) Acetyl chloride to acetophenone

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(iii) Ethyle acetate to ethyl alcohol

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(b) Give reasons for the following: **[2]**

(i) Benzene undergoes electrophilic substitution reaction even though it has a high degree of unsaturation.

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(ii) Aniline is a weak base than aliphatic amines.

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(c) (i) Explain the iso-electric point of glycine. **[1]**

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(ii) Give ***one*** difference between soap and detergent. **[1]**

Soap	**Detergent**

for Rough Work