

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1545

G

Unique Paper Code : 2172011101

**Name of the Paper : DSC: Atomic Structure &
Chemical Bonding
(Inorganic Chemistry I)**

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

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

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

P.T.O.

1545

2

I. Attempt any five of the following

- (i) What is meant by Dipole moment? Can its magnitude give an idea about the structure of molecules? Explain.
- (ii) Why NaCl is soluble in water but AgCl is not?
- (iii) The first electron ionization enthalpy of boron (B) is smaller than that of carbon (C) whereas the second electron ionization enthalpy of carbon is smaller than boron.
- (iv) Orbitals of 1p, 2d, 4g not possible.
- (v) The electron gain enthalpy of chlorine (Cl) is greater than fluorine (F).
- (vi) Calculate the effective nuclear charge of 4s and 3d electron in Scandium using Slater's rule.

(5×3)

1545

3

2. (i) Write the time independent Schrödinger wave equation for hydrogen atom and explain the terms used in it.
- (ii) Why half filled and fully filled configurations are more stable than the other configurations.
- (iii) Draw Born Haber Cycle and calculate the enthalpy of formation (ΔH_f) for MgF_2 using following data,

Sublimation Enthalpy of Mg = 146.4 kJ/mol

Ionization Enthalpy of Mg to Mg^{2+} = 2184 kJ/mol

Dissociation Energy of F_2 = 158.9 kJ/mol

Electron gain enthalpy of F(g) = -334.7 kJ/mol

P.T.O.

Lattice Energy of $\text{MgF}_2 = -2922.5 \text{ kJ/mol}$

- (iv) Calculate the limiting radius ratio (r^+/r^-) of an ionic lattice having the octahedral geometry with co-ordination number 6 around cation.

(2.5×2,5,5)

3. (i) What is normalized and orthogonal wave function? Write the mathematical expression for normalization and orthogonality of wave function.

- (ii) The bond angle in CH_2F_2 , $\text{HCH} = 112.3^\circ$ and $\text{FCF} = 108.3^\circ$. Calculate the s character used by carbon atom in the orbital directed to the hydrogen and fluorine. Discuss the result in terms of Bent rule.

- (iii) Draw the shape of the following molecules using VSEPR theory.

ClF_3 , BrF_2^+ , PCl_3 , SnCl_2 , OF_2 (5,5,5)

4. (i) Calculate ionic radii for Na^+ & K^+ ions if the internuclear distance in NaF is 231 pm.

- (ii) The so-called Lyman series of lines in the emission spectrum of hydrogen corresponds to transitions from various excited states to the $n = 1$ orbit. Calculate the wavelength of the lowest-energy line in the Lyman series. In what region of the electromagnetic spectrum does it occur?

- (iii) Draw the molecular orbital diagram of N_2 and O_2 molecules and explain their magnetic behavior.

(5,5,5)

5. (i) Based on their positions in the periodic table, arrange these ions in order of increasing radius: Cl^- , K^+ , S^{2-} , and Se^{2-} .

(ii) The bond distance between H and F in HF molecule is 91.7 pm and the experimentally observed dipole moment of this molecule is 6.6×10^{-30} Cm. Find out the percent ionic character.

(iii) Write the Born Lande equation and the Kapustinskii equation for lattice energy and define the terms involved. What is the advantage of Kapustinskii over Born Lande equation? (5,5,5)

6. (i) Calculate the electronegativity of F from the following data, electronegativity of hydrogen is 2.1, E_{F-F} bond dissociation energies = 36.6 kcal/mol, E_{H-H} = 104.2 kcal/mol, E_{H-F} = 136.6 kcal/mol.

(ii) Draw the radial distribution curve of 1s, 2s, 2p, 3p, and 3d.

(iii) Draw the MO diagram of CO with sp mixing. On the basis of it, explain it is an electron pair donor. (5,5,5)

7. (i) What is resonance? Draw the resonating structure of NO_2 , CO and O_3 .

(ii) Write the conditions for a wave function ψ acceptable to the Schrodinger wave equation. What is the physical significance of ψ and ψ^2 .

(iii) How will you convert the Cartesian co-ordinates (x, y, z) into polar co-ordinates (r, θ , ϕ) (5,5,5)

8. (i) Write short notes (any two)

(a) Heisenberg Uncertainty Principle

(b) Equivalent and Non-equivalent hybrid orbitals.

(c) Different scales of electronegativity.

(ii) Which of the following combinations are allowed in LCAO (considering Z axis as molecular axis) and sketch the shapes of molecular orbitals formed by their addition and subtraction

(a) s and p_x

(b) p_x and p_x

(iii) List the limitations of:

(a) Bohr's Theory of atomic structure.

(b) Radius ratio rule. (5,5,5)

(5)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2381

G

Unique Paper Code : 2174001001

Name of the Paper : GE-Atomic Structure and
Chemical Bonding

Name of the Course : B.Sc. (H) / B.Sc. (P)

Semester : I/III

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

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

1. (a) Write the Schrödinger's wave equation for an atom in three dimensions and explain the terms involved.
(b) Predict the shapes of ClF_3 & NH_3 molecule according to VSEPR theory.

P.T.O.

2381

2

- (c) Which one has higher melting point NaF or BeO? Give reasons.
- (d) H_2 exists but He_2 does not. Explain. (4,4,4,3)
2. (a) Draw the radial probability distribution curves for 2s, 2p, 3d and 4f.
- (b) Draw Molecular orbital diagram of CO and calculate its bond order.
- (c) Arrange the following in increasing order of ionic character giving reasons for the same.
NaCl, KCl, RbCl, CsCl
- (d) Arrange the following in order of their increasing lattice energy and give the reason for the same:
NaF, MgO (4,4,4,3)
3. (a) Give the set of all four quantum numbers for 4p and 5d orbitals.
- (b) Write any four postulates of VSEPR theory.
- (c) What is the hybridization in square planar and trigonal planar arrangements? Explain by taking suitable examples.

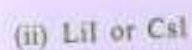
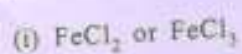
2381

3

- (d) What is the significance of Ψ and Ψ^2 ? (4,4,4,3)
4. (a) What are eigen functions and eigen values?
- (b) Calculate Bond order and comment on the nature of O_2 molecule using Molecular Orbital theory.
- (c) Write the electronic configuration of Cr (At. No. 24) and Cu (At. No. 29) and explain the reason for the observed electronic configurations of Cr and Cu.
- (d) Discuss the conditions for the formation of ionic compounds. (4,4,4,3)
5. (a) How does the presence of lone pair(s) distort the geometry of molecule? Explain by taking suitable examples.
- (b) Explain terms polarization and polarizing power by taking suitable example.
- (c) Explain (i) Pauli's exclusion principle, (ii) Heisenberg's Uncertainty principle
- (d) Calculate the wavelength of an electron (mass = 9.1×10^{-31} kg) travelling with $1/3^{rd}$ the speed of light, ($h = 6.624 \times 10^{-34}$ Js). (4,4,4,3)

P.T.O.

6. (a) Which is more covalent in the following pairs? Explain.



- (b) Why are half-filled and fully filled orbitals more stable?

- (c) Calculate the heat of formation of MgF_2 from its elements using the Born Haber's Cycle from the following thermo-chemical data:

Sublimation energy of $\text{Mg(s)} = 146.4 \text{ kJmol}^{-1}$,

Dissociation energy of $\text{F}_2(\text{g}) = 158.9 \text{ kJmol}^{-1}$,

Ionization energy of $\text{Mg(s)}/\text{Mg(g)}^{2+} = 2184 \text{ kJmol}^{-1}$,

Electron affinity of $\text{F(g)}/\text{F}^-(\text{g}) = -334.7 \text{ kJmol}^{-1}$,

Lattice energy of $\text{MgF}_2(\text{s}) = -2922.5 \text{ kJmol}^{-1}$

- (d) Predict the shapes of NH_3 and SF_6 using VSEPR theory. (4,4,4,3)

Dec-2023

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4820

G

Unique Paper Code : 42171103

Name of the Paper : Atomic Structure, Chemical
Bonding, General Organic
Chemistry & Aliphatic
Hydrocarbons

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

Semester : I

Duration : 3 Hours

Maximum Marks : 70

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use separate answer booklet for each section.
3. Attempt all parts of a question together.
4. Use of calculator is allowed.

P.T.O.

4820

2

SECTION A

(Attempt any THREE questions from Section A)

1. (a) Predict the hybridization and shapes of ClF_3 and XeF_2 .
- (b) Draw the radial probability distribution plots for 3s, 3p and 3d orbitals.
- (c) Melting points of AgCl and KCl are 455°C and 776°C respectively. Justify.
- (d) Draw the molecular orbital diagram for B_2 molecule and predict magnetic behavior of the molecule. (3,3,3,3.5)
2. (a) Arrange B_2 , B_2^+ , B_2^- , B_2^{2-} in the increasing order of their bond length.
- (b) Bond angle in CH_4 is 109.5° whereas in NH_3 the bond angle is 107.5° . Explain.
- (c) Dipole moments of NH_3 and NF_3 are 1.7D and 0.2D respectively. Justify.
- (d) Calculate the lattice energy of KCl using Born-Haber Cycle

4820

3

Sublimation energy of $\text{K(s)} = 89 \text{ KJmol}^{-1}$, Ionization energy of $\text{K(g)} = 425 \text{ KJmol}^{-1}$, Dissociation energy of $\text{Cl}_2(\text{g}) = 244 \text{ KJmol}^{-1}$, Electron gain enthalpy for $\text{Cl(g)} = -355 \text{ KJmol}^{-1}$ and heat of formation of $\text{KCl(s)} = -438 \text{ KJmol}^{-1}$. (3,3,3,3.5)

3. (a) Draw the resonating structures of CO_3^{2-} and N_3^- .
- (b) Write the time independent Schrodinger wave equation for hydrogen atom and define the terms involved in it.
- (c) Arrange the following in terms of increasing order of their lattice energy. Explain the order LiCl , CaCl_2 , AlCl_3 .
- (d) Calculate the wavelength of a line in the Lyman series of the hydrogen spectra that corresponds to an electronic transition from 3rd orbit. $R = 109679 \text{ cm}^{-1}$. (3,3,3,3.5)
4. (a) Arrange the following in the increasing order of their melting point and explain the order.

BeCl_2 , BeBr_2 and BeI_2

P.T.O.

4820

4

- (b) Write down four basic postulates of molecular orbital theory.
- (c) Draw a d_{xy} and a $d_{x^2-y^2}$ orbital, and assign their symmetry notations in terms of *gerade* and *ungerade*.
- (d) Calculate the % ionic character in the HX molecule if the dipole moment is 1.92D, bond length is 1.2\AA and charge on H is 4.8×10^{-10} esu. (3,3,3,5)

SECTION B

ORGANIC CHEMISTRY

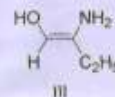
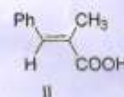
(Attempt any TWO questions from Section B)

1. (a) Give reasons for the following:
- Aniline is less basic than methyl amine.
 - Trans-2-butene is more stable than cis-2-butene.
 - Neopentane has a lower boiling point as compared to n-pentane.

4820

5

- (iv) Anti-conformation of n-butane is most stable conformation ($1\frac{1}{2} \times 4 = 6$)
- (b) Assign E/Z configuration to any two of the following:



(4)

- (c) What is the criterion for an organic compound to exhibit aromaticity? Comment on the aromaticity of the following compounds
- Cyclohexadienyl cation
 - Naphthalene
 - Pyridine
 - Cyclopentadienyl anion (2½, 6)
2. (a) How will you chemically distinguish But-1-yne and But-2-yne. Give chemical reactions involved? (2)

P.T.O.

4820

6

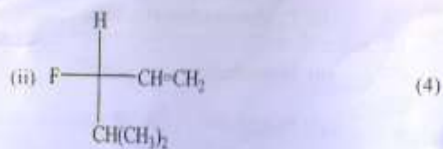
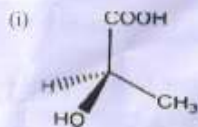
(b) Carry out the following conversions :

(i) Propane to 2,3-Dimethylbutane

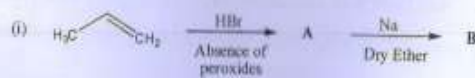
(ii) Ethyne to But-2-yne

(iii) But-1-yne to Trans-But-2-ene (6)

(c) Assign R/S configuration to the following compounds :

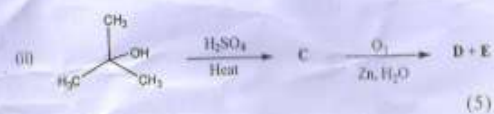


(d) Predict the products of the following reactions :



4820

7



(c) Compare the stability of Benzyl carbocation and Allyl carbocation. (2)

3. (a) Classify the following as electrophiles or nucleophiles. Justify your answer

 SO_3 , CCl_2 , BF_3 , NH_3 , H_2O (2½)

(b) Distinguish between :

(i) Enantiomers and Diastereomers

(ii) Inductive Effect and Electromeric effect (4)

(c) Write the product(s) and mechanism involved when HBr is added to 3-methyl-1-butene (3)

(d) Write short notes on any **three** of the following :

(i) Hydroboration-Oxidation Reaction

P.T.O.

(ii) Homolytic and Heterolytic Fission

(iii) Hyperconjugation

(iv) Conformations of Cyclohexane (9)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1583

G

Unique Paper Code : 2172011102

Name of the Paper : DSC – Basic Concepts and
Aliphatic Hydrocarbons
(Organic Chemistry I)

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

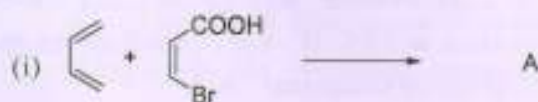
Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

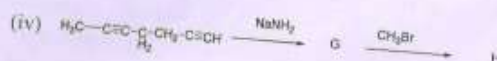
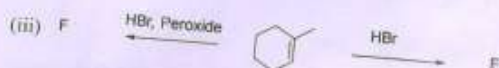
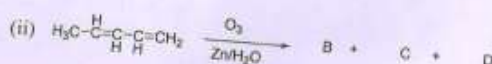
1. Write your Roll No. on the top immediately on receipt of this question paper.
 2. Attempt any **six** questions.
 3. Each question carries **15** marks.
1. Complete the following :



P.T.O.

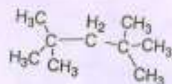
1583

2



(1.5 marks for each product)

2. (i) Predict the proportion of isomeric products obtained at room temperature from chlorination of the given molecule. The order of reactivity of hydrogen for chlorination is 3° (5.0); 2° (3.8); 1° (1.0)

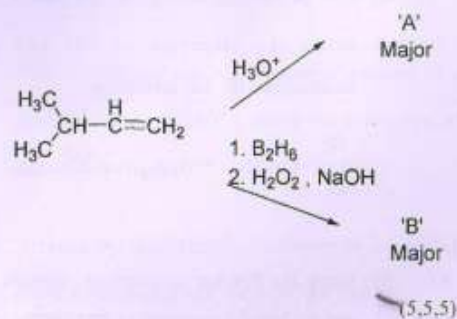


- (ii) Define specific rotation. A solution of compound 'A' (7.14 g in 100 mL) in chloroform was taken in a polarimeter tube (5 cm) and its optical rotation at 25°C is -1.3° . Calculate the specific rotation of compound 'A'.

1583

3

- (iii) Explain the formation of different products, (A) and (B) in the given reactions given below :



3. (i) 1,3-Butadiene on treating with HBr at low temperature gives 3-bromobut-1-ene (major product), whereas at high temperature, it gives 1-bromobut-2-ene (major product). Explain with mechanism.

- (ii) An alkyl halide 'A' ($\text{C}_4\text{H}_9\text{Br}$) reacts with alc. KOH and gives an alkene, B. Compound B reacts with bromine to give compound 'C'. Compound 'C' on treatment with excess of sodamide forms compound 'D'. Further, compound 'D' on

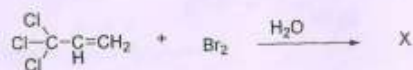
P.T.O.

1583

4

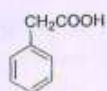
reaction with ammoniacal AgNO_3 solution, gives a precipitate (E). Write the structures of A, B, C, D and E.

- (iii) Write the structure of 'X' and give the mechanism for its formation.



(5,5,5)

4. (i) Draw the Fischer projections formula of threo- and erythro-2,3-butanediol and convert them into corresponding Sawhorse projection formula.
- (ii) Draw the possible chair conformations of 1-methylcyclohexane and compare their stability.
- (iii) Arrange the following compounds in increasing order of acidity and explain the order.



(5,5,5)

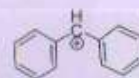
1583

5

5. (i) Draw the Fischer projection of all the possible stereoisomers of 2,3-dichlorobutan-1,4-dioic acid. Comment on optical activity of each isomer.

- (ii) How would you resolve a racemic mixture of a primary amine ($\pm\text{RNH}_2$) using the formation of diastereomeric salt?

- (iii) Arrange the following carbocations in increasing order of stability and explain the order.



(5,5,5)

6. (i) Considering the C2-C3 bond rotation in n-butane, draw the potential energy profile for its various conformations.

P.T.O.

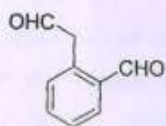
(ii) (a) Why maleic acid has lower melting point than fumaric acid?

(b) Arrange the following compounds in increasing order of their boiling points and explain the order.

2-methylbutane, 2,2-dimethylpropane and pentane.

(iii) What is allylic halogenation? Give the reason for the products obtained when propene reacts with a) NBS/ CCl_4 and b) Br_2 at room temperature. (5,5,5)

7. (i) Find the number of sigma and pi bonds in the given molecule.

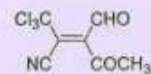
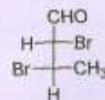


(ii) Which of the following compounds is more stable and why?



(iii) How Corey-House synthesis overcomes the limitation of Wurtz reaction?

(iv) Assign the priority order and find R/S or E/Z configuration for the given molecules:



(3,3,3,6)

8. (i) Write the reaction for hydration of 2-pentyne.

(ii) Give a test to differentiate between 1-butyne and 1-butene.

(iii) Which of the following will exhibit geometrical isomers? Explain by drawing structures.

2-Butene; 2-methyl-2-butene and 2-pentene

P.T.O.

(iv) Differentiate between the following with suitable examples (**any two**):

(a) Inductive effect and electrometric effect

(b) Relative and absolute configuration

(c) Electrophile and nucleophile (3,3,3,6)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1754

G

Unique Paper Code : 2172511101

Name of the Paper : DSC – Basic Concepts of
Organic Chemistry

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

Semester : I

Duration : 2 Hours

Maximum Marks : 60

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.

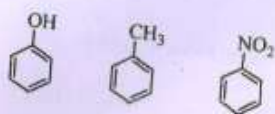
1. Attempt any **five** :

(a) Giving reasons, arrange the following in increasing order of reactivity towards ring bromination :

P.T.O.

1754

2

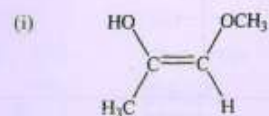


- (b) What is Markownikoff's rule? Explain by taking the example of propene and HBr.
- (c) Differentiate between D/L and d/l notations.
- (d) Explain, which of the following compound would be strongest acid?
- $\text{CHF}_2\text{CH}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}_2\text{CF}_2\text{COOH}$
 - $\text{CH}_3\text{CF}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

1754

3

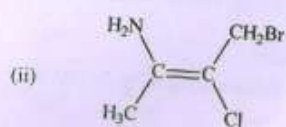
- (e) Amides are less basic than amines. Justify.
- (f) Explain Hyperconjugation and its applications.
- (g) What are free radicals? Explain decreasing order of stability of tertiary, Secondary, Primary alkyl free radical. (3,3,3,3,3)
2. (a) Draw the structure and explain, why chair form is the most stable form of cyclohexane?
- (b) Assigning the priority order, explain how will you design at E/Z to the following :



P.T.O.

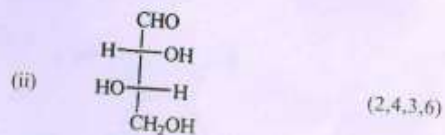
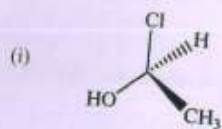
1754

4



(c) What is the difference between meso stereoisomers and racemic mixture?

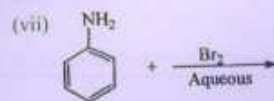
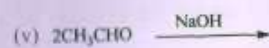
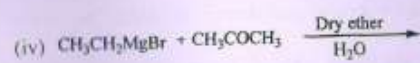
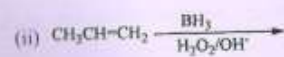
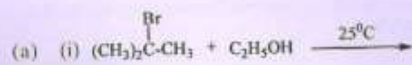
(d) Assigning the priority order and designate R/S to the following conformers :



1754

5

3. Complete the following reactions (any Six) :



P.T.O.

1754

6

- (b) Arrange the following compounds in decreasing order of reactivity towards S_N1 reactions and justify.

1-Bromopentane, Allyl bromide, Vinyl bromide.

(2,2,2,2,2,3)

4. (a) Discuss the mechanism of Friedel-Crafts acylation.
- (b) Differentiate between Hoffman and Saytzeff elimination by taking the example of 2-Bromo butane.
- (c) Give the mechanism of nitration of benzene. Explain why nitration of toluene is easier than that of benzene?

(5,5,5)

1754

7

5. Explain the following :

- (a) Discuss the stereochemistry of the product of S_N2 reaction.
- (b) How can chlorobenzene be converted into aniline via benzyne mechanism?
- (c) Write the mechanism of the reaction when two moles of aldehyde containing α hydrogen undergo condensation in the presence of a base.

(5,5,5)

6. Write short note on **any three** of the following :

- (a) Reimer-Tiemann Reaction
- (b) Beckmann rearrangement

P.T.O.

(c) Benzoin condensation

(d) Birch Reduction

(e) Pinacol-pinacolone rearrangement (5,5,5)

(3000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2573

G

Unique Paper Code : 2176000001

Name of the Paper : SEC: Essential Food Nutrients

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

Semester : I

Duration : 1 Hour

Maximum Marks : 30

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** questions in all.
3. Each Question carries equal marks.

1. (a) (i) Which vitamin helps in blood clotting?

- (a) Vitamin A (b) Vitamin D
(c) Vitamin K (d) Vitamin B

P.T.O.

(ii) Which of the following vitamin can be synthesized in our body?

- (a) Vitamin A (b) Vitamin D
(c) Vitamin K (d) None of all

(iii) Skin disorders and hair loss caused by the deficiency of

- (a) Vitamin B₁ (b) Vitamin B₂
(c) Vitamin B₆ (d) Vitamin B₁₂

(iv) Which of the following is a fat-soluble vitamin?

- (a) Vitamin B (b) Vitamin K
(c) Vitamin B₁₂ (d) Vitamin C

(v) The incorrect statement about ascorbic acid is

- (a) It shows antioxidant activity.
(b) It is also known as vitamin C.
(c) Its deficiency causes scurvy disease.
(d) Humans can synthesize ascorbic acid

(b) Describe the auto-oxidation process of lipids and write any one preventive measure of it.

(c) Discuss the sources and deficiencies of proteins with suitable examples. (5,5,5)

2. (a) Write the classification of carbohydrates based on hydrolysis of polysaccharides. Give examples.

(b) Which amino acid is involved in the formation of disulfide bond? Discuss the importance of disulfide bonds in protein folding?

(c) Define derived and miscellaneous lipids with suitable examples. Explain and classify the different types of complex lipids. (5,5,5)

3. (a) What is the significance of the secondary structure in proteins, particularly in terms of alpha helices and beta sheets?

(b) Classify and explain briefly about the different types of fatty acids with suitable examples. Write the functions of fatty acid in our body?

(c) Write short notes on (any two) :

- (i) Lactose intolerance
- (ii) Galactosemia
- (iii) Maltitol

(5,5,5)

4. (a) What are dietary minerals? Give examples of macro minerals and trace minerals.

(b) What distinctive properties do lipids possess? Elaborate on the roles that lipids play in the functioning of living organisms.

(c) Provide examples of proteins in foods and discuss their functional roles.

(5,5,5)

(1000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2604

G

Unique Paper Code : 2176000001

Name of the Paper : SEC: Essential Food Nutrients

Name of the Course : B.Sc. Hons./B.Sc. Prog./
others

Semester : 1

Duration : 1 Hour

Maximum Marks : 30

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **two** questions in all.
3. Each Question carries equal marks.

1. (a) Answer the following multiple-choice questions :

(i) What is the primary function of carbohydrates in the human body?

- (a) Energy storage (b) Structural support
(c) Enzyme catalysis (d) Oxygen transport

P.T.O.

2604

2

- (ii) Which of the following is a monosaccharide?
(a) Sucrose (b) Lactose (c) Glucose (d) Maltose
- (iii) What is the main polysaccharide found in plant cell walls?
(a) Starch (b) Glycogen (c) Cellulose (d) Chitin
- (iv) Which carbohydrate is commonly known as "blood sugar"?
(a) Fructose (b) Galactose (c) Glucose (d) Sucrose
- (v) What enzyme is responsible for breaking down complex carbohydrates into simple sugars during digestion?
(a) Lipase (b) Amylase (c) Protease (d) Nuclease
- (b) Explain the classification of proteins based on the structure.
- (c) What are saturated and unsaturated fatty acids? Give one example of each. Write the key differences between omega-3 and omega-9 fatty acids. (5,5,5)

2604

3

2. (a) Discuss the role of carbohydrates as sweeteners in food.
- (b) Explain the physico-chemical properties of proteins.
- (c) Describe rancidity and lipolysis of fats/oils with suitable examples. (5,5,5)
3. (a) Write the important roles of lipids in living organisms. Describe how simple lipids are different from phospholipids with suitable examples?
- (b) Describe the significance of animal and plant proteins in the human diet and highlighting their nutritional benefits, write any three protein-rich sources obtained from plants and animals.
- (c) Write short notes on (any two):
- (i) Macro and micro minerals
- (ii) Fat soluble vitamins
- (iii) Vitamin D deficiency (5,5,5)

P.T.O.

4. (a) What are the main two parameters used for evaluating the quality and content of edible fats/oils? What information do they convey about fats/oils?
- (b) Evaluate the nutritional implications of choosing diverse protein sources in a balanced diet.
- (c) Write short notes on (any two) :
- (i) Essential and nonessential vitamins.
 - (ii) Role of water-soluble vitamins.
 - (iii) Differentiate between vitamin and minerals.

(5,5,5)

(1000)

(10)
[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1621

G

Unique Paper Code : 2172011103

Name of the Paper : DSC: Gaseous and Liquid
State (Physical Chemistry I)

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

Semester : 1

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use of a scientific calculator and log table is allowed.
3. Attempt **four** questions out of **six**, question number **one** is compulsory.

($R = 8.314 \text{ KJ}^{-1} \text{ mol}^{-1}$ $k = 1.38 \times 10^{-23} \text{ KJ}^{-1}$ $N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$)

1. Attempt any **Five** of the following :
 - (a) An ideal gas is not expected to show any cooling on free expansion. Explain.
 - (b) Define the mean free path. Predict mean free path at high vacuum.
 - (c) Explain why the viscosity of ethyl alcohol is greater than that of ether.

P.T.O.

- (d) Addition of detergent decreases the surface tension of water while NaCl addition increases the surface tension of water. Comment.
- (e) Show that van der Waals constant b for a real gas is four times its molecular volume.
- (f) Write the formula of average speed, most probable speed, root mean square speed and arrange them in increasing order. (3×5)
2. (a) Derive an expression for the kinetic gas equation, in terms of the mass of a molecule (m), the total number of molecules (N), and the velocity of the molecule (c). (5)
- (b) Derive the reduced equation of state for a real gas using the expressions of the critical constants assuming that gas follows van der Waals equation of state. Is this equation applicable to all gases? (5)
- (c) For a gas containing 10^{23} gas particles each of mass 10^{-25} kg in a container of volume 10^{-3} m³. Calculate
- The pressure exerted by the gas.
 - The total kinetic energy of molecules.
 - Temperature of the gas.
- Given : Root mean square speed is 10^5 cm s⁻¹. (5)

3. (a) For oxygen gas at 25 °C and 1 atm pressure calculate.
- Mean free path,
 - Number of collisions per second per molecule
- The collision diameter of oxygen molecule is 361 picometre. (5)
- (b) Discuss the effect of height, temperature and molecular mass of the gas on barometric distribution of gases. (5)
- (c) (i) Write the mathematical expression for Maxwell's distribution of molecular speeds for a gas explaining briefly the terms involved.
- (ii) Derive the expression for the average speed of a gas. (5)
4. (a) The critical constants for water are 647 K, 22.09 MPa and 0.0566 dm³ mol⁻¹. Calculate the values of van der Waals constants a , b and R and also explain the abnormal value of R . (5)
- (b) Write the van der Waals equation in the virial form and evaluate the second virial coefficient. (5)
- (c) Explain the Andrews isotherms for a real gas. Derive the relations between van der Waals constants and critical constants. (5)

5. (a) Define the surface tension of a liquid, give its unit and describe in detail its determination using a stalagmometer. (5)
- (b) When a capillary is dipped in a liquid, some liquids rise in the capillary whereas some others fall. Explain the reason behind this phenomenon. What are these liquids called? Give one example of each. Give one example from your daily life where this phenomenon is observed. (5)
- (c) Benzene has a density of 0.879 g cm^{-3} and has a surface tension of 0.02888 N m^{-1} . What will be the difference of its heights in two capillaries of radii 0.10 mm and 0.15 mm , respectively? (5)
6. (a) Calculate the pressure exerted by one mole of oxygen gas at 298 K , contained in a container of volume 5 litres , if the gas is a) ideal, b) van der Waals gas. Given $a = 5.5 \text{ L}^2 \text{ atm mol}^{-1}$, $b = 63.8 \text{ cm}^3 \text{ mol}^{-1}$, $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$. (5)
- (b) How is vapour pressure of a liquid related to its boiling point? Discuss the effect of external pressure and non-volatile impurities on the boiling point of a liquid. (5)
- (c) Explain how the viscosity of a liquid varies with temperature? Support your answer with the mathematical relation between viscosity and temperature. Does viscosity of a gas also show the same variation with temperature? (5)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3850

G

Unique Paper Code : 32175901

Name of the Paper : GE: Atomic Structure, Bonding,
General Organic Chemistry
& Aliphatic Hydrocarbons

Name of the Course : B.Sc. (Hons.) : G.E.

Semester : III

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 **three** questions from **Section A** and **three** questions from **Section B**.
3. The answers of the questions should be numbered in accordance with the question paper.
4. All questions carry equal marks.

P.T.O.

3850

2

Section-A

1. (a) Draw the radial probability distribution curves for 3s, 3p and 3d orbitals. Calculate the total number of nodes in each case.
 (b) Explain Heisenberg's Uncertainty Principle with suitable example?
 (c) Explain the physical significance of ψ and ψ^2 .
 (4.5,4,4)
2. (a) Draw the MO diagram of N_2 molecule and calculate its bond order.
 (b) Calculate and arrange O_2^{2-} , O_2^- , O_2 and O_2^+ in their decreasing bond order.
 (c) Explain why bond order of NO^+ is larger than NO molecule?
 (4.5,4,4)
3. (a) Explain the term resonance and draw the resonating structures of CO_2 molecule.

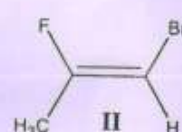
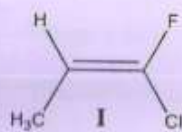
3850

5

6. (a) Which of the following is/are aromatic compounds? Give reason(s)



- (b) Assign the E/Z configuration of the following compounds.



- (c) Explain the Markovnikov's and Anti-Markovnikov's rule with suitable examples.
- (d) Convert the given compound in to (i) Sawhorse Projection (ii) Newman Projection.

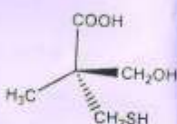
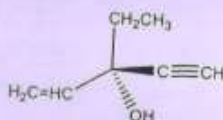
P.T.O.

3850

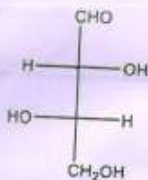
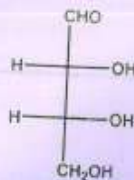
4

Section B

5. (a) Determine R and S configuration of the following compounds:



- (b) Assign *threo* and *erythro* along with D- and L-configuration to the following compounds.

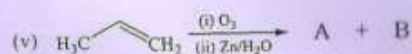
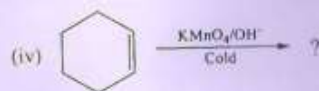
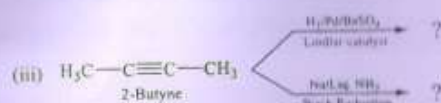


- (c) Draw all the possible conformational isomers of 1,2-dibromoethane. Arrange them in the increasing order of the stability along with proper explanation.

(4,4,4,5)

3850

7



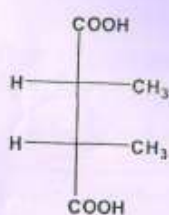
(4,5,8)

8. (a) Explain hyperconjugation. Rank the following alkenes in increasing order of stability; but-1-ene, 2,3-dimethylbut-2-ene, 2-methylbut-2-ene, but-2-ene.

- (b) Explain the term 'meso' with suitable example.

- (c) Name the instrument which is used to measure the angle of optical rotation? Also write down the formula of specific rotation?

P.T.O.



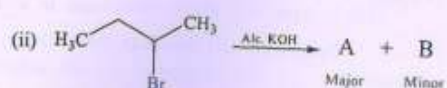
(4,2,2,4,5)

7. (a) How would you synthesize

(i) Acetone from propyne?

(ii) *n*-butane from ethane?

(b) Write the products of following reactions.



(b) Write the Schrodinger wave equation and define the terms involved in it.

(c) Write the possible values of *l* and *m* quantum numbers for an electron in 3d and 4p orbital?

(4,5,4,4)

4. (a) What is Born-Haber cycle? Calculate the lattice energy for the formation of NaCl crystal from the following data:

Heat of sublimation of sodium = 108 kJ/mol

Ionization energy of sodium = 495.2 kJ/mol

Dissociation energy of Cl_2 = 243.0 kJ/mol

Electron affinity of Chlorine = -348.3 kJ/mol

Enthalpy of formation of NaCl = -381.8 kJ/mol

(b) Explain the shape of H_2O and NH_3 molecules with the help of hybridization.

(c) Giving examples explain the stability of half-filled and fully-filled orbitals. (4,5,4,4)

P.T.O.

- (d) Explain why chair conformation of cyclohexane is more stable than that of boat conformation?
- (e) What is electromeric effect? How does it differ from inductive effect? (4,2,2,2,2,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1564

G

Unique Paper Code : 2172012302

Name of the Paper : DSC: Carbonyls, Carboxylic
Acids, Amines, Nitro
Compounds, Nitriles, Isonitriles
and Diazonium Salts

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

Semester : III

Duration : 3 Hours

Maximum Marks : 90

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) An organic compound A($C_5H_8O_2$) forms a dioxime. It gives a positive Tollen's test. On Clemmensen reduction, it forms n-pentane. It also gives a positive iodoform test to form sodium salt of

P.T.O.

1564

2

dicarboxylic acid which on acidification gives a dicarboxylic acid B ($C_4H_6O_4$).

- (i) Predict the structures of A and B.
 - (ii) Give the reagent used in Clemmensen reduction.
 - (iii) Give the reaction involved in the Iodoform test of A to form B.
 - (iv) What is the chief use of Tollen's test?
- (b) An optimum pH is required for the reaction of carbonyl compounds with ammonia derivatives. Justify the statement.
- (c) Write the synthesis of the following compounds using Ethyl acetoacetate or Diethylmalonate:
- (i) Crotonic acid
 - (ii) 5,5-Diethylbarbituric acid
- (d) Why tertiary amines with three different groups attached to nitrogen atom do not show optical activity? Explain by taking a suitable example. (4,4,4,3)
2. (a) Amine A ($C_5H_{11}N$) on treatment with methyl iodide followed by silver hydroxide forms compound

1564

3

B ($C_6H_{11}NO$) which is basic in nature. Compound B on heating forms 1-Propene and amine C (C_3H_9N). Identify A, B and C. Give the mechanism of formation of both products from B.

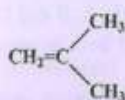
- (b) Arrange the following in order of decreasing reactivity towards nucleophilic addition reactions, giving reasons :
- CH_3COCH_3 ; $C_6H_5COCH_3$; $HCHO$;
 $CH_3COCH(CH_3)_2$
- (c) How will you distinguish between the following compounds on the basis of the product they form on heating:
- (i) Oxalic acid and Succinic acid
 - (ii) β -Hydroxy acid and γ -Hydroxy acid
- (d) Write the mechanism of Keto-enol tautomerism in an acidic OR alkaline medium. (4,4,4,3)
3. (a) Elaborate :
- (i) p-Hydroxybenzaldehyde does not undergo Cannizzaro reaction.
 - (ii) Benzil rearranges to Benzilic acid when treated with a base. Justify on the basis of reaction mechanism.

P.T.O.

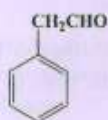
1564

4

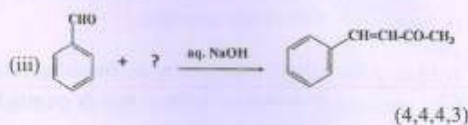
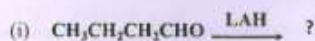
- (b) Outline the synthesis of the given alkene using Wittig reaction :



- (c) Give the product formed and the mechanism involved in the aldol condensation of the given carbonyl compound :



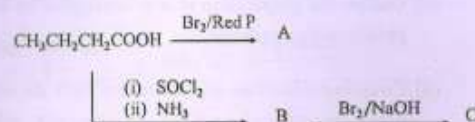
- (d) Complete the following reactions :



1564

5

4. (a) Complete the following sequence of reactions giving structures of A, B, and C. Also give the name of reactions involved in the two sequences:

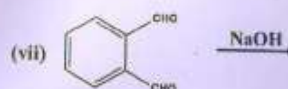
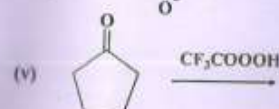
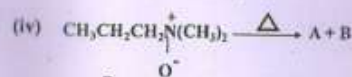
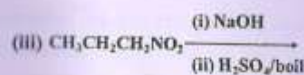
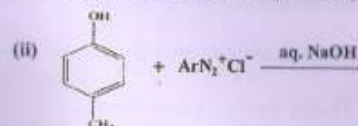
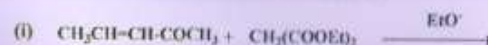


- (b) What happens when Acetone is reacted with Ethyl bromoacetate in presence of Zinc. Give the name of reaction along with the mechanism.
- (c) All ortho substituted benzoic acids are stronger acids than benzoic acid. Give reason.
- (d) Carboxylic acids do not form oxime even though they have >C=O group in their structure. Give reason. (4,4,4,3)
5. (a) Arrange the following in increasing order of basicity, give reason to justify your answer :
- $\text{C}_6\text{H}_5\text{NH}_2$; $m\text{-OCH}_3\text{C}_6\text{H}_4\text{NH}_2$; $p\text{-OCH}_3\text{C}_6\text{H}_4\text{NH}_2$

P.T.O.

- (b) How will you distinguish between ethylamine, diethylamine and triethylamine using Hinsberg's method? Give the reactions involved.
- (c) Outline the preparation of *n*-propylamine by Gabriel phthalimide synthesis.
- (d) Coupling reactions of diazonium salts do not take place in strongly acidic or strongly alkaline conditions. Explain using suitable structures. (4,4,4,3)
6. (a) Discuss the mechanism of acid-catalysed hydrolysis of nitriles.
- (b) Give a reaction to distinguish between nitriles and isonitriles.
- (c) Carry out the following conversions : (Any two)
- m*-Bromotoluene from Toluene
 - o*-Chlorophenol from Chlorobenzene
 - Adipic acid from Diethylmalonate
- (d) How do primary, secondary and tertiary nitroalkanes react with nitrous acid. Give the reactions involved. (4,4,4,3)

7. (a) Predict the product and give the name of the reaction involved : (Any six)



- (b) 1,6-diester undergo cyclization when treated with sodium ethoxide. Write the name of the reaction and its mechanism. (2×6,3)

8. (a) Write short notes (Any three)

- (i) Benzoin condensation
- (ii) Beckmann rearrangement
- (iii) Alkaline ester hydrolysis
- (iv) Thorpe nitrile condensation

(b) Write the final product formed in reduction of nitrobenzene under the following conditions :

- (i) Sn/HCl
- (ii) $\text{Zn/NH}_4\text{Cl}$
- (iii) Electrolytic reduction

(4,4,4,3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1752

G

Unique Paper Code : 2172512302

Name of the Paper : DSC: Chemical Energetics
and Equilibria

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

Semester : III

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

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

NOTE :

$$R = 8.314 \text{ JK}^{-1}\text{mol}^{-1} = 0.0821 \text{ dm}^3\text{atm mol}^{-1}\text{K}^{-1}$$

P.T.O.

1752

2

1. (a) Neatly draw the Born-Haber cycle for the formation of KCl(s) and calculate its lattice energy using the data given below :

$$\Delta_{\text{sub}}H(\text{K,s}) = 89 \text{ kJ mol}^{-1}$$

$$\frac{1}{2}\Delta_{\text{diss}}H(\text{Cl}_2\text{g}) = 122 \text{ kJ mol}^{-1}$$

$$\Delta_{\text{IE}}H(\text{K,g}) = 418 \text{ kJ mol}^{-1}$$

$$\Delta_{\text{EA}}H(\text{Cl,g}) = -349 \text{ kJ mol}^{-1}$$

$$\Delta_{\text{f}}H^\circ(\text{KCl,s}) = -437 \text{ kJ mol}^{-1} \quad (5)$$

- (b) State the third law of thermodynamics and explain its significance. What can you comment about the absolute entropy of laughing gas (N_2O) at 0 K? (5)

1752

3

- (c) Define enthalpy of formation. Calculate the enthalpy of formation of ethyl alcohol given the enthalpy of combustion of ethyl alcohol is $-1381 \text{ kJ mol}^{-1}$, and enthalpy of formation of $\text{H}_2\text{O(l)}$ and $\text{CO}_2\text{(g)}$ are -287 kJ mol^{-1} and -395 kJ mol^{-1} respectively. (5)
2. (a) Explain mathematically how decrease in Helmholtz free energy ΔA (work function) represents the maximum amount of energy that is available to be converted to work? (5)
- (b) Explain why the enthalpy of neutralization of any strong acid with a strong base is always a constant i.e., $-57.3 \text{ kJ mol}^{-1}$. 100 mL of a weak acid (1 M) is mixed with 100 mL of a strong base (1 M). Comment on whether the enthalpy of neutralization will be less, more or same as compared to the value $-57.3 \text{ kJ mol}^{-1}$ and why? (5)

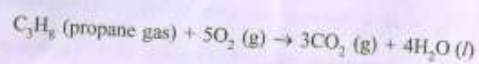
P.T.O.

1752

4

(c) One mole of an ideal gas expands reversibly from a volume of 10 dm^3 and temperature 25°C to a volume of 20 dm^3 and temperature -23°C . Assuming that $C_v = 1.5 R$, calculate the entropy change for the process. (5)

3. (a) Calculate the enthalpy change for the reaction



Given the average bond enthalpies (in kJ mol^{-1}) are

C-C	C-H	C=O	O=O	O-H
347	414	741	498	464

(5)

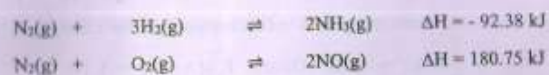
(b) What is C_p and C_v . Show thermodynamically that for an ideal gas $C_p - C_v = nR$. (5)

1752

5

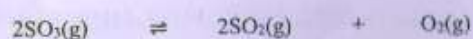
(c) Calculate q , w , ΔU and ΔH for the reversible isothermal expansion of one mole of an ideal gas at 27°C from a volume of 10 dm^3 to a volume of 20 dm^3 . (5)

4. (a) State Le Chatelier's principle. With the help of this principle, work out the conditions which would favor the formation of ammonia and nitric oxide in the following reactions :



(5)

(b) Calculate K_c for the reaction :



for which $K_p = 3.5 \times 10^{-23} \text{ atm}$ at 27°C . (5)

P.T.O.

- (c) Calculate the degree of dissociation of Br_2 gas into Br atoms if at 1600 K and a total pressure of 0.1 atm, $K_p = 0.255$ atm. (5)

5. (a) Derive the Henderson Hasselbalch equation for the expression of pH of acidic buffer solutions. (5)

- (b) (i) Solid AgNO_3 is added to a solution containing 0.1 M Cl^- and 0.001 M in CrO_4^{2-} . Which will precipitate first, AgCl or Ag_2CrO_4 , assuming that addition causes no change in the volume. Given: $K_{sp}(\text{AgCl}) = 1.7 \times 10^{-10} \text{ M}^2$, $K_{sp}(\text{Ag}_2\text{CrO}_4) = 1.9 \times 10^{-12} \text{ M}^3$. (2.5)

- (ii) Solubility of AgCl decreases on addition of some AgNO_3 to its saturated solution. Explain. (2.5)

- (c) At 25°C , the degree of ionization of water was found to be 1.8×10^{-8} . Calculate the dissociation constant and the ionic product of water at this temperature. (5)

6. (a) For 0.01 M Propanoic acid at 25°C calculate the following :

- (i) Degree of ionization
- (ii) Hydrogen ion concentration
- (iii) pH and pOH

The dissociation constant of Propanoic acid is $1.34 \times 10^{-5} \text{ M}$. (5)

- (b) Explain the following : (5)

- (i) Factors affecting the degree of ionization of electrolyte
- (ii) Ionic product of water

- (c) The solubility of CaF_2 in water at 20°C is 15.6 mg per dm^3 of the solution. Calculate the solubility product of CaF_2 . (At mean of $\text{Ca} = 40 \text{ u}$ and $\text{F} = 19 \text{ u}$) (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4510

G

Unique Paper Code : 32171303

Name of the Paper : Chemistry C – VII Physical
Chemistry III : Phase Equilibria
and Electrochemical Cells

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

Semester : III

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, selecting at least two questions from each section.
3. Question number 1 is compulsory.
4. Use of scientific calculator, log tables and graph paper is permitted.

P.T.O.

4510

2

$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \text{ and } F = 96500 \text{ C mol}^{-1}$$

$$E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.337 \text{ V}; E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.774 \text{ V}$$

$$E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.771 \text{ V}; E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V};$$

$$E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}; E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}.$$

Section A

1. Answer any five questions given below :

- (i) In water system, fusion curve of ice is inclined towards pressure axis. Explain. (3)
- (ii) Ice and common salt mixtures can be used for producing temperatures as low as -21.1°C . Explain. (3)
- (iii) Is it possible to separate an azeotropic mixture into two pure components by isobaric fractional distillation? Explain. (3)
- (iv) What are reversible cells? Explain with an example. (3)
- (v) The effect of temperature and pressure on adsorption process is in accordance with Le Chatelier's principle. Explain. (3)

4510

3

- (vi) Polarities of cathode and anode in a galvanic cell are opposite to those in an electrolytic cell. Explain giving reasons. (3)
- (vii) The e.m.f. of the hydrogen electrode is linearly dependent only on the pH of the solution. Explain. (3)

2. (i) The absence of a few components in some phases does not alter the phase rule relation, $F = C - P + 2$. Derive the above conclusion by taking the following system of three components distributed over four phases : (4)

B+C	A+C+B	A+B+C	A+B+C
Phase I	Phase II	Phase III	Phase IV

- (ii) The steam distillation of a liquid X with molar mass 120 g mol^{-1} is observed to occur at a temperature of 89.0°C when the total pressure is 0.911 bar . Assuming complete immiscibility of this liquid with water, calculate the mass of X in 200 g of distillate. The vapour pressure of water at 89.0°C is 0.6747 bar . (4)
- (iii) Derive the Langmuir adsorption isotherm for a gas on a solid and discuss the limiting cases. (4)

P.T.O.

4510

4

3. (i) Starting with the Duhem-Margules equation, derive a relation to show that the vapour phase is richer in the more volatile component for a binary system A-B. (4)
- (ii) With the help of a suitable diagram, discuss the fractional distillation process of a two-component system which exhibits negative deviation from ideal behaviour. (4)
- (iii) On heating a mixture of m-toluidine and glycerol, turbidity appears at t_1 and on further heating turbidity is lost at t_2 . Plot the phase diagram on the basis of the data and report the upper and lower consolute temperatures. Label the various regions with the number of phases and degrees of freedom. (4)

Mass % of m-toluidine	18	20	40	60	80	85
$t_1(^{\circ}\text{C})$	48	18	8	10	19	25
$t_2(^{\circ}\text{C})$	53	90	120	118	83	53

4. (i) State and derive Lever rule. (4)
- (ii) Solute (X) shows normal molecular mass in water and is associated in benzene. Find the order of association from the following data

4510

5

on the distribution of (X) between water and benzene : (4)

Concentration in H_2O , g L^{-1}	Concentration in Benzene, g L^{-1}
0.020	0.1025
0.042	0.452
0.064	1.049
0.122	3.811

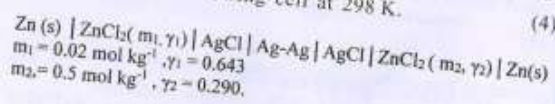
- (iii) Derive the integrated form of Clausius-Clapeyron equation for liquid-vapour equilibrium. (4)
5. (i) Explain, giving reasons : (4)
- (a) A eutectic mixture has a definite composition and a sharp melting point yet it is not a compound.
- (b) Succinic acid alters the C.S.T of phenol-water system when added as impurity at constant pressure.
- (ii) Au and Sb melt at 1060°C and 630°C respectively and form a compound AuSb_2 , which melts congruently at 850°C . Two eutectic points are observed - one at 10 mol % Au at temperature 530°C and the other at 50 mol % Au at 700°C . Sketch the simplest phase diagram consistent with the information and label all the phase regions. Draw a cooling curve for a melt containing 60 mol % of Sb. (6)

P.T.O.

- (iii) Explain the statement "physisorption does not occur at temperatures that are much above critical temperature of adsorbate". (2)

Section B

6. (i) Find the cell reaction and calculate the potential of the following cell at 298 K. (4)



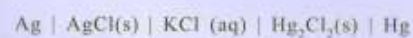
- (ii) Derive an expression for calculating liquid junction potential for a cell in which electrodes are reversible with respect to cation. (4)

- (iii) Predict whether following data of adsorption of acetic acid over 1 g of charcoal at 25°C follows Freundlich adsorption isotherms. Also determine its constants k and n . (4)

[acid]/mol L ⁻¹	0.05	0.1	0.5	1.0
Mass adsorbed/g	0.04	0.06	0.12	0.16

7. (i) Using Gibbs-Helmholtz equation derive the expressions for ΔG and ΔH . (4)

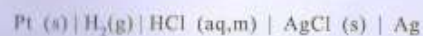
- (ii) The emf of the cell (4)



is 0.0421 V at 298 K and the temperature coefficient is $3.4 \times 10^{-4} \text{ V K}^{-1}$. What is the reaction taking place in the cell and what are the free energy, enthalpy and entropy changes at 298 K.

- (iii) Describe a glass electrode. What are its limitations? Explain, how the pH of a solution is determined using a glass electrode. (4)

8. (i) The potential of Hamed cell (4)

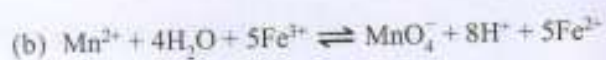


at 25°C has the following values. Determine the standard electrode potential of silver-silver chloride electrode.

$m/10^{-3}$	3.215	5.619	9.138
E_{cell}/V	0.520	0.49257	0.46860

- (ii) Discuss the criteria of spontaneity of a cell reaction in terms of cell potential. In which direction will the following reactions be spontaneous when all concentrations are unity? Give reason. (4)

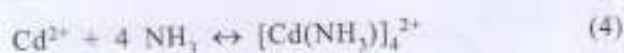




- (iii) Derive the following relation between the pressure required to produce a fixed amount of adsorption and the enthalpy of adsorption. Explain how it can be used to determine the enthalpy of adsorption of a gas on solid.

$$\ln \left(\frac{p}{p^0} \right) = \frac{\Delta_{\text{ads}} H}{R} \frac{1}{T} + \text{constant} \quad (4)$$

9. (i) Determine the standard equilibrium constant for the following reaction at 298 K.



- (ii) What is a reference electrode? Give one example; write its cell representation and Nernst equation. (4)

- (iii) Justify the following statements: (4)

(a) If the standard potential of $E_{\text{M}^{n+}/\text{M}}^0$ is positive, then M^{n+} ions can be reduced to M by hydrogen gas under standard conditions.

(b) Instead of pieces of charcoal, activated charcoal is used in adsorption studies.

(1000)

[This question paper contains 2 printed pages]

Sr. No. of the Question paper: 4728

Your Roll. No.....

Unique Paper Code : 32173910

Name of the Course : B.Sc. Hons. /B.Sc. Prog.

Name of the paper : SEC- Chemistry of Cosmetics and Perfumes

Semester : III/V

Duration : 2 Hours

Maximum Marks : 38

Instructions for the candidates:

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

1. (a) How do you classify hair dyes? Write the merits and demerits of use of dyes. 4.5

(b) Write down the preparation and uses of:

(i) Hair dye (ii) Talcum powder 5

2. (a) Aammonia or any amine is essential for permanent hair dye, comment on it. 4.5

(b) Define cosmetics. How do we classify cosmetics on the basis of physical form? 5

3. (a) Write short notes on any two of the following:

(i) Conditioners

(ii) Nail Enamels

(iii) Antiperspirants 5

(b) What are the ideal characteristics of Nail polish? Name the ingredients used in its remover. 4.5

4. (a) What is the function of borax in preparation of cold cream. Write down composition of cold cream. 4.5
- (b) Discuss the structure of skin. Describe the characteristics a skin care cosmetics product. 5
5. (a) How do differentiate between talcum powder and face powder. 4.5
- (b) What are oral hygiene products? Write down the composition of a mouth wash. 5
6. (a) Discuss the cosmetic properties and uses of Eucalyptus oil and Sandalwood oil. 5
- (b) Discuss the role of preservatives in various cosmetics. 4.5

8/11/23 (m)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1526

G

Unique Paper Code : 2172012301

Name of the Paper : DSC: Chemistry of d- and
f- Block Elements &
Quantitative, Inorganic
Analysis

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

Semester : III

Duration : 2 Hours

Maximum Marks : 60

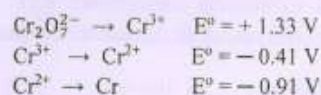
Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt *four* questions in all.
3. All Questions carry equal marks.
1. Explain the following giving reasons:
 - (a) Transition elements generally show variable oxidation states.

P.T.O.

- (b) CrO_3 is strongly oxidising while WO_3 is stable.
- (c) Titanium(III) ions are attracted by the magnetic field, while titanium(IV) ions are repelled.
- (d) Clay minerals cleave easily into thin sheets.
- (e) Lanthanides show sharp bands in the absorption spectra while transition elements show broad bands. (5x3)
2. (a) Give reason:
- Mn(II) ion shows the maximum magnetic character amongst the bivalent metal ions of the 3d series.
 - Cu(II) salts are blue while Zn(II) salts are colourless.
- (b) Write the electronic configuration and give the number of unpaired electron(s) present in 4f orbitals of the following:
- Gadolinium (Atomic number 64)
 - Terbium (Atomic number 65)
- (c) Actinides have a greater tendency to form complexes than lanthanides. Explain. (3x5)

3. (a) Explain the catalytic properties of transition elements with the help of suitable examples.
- (b) Construct the Latimer diagram for Cr in acidic medium:



- Write half cell reaction for the conversion of:
 $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$
 - Is there any tendency of Cr^{2+} to reduce to Cr? Give reason.
 - Calculate skip step emf for $\text{Cr}^{3+} \rightarrow \text{Cr}$ change.
- (c) Define Digestion. What is the importance of digestion in gravimetric analysis? (3x5)
4. (a) Explain the separation of lanthanides by ion exchange method.
- (b) What are silicates? Briefly describe various types of silicates with suitable example.

- (c) What are the conditions of good wash liquid in gravimetric analysis? How will it be ensured that the washing of the precipitate is complete by means of qualitative method? (3x5)
5. (a) What is Lanthanide contraction? What are the major consequences of lanthanide contraction?
- (b) Write a short note on Silicones.
- (c) Compare the magnetic properties of transition elements and lanthanides. (3x5)
6. (a) Draw the structures of the following:
- (i) Borax
- (ii) cyclic- $[\text{NPCl}_2]_3$
- (b) What is supersaturation? How it can be kept in low value?
- (c) Choose the correct option and give reason for the same.

Greater number of oxidation states: Fe or Mn

Good reducing agent: Ce(II) or Sm(II) (3x5)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4342

G

Unique Paper Code : 32171301

Name of the Paper : Inorganic Chemistry-II: s- and p- Block Elements

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

Semester : III

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 **five** questions in all. Question No. 1 is compulsory.
3. All Questions carry equal marks.

1. Explain the following giving reasons : (any five)

(a) CCl_4 does not act as a Lewis acid while SiCl_4 does.

P.T.O.

4342

2

- (b) Borazine is more reactive than Benzene.
- (c) Amongst the alkali metals Lithium has got the highest ionisation enthalpy, despite this it is as good a reducing agent as cesium in aqueous solution.
- (d) Carbon is a versatile reducing agent used in the extraction of metals, but it is unsuitable sometimes as a reducing agent.
- (e) Phosphorus, arsenic and antimony form pentahalides, but nitrogen and bismuth do not.
- (f) B^{3+} ion doesn't exist in solid or solution state.
- (g) Zeolites are used as water softeners. (3×5)
2. (a) Select the correct answer in each category given below and justify your answer. (any four)

4342

3

- (i) A halogen which does not exhibit positive oxidation state: Fluorine or chlorine
- (ii) Better lewis base: Trimethylamine or trisilylamine
- (iii) Stronger reducing agent: CH_4 or SiH_4
- (iv) Hydride having higher thermal stability: NH_3 or PH_3
- (v) Stronger oxidising agent: $HOCl$ or $HClO_4$
- (b) Explain with the help of Ellingham diagram, the reducing nature of carbon and carbon monoxide.
- (c) Graphite is soft, has low density and is a good conductor of electricity but diamond is extremely hard, has high density and is a non-conductor of electricity. Explain why? (6,4,5)

P.T.O.

4342

4

3. Justify the following statements, giving reason :

(a) Methane, ammonia and water have same hybridisation but different structures.

(b) Nitrogen is an inert gas while phosphorous is a highly reactive solid.

(c) CO_2 is a gas while SiO_2 is a high melting solid.

(d) Rubidium as compared to sodium has greater electrical conductivity in aqueous solution.

(e) Dilute solution of sodium in liquid ammonia is blue coloured, paramagnetic in nature and behaves as a true solution. (3×5)

4. (a) What is Inert pair effect? How does it vary down the group 14 elements? Explain.

4342

5

(b) Draw the structure of S_8 molecule and explain the effect of heating on Sulphur.

(c) Discuss the structures of any two of the following :

(i) Phosphorous pentoxide

(ii) Basic beryllium acetate

(iii) Xenon hexafluoride

(d) Silicon analogues of alkene and alkyne are not known. Give reason. (4,4,4,3)

5. (a) Which has greater bond angle and why? NH_3 or NF_3 .

(b) Which will have greater ionic radius and why? Gallium or Aluminium.

P.T.O.

4342

6

(c) A group 2 metal (M) occurs naturally in great abundance as carbonate. Metal (M) reacts with cold water forming compound (A), which is a strong base. Aqueous solution of (A) is used in the qualitative test for carbonate ion. Metal (M) combines with H_2 to give a saline hydride (B), which behaves as a drying agent. Identify (M), (A) and (B) giving balanced chemical reactions.

(d) Write short notes on **any two** of the following :

(i) van Arkel de Boer Method

(ii) Clathrate compounds

(iii) Phosphonitrilic halides (3,3,3,6)

6. (a) Potassium permanganate which is insoluble in benzene, dissolves readily in it in the presence of 18-crown-6-ether. Explain giving reason.

4342

7

(b) Which is oxidising in nature and why? PbO or PbO_2

(c) Discuss the structure of XeF_2 using Molecular orbital theory.

(d) Justify the statement: Unlike ethane, diborane is an electron deficient compound. How do you explain the structure of diborane then?

(e) Write balanced chemical reactions for **any three** of the following :

(i) Diborane reacts with ammonia in the ratio 1:2 at $200^\circ C$.

(ii) Borazine reacts with methanol.

(iii) Sulphur dioxide reacts with acidified solution of potassium dichromate.

P.T.O.

(iv) Lithium nitrate is heated.

(3×5)

(1000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1666

G

Unique Paper Code : 2173012001

Name of the Paper : DSE : Nuclear and
Environmental Chemistry

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

Semester : III

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
 2. All questions carry equal marks.
 3. Attempt any **six** questions in all.
 4. Use of scientific calculators is allowed.
-
1. (a) Define the half-life of a radioactive substance.
Provide an equation relating half-life to decay constant.

P.T.O.

- (b) The half-life period of $^{90}_{38}\text{Sr}$ is 20 years. If the rate of disintegration of a sample of $^{90}_{38}\text{Sr}$ is 7.5×10^{12} dps, calculate the same after one year.
- (c) Differentiate (i) BOD and COD (ii) Photochemical smog and reducing smog (5×3)
2. (a) ^{14}C activity in a fresh teak wood sample is 0.25 dps gm^{-1} whereas the activity of an archeological sample of wood of the same species is 0.175 dps gm^{-1} . Calculate the age of the wood sample assuming that the ^{14}C content in a particular species remain same with the passage of time as long as it is alive. Given half life period of ^{14}C is 5570 years.
- (b) Differentiate nuclear fission and nuclear fusion.
- (c) Describe impacts of water pollution on hydrological cycle. (5×3)
3. (a) Explain secondary effluent treatment.
- (b) Discuss working of Geiger-Mueller counter.
- (c) Describe the conditions required for nuclear chain reactions and its applications. (5×3)

4. (a) Compare alpha decay and beta decay in terms of particle emission and energy changes.
- (b) Calculate the amount of energy released in the process
- $$^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3{}_0^1\text{n} + \text{Energy}$$
- $^{235}_{92}\text{U} = 235.04393$ amu, ${}^1_0\text{n} = 1.008665$ amu, $^{141}_{56}\text{Ba} = 142.93511$ amu, and $^{90}_{38}\text{Sr} = 89.90774$
- (c) Describe reverse-osmosis. (5×3)
5. Write short notes on :
- (a) Photochemical smog
- (b) Green-House effect
- (c) Ozone depletion (5×3)
6. (a) Define the terms "binding energy" and "mass defect". Explain their significance in nuclear stability.
- (b) Explain Incineration and vermi-composting.
- (c) What are the sources, impacts and control methods of CO_x , SO_x , H_2S and NO_x . (5×3)

7. Write short notes on :
- (a) Disposal of nuclear waste and its management
 - (b) Carbon dating
 - (c) Impact of water pollution on ecosystem (5×3)
8. (a) Comment on spontaneity of β^+ emission and show how it is different from K-electron capture.
- (b) What is the value of N/P ratio for stability of nucleus? Discuss role of N/P ratio in deciding the stability of the nucleus.
- (c) Describe electrostatic precipitators. (5×3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4396

G

Unique Paper Code : 32171302

Name of the Paper : Organic Chemistry - II
(Oxygen Containing Functional Groups)

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

Semester : III

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 any five questions.

1. (a) An organic compound **A** (C_4H_8O) reacts with hydroxylamine in the presence of an acid to give two isomeric compounds **B** and **C** with molecular formula (C_4H_9NO). **B** reacts with *m*-

P.T.O.

4396

2

chloroperbenzoic acid and gives organic compound **D** (C_4H_9NO). **D** on hydrolysis gives acetic acid and ethanamine. **C** reacts with *m*-chloroperbenzoic acid to give organic compound **E** (C_9H_9NO). **E** on hydrolysis gives propanoic acid and methanamine. Identify the organic compounds **A**, **B**, **C**, **D** and **E**. Give the name reaction involved along with mechanism (**B** to **D**).

(b) Differentiate between the following (give visible test only) and write down the reaction involved (any three):

- Methanol and ethanol
- Benzoic acid and benzyl alcohol
- Benzaldehyde and propanal
- Formic acid and benzoic acid

(9,6)

2. (a) Identify organic compound **A** ($C_4H_{10}O_2$) which reacts with sodium metal to evolve one mole of hydrogen gas and on reaction with lead tetraacetate gives methanal and propanal. Write down the structure of the organic compound **A** ($C_4H_{10}O_2$) along with both the reactions involved.

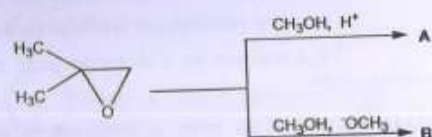
4396

3

(b) What happens when malonic acid, succinic acid and adipic acid are heated at $200^\circ C$ separately?

(c) Why *o*-bromoanisole and *m*-bromoanisole give the same product on reaction with $NaNH_2$ in NH_3 (l) at high temperature? Explain giving mechanism.

(d) Identify **A** and **B** and justify your answer with the help of mechanism:



(3,3,3,6)

3. (a) Give reasons for the following (any four):

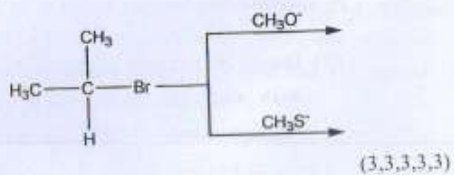
- In the Reformatsky reaction, magnesium should not be used in place of zinc.
- During the reaction of carbonyl compounds with ammonia derivatives, pH of the reaction should be well controlled.

P.T.O.

- (iii) -R group at *o*, *p*-position in aryl halide facilitates $\text{Ar}_\text{N}\text{S}$ (Aryl nucleophilic substitution) reaction.
- (iv) *p*-Dimethylaminobenzaldehyde does not respond to Cannizzaro's reaction.
- (v) Aryl vinyl ethers readily undergo hydrolysis in acidic medium to give phenol.
- (vi) Polar protic solvents speed up an $\text{S}_\text{N}1$ reaction enormously, while it slows down $\text{S}_\text{N}2$ reaction by a factor as large as 10^{20} .
- (b) Hydrolysis of an ester is preferred in alkaline medium. Explain.

OR

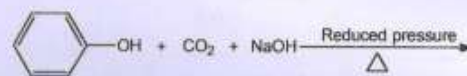
Write down the products of the following reaction and give explanation for your answer.



4. (a) Carry out the following conversions (any three) :

- (i) Toluene \rightarrow Cinnamic acid
- (ii) Ethanal \rightarrow Butanol
- (iii) Benzene \rightarrow 1-Phenylpropane
- (iv) Benzoic acid \rightarrow Acetophenone

- (b) Write down the product(s), name and mechanism of the following reaction :



Why *ortho* product is the major product in the above reaction? (3,3,3,6)

5. (a) Carry out the synthesis of any **three** following compounds either from EAA (Ethyl acetoacetate) or DEM (Diethyl malonate) :

- (i) Succinic acid
- (ii) Pentan-2-one

4396

6

(iii) Barbituric acid (Malonyl urea)

(iv) Hexane-2,5-dione

(b) Arrange the following compounds in decreasing order of reactivity towards nucleophilic substitution reaction with suitable explanation :

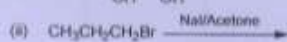
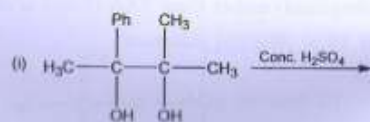


OR

Explain why benzyne have a shorter life-time.

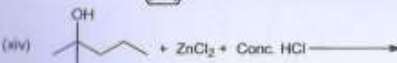
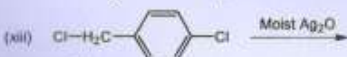
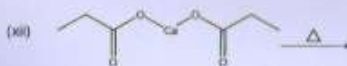
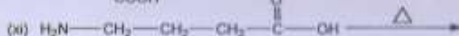
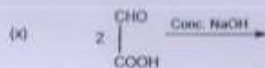
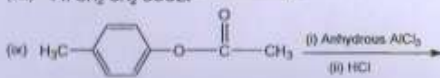
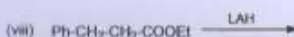
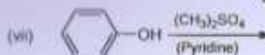
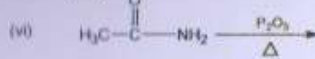
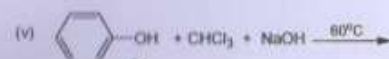
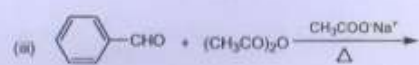
(c) Why enol form of acetylacetone is more stable than that of acetone, (3,3,3,3,3)

6. Complete the following reactions : (15)

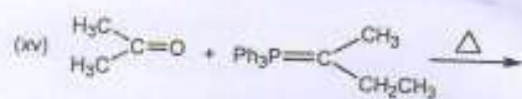


4396

7



P.T.O.



[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1791

G

Unique Paper Code : 2173522002

Name of the Paper : DSE: Polynuclear
Hydrocarbons,
Pharmaceutical Compounds,
UV-Visible & IR
Spectroscopy

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

Semester : III

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions carry equal marks.
3. Answer **any four** questions in all.
4. Attempt all parts of a question together.

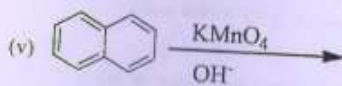
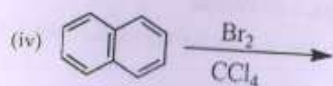
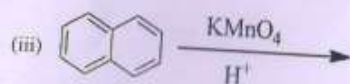
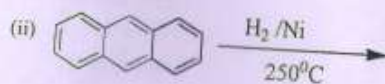
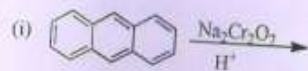
P.T.O.

1791

2

1. (a) Complete the following reactions:

(7×1)



1791

3

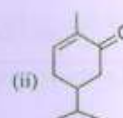
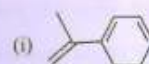


(b) Give reactions that show that naphthalene consists of two benzene rings fused together at ortho positions. (4)

(c) What is the medicinal importance of curcumin and neem? (2)

(d) How do antibiotics work in the body? (2)

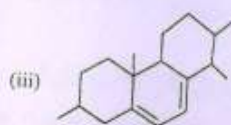
2. (a) Calculate λ_{max} for the following: (3×3)



P.T.O.

1791

4



Base value for α , β -unsaturated ketones = 215 nm

Increment for each substituent

Alkyl substituent or ring residue at the α -position = 10 nm, β -position = 12 nm, γ - or δ - or higher position = 18 nm, Exocyclic double bond = 5 nm, Double bond extended conjugation = 30 nm

Base value for acyclic /heteroannular diene = 214 nm, Homoannular diene = 253 nm

Increment for each substituent

Alkyl substituent or ring residue = 5 nm, Exocyclic double bond = 5 nm, Double bond extended conjugation = 30 nm

1791

5

(b) How is IR spectroscopy useful to distinguish inter- and intramolecular hydrogen bonding? Explain using suitable example (4)

(c) What is an exocyclic bond? Draw a molecule with an exocyclic bond. (2)

3. (a) Write a short note on the following: (2×4)

(i) Chromophore and Auxochrome

(ii) Bathochromic Shift and Hypsochromic Shift

(b) Give the resonating structures of anthracene and comment on its aromatic behavior (4)

(c) Define analgesic drugs with examples. (3)

P.T.O.

1791

6

4. (a) How will you distinguish between the following compounds using IR spectroscopy: (2×3)
- (i) CH_3COCH_3 and $\text{CH}_3\text{CH}_2\text{CHO}$
- (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- (b) Explain the sulphonation of naphthalene at different temperatures. (4)
- (c) How will you convert naphthalene into decalin? (3)
- (d) What is the principle of IR spectroscopy? (2)
5. (a) Explain the importance of fingerprint and functional group region in IR Spectroscopy in structural determination. (4)

1791

7

- (b) Explain electrophilic substitution reaction in anthracene. (4)
- (c) Explain why naphthalene is more reactive than benzene towards electrophilic substitution reaction. (4)
- (d) Why are broad absorption bands observed in the UV spectrum instead of sharp peaks? (3)
6. (a) What is the condition for a molecule to be IR active? Which of the following compounds are IR active and why, give reasons: O_2 , CO_2 , HCl , $\text{CH}_2=\text{CH}_2$, CH_3CHO . (6)
- (b) How is paracetamol synthesized? Give its mode of action. (4)

P.T.O.

(c) Give the stepwise synthesis of anthracene using phthalic anhydride. (3)

(d) Give the structure of the chloroquine. (2)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4806

G

Unique Paper Code : 42174304

Name of the Paper : Solutions, Phase Equilibria,
Conductance, Electrochemistry
& Functional Group Organic
Chemistry-II

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

Semester : III

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. **Section A** and **Section B** carry equal marks.
3. Use separate answer sheets for **Section A** and **Section B**.
4. Use of simple calculator is allowed.

P.T.O.

4806

2

SECTION A

(Attempt any **three** questions in all)

1. (a) Draw and discuss the phase diagram of water.
(b) Explain the impact of impurities on the CST of phenol-water system.
(c) Discuss the vapour pressure properties of two immiscible liquids. How are these facts utilized in determining molar mass of a liquid by steam distillation. (4,4,4,5)
2. (a) Explain how we determine transport number using Hittorf's method.
(b) Plot well labelled conductometric titration curves obtained in the titration of
 - (i) strong acid and strong base
 - (ii) weak acid and strong base

4806

3

State any two advantages of conductometric titration over volumetric titration using indicators.

- (c) Specific conductance of 0.01M acetic acid solution at 25°C is $1.63 \times 10^{-2} \text{ Sm}^{-1}$ and its molar conductance at infinite dilution is $390.7 \times 10^{-4} \text{ Sm}^2\text{mole}^{-1}$. Calculate the degree of dissociation and dissociation constant of the acid.

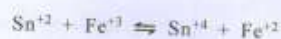
(4,4,4,5)

3. (a) Discuss the factors on which transport number depends.
(b) Explain why $\text{KCl-NaCl-H}_2\text{O}$ is a 3-component system whereas $\text{KCl-NaBr-H}_2\text{O}$ is a 4-component system.
(c) Calculate the equilibrium constant at 298K for the following reaction :

P.T.O.

4806

4



(Given that $E^\circ(\text{Fe}^{+3}, \text{Fe}^{+2}) = +0.77\text{V}$ and $E^\circ(\text{Sn}^{+4}, \text{Sn}^{+2}) = +0.15\text{V}$)

- (d) How does a salt bridge in galvanic cell prevent the liquid junction potential? (3,3,4,2.5)
4. Write short notes on the following (Any five):
- (a) Concentration cells
 - (b) Differentiate between Congruent and incongruent melting compound system.
 - (c) Solvent extraction
 - (d) Lever rule
 - (e) Determination of Transport Number using Moving Boundary method.
 - (f) Ag-AgCl electrode (2.5×5=12.5)

4806

5

SECTION B

(Attempt any three questions in all)

5. (a) How will you distinguish between aniline N-methylaniline and N,N-dimethylaniline using nitrous acid? Give the reaction involved.
- (b) Describe Edman degradation method to determine the N-terminal amino acid in a peptide chain.
- (c) Explain the term isoelectric point and its application in the separation of amino acids.
- (d) How benzene diazonium chloride can be converted to (i) Benzene (ii) Phenol. (3.5,3,3,2×1.5)
6. (a) Write the structure of products when D-glucose react with the following:

P.T.O.

4806

6

- (i) Excess of $C_6H_5NHNH_2$
- (ii) HI/Red Phosphorus
- (iii) Br_2 water
- (b) How will you convert an aldohexose to aldopentose sugar?
- (c) The alkaline hydrolysis of an ester is preferred than acidic hydrolysis. Justify.
- (d) Explain why direct nitration of aniline gives m-nitroaniline instead of o, p-products. How aniline can be converted into p-nitroaniline?
- (3×1,3,3,3.5)
7. (a) What are essential amino acids? How will you synthesize glycylalanine starting from glycine and alanine using N-protection and C-activating group.

4806

7

- (b) What happens when aqueous solution of α -D-Glucose is kept for some time? Name the phenomenon and discuss the mechanism.
- (c) Arrange the following in order of increasing basic strength and justify your answer :
- (i) $CH_3CH_2NH_2$, CH_3CONH_2 , CH_3NHCH_3
- (ii) $C_6H_5NH_2$, $C_6H_5NHCH_3$, $p\text{-NO}_2C_6H_4NH_2$
- (4.5,4,2×2)
8. (a) What are different methods used for estimation of amino acids in proteins?
- (b) Write short notes on any **three** of the following :
- (i) Claisen condensation
- (ii) Schotten-Baumann Reaction

P.T.O.

(iii) Strecker synthesis

(iv) Diazo-coupling reaction

(3.5,3×3)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3855

G

Unique Paper Code : 32175915

Name of the Paper : Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II

Name of the Course : B.Sc. (H) Generic Elective

Semester : III

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. All questions carry equal marks.
3. Attempt total **six** questions in all, **three** questions each from **Section A** and **Section B**.
4. Use of non-programmable scientific calculator is allowed.

P.T.O.

Section A: Physical Chemistry

1. (a) Draw and discuss a well-labelled phase diagram of Na-K system.
- (b) Derive Clausius-Clapeyron equation and discuss its one application.
- (c) (i) How Nernst distribution law is modified when association or dissociation of solute takes place in any solvent?
- (ii) Distribution of I_2 between H_2O and CCl_4 at 298 K, at equilibrium the following results were obtained.
- | | | | | |
|------------------------------------------------------------------|------|------|------|------|
| I_2 (in Water layer/mol dm ⁻³) × 10 ⁴ : | 2.35 | 4.69 | 7.03 | 9.30 |
| I_2 (in CCl_4 /mol dm ⁻³) × 10 ⁴ : | 2.00 | 4.00 | 6.00 | 8.00 |

Show that the results obey the distribution law.
(4,4,2+2.5)

2. (a) Explain the effect of addition of NaCl and succinic acid on CST (Critical Solution Temperature) of water-Phenol system with well labelled diagram.
- (b) When a certain conductance cell was filled with 0.03 M KCl (with specific conductance 0.002768 Ω⁻¹ cm⁻¹) it had a resistance of 82.4 Ω at 25°C. When filled with 0.005 N K₂SO₄ it had a resistance of 326 Ω. Calculate
- Cell constant, and
 - conductance of K₂SO₄.
- (c) What is meant by transport number of ions? How the transference number is determined using moving boundary method? (4,4,4.5)

3855

4

3. (a) The resistance of 0.01N NaCl solution at 25°C is 100Ω. The cell constant of conductivity cell is unity. Calculate the equivalent conductivity.
- (b) What is liquid junction potential? How is it eliminated? What is property of electrolyte used in salt bridge? Give two examples of it.
- (c) Write three advantages of conductometric titration over volumetric titration. Discuss the nature of curve for CH₃COOH vs. NaOH titration.
- (4,4,4.5)
4. (a) Derive the expression for the EMF of an electrolyte concentration cell with transference.
- (b) Briefly explain calomel electrode.

3855

5

- (c) (i) Differentiate between reversible and irreversible cells.
- (ii) If the molar conductivities at infinite dilution of NaCl, HCl and CH₃COONa are 126.4, 426.1 and 91.0 Ω⁻¹cm² respectively, what will be the molar conductivity of CH₃COOH?
- (4,4,4.5)

Section B: Organic Chemistry

5. (a) Define isoelectric point. Calculate isoelectric point (pI) of Valine (pK_{a1} = 2.32, pK_{a2} = 9.62).
- (b) Give the preparation of glycine using Strecker's synthesis.
- (c) What is mutarotation? Explain taking the example of D-(+) Glucose.

P.T.O.

3855

6

(d) Discuss the Hinsberg test used for the identification of 1°, 2°, 3° amines. Outline the chemistry involved.

(2,2,4,4.5)

6. (a) Explain why D-fructose reduces Fehling's solution although it is a ketose.

(b) Giving suitable explanation arrange the acid derivatives (ester, acid chloride, acid anhydride and amide) in increasing order of reactivity towards nucleophilic acyl substitution reaction.

(c) An aliphatic amine with molecular formula C_2H_7N exists in two isomeric forms 'A' and 'B'. When warmed with chloroform and KOH only 'A' reacts resulting into foul smell. What are the structures and names of 'A' and 'B'? Give name of the reaction and chemical equation involved in it.

(4,4,4.5)

3855

7

7. Convert (any five) :

(a) Aniline to p-Nitro aniline

(b) D-Glucose to D-Fructose

(c) Phenylacetic acid to benzylamine

(d) Benzaldehyde to Benzamide

(e) Ethyl acetate to Acetic acid

(f) o-Toluidine to o-Cresol (5×2.5)

8. (a) How will you separate Arginine, Alanine and Aspartate by electrophoresis technique? (Isoelectric points for Arginine, Alanine and Aspartate are 10.76, 6.02, and 2.98, respectively).

(b) How will you convert D-arabinose to D-glucose and D-mannose by Killiani-fisher synthesis?

P.T.O.

(c) Write short notes on :

(i) Anomers and Epimers

(ii) Zwitter ion

(iii) Claisen condensation reaction. (4,4,4.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2497

G

Unique Paper Code : 2174001011

Name of the Paper : (GE) States of Matter

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

Semester : III

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **FOUR** questions in all. Question No. 1 is compulsory.
3. The questions should be numbered in accordance to the number in the question paper.
4. Use of Scientific Calculator is permitted.

($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$; $k = 1.38 \times 10^{-23} \text{ J K}^{-1}$;
 $N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$)

P.T.O.

2497

2

1. Answer any 5 of the following :

- (a) The mean free path of gas molecules increases and the number of collisions per unit time decreases with the increase in temperature of ideal gases. Explain. (3)
- (b) What do you understand by the term "compression factor" of a gas? (3)
- (c) Real gases approach ideal behaviour at low pressures and high temperatures. Give reason. (3)
- (d) Calculate the interplanar distance between planes of Miller indices (200) in a cubic lattice of edge length 400 pm. (3)

2497

3

- (e) Solids are essentially incompressible while gases are easily compressed. Explain. (3)
- (f) Discuss the effect of temperature on surface tension. (3)
2. (a) What are the assumptions of kinetic theory of gases? Which assumptions had to be greatly modified to explain behaviour of real gases? (5)
- (b) The van der Waals constants 'a' and 'b' for NO_2 gas are $5.36 \text{ atm dm}^6 \text{ mol}^{-2}$ and $0.04424 \text{ dm}^3 \text{ mol}^{-1}$ respectively. Calculate the critical temperature, critical pressure and critical volume of the gas. Given $R = 0.08206 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$. (5)

P.T.O.

2497

4

- (c) Describe with the help of a diagram, the Ostwald's viscometer method for the determination of coefficient of viscosity of a liquid. Derive the equation

$$\eta_l = \frac{d_l t_l}{d_w t_w} \eta_w \text{ where } d \text{ denotes density, } t \text{ denotes time of flow and } \eta \text{ is coefficient of viscosity, subscript } l \text{ and } w \text{ indicating liquid and water respectively.} \quad (5)$$

3. (a) Explain the following *elements of symmetry* and their associated operations using suitable examples:
n-fold axis of symmetry
Mirror plane

(4)

- (b) Calculate the (i) collision number, Z_1
(ii) collision frequency, Z_{11} and

2497

5

- (iii) the mean free path, λ , at 1 bar pressure and 305 K for hydrogen gas given that the collision diameter = 2.73×10^{-10} m.

(6)

- (c) Derive the total number of bimolecular collisions of gas molecules Z_{11} :

$$Z_{11} = \frac{1}{\sqrt{2}} \pi \sigma^2 \bar{u} N^2 \text{ where } Z_{11} \text{ is number of bimolecular collisions per unit volume per unit time, } \pi \sigma^2 \text{ is collisional cross section, } \bar{u} \text{ is average velocity and } N^* \text{ is the number of molecules per unit volume.} \quad (5)$$

4. (a) Describe the powder method of X-ray diffraction for the determination of crystal structure with a suitable diagram.

(4)

P.T.O.

2497

6

- (b) Deduce the following gas laws from Kinetic gas equation (i) Boyle's law (ii) Graham's law of diffusion. (5)

- (c) Calculate the Miller indices of the planes in primitive cubic unit cells having the following intercepts on the x, y and z axes :

(i) $a : b : c$

(ii) $\frac{1}{2}a : b : \infty c$

(iii) $2a : 2b : 3c$

Also show these planes in a cubic lattice with the help of a diagram. (6)

5. (a) Discuss the crystal structure of NaCl with a diagram. (5)

2497

7

- (b) Define critical constants of a gas. Obtain the relation from van der Waals gas

$$\frac{p_c V}{RT_c} = \frac{3}{8} \quad (5)$$

- (c) The density of a gas is 1.331 kg m^{-3} at a temperature of 20°C and a pressure of $1 \times 10^5 \text{ Pa}$. Calculate the root mean square velocity and average velocity of its molecules. Given that $R = 8.314 \text{ Pa m}^3 \text{ K}^{-1} \text{ mol}^{-1}$. (5)

6. (a) What do you understand by distribution of molecular velocities of a gas? Explain using a suitable plot. (5)

- (b) Equal volumes of an organic liquid and water gave 60 and 35 drops respectively in a stalagmometer experiment. The densities of the liquid and water were found to be 0.75 g mL^{-1} and 0.99 g mL^{-1} . Surface tension of water at 25°C is $72 \times 10^{-3} \text{ Nm}^{-1}$. (5)

P.T.O.

(c) Write short notes on point defects in crystals.

(5)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4806

G

Unique Paper Code : 42174304

**Name of the Paper : Solutions, Phase Equilibria,
Conductance, Electrochemistry
& Functional Group Organic
Chemistry-II**

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

Semester : III

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. **Section A** and **Section B** carry equal marks.
3. Use separate answer sheets for **Section A** and **Section B**.
4. Use of simple calculator is allowed.

P.T.O.

4806

2

SECTION A

(Attempt any **three** questions in all)

1. (a) Draw and discuss the phase diagram of water.
(b) Explain the impact of impurities on the CST of phenol-water system.
(c) Discuss the vapour pressure properties of two immiscible liquids. How are these facts utilized in determining molar mass of a liquid by steam distillation. (4,4,4,5)
2. (a) Explain how we determine transport number using Hittorf's method.
(b) Plot well labelled conductometric titration curves obtained in the titration of
 - (i) strong acid and strong base
 - (ii) weak acid and strong base

4806

3

State any two advantages of conductometric titration over volumetric titration using indicators.

- (c) Specific conductance of 0.01M acetic acid solution at 25°C is $1.63 \times 10^{-2} \text{ Sm}^{-1}$ and its molar conductance at infinite dilution is $390.7 \times 10^{-4} \text{ Sm}^2 \text{ mole}^{-1}$. Calculate the degree of dissociation and dissociation constant of the acid.

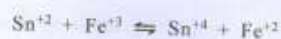
(4,4,4,5)

3. (a) Discuss the factors on which transport number depends.
(b) Explain why $\text{KCl-NaCl-H}_2\text{O}$ is a 3-component system whereas $\text{KCl-NaBr-H}_2\text{O}$ is a 4-component system.
(c) Calculate the equilibrium constant at 298K for the following reaction :

P.T.O.

4806

4



(Given that $E^\circ(\text{Fe}^{+3}, \text{Fe}^{+2}) = +0.77\text{V}$ and $E^\circ(\text{Sn}^{+4}, \text{Sn}^{+2}) = +0.15\text{V}$)

- (d) How does a salt bridge in galvanic cell prevent the liquid junction potential? (3,3,4,2.5)
4. Write short notes on the following (Any five):
- (a) Concentration cells
 - (b) Differentiate between Congruent and incongruent melting compound system.
 - (c) Solvent extraction
 - (d) Lever rule
 - (e) Determination of Transport Number using Moving Boundary method.
 - (f) Ag-AgCl electrode (2.5×5=12.5)

4806

5

SECTION B

(Attempt any three questions in all)

5. (a) How will you distinguish between aniline N-methylaniline and N,N-dimethylaniline using nitrous acid? Give the reaction involved.
- (b) Describe Edman degradation method to determine the N-terminal amino acid in a peptide chain.
- (c) Explain the term isoelectric point and its application in the separation of amino acids.
- (d) How benzene diazonium chloride can be converted to (i) Benzene (ii) Phenol. (3.5,3,3,2×1.5)
6. (a) Write the structure of products when D-glucose react with the following:

P.T.O.

4806

6

- (i) Excess of $C_6H_5NHNH_2$
- (ii) HI/Red Phosphorus
- (iii) Br_2 water
- (b) How will you convert an aldohexose to aldopentose sugar?
- (c) The alkaline hydrolysis of an ester is preferred than acidic hydrolysis. Justify.
- (d) Explain why direct nitration of aniline gives m-nitroaniline instead of o, p-products. How aniline can be converted into p-nitroaniline?
- (3×1,3,3,3.5)
7. (a) What are essential amino acids? How will you synthesize glycylalanine starting from glycine and alanine using N-protection and C-activating group.

4806

7

- (b) What happens when aqueous solution of α -D-Glucose is kept for some time? Name the phenomenon and discuss the mechanism.
- (c) Arrange the following in order of increasing basic strength and justify your answer :
- (i) $CH_3CH_2NH_2$, CH_3CONH_2 , CH_3NHCH_3
- (ii) $C_6H_5NH_2$, $C_6H_5NHCH_3$, $p\text{-NO}_2C_6H_4NH_2$
- (4.5,4,2×2)
8. (a) What are different methods used for estimation of amino acids in proteins?
- (b) Write short notes on any **three** of the following :
- (i) Claisen condensation
- (ii) Schotten-Baumann Reaction

P.T.O.

(iii) Strecker synthesis

(iv) Diazo-coupling reaction

(3.5,3×3)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3855

G

Unique Paper Code : 32175915

Name of the Paper : Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II

Name of the Course : B.Sc. (H) Generic Elective

Semester : III

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. All questions carry equal marks.
3. Attempt total **six** questions in all, **three** questions each from **Section A** and **Section B**.
4. Use of non-programmable scientific calculator is allowed.

P.T.O.

Section A: Physical Chemistry

1. (a) Draw and discuss a well-labelled phase diagram of Na-K system.
- (b) Derive Clausius-Clapeyron equation and discuss its one application.
- (c) (i) How Nernst distribution law is modified when association or dissociation of solute takes place in any solvent?
- (ii) Distribution of I_2 between H_2O and CCl_4 at 298 K, at equilibrium the following results were obtained.
- | | | | | |
|-------------------------------------------------------|------|------|------|------|
| I_2 (in Water layer/mol dm^{-3}) $\times 10^4$: | 2.35 | 4.69 | 7.03 | 9.30 |
| I_2 (in CCl_4 /mol dm^{-3}) $\times 10^4$: | 2.00 | 4.00 | 6.00 | 8.00 |

Show that the results obey the distribution law.
(4,4,2+2.5)

2. (a) Explain the effect of addition of NaCl and succinic acid on CST (Critical Solution Temperature) of water-Phenol system with well labelled diagram.
- (b) When a certain conductance cell was filled with 0.03 M KCl (with specific conductance $0.002768 \Omega^{-1} cm^{-1}$) it had a resistance of 82.4Ω at $25^\circ C$. When filled with 0.005 N K_2SO_4 it had a resistance of 326Ω . Calculate
- Cell constant, and
 - conductance of K_2SO_4 .
- (c) What is meant by transport number of ions? How the transference number is determined using moving boundary method? (4,4,4.5)

3855

4

3. (a) The resistance of 0.01N NaCl solution at 25°C is 100Ω. The cell constant of conductivity cell is unity. Calculate the equivalent conductivity.
- (b) What is liquid junction potential? How is it eliminated? What is property of electrolyte used in salt bridge? Give two examples of it.
- (c) Write three advantages of conductometric titration over volumetric titration. Discuss the nature of curve for CH₃COOH vs. NaOH titration.
- (4,4,4.5)
4. (a) Derive the expression for the EMF of an electrolyte concentration cell with transference.
- (b) Briefly explain calomel electrode.

3855

5

- (c) (i) Differentiate between reversible and irreversible cells.
- (ii) If the molar conductivities at infinite dilution of NaCl, HCl and CH₃COONa are 126.4, 426.1 and 91.0 Ω⁻¹cm² respectively, what will be the molar conductivity of CH₃COOH?
- (4,4,4.5)

Section B: Organic Chemistry

5. (a) Define isoelectric point. Calculate isoelectric point (pI) of Valine (pK_{a1} = 2.32, pK_{a2} = 9.62).
- (b) Give the preparation of glycine using Strecker's synthesis.
- (c) What is mutarotation? Explain taking the example of D-(+) Glucose.

P.T.O.

3855

6

(d) Discuss the Hinsberg test used for the identification of 1°, 2°, 3° amines. Outline the chemistry involved.

(2,2,4,4.5)

6. (a) Explain why D-fructose reduces Fehling's solution although it is a ketose.

(b) Giving suitable explanation arrange the acid derivatives (ester, acid chloride, acid anhydride and amide) in increasing order of reactivity towards nucleophilic acyl substitution reaction.

(c) An aliphatic amine with molecular formula C_2H_7N exists in two isomeric forms 'A' and 'B'. When warmed with chloroform and KOH only 'A' reacts resulting into foul smell. What are the structures and names of 'A' and 'B'? Give name of the reaction and chemical equation involved in it.

(4,4,4.5)

3855

7

7. Convert (any five) :

(a) Aniline to p-Nitro aniline

(b) D-Glucose to D-Fructose

(c) Phenylacetic acid to benzylamine

(d) Benzaldehyde to Benzamide

(e) Ethyl acetate to Acetic acid

(f) o-Toluidine to o-Cresol (5×2.5)

8. (a) How will you separate Arginine, Alanine and Aspartate by electrophoresis technique? (Isoelectric points for Arginine, Alanine and Aspartate are 10.76, 6.02, and 2.98, respectively).

(b) How will you convert D-arabinose to D-glucose and D-mannose by Killiani-fisher synthesis?

P.T.O.

(c) Write short notes on :

(i) Anomers and Epimers

(ii) Zwitter ion

(iii) Claisen condensation reaction. (4,4,4.5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2497

G

Unique Paper Code : 2174001011

Name of the Paper : (GE) States of Matter

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

Semester : III

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **FOUR** questions in all. Question No. 1 is compulsory.
3. The questions should be numbered in accordance to the number in the question paper.
4. Use of Scientific Calculator is permitted.

($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$; $k = 1.38 \times 10^{-23} \text{ J K}^{-1}$;
 $N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$)

P.T.O.

2497

2

1. Answer any 5 of the following :

- (a) The mean free path of gas molecules increases and the number of collisions per unit time decreases with the increase in temperature of ideal gases. Explain. (3)
- (b) What do you understand by the term "compression factor" of a gas? (3)
- (c) Real gases approach ideal behaviour at low pressures and high temperatures. Give reason. (3)
- (d) Calculate the interplanar distance between planes of Miller indices (200) in a cubic lattice of edge length 400 pm. (3)

2497

3

- (e) Solids are essentially incompressible while gases are easily compressed. Explain. (3)
- (f) Discuss the effect of temperature on surface tension. (3)
2. (a) What are the assumptions of kinetic theory of gases? Which assumptions had to be greatly modified to explain behaviour of real gases? (5)
- (b) The van der Waals constants 'a' and 'b' for NO_2 gas are $5.36 \text{ atm dm}^6 \text{ mol}^{-2}$ and $0.04424 \text{ dm}^3 \text{ mol}^{-1}$ respectively. Calculate the critical temperature, critical pressure and critical volume of the gas. Given $R = 0.08206 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$. (5)

P.T.O.

2497

4

- (c) Describe with the help of a diagram, the Ostwald's viscometer method for the determination of coefficient of viscosity of a liquid. Derive the equation

$$\eta_l = \frac{d_l t_l}{d_w t_w} \eta_w \text{ where } d \text{ denotes density, } t \text{ denotes time of flow and } \eta \text{ is coefficient of viscosity, subscript } l \text{ and } w \text{ indicating liquid and water respectively.} \quad (5)$$

3. (a) Explain the following *elements of symmetry* and their associated operations using suitable examples:
n-fold axis of symmetry
Mirror plane

(4)

- (b) Calculate the (i) collision number, Z_1
(ii) collision frequency, Z_{11} and

2497

5

- (iii) the mean free path, λ , at 1 bar pressure and 305 K for hydrogen gas given that the collision diameter = 2.73×10^{-10} m.

(6)

- (c) Derive the total number of bimolecular collisions of gas molecules Z_{11} :

$$Z_{11} = \frac{1}{\sqrt{2}} \pi \sigma^2 \bar{u} N^*{}^2 \text{ where } Z_{11} \text{ is number of bimolecular collisions per unit volume per unit time, } \pi \sigma^2 \text{ is collisional cross section, } \bar{u} \text{ is average velocity and } N^* \text{ is the number of molecules per unit volume.} \quad (5)$$

4. (a) Describe the powder method of X-ray diffraction for the determination of crystal structure with a suitable diagram.

(4)

P.T.O.

2497

6

- (b) Deduce the following gas laws from Kinetic gas equation (i) Boyle's law (ii) Graham's law of diffusion. (5)

- (c) Calculate the Miller indices of the planes in primitive cubic unit cells having the following intercepts on the x, y and z axes :

(i) $a : b : c$

(ii) $\frac{1}{2}a : b : \infty c$

(iii) $2a : 2b : 3c$

Also show these planes in a cubic lattice with the help of a diagram. (6)

5. (a) Discuss the crystal structure of NaCl with a diagram. (5)

2497

7

- (b) Define critical constants of a gas. Obtain the relation from van der Waals gas

$$\frac{p_c V}{RT_c} = \frac{3}{8} \quad (5)$$

- (c) The density of a gas is 1.331 kg m^{-3} at a temperature of 20°C and a pressure of $1 \times 10^5 \text{ Pa}$. Calculate the root mean square velocity and average velocity of its molecules. Given that $R = 8.314 \text{ Pa m}^3 \text{ K}^{-1} \text{ mol}^{-1}$. (5)

6. (a) What do you understand by distribution of molecular velocities of a gas? Explain using a suitable plot. (5)

- (b) Equal volumes of an organic liquid and water gave 60 and 35 drops respectively in a stalagmometer experiment. The densities of the liquid and water were found to be 0.75 g mL^{-1} and 0.99 g mL^{-1} . Surface tension of water at 25°C is $72 \times 10^{-3} \text{ Nm}^{-1}$. (5)

P.T.O.

(c) Write short notes on point defects in crystals.

(5)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4847

G

Unique Paper Code : 42177925

Name of the Paper : DSE -Chemistry of d-block
Elements, Quantum Chemistry
and Spectroscopy

Name of the Course : B.Sc. (Program)

Semester : V

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 total with three from SECTION A and three from SECTION B.
3. Attempt SECTION A and SECTION B on separate answer sheets. Do not mix the questions of SECTION A and SECTION B.
4. Use of scientific calculator and Log table is allowed.

P.T.O.

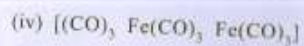
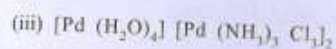
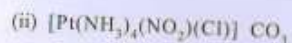
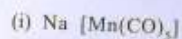
4847

2

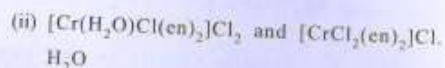
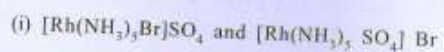
SECTION A
INORGANIC CHEMISTRY

Attempt ANY THREE questions. Attempt any three questions in this section. All questions carry equal marks.

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



- (b) Indicate the isomerism exhibited in the following pairs of compounds and give one method to distinguish between them :



4847

3

- (c) Give brief reasons for any **two** of the following :

(i) Transition metals have a high tendency to form complexes.

(ii) An aqueous solution of copper sulphate is blue while that of zinc sulphate is colourless.

(iii) Ca^{2+} & Sc^{3+} are isoelectronic but have different electronic configurations.

(4.5,4,4)

2. (a) Write the formulae of **any three** of the following according to IUPAC convention :

(i) Caesium tetrachloridooxidochromate(III)

(ii) μ -amido- μ -peroxidobis{bis(ethane-1,2-diamine)iron(III)} chloride

(iii) Hexaamminecobalt(III) pentachlorocuprate(II)

(iv) Triamminetrinitrito-Niobate(III) ion

- (b) Why is TiCl_3 coloured while TiO_2 is colourless? Can this reason explain the colour of KMnO_4 ? If not, then assign the reason.

P.T.O.

4847

4

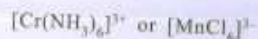
(c) Predict the appropriate choice and give brief reasons :

- (i) Higher magnetic moment Ti(III) Fe(III)
 (ii) Bidentate ligand $C_2O_4^{2-}$ SCN^-

(4,5,4,4)

3. (a) The complex $[Co(en)_2Cl_2]^+$ exists in two isomeric forms A & B. A is optically active but B is not. Explain the reason briefly and draw the structures of A & B.

(b) State Jahn Teller theorem. Which of the following high spin complexes would you expect to exhibit Jahn Teller distortion? Give reasons.



(c) Calculate CFSE in terms of Δ_t of a d^7 metal ion placed in a tetrahedral field. Draw the splitting diagram. (4,5,4,4)

4. (a) For Mn^{2+} ion, the electron pairing energy is 336 KJ mole^{-1} . The crystal field splitting energy for $[Mn(H_2O)_6]^{2+}$ ion is 250 KJ mole^{-1} . Will the complex ion have a high spin or a low spin configuration? Calculate CFSE for both the configurations to justify your answer.

4847

5

(b) Given below is the Latimer diagram for copper :



Answer the following questions :

(i) Is there any state which undergoes disproportionation? Explain by showing necessary calculations.

(ii) Calculate skip step potential for $Cu^{2+} \longrightarrow Cu$ change.

OR

Briefly discuss any two of the following :

(i) Ion exchange method for separation of lanthanoids.

(ii) Transition metals are hard and have high melting and boiling points.

(iii) Octahedral complexes may be high spin or low spin but tetrahedral complexes are always low spin.

P.T.O.

- (c) $[\text{Ni}(\text{CO})_4]$ has tetrahedral geometry but $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar. Explain with the help of VBT. (4,5,4,4)

SECTION B

Planck's constant, $h = 6.626 \times 10^{-34} \text{ Js}$;

Velocity of light, $c = 3 \times 10^8 \text{ ms}^{-1}$

Mass of an electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$

Attempt any **three** questions.

1. (a) State the two laws of photochemistry. Define quantum yield.
- (b) The microwave spectrum of HI consists of a series of equally spaced lines with spacing equal to 12.8 cm^{-1} . Calculate (a) the moment of inertia and (b) the internuclear distance.
- (c) Determine the expressions for

$$(i) \left(\frac{d}{dx} + x \right)^2; \quad (ii) \left[x^2, \frac{d^2}{dx^2} \right] \quad (4,4,5,4)$$

2. (a) On what factors does the vibrational frequency of a molecule depend? Arrange the following functional groups in the order of their increasing vibrational frequency: H-Cl, H-I, H-F, H-Br.
- (b) How is the particle in a box model applied to FMO theory of the electronic spectra of conjugated molecules? Calculate the wavelength of the transition between HOMO and LUMO for 1,3,5,7-octatetraene molecule if the C - C bond length is 154 pm and C = C bond length is 140 pm.
- (c) Explain the phenomenon of phosphorescence with the help of suitable example. (3,5,5,4)
3. (a) Determine which of the following functions are eigenfunctions of the operator d/dx : (i) $\exp(ikx)$ (ii) $\cos kx$. Determine the eigenvalue wherever applicable.
- (b) State the essential condition for obtaining IR spectrum. Which of the following molecules will be IR active: H_2 , HCl , NH_3 , CO_2 .
- (c) Write short notes on:
 - (i) Lambert Beer's law and
 - (ii) Degeneracy (4,5,4,4)

4. (a) Giving examples of reactions having low and high quantum yields, explain the reasons for obtaining low and high quantum yields in photochemical reactions.
- (b) Write down the expression for quantum mechanical operator p_x . Find whether the momentum operator p_x and position operator x commute with each other. Interpret your result.
- (c) The force constant of $^{12}\text{C}^{16}\text{O}$ is 1840 N m^{-1} . Calculate the vibrational frequency in cm^{-1} and the spacing between the vibrational energy levels in eV. ($1 \text{ eV} = 8066 \text{ cm}^{-1}$). (4,4,4,5)

3
[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4950 **G**

Unique Paper Code : 42177925

Name of the Paper : DSE Chemistry of d-block
Elements, Quantum Chemistry
and Spectroscopy

Name of the Course : B.Sc. Prog. / Analytical
Chemistry / Industrial
Chemistry

Semester : V

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. Use separate answer sheets for **Section A** and **B**.
3. Attempt **three** questions from each section.
4. Each question carries equal marks.
5. Do not intermix the sections and attempt all parts of a question together.
6. Use of scientific calculator and logarithmic tables is allowed.

P.T.O.

4950

2

Section A

(Inorganic Chemistry)

Attempt any three questions.

1. (a) Give the IUPAC names of any three complexes of the following :

- (i) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{C}_2\text{O}_4)_3]$
 (ii) $[(\text{NH}_3)_5\text{Co}-\text{O}_2-\text{Co}(\text{NH}_3)_5](\text{NO}_3)_4$
 (iii) $[\text{Mo}(\text{N}_3)(\text{NH}_3)_5](\text{SO}_4)_3$
 (iv) $[\text{RhBrCl}(\text{en})_2]^+$

- (b) Name the type of isomerism in the following pairs and suggest a method to distinguish them :

- (i) $[\text{Cr}(\text{en})_2(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$ and $[\text{Cr}(\text{en})_2\text{Cl}_2]\text{Cl}\cdot\text{H}_2\text{O}$
 (ii) $[\text{Co}(\text{SO}_4)(\text{NH}_3)_5]\text{Br}$ and $[\text{CoBr}(\text{NH}_3)_5]\text{SO}_4$

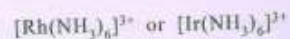
4950

3

- (c) Give all possible stereoisomers (geometrical and optical isomers) for the following complexes :
 $[\text{Pt}(\text{en})_2\text{Cl}_2]\text{Cl}_2$; $[\text{Cr}(\text{gly})_3]$ (6,3,3,5)

2. (a) Answer any three of the following :

- (i) What is CFS? Define Crystal Field Stabilization Energy (CFSE).
 (ii) All the octahedral complexes of Ni(II) must be outer orbital complexes. Explain why?
 (iii) Which of the following complexes amongst the following pairs, have high 10Dq value and why?



- (iv) Explain why $[\text{CoCl}_4]^{2-}$ (blue) and $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ (pink) have different colours. Which complex has its absorption bands at longer wavelength and why?

- (b) Write the IUPAC formulae of any two of the following :

P.T.O.

4950

4

- (i) Sodium dithioscyanato(S)) argentate(I)
 - (ii) Potassium dicyanidobis(oxalato) nickelate(II)
 - (iii) Diamminebis(triethylphosphine)palladium(II) perchlorate
- (c) State Jahn Teller theorem. Chromium(II) fluoride has a central metal ion surrounded by six fluoride ligands having two Cr-F bonds longer than the remaining four Cr-F bonds. Give reason for the observed distortion and also draw the crystal field splitting diagram. (6,3,3,5)
3. (a) Answer **any three** of the following :
- (i) Transition elements can form complexes in zero or even negative oxidation states. Explain giving reasons.
 - (ii) The radii of the elements of third transition series are very similar to those of second transition series.

4950

5

- (iii) Explain the electronic spectra observed in Lanthanoids and actinoids. What are the main transitions involved.
 - (iv) Actinoids exhibit other than +3 oxidation states. Why.
- (b) Write the complete electronic configuration for the following elements / ions. Calculate the number of unpaired electrons in each :
- (i) Element with atomic number 76
 - (ii) Element with atomic number 107
- (c) What is the difference between an inner orbital complex and an outer orbital complex? Discuss with one example each. (6,3,3,5)
4. (a) Answer **any two** of the following :
- (i) How does the crystal field theory interpret the colour and spectra of transition metal complexes? Explain giving examples.

P.T.O.

4950

6

(ii) In a square planar complex, the CFS of the d-orbital energies of a central ion decrease in the sequence: $d_{x^2-y^2} > d_{xy} > d_{z^2} > d_{xz}, d_{yz}$. Explain the decreasing trend in energies.

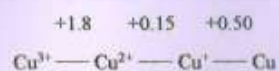
(iii) For a metal ion having d^6 configuration in an octahedral complex, the magnitude of crystal field splitting is $32,200 \text{ cm}^{-1}$, and the electron-pairing energy is $17,600 \text{ cm}^{-1}$. Calculate the crystal field stabilization energy for both the spin states. Predict whether the complex will be high spin or low spin.

(b) Using the valence bond method, i) assign the valence shell electronic configuration to the central metal atom, ii) predict the type of hybridization involved, and iii) the magnetic moment (in Bohr magnetons) for the following complex: $[\text{Cr}(\text{NO}_2)_6]^{3+}$.

4950

7

(c) The Latimer Diagram (the reduction potential diagram) for Cu in acid solution is:



Based on the Latimer diagram:

- Which is the most stable species? Give reasons.
- Calculate the skip step emf for the reduction of CuO^+ (i.e. Cu^{3+}) to Cu^+ .
- Which species of Cu is / are unstable with respect to disproportionation and why?

(6,3,3.5)

P.T.O.

4950

8

Section B

(Physical Chemistry)

Attempt any three questions.

Physical Constants

Planck's Constant 6.626×10^{-34} JsAvogadro's Number 6.023×10^{23} mol⁻¹Mass of electron 9.109×10^{-31} kg

5. (a) What do you understand by an eigen value equation? Show which of the following mathematical functions are eigen functions of d/dx operator. Give the corresponding eigen values.

(i) $5e^{3x}$

(ii) $5 \cos 8x$

- (b) What is Grothus-Draper's law? A 0.04 M solution of a substance has an absorbance of 0.65 at 550 nm using a cell of path length 1 cm. Calculate molar extinction coefficient.

4950

9

- (c) What is the criteria for a molecule to be IR active?

Based on this criterion, explain whether the following molecules are IR active or not and why?



(4,4,4,5)

6. (a) Define Linear operator. If \hat{A} & \hat{B} are two operators show that:

(i) $[\hat{A}, [\hat{B}, \hat{C}]] = \hat{A}[\hat{B}, \hat{C}] - [\hat{B}, \hat{C}]\hat{A}$

(ii) $[\hat{A}^2, \hat{B}] = \hat{A}[\hat{A}, \hat{B}] + [\hat{A}, \hat{B}]\hat{A}$

P.T.O.

4950

10

(b) Determine the expectation value of kinetic energy for particle in a one dimensional box.

(c) What do you mean by quantum yield?

Photobromination of cinnamic acid to dibromocinnamic acid was carried in blue light at the wavelength of 430nm, at 300K using the light intensity of 1.7×10^{-3} J per second. An exposure of 25 minutes produced a decrease of 0.082 millimole of bromine. The solution absorbed 85% of the light passing through it. Calculate the quantum yield of the reaction. (4,4,4.5)

7. (a) An electron is confined in a one dimensional box of length 10^{-9} m.

(i) What is the energy of the electron in $n = 1$ level?

4950

11

(ii) Calculate the energy absorbed when electron undergoes transition from E_5 to E_6 and E_6 to E_7 .

(b) With the help of Jablonski Diagram, explain briefly the various types of radiative and non-radiative transitions.

(c) The force constant of $^1\text{H } ^{35}\text{Cl}$ molecule is 950 Nm^{-1} . Calculate the fundamental vibrational frequency as well as the zero-point energy. The atomic masses are: $\text{H} = 1.673 \times 10^{-27} \text{ kg}$; $\text{Cl} = 58.06 \times 10^{-27} \text{ kg}$. (4,4,4.5)

8. (a) Write short notes on any two of the following :

(i) Phosphorescence with diagram

(ii) Significance of ψ and ψ^2

(iii) Selection Rules for Rotational spectra

P.T.O.

- (b) What are the assumptions of the free electron model for polyenes. With the help of this model determine the energy for the first excited state of hexatriene molecule. Given that C-C bond length is 135 pm & that of C=C is 154 pm. Radius of carbon atom at the end is 77 pm.

(8,4.5)

(700)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4546

G

Unique Paper Code : 32177908

Name of the Paper : Green Chemistry

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

Semester : V

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 Total **SIX** questions in all.
3. Question No. 1 is compulsory and carries 15 marks. Rest of five questions carry 12 marks each.
4. Answer all parts of a question together.

P.T.O.

4546

2

1. (a) Fill in the blanks with the appropriate word :
(1×6)

- (i) A renewable feedstock used in the synthesis of adipic acid is _____.
- (ii) _____ is fulfilling the needs of the present generation without compromising the ability of future generations to meet their needs.
- (iii) A chemical process with an E-factor of 100 produces _____ waste than a process with E-factor of 10.
- (iv) EcoWorx™ fully recyclable carpet is an example of the _____ approach.
- (v) A chemical which causes the depletion of the ozone layer is _____.
- (vi) A clean, non-polluting, and readily available source of energy is _____.

(b) Choose the correct answer in the following multiple choice questions:
(1×3)

- I. Atom Economy is highest in which of the following type of reactions :

4546

3

- (i) Substitution
- (ii) Addition
- (iii) Elimination
- (iv) Condensation

II. The word green in green chemistry relates to which of the following:

- (i) Green colored chemicals
- (ii) Safe and benign chemicals
- (iii) Toxic chemicals
- (iv) None of the above

III. Wearing personal protection gear in the chemistry laboratory reduces:

- (i) Hazard
- (ii) Exposure
- (iii) Effort
- (iv) Energy

P.T.O.

(c) Correct the following statements: (1×6)

- (i) Hydrogenation of alkenes with metal catalysts such as Pt or Ni is an example of homogenous catalysis.
 - (ii) Volatile organic compounds, VOCs, such as formaldehyde, have been replaced and banned in paints.
 - (iii) Potato, corn and molasses are examples of non-renewable feedstocks.
 - (iv) According to the Pollution Prevention Act by US EPA, risk = f(safety × exposure).
 - (v) Saponification is the process used for the preparation of biodiesel from used cooking oil.
 - (vi) The first principle of the 12 principles of green chemistry is use of benign solvents.
2. (a) What do you understand by the term "Green Solvent"? Which green solvent is used by the dry-cleaning industry? List four advantages of this green solvent over traditional organic solvents. (1,1,2)

(b) Define terms Green Chemistry and green synthesis. List any four aspects a chemist should include to develop the "ideal green synthesis". (1,1,2)

(c) What is poly lactic acid? Outline the green synthesis of poly-lactic acid from corn? What are the main uses of this polymer? (1,2,1)

3. (a) What are the advantages of microwave assisted reactions in organic synthesis? Write the following appropriate reaction: (1,2,2)

(i) Microwave assisted Hoffman Elimination reaction

(ii) Microwave assisted hydrolysis of methylbenzoate.

(b) The city of Bhopal, in India, witnessed one of the biggest chemical accidents. Which gas was responsible for this accident? Outline the synthesis of production of Carbaryl using the greener approach. (1,2)

(c) Provide one example of each of the following: (1×4)

(i) Persistent chemical

- (ii) Auxiliary Substance
 - (iii) Green alternative to tetrahydrofuran
 - (iv) Crown ether
4. (a) In a chemical industry, strengthening analytical techniques helps to avoid accidents. Which green principle emphasise this? Explain taking a suitable example. (1,3)
- (b) Compare homogenous and heterogeneous catalysis in context to green chemistry with suitable examples. (2,2)
- (c) What is "asymmetric catalysis"? Highlight the importance of asymmetric catalysts by illustrating the thalidomide drug causing birth defects in babies. (1,3)
5. (a) State the key Green Chemistry Principles associated with the following examples: (1×3)
- (i) Extraction of D-Limonene from Orange Peels
 - (ii) Preparation of biodiesel from used vegetable oil

(iii) Preparation of copper phthalocyanine using microwave oven

- (b) Define Atom Economy. Calculate the atom economy for the production of propene as per the following reaction: (2,3)



- (c) Briefly explain how sonochemical reactions are an integral part of greener practices. Explain giving suitable example. (1,3)
6. (a) State the differences between conventional heating and heating via microwaves. What is the mechanism of microwave heating? (2,2)
- (b) What is the role of protecting group in a chemical reaction? What are the drawbacks of using a protecting group? (2,2)
- (c) What does PEG stand for? Discuss its role as an alternate green solvent in organic synthesis. (1,3)

(2)

7. (a) Highlight the green synthesis of the following :
(3×2)

(i) Adipic acid

(ii) Disodium iminodiacetate

(iii) Catechol

(b) Provide an example of a solventless reaction. List two green chemistry principles involved therein.
(2,2)

(c) How does green chemistry works towards sustainability?
(2)

8. Write brief notes on any **three** of the following topics :
(4×3)

(i) Waste Management Hierarchy

(ii) Future Direction of Green Chemistry

(iii) Ionic Liquids

(iv) Flixborough Accident

(1000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4430

G

Unique Paper Code : 32177902

Name of the Paper : DSE - Inorganic Materials of
Industrial Importance

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

Semester : V

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. Question 1 is compulsory.
4. Attempt any **five** other questions.

1. (a) Give one word for the following / Fill in the blanks as required :

(i) A battery that cannot be recharged and must be discarded after single use.

(ii) Glassware which is preferred for laboratory apparatus that is graduated or needs to be strongly heated.

P.T.O.

- (iii) Additives in an emulsion paint formulation which prevent excessive foam formation during manufacturing.
 - (iv) Nutrients which are required in very small amounts by plants.
 - (v) Urea is an example of a _____ fertilizer.
 - (vi) The process of surface hardening caused due to the diffusion of boron into the base metal or alloy is called _____
 - (vii) Safety glass has a layer of _____ sandwiched between two layers of glass.
- (b) Distinguish between the following :
- (i) Physical Vapor Deposition and Chemical Vapor Deposition.
 - (ii) Wet and Dry process for the manufacture of cement.
- (c) Write short notes on :
- (i) Nitrogenous Fertilizers
 - (ii) Fire Retardant Paints (7,4,4)
2. (a) What are the various components of a battery? Differentiate between primary and secondary battery.
- (b) Write the discharging and charging reactions of a lead acid battery and explain how the battery works.

- (c) How do photons initiate the reactions in a solar cell? Describe the working of a solar cell with a diagrammatic representation. (4,4,4)
3. (a) How does urea function as an effective fertilizer for plants? Give one method for the manufacture of urea.
- (b) How is ammonium nitrate fertilizer prepared? What are the drawbacks of using ammonium nitrate fertilizer?
- (c) Define alloy steel? Discuss the effects of Nickel, Chromium and Manganese on steel. (4,4,4)
4. (a) What are composite materials? Discuss their importance as engineered materials giving examples.
- (b) Write down the uses of ceramic products. How is glazing of ceramics done?
- (c) Discuss the characteristics and applications of the following :
- (i) Soda lime glass
 - (ii) Borosilicate glass (4,4,4)
5. (a) What are carbon nanotubes? Describe the formation, characteristics, and applications of carbon nanotubes.
- (b) What are superconducting oxides? Explain giving examples.

- (c) Discuss the various types of cast iron. Write their composition and applications. (4,4,4)
6. (a) Write different constituents of a paint. What are the requisites of a good paint?
- (b) What is the purpose of applying surface coatings to objects? Discuss the process of galvanization.
- (c) Explain electroless plating with an example. What are the advantages of electroless plating? (4,4,4)
7. (a) Describe the steps involved in the manufacture of glass and give the reactions involved.
- (b) Explain the process of setting and hardening of cement. Give the reactions involved.
- (c) What are zero and two-dimensional nanomaterials? Explain giving examples. (4,4,4)
8. (a) What is CAN? Give the general steps involved in the manufacture of this fertilizer.
- (b) What is the significance of pigment in a paint? Define Pigment Volume Concentration (PVC) and Critical Pigment Volume Concentration (CPVC).
- (c) What is a fuel cell? Explain the working of a fuel cell. (4,4,4)
- (1000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4324

G

Unique Paper Code : 32171501

Name of the Paper : Organic Chemistry IV :
Biomolecules

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

Semester : V

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 any 6 questions.
3. All Questions carry equal marks.

1. (a) (i) Give the sequence of reactions to establish the pyranose ring size in glucose? (3)

(ii) Draw Fisher projection and Haworth structure of β -D-Fructofuranose. (3)

(b) A pentapeptide, X with empirical composition, Phe-2, Lys, Trp, Tyr was recovered unchanged on treatment with Trypsin. DNFB treatment of X

P.T.O.

followed by hydrolysis gave DNP-Tyr. Partial acid hydrolysis of X gave two tripeptides with the following amino acid composition :

1. Phe,Tyr,Trp

2. Phe, Trp,Lys

Elucidate the sequence of amino acids in X. Give the products of treatment of X with Chymotrypsin.

(6.5)

2. (a) Draw the complimentary DNA sequence of the given fragment specifying the direction 5'—ATGC—3'. (4.5)

(b) Draw the structure of glyceryl trilinoleate and calculate its iodine value. (4)

(c) Fructose contains a ketonic group, yet it reduces Tollens' reagent and Fehling's solution. Why? Give the mechanism and name of reaction involved. (4)

3. (a) (i) How is pyruvate converted to ethanol under anaerobic conditions? Name the enzyme and give the reaction involved. (3.5)

(ii) ATP is called the universal currency of cellular energy. Explain giving its hydrolytic pathway. (3)

(b) Give the complete name and structure of

(i) dAMP

(ii) UDP (4)

(c) What are cofactors? Give an example. (2)

4. (a) Give the structure of the disaccharide sucrose. What is its IUPAC name? Account for the observation that it does not reduce Fehling's solution and it does not mutarotate. (3)

(b) Give the mechanism of osazone formation for D-glucose. D-Glucose and D-Fructose give the same osazone. Explain. (3.5)

(c) How would you synthesize the tripeptide, Ala-Gly-Ala using solid phase peptide synthesis. (6)

5. (a) Explain the mechanism of action of chymotrypsin. (6)

(b) What are drying and non-drying oils? Give one example of each type. (4)

(c) What is denaturation of protein? How it is caused? (2.5)

6. (a) An α -D - methylglycoside, X, with molecular formula $C_7H_{14}O_6$, consumes 2 moles of HIO_4 and gives one mole of $HCHO$. Arrive at possible structure/s of X. (4)

P.T.O.

27/12/22
(m)

- (b) Define genetic code. Give at least three characteristics of genetic code. (4.5)
- (c) Differentiate between competitive and non-competitive enzyme inhibition and give examples of each kind. (4)
7. (a) Discuss various steps involved in the glycolysis cycle, giving the names of enzymes and structures of intermediates. (6)
- (b) List any two reactions that were not explained by the open chain structure of glucose. How does the cyclic hemiacetal structure of glucose explain them. (4)
- (c) Define ω - fatty acids giving suitable example. (2.5)
8. (a) How will you convert :
- (i) D-Glucose to D- Arabinose.
- (ii) D-Glucose to D-Fructose. (4.5)
- (b) List four important characteristic of Watson and Crick model of DNA. (4)
- (c) Discuss the 2° structure of proteins. (4)

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4378

G

Unique Paper Code : 32171502

Name of the Paper : Physical Chemistry V: Quantum
Chemistry & Spectroscopy

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

Semester : V

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, three questions each from sections A and B.
3. Attempt all part of a question together.
4. All questions carry equal marks.
5. Use of a non-programmable scientific calculator is allowed.

P.T.O.

Physical constants

Atomic mass unit	$= 1.66 \times 10^{-27} \text{ kg}$
Planck's constant	$= 6.626 \times 10^{-34} \text{ J s}$
Velocity of Light	$= 3 \times 10^8 \text{ m s}^{-1}$
Boltzmann constant	$= 1.381 \times 10^{-23} \text{ J K}^{-1}$
Mass of Electron	$= 9.1 \times 10^{-31} \text{ kg}$
Avogadro's number	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
Nuclear magneton	$= 5.05 \times 10^{-27} \text{ J T}^{-1}$
Bohr magneton	$= 9.274 \times 10^{-24} \text{ J T}^{-1}$

Section A*(Quantum Chemistry)*

1. (a) The uncertainty in a quantity, represented by operator A is given as under,

$$\sigma_A^2 = \langle A^2 \rangle - \langle A \rangle^2$$

For a particle in the ground state of a one-dimensional box having length, L , represented by

$$\psi = \left(\frac{2}{L}\right)^{1/2} \sin\left(\frac{\pi x}{L}\right), \text{ determine } \sigma_x, \sigma_p$$

where x and p represent position and momentum respectively.

Use standard integral $\int x \sin\left(\frac{\pi x}{L}\right) = \frac{L^2}{4}$ and

$$\int x^2 \sin^2\left(\frac{\pi x}{L}\right) = \left(\frac{L}{2\pi}\right)^2 \left(\frac{4\pi^2}{3} - 2\pi\right).$$

- (b) Prove that the functions having different real eigen values for linear momentum operator are orthogonal.

- (c) Starting from $\left[\frac{d}{dx}, x\right] = 1$, use the commutator identities to find

(i) $[\hat{x}, \hat{p}_x^2]$

- (ii) $[\hat{x}, \hat{H}]$, \hat{H} is Hamiltonian for a one-particle, three-dimensional system. (4.5, 4.4)

2. (a) Demonstrate that the Eigen functions for the particle in a one-dimensional box are orthonormal.

$$\psi(x) = \left(\frac{2}{L}\right)^{1/2} \sin\left(\frac{n\pi x}{L}\right)$$

P.T.O.

- (b) Write Hamiltonian operators for a particle moving under constant potential 'V' in a (i) one-dimensional box and (ii) three-dimensional box.
- (c) As a crude treatment for the π electrons of a conjugated polyene, the π electrons of the conjugated chain are considered as moving in a one-dimensional box across the end to end conjugated chain. Considering 1,3-butadiene as a one-dimensional box of box length, 7.0 Å, calculate the wavelength of light absorbed when a π electron is excited from the highest-occupied to the lowest-vacant level of the molecular electronic ground state. (4.5,4,4)
3. (a) Construct the Hamiltonian operator for Simple Harmonic oscillator and write the Schrodinger equation. What is the zero-point energy of this type of system?
- (b) A molecule X has 10 π electrons and it is assumed to have cubical shape with edge length 10 pm. Give the quantum numbers corresponding to the highest occupied energy levels. Based on the free electron model, calculate the longest wavelength required for transition.

- (c) Normalize the following functions :

(i) $f(r) = r \exp(-ar)$ $0 \leq r \leq \infty$

(ii) $f(\phi) = N \exp(im\phi)$ $0 \leq \phi \leq 2\pi$
(4.5,4,4)

4. (a) Using linear momentum operator \hat{p}_x , \hat{p}_y and \hat{p}_z , derive angular momentum operators, \hat{L}_x , \hat{L}_y and \hat{L}_z . Using $\hat{L}_x = -i\hbar \left(\frac{d}{d\phi} \right)$ construct the Schrodinger equation dependent on variable ϕ only. Write a possible solution as an eigen function and determine eigen values.

- (b) Using normalized ground state wave function for hydrogen atom

$$\psi(r) = 2 \left(\frac{1}{a} \right)^{3/2} \exp\left(-\frac{r}{a}\right)$$

Determine

- (i) $\langle E \rangle$
- (ii) The radius of maximum radial density distribution of electron

P.T.O.

- (c) Why do we need to employ approximate methods to determine solution for multielectron atoms? Explain Variation principle as an approximate method' to determine approximate wave function. (4.5,4,4)

Section B

(Molecular Spectroscopy)

5. (a) A molecule AB_2 has the following infra-red and Raman spectra :

Wave number (cm^{-1})	Infrared	Raman
589	Active (PQR)	Inactive
1285	Active (PR)	Active (polarized)
2224	Active (PR)	Active (depolarized)

Giving proper explanation and arrive at the geometry of the molecule. Assign the wavenumbers to specific vibrations.

- (b) The intensities of Stokes and anti-Stokes lines are similar in rotational Raman spectra. However, in the vibrational Raman spectra, the Stokes lines are more intense than the anti-Stokes lines. Explain.

- (c) Discuss how a simple harmonic oscillator system differs from a homonuclear diatomic molecule undergoing anharmonic oscillations in terms of energy relation and energy vs displacement curve from mean position. (4.5,4,4)
6. (a) Given that the spin quantum numbers of $^{12}C_6$, 1H_1 and 2D_1 are zero, half and one, respectively, how many different energy states do these nuclei have in a magnetic field? Which of these atoms will show peak in the NMR spectra?
- (b) Draw and discuss, the low and high-resolution NMR spectrum of CH_3CHO showing the peak corresponding to the reference standard TMS.
- (c) The pure microwave spectrum for $^1H^{35}Cl$ is observed as a series of lines at 20.7, 41.5, 62.0, 83.0, 103.8 cm^{-1} . Evaluate the rotational constant and the internuclear distance for this molecule. (4.5,4,4)
7. (a) What do you understand by the terms, 'singlet' and 'triplet'? On the basis of these terms explain why fluorescence is a rapid phenomenon as compared to phosphorescence.

- (b) Explain Larmor precession of a spinning nucleus and derive expression for precessional frequency.
- (c) The spacing between the successive lines of Raman rotational spectrum of O_2 molecule is $8B$ while for H_2 molecule it is $4B$ (where B is the rotational constant). Explain. (4.5,4,4)
8. (a) What is Fermi Resonance and hot bands in IR spectroscopy.
- (b) Write short notes on the following:
- (i) Dissociation and Predissociation
 - (ii) Franck Condon principle (4.5,4+4)