[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 764 **B**

Unique Paper Code : 42171205

Name of the Paper : Chemical Energetics, Equilibria & Functional Group Organic Chemistry

Name of the Course : **B.Sc. (Prog.)**

Semester : II

Duration : 3 hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Students should attempt, **Section A** and **Section B** on separate Answer sheets.
3. Attempt **three** questions from **Section A** and **three** questions from **Section B** (total **6** questions).
4. Use of non-Scientific calculator and log tables are allowed.

0)

P.T.O.

Section A: Physical Chemistry

(Attempt any **three** questions in this section)

1. (a) What do you understand by buffer and buffer capacity? Give one example of acidic and basic buffer?

(b) Explain the term entropy and give its physical significance. Calculate the molar entropy (ΔS°_m) of $H_2O(l)$ at 298 K if S°_m of $H_2O(l)$, $H_2(g)$ and $O_2(g)$ are 69.91 J mol^{-1} K^{-1}, 130.684 J mol^{-1} K^{-1} and 205.138 J mol^{-1} K^{-1}.

(c) State the Le-Chatelier's principal. Predict the effect of increase of temperature and pressure on the following reaction :

$$H_2(g) + N_2(g) \rightleftharpoons 2NH_3 \quad \Delta H = -92.4 \text{ kJ mol}^{-1}$$

What will happen if some more molecules of $N_2(g)$ introduced in the reaction? (4,4,4.5)

2. (a) The solubility of CaF_2 in water at 20°C is 15.6 mg per dm^3 of solution. Calculate the solubility product of CaF_2 (molar mass of CaF_2 = 78 g mol^{-1}).

(b) Define pH. What is the pH at 25°C for a solution which is twice as alkaline (i.e. which contains twice as many hydroxide ions) as pure water?

(c) Define Heat of Vaporization, Heat of Fusion, Heat of Sublimation. Differentiate among them by considering a suitable example. Explain Hess's law diagrammatically by considering these three enthalpy of water. (4,4,4.5)

(a) Explain first law of thermodynamics and give the mathematical form of first law of thermodynamics.

(b) Calculate the enthalpy change for the reaction:

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$

Data : $\Delta H^\circ_{(C=C)} = 610$ kJ mol^{-1}; $\Delta H^\circ_{(H-H)} = 436$ kJ mol^{-1}; $\Delta H^\circ_{(C-H)} = 413$ kJ mol^{-1} $\Delta H^\circ_{(C-C)} = 348$ kJ mol^{-1}.

(c) Hydrolysis of acetate ion is represented as

$$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$$

Calculate the hydrolysis constant (K_h) and its degree of hydrolysis (α) in 0.1 M solution of sodium acetate. Given $K_a(CH_3COOH) = 1.8 \times 10^{-5}$ M and $K_w = 1 \times 10^{-14}$ M^2. (4,4,4.5)

P.T.O.

4 (a) Write a short note on "bond energy and bond dissociation energy".

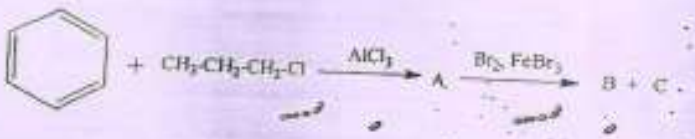
(b) Define integral and Differential enthalpies of solution and write their expression.

(c) Derive the expression for Kp, Kx and Kc by considering a general reaction and also find out relationship between Kp, Kx and Kc. (4,4,4,3)

Section B: Organic Chemistry

(Attempt any **three** questions in this section) 3

5. (a) Complete the following reaction and draw the structures of A, B and C.



(b) How will you convert?

(i) Toluene to nitrobenzene

(ii) Benzene to diphenylmethane

(c) Explain why aromatic hydrocarbon undergoes electrophilic substitution reaction and carbonyl compound undergoes nucleophilic addition reaction. Give one example of electrophilic substitution and nucleophilic addition reaction. (4,4,4.5)

6. (a) What is the criterion of aromaticity according to Huckel's rule?

(b) Nitrophenols are more acidic than phenol: comment. Why the meta isomer has significantly low acidity?

(c) Explain why aryl halides undergo low reactivity towards nucleophilic substitution reaction (SN1 & SN2) than alkyl halides. (4,4,4.5)

7. (a) Write down the reactions involved in the industrial preparation of Phenol.

(b) Describe the benzyne mechanism for nucleophilic substitution of aryl halide by taking an example.

(c) What type of chemical reactions carbonyl compounds undergo? (4,4,4.5)

P.T.O.

8. (a) Write a short note on **any two** of the following

(i) Iodoform reaction

(ii) Pinacol- Pinacolone rearrangement

(iii) Wolf Kishner reduction

(b) Explain Crossed Aldol condensation via suitabl
example. (2×4,4.5)

(100)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1623 **A**

Unique Paper Code : 42171205

Name of the Paper : Chemical Energetics, Equilibria & Functional Group Organic Chemistry

Name of the Course : **B.Sc. (Prog.)**

Semester : II

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Students should attempt, **section A** and **section B** on separate Answer sheets.
3. Attempt **three** questions from **section A** and **three** questions from **section B** (total **6** questions).
4. Use of non-Scientific calculator and log tables are allowed.

P.T.O.

Section A: Physical Chemistry
(Attempt any three questions in this section)

Q. 1.

a) Derive Kirchhoff's equation to explain the variation of enthalpy of a reaction with temperature.

b) Define solubility and solubility product. Calculate the solubility product of strontium oxalate (SrC_2O_4) at 20 °C if solubility at this temperature is 0.00054 M.

c) Write the Henderson–Hasselbalch equation. Using the Henderson–Hasselbalch equation, calculate the pH of a solution made from 0.400 mol of acetic acid and 0.600 mol of sodium acetate in 1 litre of water. (given $K_a = 1.75 \times 10^{-5}$).

(4,4,4.5)

Q. 2.

a) What is Gibbs free energy? Using given data of Gibbs energy changes of formation, find the standard-state Gibbs energy change at 298.15 K for the reaction $2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$

Given data: $\Delta_f G(CO_2) = -394.389$ kJ mol^{-1} $\Delta_f G(CO) = -137.163$ kJ mol^{-1}.

b) Explain degree of ionization. What are the factors affecting Degree of ionization?

c) State the Le-Chatelier's Principle. Explain how this principle helps in understanding the effect of change of concentration, pressure and temperature on chemical equilibrium of any reaction (consider any reaction to explain).

(4,4,4.5)

Q. 3.

a) Write short note on 'Law of chemical equilibrium'.

b) State third law of thermodynamics? How is it useful in calculation of the absolute entropy of a substance?

c) Define integral heat of dilution and calculate integral Heat of solution of one mole HCl (g) in 100 H_2O, using the following data. Dissolution process represented by:

$HCl(g) + 100\ H_2O \rightarrow HCl.100\ H_2O$

ΔH°_f (HCl) = -92.3 kJ mol^{-1}; ΔH°_f (HCl in 100 H_2O) = -92.3 kJ mol^{-1}.

(4,4,4.5)

Q. 4.

a) What is Ionic Equilibria? Differentiate among Strong, moderate and weak electrolytes?

b) Calculate pH of pure water at 40 °C given that K_w at this temperature is 3.8×10^{-14} M^2.

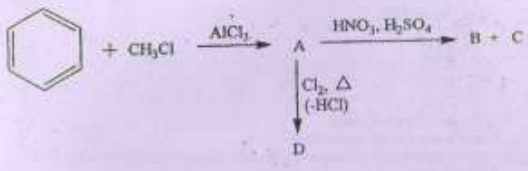
c) Explain the phenomena of salt hydrolysis. Derive the expression for hydrolysis of anion and hydrolysis of cation.

(4,4,4.5)

Section B: Organic Chemistry
(Attempt any three questions in this section)

Q. 5.

a) Complete the following reaction and draw the structures of A, B, C and D.



b) How will you convert?

i. Acetaldehyde to isopropyl alcohol

ii. Benzene to 2,4,6-trinitrotoluene

c) Explain why allyl bromide is more reactive than vinyl chloride towards nucleophilic substitution reaction.

(4,4,4.5)

Q. 6.

a) Write down the key difference between the SN1 and SN2 reaction mechanism with a suitable example.

b) What products will be formed when 1-bromopropane is treated with

i. Alcoholic KOH;
ii. Aqueous KOH;
iii. Mg/ether;
iv. Na/ether

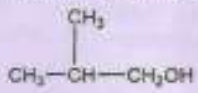
c) Why do aldehydes and ketones undergo nucleophilic addition reactions? Give chemical reaction for the formation of 2,4-DNP derivative.

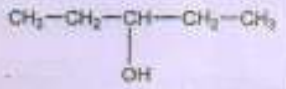
(4,4,4.5)

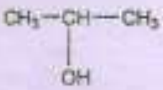
P.T.O.

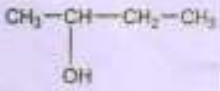
Q. 7.

a) Which of the following alcohol will give a positive Iodoform test and why?

i. 

ii. 

iii. 

iv. 

b) Give reason for the following:
(i) Phenol is more acidic than alcohol.
(ii) *p*-Nitrochlorobenzene undergoes nucleophilic substitution reaction faster than chlorobenzene.

c) What is Lucas reagent? Describe Lucas test for distinguishing between primary secondary and tertiary alcohol.

(4,4,4.5

Q. 8.

(a) Write a short note on ***any two*** following:

(i) Oppenauer Oxidation

(ii) Williamson Ether Synthesis

(iii) Canizzaro reaction

(b) Explain Benzoin condensation by considering suitable examples?

(2x4, 4.

(10

03)

[This question paper contains 3 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1873 A

Unique Paper Code : 32175913

Name of the Paper : Generic Elective - Chemistry of s and p block elements, States of matter and Chemical Kinetics

Name of the Course : B.Sc. (Hons.) Botany/Zoology/Biochem/Maths/Physics

Semester : II/IV

Duration : 3.5 Hours

Maximum Marks : 75

Instructions for candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions in all, three questions from SECTION A and three questions from SECTION B.
3. Use separate answer sheets for section A and section B and indicate the section you are attempting by putting a heading of Section.
4. The questions should be numbered in accordance to the number in the question paper.
5. Use of Scientific Calculator is permitted.

SECTION - A
(Inorganic chemistry)

1. (a) What are standard electrode potentials (SEP)? What are the categories in which metals are divided based on SEP? 4.5

   (b) Define Electronegativity? How Mulliken values can be converted to Pauling scale. 4

   (c) On moving from left to right in a period atomic size decreases. Explain. 4

2. (a) How Diborane, B_2H_6 is an electron deficient compound? Draw its structure and complete the following reaction at higher temperature

   $$B_2H_6 + 2NH_3 \rightarrow$$ 4.5

   (b) Why Sulphur has a greater number of allotropes than any other elements. Give different allotropes of sulphur. 4

   (c) Silver can be easily extracted from its oxide by the method of thermal decomposition. Explain by taking the reference of Ellingham diagram. 4

3. (a) What is the chemical name of 'HYPO'. Give its structure and chemical reaction with I_2 and one application area. 4.5

   (b) Why lower oxidation state becomes more stable on descending the group in p-block elements? Why Sn^{2+} is a reducing agent and Pb^{2+} is stable. 4

   (c) Complete any four reactions 4

P.T.O.

4. Short note on the following

(a) Zone refining process 4

(b) Mond's process 4

(c) Peroxo acids of Sulphur 4.5

SECTION – B
(Physical Chemistry)

(Answer any three questions from this section)

(R = 8.314 J K^{-1} mol^{-1} k = 1.38 × 10^{-23} J K^{-1} N_A = 6.023 × 10^{23})

5. (a) The viscosity of liquids decreases while that of gases increases with rise in temperature. Explain. 3

(b) What are Miller indices? Calculate miller indices for planes having Weiss indices:

(a) 2a, 3b, c (b) 2a, –3b, –3c. 3

(c) Roughly sketch the Maxwell distribution curve for the gas molecules in terms of molecular speeds. Label both axes and explain the effect of temperature on the distribution curve. 3

(d) Differentiate between order and molecularity of a reaction giving examples. 2

(e) Why the crystals of NaCl appear yellow in colour on heating in sodium vapour? 1.5

6. (a) Describe the reasons for deviation of gases from ideal behaviour. Derive van der Waals equation of state for a real gas. 4.5

(b) Calculate the collision number, Z, and mean free path, λ of oxygen gas at 1 atm pressure and 27 °C. The collision cross-section is 0.27 (nm)^2. 4

(c) The critical constants for water are T_c = 647 K, P_c = 218 atm and V_c = 0.05 dm^3 mol^{-1}. Calculate the van der Waals constants and critical compressibility factor. 4

7. (a) What do you understand by the term surface tension? What are its units? Describe the stalagmometer method for the measurement of surface tension of a liquid giving expression. 3.5

(b) The viscosity of an oil is 0.05 Nm^{-2}s and its density is 0.97 g cm^{-3} at 298 K. How

long a given volume of the oil will take to flow through a viscometer if same volume of water takes 50 s? Given viscosity of water = 0.00089 Nm^{-2}s and density of water = 1 g cm^{-3}.

(c) Derive expression for Bragg's Law sketching labelled diagram and explain the significance of n in the equation.

(d) The density of Li metal is 0.53 g cm^{-3} and the separation of (100) planes is 350 pm. Determine whether the lattice is f.c.c. or b.c.c. M(Li) = 6.941 g mol^{-1}. 3

8. (a) Derive integrated rate expression for second order reaction assuming reactants to be different. 4.5

(b) The rate constant for a second order reaction is 5.7 × 10^{-4} dm^3 mol^{-1} s^{-1} at 25 °C and 1.64 × 10^{-3} dm^3 mol^{-1} s^{-1} at 40 °C. Calculate the activation energy of the reaction. 4

(c) Explain the concept of activation energy of reaction. Derive expression for its calculation from Arrhenius equation. 4

May 2022

6

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 730 **B**

Unique Paper Code : 32171201

Name of the Paper : Organic Chemistry – I

Name of the Course : **B.Sc. (H) Chemistry**

Semester : II

Duration : 3 hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all.
3. **All** questions carry equal marks.

1. Give reasons for the following statements. Attempt any **five** :

   (a) Methyl group in Toluene is ortho-para directing.

   (b) Chair conformation of cyclohexane is more stable than boat conformation.

   (c) Both racemic mixture and meso compound are optically inactive.

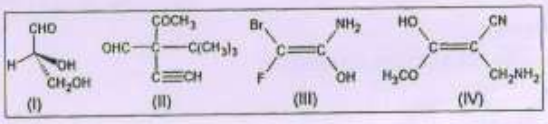
P.T.O.

(d) Phenols are less acidic than carboxylic acids.

(e) Terminal alkynes are acidic in nature.

(f) Alkenes are more reactive than alkynes towards electrophilic addition reactions. (2.5×5=12.5)

2. (a) Assigning priorities, determine the configuration (E/Z or R/S) for the following compounds



(b) An alkene on reductive ozonolysis yields a mixture of two isomers with molecular formula C_5H_8O. Identify the structure of the alkene and the products. Write the product of the reaction between alken e with HBr. (8,4.5)

3. (a) Comment on the aromaticity of the following compounds

(i) Naphthalene

(ii) Cyclopentadienyl cation

(iii) Cycloheptatriene

(iv) Pyridine

(b) A compound (4.25 g in 100 mL)'s solution in chloroform was taken in a polarimeter tube of length 5 cm and its optical rotation (at 25°C) was observed to be −1.2°. Calculate the specific rotation. (8,4.5)

4. (a) Carry out the following conversions :

(i) Propane to 2,3-Dimethyl butane

(ii) Propyne to Pent-2-yne

(iii) But-1-yne to Butan-2-one

(iv) But-1-ene to But-2-ene

(b) Write down the mechanism involved in Friedel Craft's alkylation of benzene with propyl chloride. (8,4.5)

5. (a) Draw the Fischer projection for all the possible stereoisomers of butane-2,3-diol. State the correlation among these stereoisomers? Comment on the optical activity of these isomers.

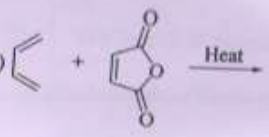
(b) In halogenation of alkanes why chlorination is more reactive but less selective than bromination?

P.T.O.

(c) Why peroxide effect is observed in case of addition of HBr? (5,4.5,3)

6. (a) Complete the following reaction with product(s) (including stereochemistry wherever applicable)

(i) $H_3CC{\equiv}CCH_3 \xrightarrow[\text{Liq. } NH_3]{Na}$

(ii)  $\xrightarrow{\text{Heat}}$

(iii)  $\xrightarrow[\text{Cold}]{\text{dil. aq. } KMnO_4}$

(iv) $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{H}{|}}{C}=CH_2 \xrightarrow{HCl}$

(b) Calculate the percentage of isomers formed on monochlorination of n-butane. Relative rates of hydrogens 3°:2°:1° towards chlorination at room temperature are 5.0:3.8:1. (8,4.5)

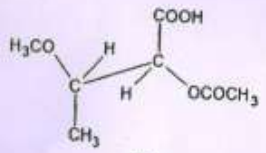
7. (a) Comment on the stereochemistry of the products formed when cis and trans isomers of but-2-ene reacts with bromine solution. Explain the reaction with mechanism.

(b) State limitations of Wurtz reaction. How Corey-House synthesis overcomes these limitations? Give with suitable examples.

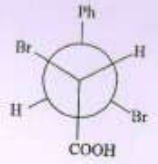
(c) Which is more acidic, p-nitrophenol or o-nitrophenol? Give reasons. (5,4.5,3)

8. (a) How will you chemically distinguish between 1-butyne and 2-butyne?

(b) Convert the following structures to standard Fischer projections :



(I)



(II)

(c) Explain why 1,3-pentadiene is more stable than 1,4-pentadiene?

P.T.O.

(d) Why nitration of toluene is faster than nitration of benzene? (2,4,3,3.5)

9. Write short notes on the following : **(any four)**

(a) E1 and E2 reactions (including mechanism)

(b) D,L system of configuration (including limitations)

(c) Oxymercuration – Demercuration Reaction (including mechanism)

(d) Allylic Halogenation using NBS (including mechanism)

(e) Nucleophilic addition reactions in alkynes (3.5,3,3,3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 748 **B**

Unique Paper Code : 32171202

Name of the Paper : Physical Chemistry II

Name of the Course : **B.Sc. (Hons.)**

Semester : II

Duration : 3 hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Answer any **six** questions.
3. Use of calculator is allowed.

1. (a) Why ΔG is used more compared to ΔA to express the condition of spontaneity of the reaction? (2)

(b) Give reason why reversible processes are ideal processes & cannot be carried out in practice. (2)

P.T.O.

(c) How equilibrium constant K_p is a dimensionless quality? (2)

(d) Why it is necessary to make standard solutions in standard flasks instead of a beaker? (2)

(e) Explain Q is a path function and not a state function. (2)

(f) Predict whether the following variables are intensive or extensive :

mass, enthalpy, mole fraction, boiling point, entropy (2.5)

2. (a) A 25 g mass of ice at 273 K is added to 150 g of liquid water at 360K at constant P. What is the final state of the system? Calculate ΔS for the process. Given $\Delta H_{fus.}$ (H_2O) = 6.0095 kJ mol^{-1}, C_p $(H_2O, 1)$ = 75.29 JK^{-1} mol^{-1} & T_m (H_2O, S) = 273 K. (4)

(b) Derive the relation : (4)

$$\left(\frac{\partial V}{\partial S}\right)_T = \left(\frac{\partial T}{\partial p}\right)_V$$

(c) Show that entropy is a state function & dS is an exact differential using first law of thermodynamics. (4.5)

3. (a) Prove the Kirchhoff s relations: (4)

(i) $\Delta H_2 - \Delta H_1 = \Delta C_p(T_2 - T_1)$

(ii) $\Delta U_2 - \Delta U_1 = \Delta C_v(T_2 - T_1)$

(b) Calculate the enthalpy change for the following reactions :

(i) $C_2H_4(g) + Cl_2(g) \rightarrow C_2H_4Cl_2(g)$

(ii) $C_2H_6(g) + 2Cl_2(g) \rightarrow C_2H_2Cl_2(g) + 2HCl(g)$

Given B.E. (C-C) = 348 kJ mol^{-1}

B.E. (C=C) = 610 kJ mol^{-1}

B.E. (C–H) = 413 kJ mol^{-1}

B.E. (Cl–Cl) = 242 kJ mol^{-1}

B.E. (C–Cl) = 328 kJ mol^{-1}

B.E. (H–Cl) = 432 kJ mol^{-1} (4)

(c) Define enthalpy of neutralization. Enthalpy of neutralization of HCl by NaOH is 257.32 kJ mol^{-1} and by NH_4OH is –51.34 kJ mol^{-1}. Calculate the enthalpy of dissociation of NH_4OH. (4.5)

4. (a) Prove thermodynamic equation of state :

$$\left(\frac{\partial U}{\partial V}\right)_T + p = T\left(\frac{\partial p}{\partial T}\right)_V \quad (4)$$

(b) For an ideal gas $C_{pm} = (5/2\ R)$. Calculate the change in entropy when 3 moles of gas is heated from 300K to 600K at

(i) constant pressure

(ii) constant volume (4)

(c) Show that :

(i) $\left(\frac{\partial U}{\partial V}\right)_T = 0$ for an ideal gas.

(ii) $C_p - C_V = R$ for one mole of an ideal gas. (4.5)

5. (a) Derive Gibbs – Helmholtz equation,

$$\frac{\Delta G}{T} = \frac{\Delta H}{T} + I.$$

Where I is the constant of integration. (4)

(b) Starting from the fundamental expressions of first and second laws of thermodynamics derive the following relations :

(i) $dA = -SdT - pdV$

(ii) $dG = -SdT + Vdp$ (4)

(c) Derive Gibbs Duhem equation and prove :

$$\sum_i n_i dV_{i,pm} = 0 \quad (4.5)$$

6. (a) (i) Show that the pressure for a gas obeying

$$\left(p + \frac{a}{V^2}\right)(V) = RT$$

is a state function. (2)

(ii) Prove that :

$$\left(\frac{\partial H}{\partial P}\right)_T = 0 \quad (2)$$

(b) In the following reactions, involving change in number of mol, what will be the effect of increase

in pressure from external source on the equilibrium of the reactions :

$N_2O_4(s) \rightarrow 2NO_2(g)$

$2SO_2(s) + O_2(g) \rightarrow 2\ SO_3(g)$ (4)

(c) 1 mole of an ideal gas at 300K expands isothermally and reversible from an initial volume of 2 litres to a final volume of 20 litres. Calculate q, w, ΔU, ΔH, ΔS and ΔG. (4.5)

7. (a) The boiling point of chloroform was raised by 0.325K when 5.141×10^{-4} kg of anthracene was dissolved in 3.5×10^{-2} kg of chloroform. Calculate the molar mass of solute.

$K_b = 3.9$ K kg mol^{-1}. (4)

(b) van't Hoff factor, i, for aqueous solution of both NaCl and CH_3COOH depends on the concentration of the solution. Explain. (4)

(c) At 480K and a total pressure of 1 atmosphere, a mixture consisting of nitrogen and hydrogen in the mole ratio of 1:3 contains 16% ammonia at equilibrium. Calculate K_p for the reaction. (4.5)

8. (a) What is the Osmotic pressure at 25°C when 72.5 mL of a solution containing 4.25 grams of electrolyte $CaCl_2$ (molar mass = 111 g/mol) is prepared? (4)

(b) How much heat (in kJ) is needed to convert 100.0 grams of ice at –10°C to steam at 115°C? (4)

(c) Prove that :

(i) $TV^{\gamma-1}$ = constant

(ii) PV^{γ} = constant (4.5)

9. (a) How many grams of non-electrolyte sucrose (molar mass = 342 g/mole) must be added to 450 g of water (molar mass = 18.0 g/mole) to change its vapour pressure of 745 mm Hg at 100°C? (4)

(b) State the third law of thermodynamics. Write the expressions for the change in entropy per mole of a substance undergoing each of the phase transitions – fusion, vaporization and sublimation. (4)

P.T.O.

(c) Explain :

(i) Criteria for spontaneity and equilibrium

(ii) Le Chatelier's principle. (4.5)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1498 **A**

Unique Paper Code : 42174404

Name of the Paper : Chemistry of s and p block Elements, States of Matter and Chemical Kinetics

Name of the Course : **B.Sc. Physical Science/Life Science**

Semester : IV

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all, three questions from **SECTION A** and **three** questions from **SECTION B**.
3. Use separate answer sheets for **Section A** and **Section B** and indicate the section you are attempting by putting a heading of Section.
4. The questions should be numbered in accordance to the number in the question paper.
5. Use of Scientific Calculator is permitted.

P.T.O.

SECTION A

(Inorganic Chemistry)

Attempt any **three** *questions from this section.*

1. (a) What is Ellingham's diagram? Draw it for metal oxides and give its salient features. (4.5)

   (b) List the three different scales of Electronegativity. Briefly describe the Pauling scale. (4)

   (c) Why first element in each of main groups differs from the rest of the group? Give anomalous behavior shown by Lithium. (4)

2. (a) Explain the hybridization in ortho-phosphoric acid. Give its structure and mechanism of its preparation from phosphorous pentoxide. (4.5)

   (b) Why graphite is a good conductor of electricity but diamond is not? (4)

   (c) Why first ionization enthalpy does not continue the decreasing trend from Al to Ga and In to Tl? (4)

3. (a) What are carbides? What happens when CaC_2, Al_4C_3 and Mg_2C_3 are hydrolysed? (4.5)

   (b) Using diborane, explain the concept of multi centre bonding. (4)

   (c) Complete any **four** reactions (4)

   (i) $SOCl_2 + H_2O \rightarrow$

   (ii) $P_4O_{10} + 6PCl_5 \rightarrow$

   (iii) $6HN_3 + 4\ Li \rightarrow$

   (iv) $4NH_3 + 3O_2 \rightarrow$

   (v) $SiC + 2NaOH + 2O_2 \rightarrow$

4. (a) Give the names of four different types of oxo acids of chlorine. Arrange them in order of increasing strength and give the justification in support of order. (4.5)

   (b) Short note on the following : (4×2)

   (i) van Arkel De Boer process

   (ii) Zone refining

P.T.O.

SECTION-B

(Physical Chemistry)

Attempt **Three** *questions from this section.*

$R = 8.314\ J\ K^{-1}\ mol^{-1}$ $k = 1.38 \times 10^{-23}\ J\ K^{-1}$

$N_A = 6.023 \times 10^{23}$

5. (a) Write the postulates of kinetic theory of gases. Is it possible to liquify an ideal gas? (2.5)

(b) The van der Waals constant 'a' for N_2 and NH_3 are 1.39 and 4.17 $dm^6\ atm\ mol^{-2}$, respectively. Which one of these two gases can be liquefied more easily and why? (2)

(c) In a crystal, the planes cut through the crystal axes at (2a, 3b, c) and (2a, -3b, -3c). Identify the Miller indices of these planes. (2)

(d) It is not possible to distinguish between K^+ and Cl^- ions by X-ray diffraction method. Explain. (2)

(e) Explain the effect of temperature on rate of a reaction. Give reasons for your answer. (2)

(f) The viscosity of liquids deceases while that of gases increases with rise in temperature. Explain. (2)

6. (a) Using the van der Waals equation, derive the relationships between critical constants and van der Waals constants of a real gas. (4)

(b) The viscosity of oxygen is at 7°C is 208 micropoise. Calculate the mean free path and collision diameter of oxygen molecules at STP. (4)

(c) What do you understand by the term surface tension? What are its units? Describe the stalagmometer method using water as reference for the measurement of surface tension of a liquid giving expression. (4.5)

7. (a) What are elements of symmetry in crystal systems? Describe number of various symmetry elements in cubic crystal system. (4)

(b) The density of $LiBH_4$ crystal is 0.668 g cm^{-3} and the unit cell dimensions are a = 6.81 Å, b = 4.43 Å and c = 7.17 Å. Determine whether the lattice is f.c.c. or b.c.c. The molar mass of $LiBH_4$ = 21.76 g mol^{-1}. (4)

(c) Write expression of Maxwell distribution law molecular speeds. Name the terms involved in expression. Calculate the most probable, average and root mean square velocity of hydrogen gas molecules at 27°C. (4.5)

8. (a) Derive integrated rate expression for second order reaction assuming reactants to be different. (4)

(b) Derive expressions to determine order of reaction using half-life method and van't Hoff differential rate method. (4)

(c) What is the rate constant (k) of a reaction, $2N_2O_5 \longrightarrow 4NO_2 + O_2$ at 27°C? The activation energy and pre-exponential factor for the reaction are found to be 103.35 kJ mol^{-1} and 4.3×10^{13} s^{-1}, respectively. (4.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1142 **A**

Unique Paper Code : 32171401

Name of the Paper : Inorganic Chemistry – III

Name of the Course : **B.Sc. (H) Chemistry**

Semester : IV

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in all.
3. **All** questions carry equal marks.

1. (a) Name of the following complexes according to the IUPAC system of nomenclature :

(i) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$

(ii) $[(NH_3)_5Cr(NH_2)\ Cr(NH_3)_4(H_2O)]Cl_5$

(iii) $[Co(NH_3)_6]_3[Co(CN)_6]_2$

P.T.O.

(b) Write the formulae of the following complexes :

(i) Sodium bis(thiosulphato)argentate(I)

(ii) Triamminechlorocyanonitrocobalt(III)

(iii) Potassium diaquatetrabromovanadate(III)

(c) Given below is the Latimer diagram for Fe in acidic medium :

$$FeO_4^{2-} \xrightarrow{2.20} Fe^{3+} \xrightarrow{0.77} Fe^{2+} \xrightarrow{-0.47} Fe$$

(i) Why FeO_4^{2-} is strong oxidising agent?

(ii) Is there any tendency of Fe^{2+} to reduce to Fe. Give reasons.

(d) A strong oxidizing agent(A) on heating with KCl and conc. H_2SO_4 gives red coloured gas B which on passing through potassium hydroxide solution gives yellow solution C. C may also be obtained on heating A on treatment with conc. H_2SO_4 gives a red product D which decomposes on heating to give a product. Identify A, B, C, D.

(3,3,3,3.5)

2. (a) Which of the following is more stable :

$[Co(en)_3]^{3+}$, $[Co(dien)_3]^{3+}$

(b) Justify the presence of copper in the transition series.

(c) Explain $d_\pi - p_\pi$ bonding in complexes.

(d) Explain Jahn Teller effect.

Which of the following complex have all equal bond length and why?

$[CrF_6]^{3-}$ and $[MnF_6]^{3-}$ (3,3,3,3.5)

3. (a) Identify A, B, C, D in the following reactions :

(i) $[PtCl_4]^{2-} \xrightarrow{NH_3} [A] \xrightarrow{NH_3} [B]$

(ii) $[Pt(NH_3)_4]^{2+} \xrightarrow{Cl^-} [C] \xrightarrow{Cl^-} [D]$

(b) What happens when

(i) KI is added to $KMnO_4$ in acidic medium.

(ii) SO_2 is passed through acidified $K_2Cr_2O_7$ solution.

P.T.O.

(c) +3 is the most common oxidation state of lanthanides. Explain.

(d) Fe_3O_4 is inverse spinel while Mn_3O_4 is normal spinel. Explain on the basis of CFT. (3,3,3,3.5)

4. (a) The pairing energy (P) for the $[Cr(H_2O)_6]^{2+}$ ion is 23000 cm^{-1} and crystal field splitting (Δ_0) is 14000 cm^{-1}. Calculate the crystal field stabilization energy in high spin and low spin state. Which state is more stable?

(b) 4d and 5d elements usually form low spin complexes. Justify.

(c) Tetrahedral complexes are high spin. Explain

(d) Using the valence bond theory method, work out following for $[Cr(CN)_6]^{3-}$

(i) Assign the electronic configuration to the central metal ion,

(ii) predict the type of hybridization involved,

(iii) geometry, and

(iv) the magnetic moment (3,3,3,3.5)

5. (a) What are differences between valence bond theory and crystal field theory?

(b) Explain Spectrochemical series.

(c) Higher Oxidation states of transition elements are stabilized by small anions like F^-, O^{2-}. Explain.

(d) For Cr^{2+} octahedral complexes in strong and weak field, determine the (i) configuration in terms of $t_{2g}^x e_g^y$, (ii) number of unpaired electrons, and (iii) crystal field stabilization energy. (3,3,3,3.5)

6. (a) Write three differences between the characteristic features of lanthanides and actinides.

(b) Ce^{4+} ion is coloured whereas Ce^{3+} ion is colourless. Why?

(c) Work out the number of unpaired electrons in the following ions :

Eu^{2+}, Tb^{4+}, Lu^{3+}

(Atomic number of Eu = 63, Tb = 65, Lu = 71)

(d) What is lanthanide contraction? What are the major consequences of lanthanide contraction on the chemistry of d block elements? (3,3,3,3.5)

P.T.O.

7. (a) The compound $CoCl_3.4NH_3$ gives one Cl^- ion on the addition of Ag^+ ion. Draw the structure of the compound on the basis of Werner's coordination theory.

(b) Explain the following with suitable examples :

(i) Ionisation isomerism

(ii) Linkage isomerism

(c) Using valence bond theory, discuss hybridization and structure of the following :

(i) $[Cr(NH_3)_6]^{3+}$

(ii) $Ni(CO)_4$

(d) $[Fe(CN)_6]^{4-}$ ion is diamagnetic but $[Fe(CN)_6]^{3-}$ ion is paramagnetic in nature. Explain using V.B.T. (3,3,3,3.5)

8. (a) Explain why does colour of $KMnO_4$ disappear when oxalic acid is added to its solution in acidic medium.

(b) $K_2Cr_2O_7$ is a good oxidising agent in acidic medium.

Explain.

(c) Write down the number of 3d electrons in each of the following ions :

(i) Cr^{3+}

(ii) Fe^{3+}

(iii) Cu^{2+}

(d) Transition elements and their compounds are generally found to be good catalyst in chemical reaction. Discuss. (3,3,3,3.5)

9. (a) Give the reasons for the following **(any two)** :

(i) Mn(II) ion shows maximum magnetic character among the bivalent ions of first transition series.

(ii) Cu(I) is diamagnetic while Cu(II) is paramagnetic.

(iii) Zn^{2+} salts are white while Cu^{2+} salts are blue.

(b) Although Cr^{3+} and Co^{2+} ions have same number of unpaired electrons but the magnetic moment of

Cr^{3+} is 3.87 B.M. and that of Co^{2+} is 4.87 B.M. Explain.

(c) Explain why Fe(II) and Fe(III) form complexes with CN^- ions but not with NH_3. (6,3,3.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1369 **A**

Unique Paper Code : 32171402

Name of the Paper : Organic Chemistry – III, Heterocyclic Chemistry

Name of the Course : **B.Sc. (Hons.) Chemistry**

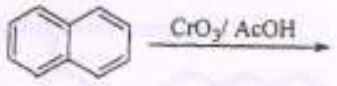
Semester : IV

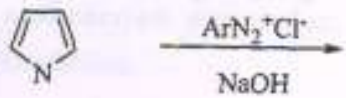
Duration : 3 Hours 30 Mins Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **six** questions.
3. **All** questions carry equal marks.

1. (a) Complete the following reactions :

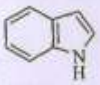
(i) 

(ii) 

P.T.O.

(iii)  $\xrightarrow{H_2, Ni}$

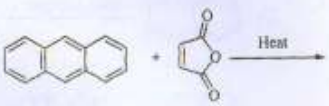
(iv)  $\xrightarrow{Na/\ C_2H_5OH}$

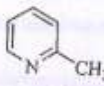
(v)  $\xrightarrow[Pyridine]{SO_3}$

(vi)  $\xrightarrow{Alk.\ KMnO_4}$

(vii) $CH_3CH_2CN \xrightarrow{C_2H_5O^-}$

(viii) $CH_3NC \xrightarrow[2.\ H_2O,\ H^+]{1.\ CH_3MgBr}$

(ix) 

(x)  $\xrightarrow[NaOH]{CH_3CHO}$

(b) Explain the order of basicity of following anilines :

$PhNH_2$, $p\text{-}NO_2C_6H_4NH_2$, $m\text{-}NO_2C_6H_4\ NH_2$, $p\text{-}CH_3OC_6H_4NH_2$ (10,2.5)

2. (a) How will you carry out following conversions :

(i) Quinoline to 8-Hydroxyquinoline

(ii) Naphthalene to 1 -Naphthoic acid

(iii) β-Picoline to 3-Aminopyridine

(b) Give the Gabriel phthalimide synthesis and explain why neopentylamine and aniline cannot be prepared by it. (9,3.5)

3. (a) Explain the following :

(i) Nitration and sulphonation reaction of furan are carried out under mild reaction conditions.

P.T.O.

(ii) Sulphonation of naphthalene gives different products at low and high temperatures.

(iii) Formation of 3-chloropyridine when pyrrole is heated with chloroform in presence of KOH.

(b) Discuss the advantages of Emde's modification over Exhaustive methylation using suitable example? (9,3.5)

4. (a) Explain the following :

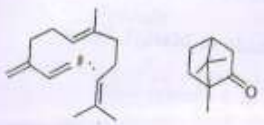
(i) Pyridine undergoes nucleophilic sub reactions at C-2 or C-4. Explain.

(ii) Phenanthrene undergoes electrophilic substitution as well as addition reactions preferentially at C-9 and C-10 positions. Explain with the help of examples.

(iii) Order of aromatic character: Pyrrole, furan, thiophene.

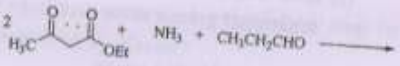
(b) Define 'Isoprene rule'. Mark out the isoprene units

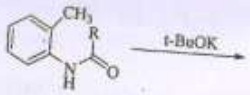
with dotted lines and mention the class of terpenes to which each one belongs to :



(9,3.5)

5. (a) Identify the product,reaction name and suggest the mechanism for the following reaction :

(i) 

(ii) 

(c) How are primary, secondary and tertiary amines distinguished using Hinsberg test ? Give the relevant chemical reactions. (9,3.5)

6. (a) Suggest the best suitable reagent to bring out the following conversions :

P.T.O.

(i) Pyrrole to pyrrole-2-aldehyde

(ii) Pyridine to n-Pentane

(iii) Acetamide to Methyl amine

(iv) Furan to 2-Phenyl furan

(b) How will you synthesize 2-Methyl quinoline by Skraup synthesis? Explain with the help of mechanism.

(c) How will you show the presence of the following functional groups in an alkaloid.

(i) O- Methyl group

(ii) -COOH group (4,5,3.5)

7. (a) Write short note on **(any TWO)** :

(i) Reduction of nitrobenzene

(ii) Mannich Reaction

(iii) Pomeranz-Fritsch reaction

(b) Explain how can we synthesize 2,3,4,5-tetramethyl furan starting from acetoacetic ester. (8,4.5)

8. (a) What happens when

(i) Citral is treated with aq. Potassium carbonate

(ii) Mixture of a methylamine and chloroform is treated with ethanolic potassium hydroxide

(iii) Anthracene is treated with bromine in carbon tetrachloride.

(b) How was the presence of pyrrolidine ring in nicotine proved by Karrer?

(c) Electrophilic substitution in naphthalene is favored at 1 -position. Explain. (6,3,3.5)

9. (a) N-Ethyl-N-methylamine is chiral but non-resolvable however 2-aminobutane is resolvable. Explain.

(b) Explain how the presence of two benzene rings fused together was confirmed in case of naphthalene.

P.T.O.

(c) Diazo coupling takes place either in mild acidic medium or mild alkaline conditions. Explain.

(d) Pyrrole behaves like phenol. Justify the statement using suitable examples. (3,3,3,3.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1387 **A**

Unique Paper Code : 32171403

Name of the Paper : Physical Chemistry – IV

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : IV

Duration : 3½ Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **six** questions in all.
3. Use of scientific calculator is permitted.

1. (i) Comment on the following :

   (a) Elementary reaction with molecularity greater than three are unknown.

   (b) In the steady state, the concentration of the reactive intermediate though small remains the same for an appreciable time.

(2+2)

(ii) Predict the overall order of reaction for which half-life period depend inversely on the concentration and derive the expression for its half-life. (4)

(iii) The rate constant for a certain reaction is found to be tripled when the temperature is increased from 288K to 323K. If the enthalpy of reaction is 80 kJ/mol, calculate the activation energy of the reaction. (4.5)

2. (i) Differentiate the following **(any two)** :

(a) Stationary and non-stationary chain reaction

(b) Order and molecularity

(c) Average rate and Instantaneous rate of reaction (2+2)

(ii) Under what conditions a given catalytic reaction may be classified into a general acid catalysis and a specific hydrogen-ion catalysis, if the acid catalysed reaction follows the mechanism :

$$S + HA \underset{k_{-1}}{\overset{k_1}{\leftrightarrows}} SH^+ + A^-$$

$$SH^+ + H_2O \xrightarrow{k_2} P + H_3O^+$$ (4)

(iii) Derive the Michaelis - Menten equation for enzyme catalysed reactions. The mechanism involves the following steps :

$$E + S \underset{k_{-1}}{\overset{k_1}{\leftrightarrows}} ES$$

$$ES \xrightarrow{k_2} P + E$$

Show that the enzyme catalysed reaction is first-order and zero-order with respect to S at low and high concentrations of S, respectively. (4.5)

3. (i) Explain the role of catalyst with the help of potential energy diagram? (4)

(ii) Hydroxide ion is involved in the mechanism but not consumed in this reaction in aqueous solution.

$$OCl^-(aq) + I^-(aq) \xrightarrow{OH^-} OI^-(aq) + Cl^-(aq)$$

(a) From the data in the table, determine the order of reaction with respect to OCl^-, I^-, and OH^-, and the overall order.

$[OCl^-]$ /(M)	$[I^-]$/ (M)	$[OH^-]$ /M	Rate of formation of OI^- (mol $L^{-1}s^{-1}$)
0.004	00.0020	1.00	4.8×10^{-4}
0.002	00.0040	1.00	5.0×10^{-4}
0.002	00.0020	1.00	2.4×10^{-4}
0.002	00.0020	0.50	2.4×10^{-4}
0.002	00.0020	0.25	9.4×10^{-4}

(b) Write the rate law. (4)

(iii) The following mechanism has been suggested for the decomposition of O_3

$$O_3 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} O_2 + O$$

$$O_3 + O \xrightarrow{k_2} 2O_2$$

(a) Assuming $k_{-1}[O_2] > k_2[O_3]$, show that the rate of the all-overall reaction is

$$-\frac{d[O_2]}{dt} = \frac{k[O_3^2]}{[O_2]}$$

(b) What could be concluded from the appearance of $\frac{1}{[O_2]}$ in the rate equation? (4.5)

4. (i) Derive the relation between Arrhenius activation energy E_a and the minimum energy E_0 of the collision theory of bimolecular reaction theory. (4)

(ii) (a) What are the two conditions that are necessary for effective collisions?

(b) Why the value of steric factor p is usually less than 1 ? (2+2)

(iii) Show that for a first order reaction, the time required for 99.9% completion of the reaction is 10 times the time for 50.0% completion. (4.5)

5. (i) Write a short note on **any three** :

(a) Effect of temperature on Photochemical Reactions

(b) Activated Complex Theory

(c) Conductometric titration of mixture of HCl and CH_3COOH against NaOH

(d) Kohlrausch Law of Independent Migration of Ions (3×3)

P.T.O.

(ii) Why does the transport number of Cd^{2+} ions in concentrated solutions of CdI_2 is negative? (3.5)

6. (i) State and derive Lambert-Beer's Law. (4)

(ii) 2.0×10^{-3} m thickness of a certain glass transmits 10% of the incident light of wavelength 300 nm. What percentage of light of the same wavelength will be absorbed by a 1.0×10^{-3} m thickness of the glass? (4)

(iii) The proposed mechanism of photochemical reaction between H_2 and Br_2 is

$$Br_2 \xrightarrow{h\nu} 2\,Br$$

$$Br + H_2 \xrightarrow{k_1} HBr + H$$

$$H + Br_2 \xrightarrow{k_2} HBr + Br$$

$$H + HBr \xrightarrow{k_3} H_2 + Br$$

$$Br + Br \xrightarrow{k_4} Br_2$$

Derive the quantum yield of reaction. (4.5)

7. (i) Explain, giving reasons : **(any two)**

(a) Specific conductance decreases while equivalent conductance increase on dilution.

(b) Molar conductance values for alkali metal cations are in the order $Rb^+ > K^+ > Na^+ > Li^+$.

(c) ADC current cannot be used for conductance measurements. (2+2)

(ii) What are the various factors affecting the conductance of a solution? How do you account for the increase in conductance of solutions at high field strength and at high frequency? (4)

(iii) A conductance cell when filled with 0.05 M solution of KCl records the resistance of 410.0 ohm at 25°C. When filled with $CaCl_2$ solution (11g $CaCl_2$ in 500 mL) it records 990 ohm. If the specific conductance of 0.05 M KCl solution is 0.00189 mho/cm, calculate (a) Cell constant, (b) specific conductance and (c) Molar conductance of $CaCl_2$. (4.5)

8. (i) Discuss **(any two)** applications of conductance measurements :

(a) Solubility and solubility product of a sparingly soluble salt.

(b) Determination of Ionic product of water.

P.T.O.

(c) Degree of hydrolysis and hydrolysis constant of a hydrolysable salt. (4+4)

(ii) A solution of HCl acid is electrolysed in a transport cell using platinum electrodes. 20.175 g of the cathode solution contained 0.175g of Cl^- ion before electrolysis and 18.466 g of the cathode solution contained 0.146 g Cl^- ion after electrolysis. A silver coulometer connected in series had a deposit of 0.2508 g Ag. Calculate the transport number of Cl^- and H^+ ions. (4.5)

9. (i) Describe Hittorf's method or Moving boundary method employed in determining the transport number of an ion. (4)

(ii) Which of the following pairs will have higher molar conductance and why?

(a) LiCl or NaCl

(b) Cl^- ion in HCl or in NaCl (2+2)

(iii) The resistance of a 0.02. mol/dm^3 solution of acetic acid in a cell having cell constant 0.2063 cm^{-1} was found to be 888ohm. What is the degree of ionization of the acid at this concentration? (Given Λ_m^0 for acetic acid = 387.9 $\times 10^{-4}$ $Smol^{-1}m^2$). (4.5)

[This question paper contains 3 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1022 **A**

Unique Paper Code : 32173907/42173922

Name of the Paper : SEC – Analytical Clinical Biochemistry

Name of the Course : **B.Sc. (Hons.) / B.Sc. (Prog.)**

Semester : IV/VI

Duration : 2.5 Hours Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. **All** questions carry equal marks.

1. (a) What makes allosteric inhibitors different from competitive inhibitors?

(b) Give two chemical tests for the detection of fat molecules.

(c) What do you understand by HbAlc test?

(4,3,2.5)

P.T.O.

2. (a) Draw the segment of RNA molecule with base guanine, adenine cytosine and uracil indicating 5' and 3' ends.

(b) Write functions of nucleotides and draw the structure of any three nucleotides.

(c) What is the significance of creatinine value? (4,3.5,2)

3. (a) Write the steps involved in the glucose metabolism.

(b) Explain the process of Blood coagulation.

(c) Briefly describe the role of cholesterol in our body. (4,3,2.5)

4. (a) Explain Citric acid cycle.

(b) Differentiate between Competitive and Non-Competitive enzyme inhibitors.

(c) How do you determine the structure activity relationships of drug molecules? (4,3,2.5)

5. (a) Differentiate between nucleotide and nucleoside with two examples and structures.

(b) How would you determine the iodine number of oil?

(c) What do you understand by high uric acid in blood? (4,3,2.5)

6. Write short notes on the following :

(a) Classification of enzymes

(b) Steroid hormone

(c) Lactic acid fermentation (3.5,3,3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1424 **A**

Unique Paper Code : 32173901

Name of the Paper : SEC – IT Skills for Chemists

Name of the Course : **B.Sc. (Hons.) Chemistry / B.Sc (Prog.)**

Semester : IV/VI

Duration : 2.5 Hours Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use of Scientific calculators and log tables is allowed.
3. Attempt any **4** questions in all. **All** questions carry equal marks.

1. (i) Simplify/Expand the following expressions :

(a) $(x^2 + 2x)^2 - x^2 (x-2)^2 + 12x^4$

(b) $(P + an^2/V^2)(V - nb) = nRT$

P.T.O.

(ii) The Dieterici equation of state is given below :

$$Pe^{a/VmRT}(V_m - b) = RT$$

where V_m, R and T represent molar volume, pressure, universal gas constant, and temperature, respectively.

(a) Identify the variables and coefficients in the above equation.

(b) What are the dependent and independent variable in above equation?

(c) What is the effect on value of pressure if the value of V_m becomes extremely small?

(iii) True or False :

(a) Systematic errors affect both the accuracy and the precision.

(b) Random errors are determinate errors.

(c) Systematic errors lead to inconsistent error that cannot be detected or corrected.

(iv) What is the relation between natural log and log base 10 of a number? (2,3,3,1.5)

2. (i) The length of a rope is measured as 32.6 ± 0.4 cm. Calculate :

(a) Fractional uncertainty

(b) Percentage uncertainty

(ii) Three variables are measured as :

$a = 4.56 \pm 0.03$, $b = 2.16 \pm 0.03$,

$c = 8.61 \pm 0.09$, $d = 1.96 \pm 0.01$,

$e = 7.43 \pm 0.05$.

Determine the maximum probable uncertainty in

$$a - b + \frac{c \times d}{e}.$$

(iii) Kohlrausch's law for the molar conductivity Λ_m of a strong electrolyte at low concentration c is given as : $\Lambda_m = \Lambda_m^* - Kc^{1/2}$

where Λ_m^* is the molar conductivity at infinite dilution and K is a constant. Explain how K and Λ_m^* can be obtained graphically from results of measurements of Λ_m over a range of concentration c.

(iv) The van der Waals equation of state is expressed as :

$$\left(p+\frac{n^2a}{V^2}\right)(V-nb) = nRT$$

where all the symbols have usual meaning. Write 'p' in terms of V. (2,3,3,1.5)

3. (i) With reference to SI units which of the following unit/s are written incorrectly? Also, write their corrected form if any.

(a) 528 Hertz

(b) 496 NM

(c) 906K

(ii) Solve a pair of simultaneous equation :

$x + y = 3$

$2x + 3y = 4$

(iii) Write short note on :

(a) Gaussian distribution

(b) Systematic and random errors

(iv) Calculate the mean, variance and standard deviation for given set of 7 data points: 842, 821, 796, 865, 834, 862, and 842. (1.5,2,3,3)

4. (i) Convert the following :

(a) 1000 ml (ml to dm^3)

(b) Joule 'J' in terms of kg, m, s.

(ii) What is relative error or percentage error?

(iii) What are the significant figures in experimental measurements? Explain taking the example of volumetric titrations.

(vi) What is the method of least squares curve fitting? Using this method to fit the following data equation like $y = mx + c$ and report the slope 'm' and intercept 'c'.

X	1	2	3	4	5	6	7
Y	5	7	9	10	11	13	15

(2,2,1.5,4)

5. (i) Express a wavenumber of 2318 cm^{-1} in terms of frequency, wavelength, and energy.

(ii) The melting point of a compound is generally determined using the Kjeldahl method. Listed below are some experimental error sources.

in this determination. Classify each error as systematic or random. Give reasons wherever necessary :

(a) Faulty thermometer calibration

(b) Failure to read the thermometer correctly

(c) Presence of impurities in the sample

(iii) The following data shows the variation in the vapor pressure of water at various temperature values :

Temperature (°C)	Vapor Pressure (Torr)
0	4.579
5	6.543
10	9.209
15	12.788
20	17.535
25	23.756

The variation of pressure with temperature is given as :

$$\ln(P) = -\frac{\Delta H_{vap}}{RT} + C$$

Transform the data, using ln (P) for the dependent variable and (1/T) for the independent variable. Calculate the molar enthalpy change of vaporization using the linear least-squares fit method. (1.5,3,5)

6. (i) How many significant figures are present in the following?

(a) 0.005601

(b) 91600

(c) 7.0600

(d) 1.2500×10^4

(e) 82.0

(ii) Find the pH of 0.01 M solution of acetic acid assuming that there is no other source of $[H_3O^+]$ present. The dissociation constant is given by the following equation :

$$K_a = \frac{\left[H_3O^+\right]^2}{[HA] - \left[H_3O^+\right]}$$

Given : $K_a = 1.85 \times 10^{-5}$. Report the answer upto 3 decimal places.

(iii) Solve the following integral using Simpson method of numerical integration n = 10.

$$y(x) = \int_0^5 4x^3 + 3x^2 - 5\,dx \qquad (2.5.3.4)$$

[This question paper contains 9 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1258 **A**

Unique Paper Code : 32177903

Name of the Paper : DSE – Applications of Computers in Chemistry

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : VI

Duration : 3 hours 30 min Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **SIX** questions in all.
3. Each question carries **12.5** marks.
4. Preferably attempt all parts of a question together.

1. Attempt **all** parts of the question.

(a) Write the algebraic expression of any **three** of the following in BASIC :

(i) $V = \frac{nRT}{P + \frac{an^2}{V^2}} - nb$

P.T.O.

(ii) $E_n = \frac{n^2h^2}{8ml^2}$

(iii) $y = A \exp(-B^2/x)$

(iv) $y = |x|$

(v) $x = \frac{n\left(x_1^2 - x_2^2\right)}{2(a+b)x}$

(b) Write the full form of any **four** of the following :

(i) GIGO

(ii) PDF

(iii) CPU

(iv) OCR

(v) USB

(vi) BASIC

(c) Differentiate between any **two** of the following with one example :

(i) Compiler and Interpreter

(ii) Virus and Bug

(iii) Hardware and software (4.5,4,4)

2. (a) Select the graphics commands from the following :

(i) CLS

(ii) LINE

(iii) LOCATE

(iv) CIRCLE

(v) PSET

(vi) WINDOW

(vii) DRAW

(viii) VIEW

(ix) INPUT

(b) Find the error, if any, in the following BASIC file names :

(i) New-Raph.bas

(ii) 123myfil.bas

(iii) myfile.123

(iv) SUM*.bas

(c) Explain the use of any **four** of the following commands with one example each :

(i) LEN(B$)

(ii) INT

(iii) SCREEN 1

(iv) LOCATE 18,60

(v) REM (4.5,4,4)

3. (a) Convert the following :

(i) $(281.125)_{10}$ to $(?)_2$

(ii) $(111111.01)_2$ to $(?)_{10}$

(iii) $(54.6)_{10}$ to $(?)_2$

(b) Explain the meaning of the following error messages :

(i) WEND without WHILE

(ii) Overflow

(iii) Out of data

(iv) Syntax error

(c) Identify the error, if any, in any **four** of the following constants and correct them :

(i) 8,15,325.30

(ii) 6.022×E23

(iii) "New Delhi-"110001

(iv) $100.00

(v) "ABC123" (4.5,4,4)

4. (a) What is the use of DEF and GOSUB statements in BASIC? Explain with an example.

(b) Find the error and correct them in the following BASIC expressions :

(i) Y= "DATE"

(ii) For J=100 TO 50 STEP2

(iii) Y=2.54E-54

(iv) LET A/B=35

(c) Write a program in BASIC to find sum of squares of first ten odd numbers. (4.5,4,4)

5. (a) Write a program in BASIC to draw three concentric circles with centre (320,100) and radii 40, 60 and 80 pixels respectively, in high resolution mode.

(b) Write a program in BASIC to find transpose of a 3×3 Matrix.

(c) Write a program in BASIC to evaluate the following series :

$$\text{Cos}(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} \qquad (4.5,4,4)$$

6. Find out the errors in the following programs :

(a)
```
10 REM "To Integrate A Given Function Using Simpson's Method"
20 FNY (T) = 3* X^3 + 4 * X^2
30 INPUT "THE LOWER & UPPER LIMITS"; A, B
40 INPUT "THE NUMBER OF INTERVALS", N
50 H = (A-B)/N
60 S=0 : X = A: M= 2
70 FOR I = 1 TO N
80 X =X + H
90 S = S + M * FNY(X)
100 IF M = 2 THEN M =4 ELSE M =2
105 NEXT I
110 S = H * (FNY(A) +S + FNY(B)) * (1/4)
120 PRINT "THE INTERGRATION VALUE IS = "; S
130 END
```

(b)
```
10 REM "To Evaluate Rms, Avg Speed And Most Probable Speed"
20 INPUT "1 FOR VMP, 2 FOR VAVG, 3 FOR VRMS"; N
30 T = 300: R = 8.314: M = 0.028: PI = 3.14
```

```
40 ON I GOTO 50, 80 , 100
50 VMP = SQRT((2 * R * T )/ M)
60 PRINT "VMP"; VMP
70 GOTO 130
80 VAVG = SQR(8 * R * T )/(π * M))
90 PRINT "VAVG"; VAVG
100 GOTO 130
110 VRMS = SQR (3 * R * T )/M
120 PRINT " VRMS"; VRMS
130 END
```

(c)
```
10 REM "To Plot pH Titration Curve For SA Vs SB"
20 SCREEN 2
30 COLOR 50, 0
40 VIEW (25, 20) - (300,170),,2
50 WINDOW (0,0)-(80,14)
60 INPUT " NO. OF MOLES OF A & B"; A, B : VA = 40
70 FOR VB = 1 TO 80 STEP -1
80 H = (NA * VA – NB * VB) / (VA+VB)
90 IF H > 0 THEN PH = -LOG(H)/LOG(10) ELSE 140
100 PSET (VB, PH): CIRLCE (40 , 7), 0.5
110 NEXT VB : END
120 PRINT " SOLUTION IS EITHER NEUTRAL OR BASIC" ;
130 END
```

(4.5,4,4)

7. Write the output of the following programs :

(a)
```
10 PRINT " THE REQUIRED SENTENCE TO FIND NO. OF WORDS IN IT"
20 PRINT
30 A$ = "A TEXTBOOK OF CHEMISTRY IS MISSING IN THE CUPBOARD"
40 LET L = LEN (A$)
50 LET COUNT = 1
60 FOR K = 1 TO L
70 IF MID$(A$, K, 1) = " " THEN COUNT = COUNT + 1
80 NEXT K
90 PRINT
100 PRINT "THE NUMBER OF WORDS IN :" A$;"IS" ; COUNT
110 END
```

(b) 10 SCREEN 1
20 COLOR 1,0
30 LINE (160, 30) – (250, 180), 1
40 LINE – (70,180), 2
50 LINE –(160, 30), 1
60 END

(c) 10 DIM A(12)
20 LET A (2) = 10
30 FOR K = 1 TO 5

40 LET A (2 * K +2) = K
50 PRINT A(2*K);
60 NEXT K
70 END (4.5,4,4)

8. (a) Explain the following in BASIC with an example :

(i) SCREEN 2

(ii) VIEW

(iii) CHR$

(iv) DRAW

(b) Write a Program in BASIC to draw following figure in the centre of the output screen :

(8,4.5)

(a) Explain Iteration Method for solving a polynomial equation. Write a program using Iteration method, to calculate the volume of van der Waals using BASIC.

Given: a=0.4, b=0.427, P=80, T=298

(b) Write a program in BASIC to determine the Binomial Coefficient, ^nC_r using subroutine.

(8,4.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1530 **A**

Unique Paper Code : 42177926

Name of the Paper : DSE : Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy

Name of the Course : **B.Sc. (Prog.)**

Semester : VI

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **three** questions from **Section A** and **three** from **Section B**.

SECTION A

(Attempt any **three** *questions)*

1. (a) Discuss different oxidation states displayed by Fe and Cu. Name any one compound in each oxidation state.

P.T.O.

(b) Classify the elements according to their role in biological system. Give examples.

(c) Using valence bond theory (VBT) explain the structure of $Co_2(CO)_8$ in solid state and in solution. (4,4,4.5)

2. (a) Using 18-electron rule predict :

(i) 3d metal in $M(CO)_5$.

(ii) The value of x in $Fe_3(CO)_x$.

(iii) Number of metal-metal bond in $Fe_3(CO)_{12}$

(iv) Number of metal-metal bond in $Mn_2(CO)_{10}$

(b) With the help of balanced chemical equations discuss the use of potassium dichromate for the detection of sulphite ions and chloride ions in an inorganic salt.

(c) Compare the structure and functions of haemoglobin and myoglobin. (4,4,4.5)

3. (a) What do you mean by active transport with reference to Na^+/K^+ pump? Give a diagrammatic explanation of the process.

(b) A lemon yellow crystalline compound A reacts with Zn(II) salt to give bluish white precipitate and reacts with Cu(II) salt to give red brown precipitate. These reactions are used to detect Zn^{+2} ions and Cu^{+2} ions respectively. Identify A and write the discussed chemical equations.

(c) What do you mean by the term hapticity? What hapticity is possible with following ligands

(i) cyclopentadienyl

(ii) cyclobutadiene

(iii) ethylene

(iv) benzene (4,4,4.5)

4. (a) Discuss synergistic effect in metal carbonyls. With the help of molecular orbital diagram of CO explain that the CO molecule acts as an electron pair donor through carbon atom and not through oxygen atom.

(b) Explain the role of Na^+ and K^+ ions in living organisms.

P.T.O.

(c) What is the oxidation state of Mn in $KMnO_4$? Give method of preparation of $KMnO_4$ from pyrolusite ore. With the help of chemical equations show how $KMnO_4$ acts as an oxidising agent in alkaline, neutral and acidic medium.

(4,4,4.5)

SECTION B

(Attempt any **three** *questions)*

5. (a) Write the products formed in the following reaction conditions :

(i) Anthracene is treated with Conc. H_2SO_4 at lower temperature and at higher temperature.

(ii) Naphthalene is oxidised with CrO_3/ CH_3COOH and V_2O_5/O_2.

(b) Aromatic electrophilic substitution reaction of naphthalene form α- substituted product predominantly. Explain.

(c) How the dimerization of carboxylic acids affects the O-H and C=O stretching frequencies? Explain.

(d) How will you carry out?

(i) Synthesis of butanoic acid from ethyl acetoacetate.

(ii) Conversion of ethyl acetoacetate to cyclopentyl methyl ketone.

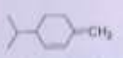
(e) What do you understand about blue shift and red shift? (2,2,2.5,4,2)

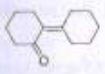
6. (a) Give the approximate IR bands and possible electronic transitions in the following compounds :

(i) CH_3-CH_2-OH

(ii) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

(b) Calculate the absorption maximum (λ_{max}) for $\pi \rightarrow \pi^*$ transition in the following compounds using Woodward-fieser rules.

i. 

ii. 

Parental/Base values	λ_{max} (nm)
Acyclic/ Heteroannular dienes	214
Homoannular dienes	253
α, β unsaturated Acyclic ketones	215
α, β unsaturated Aldehydes	210

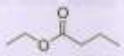
Increments	(nm)
Alkyl substitution/ Ring residue	+5
Additional conjugation	+30
Exocyclic double bond	+5
α-alkyl substituent	+10
β-alkyl substituent	+12

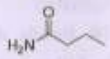
P.T.O.

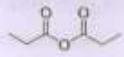
(c) Write notes on: Finger print region.

(d) Match the following compounds with suitable carbonyl frequency.

i.  1680 - 1630 cm^{-1}

ii.  1730 - 1700 cm^{-1}

iii.  1750 - 1735 cm^{-1}

iv.  1830 -1800 cm^{-1} and 1775 - 1740 cm^{-1}

(e) Explain the principle of UV spectroscopy. Write the electronic transitions responsible for UV spectra. (3,3,2,2,2.5)

7. (a) What is Claisen ester condensation. Discuss mechanism of the reaction.

(b) Explain the keto-enol tautomerism by taking ethyl acetoacetate.

(c) How will you prepare the following from ethyl acetoacetate : **(Attempt any three)**

(i) 2-methyl butanoic acid

(ii) Acetyl acetone

(iii) Methyl ethyl ketone

(iv) 4-methyl uracil (4.5,2,6)

8. (a) Complete the following reactions :

(i)  $\xrightarrow[NaOAc]{HgCl_2}$?

(ii)  + $(CH_3CO)_2O$ $\xrightarrow{H_3PO_4}$?

(iii)  + $2\,Br_2$ ⟶ ?

(iv)  $\xrightarrow{\Delta}$?

(v)  $\xrightarrow[Boil]{Na/C_2H_5OH}$?

P.T.O.

(b) How do you synthesize 2,5-dimethylfuran using Paal-knorr synthesis?

(c) Electrophilic substitution in pyridine takes place preferentially at 3-position rather than 2- or 4-position. Why?

(d) Arrange Pyrrole, piperidine and pyridine in decreasing order of basicity. Justify your answer.

(5, 3,2.5,2)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1649 **A**

Unique Paper Code : 42177926

Name of the Paper : DSE : Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy

Name of the Course : **B.Sc. (Prog.)**

Semester : VI

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **three** questions from **Section A** and **three** from **Section B**.

SECTION A

(Attempt any **three** *questions)*

1. (a) A dark purple coloured compound A is used as a disinfectant. The compound A when warmed with H_2SO_4 oxygen gas is evolved. In alkaline solution,

P.T.O.

A is first reduced to a green coloured compound B and finally to colourless compound C. Identify A, B and C and write the chemical reactions involved.

(b) Draw and explain the structure of Methyl Lithium and Zeise salt.

(c) Name the process used to maintain the concentration of sodium ions and potassium ions in extracellular and intracellular fluid. Explain the mechanism of the process with the help of a diagram. What is the source of energy for the functioning of the process? (4,4,4.5)

2. (a) Give any one method of preparation of $Ni(CO)_4$. With reason arrange the metal carbonyls $[Ni(CO)_4]$, $[Co(CO)_4]^{1-}$, $[Fe(CO)_4]^{2-}$ in increasing order of

(i) M-C bond order.

(ii) C-O bond order

(iii) IR stretching frequency of CO

(b) What are metallo-porphyrin? Draw and discuss the structure and any one function of heme and chlorophyll.

(c) What is the oxidation state of chromium in $K_2Cr_2O_7$? Discuss the oxidising properties of $K_2Cr_2O_7$ in acidic medium. What happens when acidified $K_2Cr_2O_7$ reacts with :

(i) Ferrous sulphate

(ii) Sodium sulphite (4,4,4.5)

3. (a) Metal carbonyl $Mn(CO)_5$ dimerize to give stable carbonyl $Mn_2(CO)_{10}$ but $V(CO)_6$ does not, although both $Mn(CO)_5$ and $V(CO)_6$ do not follow 18-electron rule. Explain.

(b) What are bulk and trace elements in biological system? Give Examples. Discuss the toxicity of Hg^{+2} ions.

(c) Give laboratory preparation of $K_4[Fe(CN)_6]$. Write the chemical reactions when $K_4[Fe(CN)_6]$ is treated with

(i) Conc. H_2SO_4

(ii) $KMnO_4$ in acidic medium

(iii) Silver nitrate (4,4,4.5)

4. (a) What are the functions of myoglobin? Discuss the changes that occurs in the heme group of myoglobin on going from deoxy to oxy form.

(b) Discuss with examples the various oxidation states displayed by Cr and Fe.

(c) Using Molecular orbital diagram of CO explain the bonding in metal carbonyls and give reasons

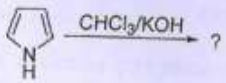
(i) CO molecule acts as electron pair donor through C atom and not through oxygen atom

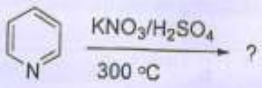
(ii) CO is a π-acceptor ligand (4,4,4.5)

SECTION B

(Attempt any **three** *questions)*

5. (a) What happens when :

(i) 

(ii) 

(b) The C_1-C_2 bond length in naphthalene is shorter than C_2-C_3 bond length. Why?

(c) Explain :

(i) Ketonic hydrolysis of ethyl acetoacetate.

(ii) Acidic hydrolysis of ethyl acetoacetate.

(d) Write short notes on: Various types of electronic transitions of UV spectroscopy.

(e) C=O stretching frequency is higher in acids than the corresponding amides. Explain.

(2,2,4,2.5,2)

6. (a) Give the approximate IR bands for the following characteristic absorptions: (Attempt any **four**)

(i) C=O stretching in CH_3CHO and CH_3COCH_3.

(ii) C-H stretching in alkanes and alkynes.

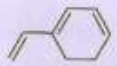
(iii) C=C stretching in aliphatic compounds and aromatic compounds.

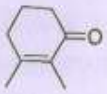
(iv) O-H stretching in intramolecular and intermolecular hydrogen bonded O-H.

P.T.O.

(v) C=O stretching in dimeric and monomeric forms of carboxylic acids.

(b) Calculate the absorption maximum (λ_{max}) for $\pi \rightarrow \pi^*$ transition in the following compounds using Woodward-fieser rules.

(i) 

(ii) 

Parental/Base values	λ_{max} (nm)
Acyclic/ Heteroannular dienes	214
Homoannular dienes	253
α, β unsaturated Acyclic ketones	215
α, β unsaturated Aldehydes	210

Increments	(nm)
Alkyl substitution/ Ring residue	+5
Additional conjugation	+30
Exocyclic double bond	+5
α-alkyl substituent	+10
β-alkyl substituent	+12

(c) Write notes on: Finger print region

(d) Assign the fundamental vibrational modes of the following molecules: H_2O and CO_2

(4,3,2.5,3)

7. (a) Write reaction and reaction mechanism for the synthesis of ethyl acetoacetate using Claisen condensation.

(b) Explain: Why the order of the percentage of enol form in following active methylene compounds are found as:

Acetyl acetone > Ethyl acetoacetate > Diethyl malonate

(c) How will you prepare the following from ethyl acetoacetate: (Attempt any **four**)

(i) Adipic acid

(ii) 4-oxopentanoic acid

(iii) Hexane 2,5-dione

(iv) 4-methyluracil

(v) Pentane 2,4-dione (4,4.5,4)

8. (a) How will you carry out the following conversions?

(i) Naphthalene to 1 -chloronaphthalene

(ii) Anthracene to 9,10-Dihydroanthracene

(iii) Furan to Tetrahydrofuran

(iv) Thiophene to 2-acylthiophene

(v) Pyrrole to 2-Phenylazopyrrol

P.T.O.

(b) How do you synthesize naphthalene using Haworth synthesis?

(c) Arrange the followings in decreasing order of basicity. Give suitable explanation.

Pyridine, Pyrrole, aliphatic amine

(d) Draw the resonating structure of furan.

(5,3,3,1.5)

03

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1107 **A**

Unique Paper Code : 32171601

Name of the Paper : Inorganic Chemistry IV: Organometallic Chemistry and Bio-inorganic Chemistry

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : VI

Duration : 3 hours 30 minutes Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **six** questions out of nine.
3. **All** questions carry equal marks **(12.5)**.

1. (i) What are Metalloenzymes and Metal Activated Enzymes? Give the name and the mechanism of action of the enzyme transporting CO_2 from the tissues to the lungs.

P.T.O.

(ii) What are interfering anions? How do they interfere in the cation analysis? Why do they interfere only after the second group cation analysis and not before?

(iii) Predict whether the following compounds obey EAN rule or not.

(a) $[Fe(CO)_2(\eta^5\text{-}C_5H_5)(\eta^1\text{-}C_5H_5)]$

(b) $[Fe(CO)_2(NO)_2]$ (5,5,2.5)

2. (i) The Heam group in Haemoglobin cannot function as an oxygen carrier in the absence of the globin chain. Explain. Give the Hill's equation for the oxygenation of Haemoglobin.

(ii) What is Zeise's salt? Discuss the bonding in Zeise's salt on the basis of Dewar-Chatt-Duncanson model and IR studies. How is M-C bonding in Zeise's salt different from that in metal carbonyl complexes?

(iii) Explain the steps involved in the identification of NO_2^- and NO_3^- ions when present together in a salt mixture. (5,5,2.5)

3. (i) A mixture of anions gives brown vapours with concentrated H_2SO_4, which are intensified on adding copper turnings. A rod dipped in ammonia solution gives white dense fumes when brought near the mouth of the test tube. The sodium carbonate extract gives a white precipitate with silver nitrate after acidification, which is completely soluble in ammonium hydroxide solution. Explain with reactions how will you confirm the anions present.

(ii) How are organometallic compounds classified on the basis of type of bonding? Explain giving examples.

(iii) State what special features of Zn(II) make it an excellent biocatalyst? (5,5,2.5)

4. (i) State how does cis-platin block cell proliferation? Explain.

(ii) What is Bohr Effect? Draw the oxygen saturation curves for haemoglobin and myoglobin. Why do their shapes differ?

(iii) What is meant by the term hapticity? Give an example where the same ligand can show varying hapticity. (5,5,2.5)

5. (i) Give examples of metal containing biomolecules which perform the following functions. (Give the name of the metal and the biomolecule which contains the metal)

(a) Oxygen storage

(b) Metal storage

(c) Electron carrier

(d) Photoredox

(e) Prevention of disease

(ii) Ferrocene on acetylation with excess of reagent shows heteroannular substitution while on alkylation with excess of reagent shows homoannular substitution. Give reason.

(iii) Which alkaline earth metal is also involved in the sodium - potassium pump? What is the source of energy for this pump? (5,5,2.5)

6. (i) Explain the functioning and mechanism of action of the enzymes: Carbonic anhydrase and Carboxypeptidase A?

(ii) Define the following terms with reference to Catalysis :

(a) Catalytic cycle

(b) Tolman catalytic loop

(c) Lifetime of a catalyst

(d) Turnover number

(e) Poison

(iii) How will you detect potassium ion in presence of ammonium ions? (5,5,2.5)

7. (i) Name the metal with oxidation state involved in following biomolecules.

(a) Ferritin

(b) Vitamin B12

(c) Haemoglobin

(d) Chlorophyll

(e) Transferrin

(ii) What is Zieglar Natta Catalyst? Explain the active form of this catalyst which is involved in the oligomerization of olefin.

(iii) Write the formulae and draw the structures of two organometallic compounds having multicentre bonding. What is the reason of their multicentre bonding? (5,5,2.5)

8. (i) An unknown salt A, when heated with NaOH solution, produced a pungent smelling gas B. B turned red litmus blue and gave dense white fumes of C when a glass rod dipped in HCl was held at the mouth of the test tube. A, on heating with concentrated sulphuric acid, gave a mixture of two odourless gases D and E. D burnt with a blue flame while E turned lime water milky. An aqueous solution of A gave a white precipitate with calcium chloride solution, the acid

extract of which discharged the colour of acidified potassium permanganate solution. Identify A, B, C, D and E giving the reactions involved.

(ii) What do you mean by reductive carbonylation? Give a suitable example for this. The symmetric CO stretching frequencies in isoelectronic series of $[V(CO)_6]^-$, $Cr(CO)_6$ and $[Mn(CO)_6]^+$ are 1860 cm^{-1}, 2000 cm^{-1} and 2090 cm^{-1} respectively. Explain these observations.

(iii) In what form iron is stored in the human body? How is it taken from the storage site for the incorporation into haemoglobin? (5,5,2.5)

9. (i) Both carbon and oxygen have one lone pair of electron but in metal carbonyls, bonding is through carbon and not through oxygen. Explain with help of Molecular orbital diagram.

(ii) Write the toxic effects of Pb(II). Give the reasons for its toxicity. How it can be treated?

P.T.O.

(iii) What is Wilkinson's catalyst. Explain its structure and oxidation state of the central metal ion. (5,5,2.5)