

(c) Give reasons for the following :

- (i) LiF flouts the radius ratio rules.
- (ii) Half-filled and fully filled orbitals are associated with extra stability (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1354

I

Unique Paper Code : 2172011101

Name of the Paper : DSC: Atomic Structure and
Chemical Bonding (Inorganic
Chemistry – I)

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

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

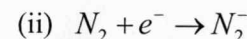
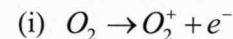
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **6** questions in all. **All** the questions carry equal marks.
3. The questions should be numbered in accordance to the number in the question paper.
4. Calculators and log tables may be used.

1. Explain the following (Any Five)

- (i) The bond angle of $\text{OF}_2 < \text{H}_2\text{O}$ whereas $\text{Cl}_2\text{O} > \text{H}_2\text{O}$.
- (ii) NF_3 has a dipole moment, while BF_3 has zero dipole moment.
- (iii) PF_5 exists but PH_5 does not.
- (iv) Though the radii of Ag^+ is comparable with the radii of K^+ , but the melting point of AgCl is much lower than that of KCl .
- (v) The first electron gain enthalpy of O is exothermic, whereas its second electron gain enthalpy is endothermic; still, it exists as O^{2-} in oxides.
- (vi) Electronic configuration of Cr is $3d^5 4s^1$ and not $3d^4 4s^2$. (5×3)

2. (a) Name the quantum numbers which arise as a consequence of the solution of the wave equation for H-atom. What idea do you get from all these quantum numbers?

- (b) Arrange the following in increasing order of dipole moment: BF_3 , NH_3 , NF_3 . Justify your answer.
- (c) Define Bent's Rule. How does it help to decide the bond angles of CH_2F_2 ?
- (d) What is the expected change in Bond order during the following ionization processes :



8. (a) What do you understand by the term effective nuclear charge? Calculate the shielding constant and effective nuclear charge (Z_{eff}) for the electron present in 4s and 3d of Scandium ($Z = 21$).

(b) Differentiate between :

(i) Orbit and orbital.

(ii) Electronegativity and electron affinity

6. (a) (i) What is a radial node? How many radial nodes are there in a 3s orbital?

(ii) What is radial probability distribution function? Explain it for 1s orbital.

(b) "In case of B_2 , C_2 and N_2 molecules s- p_z mixing cannot be neglected while in case of O_2 and F_2 , MO diagrams explain most of the characteristics of these molecules without considering s- p_z mixing." Justify the statement.

Draw MO diagram of N_2 molecule using s- p_z mixing.

(c) On which law is the Born-Haber cycle based? Set up a Born-Haber cycle for the formation of MgO from magnesium metal and oxygen, i.e.



7. (a) The bond angle in water molecule is 104.5° . Calculate the s character used by the oxygen atom directed to the two bonded orbitals and two non-bonded orbitals.

(b) Write the Kaputinskii equation for lattice energy and define the terms involved. What are the advantages and disadvantages over Born-Landé equation?

(c) What do you understand by partial ionic character in a covalent bond? The electronegativity of hydrogen and bromine are 2.2 and 3.0 respectively. Calculate percent ionic character of HBr. Also predict the nature of HBr molecule.

(d) On the basis of the Slater's rule, explain why 4s orbital is filled before the filling up of 3d orbitals in potassium atom? (4,5,4,2)

3. (a) Given the equation :

$$\Psi_{4,1,0} = R_{4,1} \cdot \theta_{1,0} \cdot \phi_0$$

Based upon the equation, answer the following questions.

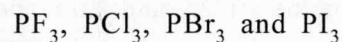
(i) Name the equation.

(ii) Define the terms involved in the equation.

(iii) Which orbital is related with the equation?

(b) Why the covalent radius of Ge (122 pm) is almost the same as that of Si (117 pm) even though Ge has 18 electrons more than Si?

(c) Arrange the following in order of increasing bond angles X – P – X and justify your answer.



(d) The dipole moment of HX molecule is 1.92 D and the bond distance 1.2 Å. Calculate the percent ionic character of HX. ($1\text{D} = 3.336 \times 10^{-30} \text{ Cm}$, charge on one electron = $1.6 \times 10^{-19} \text{ C}$).

(4,3,4,4)

4. (a) Draw the radial probability distribution curves for 3s, 3p, and 3d orbitals. Based on these plots explain their shielding effect and penetration power.

(b) Calculate the limiting radius ratio of cation to that of anion when coordination number is six.

Given $r_{\text{A}^{2+}} = 59 \text{ pm}$ and $r_{\text{B}^{2-}} = 170 \text{ pm}$, predict the geometry of AB.

(c) Using VSEPR theory, predict the shapes of the following species :



5. (a) Give the mathematical expression for the conditions of orthogonality and normalization wave function. What is meant by well-behaved wave function?

(b) Write the following in order of as mentioned in each case with suitable reasons:

(i) Increasing acidity – Acetylene, ethane and ethene.

(ii) Decreasing melting points – KF, KCl, KBr, KI

(c) Ψ_A and Ψ_B are wave functions of two atomic orbitals A and B. Draw the molecular orbital diagrams obtained by combination of the atomic orbitals when

(i) $\chi_A = \chi_B$

(ii) $\chi_A < \chi_B$

where χ_A and χ_B are the electronegativities of atoms A and B. (6,6,3)

1374

- (c) Resonance Effect
(d) Diels-Alder reaction

[This question paper contains 8 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **1374** **I**

Unique Paper Code : 2172011102

Name of the Paper : DSC 2 - Basic Concepts
and Aliphatic
Hydrocarbons (Organic
Chemistry-1)

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

Semester : I

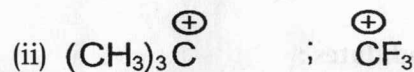
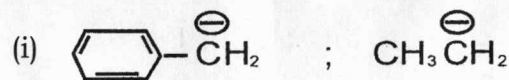
Time : 3 Hours **Maximum Marks : 90**

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **six** questions.
- (c) **All** questions carry **15** marks.
1. (a) An alcohol **A** having molecular formula C_2H_6O , when treated with conc. H_2SO_4 gives an alkene **B**. When **B** is bubbled through

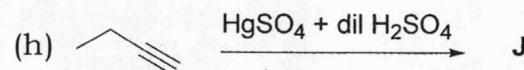
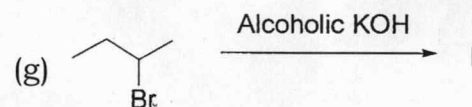
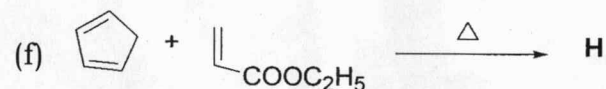
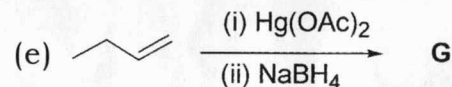
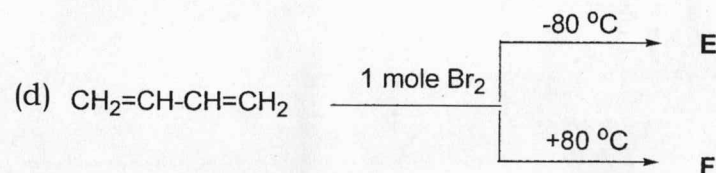
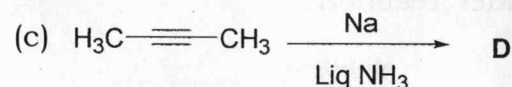
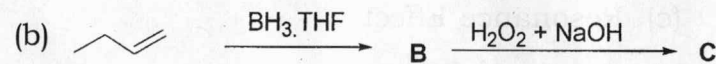
bromine water ($\text{Br}_2/\text{H}_2\text{O}$) and the product obtained is dehydrohalogenated with an excess of strong base sodamide a new compound **C** is obtained. Compound **C** is also obtained by reacting calcium carbide with water. Compound **C** gives **D** when treated with dilute H_2SO_4 in presence of HgSO_4 . Identify **A** to **D**. Write the sequence of chemical reactions involved. 5

- (b) Out of following pairs, which is more stable? Give reason. 5



- (c) Define the terms racemic mixture. Demonstrate the chemical method for resolving a racemic mixture of an acid, using an example. 5

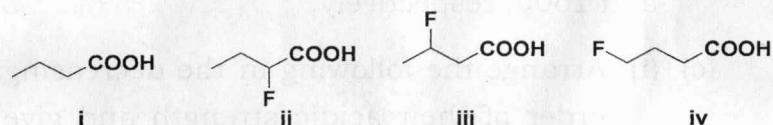
2. (a) How many stereoisomers are possible for tartaric acid? Draw their Fischer projection structures, describe the relationships between them and identify which are optically active and which are optically inactive. 5



8. Write short note on the following (attempt any **three**): 5×3=15

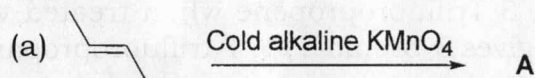
- (a) Wurtz-Fittig reaction
(b) Elcb reaction

- (b) *trans*-2-Butene upon bromination gives meso-dibromo product, while *cis*-2-butene gives racemic mixture ? 5
- (c) Bromination is more selective than chlorination of alkanes ? 5
6. (a) What do you mean by inductive effect ? Arrange the following carboxylic acids in the **increasing order** of their acidity strength. 5

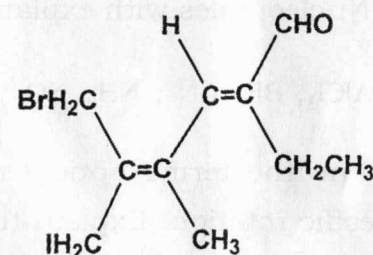


- (b) 2, 3-Dimethylbut-2-ene is more stable than 2-methylbut-1-ene. Explain. 5
- (c) Draw and name various Conformations of Cyclohexane and arrange them in increasing order of their Stability. Draw their potential Energy diagram. 5

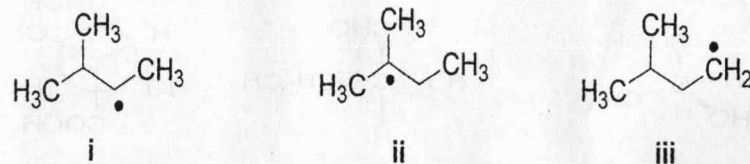
7. Write the structure of product(s) A to J: $10 \times 1.5 = 15$



- (b) (i) A 90° in the plane rotation is not allowed in a Fischer projection, while a 180° rotation is permitted. Justify this statement with a suitable example. 2.5
- (ii) Assign E/Z configuration at all the stereogenic centre(s) present in the following molecule : 2.5



- (c) Define the term hyperconjugation effect and arrange the following free radicals in the increasing order of their stability, giving a suitable reason. 5



3. (a) Draw all conformations of *n*-butane resulting from rotation about the C2-C3 bond and arrange them in order of increasing stability, providing reasons for the stability order. Also, illustrate the potential energy diagram.

5

- (b) (i) Classify the following into Electrophiles or Nucleophiles with explanation.

2.5

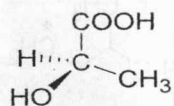


- (ii) Define the terms optical rotation and specific rotation. Explain the factors on which they depend.

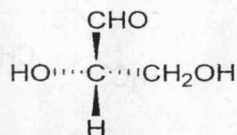
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- (c) Assign the R/S nomenclature at all the chiral centre(s) present in the following molecules : (Do any **two**).

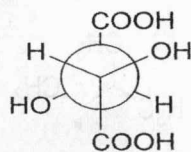
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i



ii

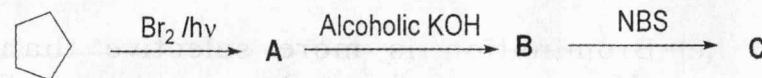


iii

4

4. (a) Complete the following set of chemical reactions :

5

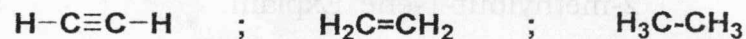


- (b) 2-Methylpropane is brominated at 125°C in the presence of light. What % of product will be 2-bromo-2-methylpropane. The relative reactivity for 1°, 2°, 3° hydrogens are 1, 82 and 1600, respectively.

5

- (c) (i) Arrange the following in the decreasing order of their acidic strength and give suitable explanation.

2.5



- (ii) How will you distinguish between 1-butyne and 2-butyne ? Provide the chemical reaction.

2.5

5. Give suitable explanations with mechanism (if involved).

- (a) 3, 3, 3-Trifluoropropene when treated with HBr gives 3-bromo-1, 1, 1-trifluoropropane ?

5

5

P.T.O.

6. Write short notes on the following name reactions

(Do any **three**):

(i) Benzoin Condensation

(ii) Williamson's Ether Synthesis

(iii) Aldol Condensation

(iv) Wagner-Meerwein Rearrangement (5,5,5)

(1500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1557

I

Unique Paper Code : 2172511101

Name of the Paper : DSC-A1 (Basic Concepts of Organic Chemistry)

Name of the Course : **B.Sc. Program Physical Sciences**

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.

P.T.O.

1. (a) What is hyperconjugation effect? Explain the order of stability of primary, secondary and tertiary carbocations on the basis of this effect.

(b) Give the hybridization state and shape of CH_3^- anion.

(c) Arrange the following in increasing order of acidity and justify your answer: Phenol, Benzoic acid, Acetic acid and Ethanol.

(d) What is electromeric effect? Explain with the help of a suitable example.

(e) Distinguish between inductive effect and resonance effect. (Give atleast three points of difference).

(3,3,3,3,3)

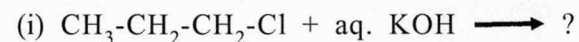
(b) Compare basicity order of primary secondary and tertiary amines in gaseous medium and aqueous medium. Justify the basicity order in each case.

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

5. (a) Draw all possible stereoisomers of tartaric acid and identify which of them are optically active. Also identify the pair of enantiomers and diastereomers among them.

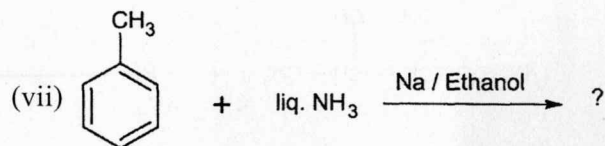
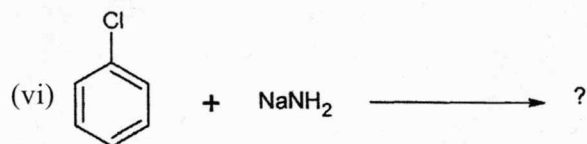
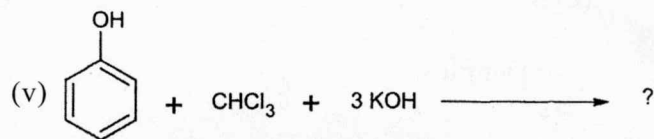
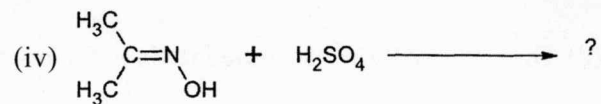
(b) Give the mechanism of Michael addition reaction.

(c) Predict the products and mention the type of reaction mechanism in the following reactions:

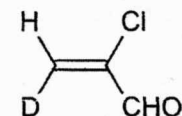
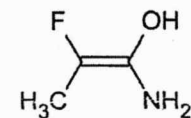


(d) Give the reaction and specify the major product when propene is subjected to hydroboration-oxidation reaction.

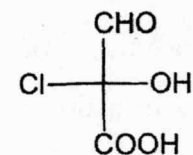
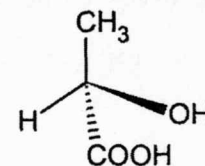
(4,4,4,3)



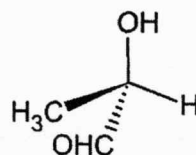
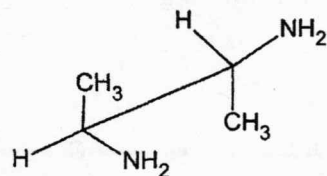
2. (a) Assign the priority sequence and designate E/Z configuration to the following :



- (b) Assign the priority sequence and designate R/S configuration to the following :



- (c) Convert the following projection formulae to Fischer projection :



- (d) Draw energy profile diagram for conformations of n-butane and label the energy gaps between significant conformations. (4,4,4,3)

3. (a) Name a reaction which involves carbene as an intermediate. Give the steps for generation of carbene in this reaction.

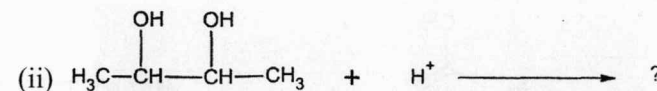
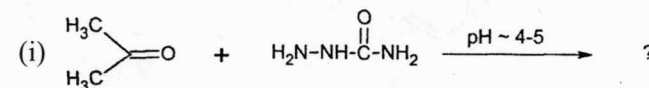
- (b) What is Kharasch effect? Explain the stereochemical aspect of this effect. Name the major product obtained when 1-butene is subjected to reaction with HBr in presence of benzoyl peroxide.

- (c) Explain why nitrobenzene directs the incoming electrophile to meta position?

- (d) Give the reaction and mechanism for bromination of phenol.

- (e) What is an ambidentate nucleophile? Give two examples. (3,3,3,3,3)

4. (a) Complete the following reactions (**Do any six**) :



5. (a) Starting with the Clapeyron equation, derive the expression for Clausius-Clapeyron equation that explains the effect of temperature on pressure of a liquid. 5
- (b) The vapour pressure of water at 90°C is 70.13 kPa and the molar enthalpy of vaporization between 90°C and 100°C is 2.268 kJ/g. Calculate the vapour pressure of water at 100°C. 5
- (c) Calculate the surface tension of liquid toluene and the radius of the capillary tube, if the level of water and toluene rose in the capillary is 9.8 cm and 5.2 cm, respectively. Given surface tension of water at 20°C = 72.75 dyne cm⁻¹, density of water = 998.2 kg m⁻³ and density of toluene = 890.5 kg m⁻³. 5
6. (a) Define coefficient of viscosity. Write SI unit of viscosity. Derive the expression for determination of viscosity of a liquid by using Ostwald's viscometer method. 5
- (b) The viscosity of a liquid is 5×10^{-4} Nsm⁻² at 27°C and 2.5×10^{-4} Ns m⁻² at 327°C. Calculate the energy of activation of viscous flow assuming it to be constant in this temperature range. 5
- (c) (i) The heat of vaporization of water is 1.5 times that of CCl₄. Which liquid will have the higher surface tension and why? 2
- (ii) Comment on the effect of addition of sucrose on the viscosity of water? 2
- (iii) Is it possible to liquify an ideal gas? Explain. 1

[This question paper contains 4 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : 1393 I

Unique Paper Code : 2172011103

Name of the Paper : DSC 3 : Gaseous and Liquid State (Physical Chemistry - I)

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

Semester : I

Time : 2 Hours **Maximum Marks : 60**

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt **four** questions in **all**. Question **NO.1** is compulsory.
- (c) The questions should be numbered in accordance to the number in the question paper.
- (d) Use of Scientific Calculator is permitted.
 $(R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \quad k = 1.38 \times 10^{-23} \text{ JK}^{-1})$
 $N_A = 6.023 \times 10^{23})$

1. Answer any 5 of the following :

- (a) Why are viscosity of gases increases with increase in temperature whereas viscosity of liquids decreases with increase in temperature? 3

- (b) Explain the effect of temperature and pressure on collision frequency of a gas. 3
- (c) At same temperature the distribution of molecular speeds of hydrogen and helium is same. Explain. 3
- (d) Why the composition of gases in the earth's atmosphere varies with height? 3
- (e) Discuss the effect of detergent concentration on the surface tension of water giving graphical representation. Why surface tension becomes nearly constant at higher concentrations of detergent? 3
- (f) Explain the dependence of surface tension on temperature and why the surface tension of a liquid becomes zero at its critical temperature. 3

2. (a) Starting from the postulates of the kinetic theory of gas derive the following equation

$$PV = \frac{1}{3} mN \langle c^2 \rangle \quad 5$$

- (b) Calculate the root mean square speed, average speed and most probable speed of H_2 molecules at 298K. 5
- (c) Draw labelled diagram of P-V isotherms of CO_2 . Explain these isotherms and continuity of states. 5

3. (a) Using the van der Waals equation of state, derive the following relation :

$$P_r = \frac{8T_r}{3V_r - 1} - \frac{3}{V_r}$$

State law of corresponding states based on this relation and significance of this relation. 5

- (b) Calculate the fraction of oxygen gas molecules at $27^\circ C$ and 1 atm possessing velocities between $400 \pm 10 \text{ m/s}$. 5
- (c) Derive an expression for the coefficient of viscosity of a gas, η in terms of the mean free path, λ and show that η of a gas is dependent on temperature, but is independent of pressure. 5

4. (a) Derive the expression of Barometric law :

$$p = p_0 \exp\left(-\frac{Mgh}{RT_0}\right)$$

Explain the effects of temperature and molar mass of the gas on the variation of pressure with height. 5

- (b) Determine the molar mass of a gas if its pressure falls to one - fourth of its value in a vertical distance of 8 km at $27^\circ C$ 5
- (c) The Critical constants for water are $T_c = 647K$, $P_c = 218 \text{ atm}$ and $V_c = 0.05 \text{ dm}^3 \text{ mol}^{-1}$. Calculate the van der Waals constants and critical compressibility factor. 5

3516

5. (a) Determine the hybridization of the central atom and the shape of the following molecules:
 $\text{XeOF}_4, \text{NO}_3^-, \text{ClO}_4^-, \text{SF}_4, \text{CO}_2$ 5
- (b) (i) Explain on the basis of Molecular orbital theory why N_2 is diamagnetic and O_2 is paramagnetic. 3
- (ii) Differentiate between bonding and antibonding molecular orbitals ? 2
- (c) Write the Born-Landé equation for calculating the lattice energy of an ionic crystal and explain the various terms involved. 5
6. (a) (i) Calculate the percentage of ionic character in HCl molecule, given that the bond length is $1.275 \text{ \AA}$ and the observed dipole moment is 1.03 D. 2.5
- (ii) What is resonance ? Draw the resonance structures of CO_3^{2-} 2.5
- (b) Write a short note on the following: $2 \times 2.5 = 5$
- (i) Lattice energy
- (ii) Hydration energy
- (c) Explain Fajan's rules and based on these rules compare the covalent character of the following compounds. 5
- (i) NaCl and CuCl
- (ii) AgCl and AgI

[This question paper contains 4 printed pages]

Your Roll No. :,.....

Sl. No. of Q. Paper : 3516 I

Unique Paper Code : 2174001001

Name of the Paper : Atomic Structure and Chemical Bonding

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

Semester : I/III/V

Time : 2 Hours Maximum Marks : 60

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **four** questions out of six.
- (c) **All** question carry equal marks.
1. (a) (i) Why are electronic configurations with half-filled and fully filled orbitals more stable than the other configurations. Explain with suitable example. 3
- (ii) Differentiate between the terms 'shell' and 'subshell.' 2
- (b) (i) Write the significance of $\Psi(x)$ and $\Psi^2(x)dx$, where Ψ is representing an electronic wave-function. 2.5

- (ii) What are some special properties which must be fulfilled by acceptable wave function ? 2.5
- (c) (i) Calculate the wavelength of electron (mass = 10^{-30} kg) moving with kinetic energy 10^{-14} J ($h = 6.626 \times 10^{-34}$ Js) 2.5
- (ii) What do you understand by the Aufbau Principle ? Why is the 4s orbital filled before the 3d orbital ? 2.5
2. (a) Write the time-independent Schrodinger wave equation (three dimensional) for the electron in a hydrogen atom in Cartesian coordinates and explain all the terms involved. What three quantum numbers are derived from its solution ? 5
- (b) State and explain the Pauli Exclusion principle and the Heisenberg uncertainty Principle. 5
- (c) The Lyman series of emission lines in the hydrogen atom's emission spectrum corresponds to electronic transitions from excited states to the $n = 1$ orbit. Calculate the wavelength of the lowest energy line in the Lyman series and specify the region of the electromagnetic spectrum in which it occurs. 5
3. (a) Draw the radial probability distribution curves for the 1s, 2s and 2p orbitals, labeling the nodes present and the most probable distance for each. 5

- (b) Write a short note on the following : ($2 \times 2.5 = 5$)
- (i) Bohr's theory and its limitations
- (ii) Radial and angular parts of a wave function and their significance
- (c) Give the values of all four quantum numbers for the 2s, 5p and 4d orbitals. 5
4. (a) Draw Born Haber cycle and the enthalpy of formation (ΔH_f°) for MgF_2 using the following data- 5
- Enthalpy of sublimation of Mg = 146.4 KJ/mol
 Ionization energy 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
 Lattice energy of MgF_2 = -2922.5 KJ/mol
- (b) What do you understand by the term VSEPR theory ? Write the postulates of VSEPR theory. 5
- (c) (i) What is Madelung constant ? Is the Madelung constant same or different for NaCl and CsCl ionic structures ? 3
- (ii) Why is the bond order of O_2^+ is more than that of O_2 ? 2

(ख) किसी फर्म के राजस्व और उसके लाभ के बीच अंतर स्पष्ट कीजिए। इनमें से किसको अधिकतम करने का लक्ष्य फर्म रखती हैं?

8. (a) Differentiate between external economies and diseconomies of industry. (9)

(b) Define sunk cost. Explain firm's long-run decision to exit or enter a market. (9)

(क) उद्योग की बाह्य मितव्ययिताओं और अमितव्ययिताओं के बीच अंतर बताइए।

(ख) डूबी हुई लागत को परिभाषित कीजिए। किसी बाजार से बाहर निकलने या उसमें प्रवेश करने के लिए फर्म के दीर्घकालिक निर्णय की व्याख्या कीजिए।

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3432

I

Unique Paper Code : 2274001003

Name of the Paper : Principles of Microeconomics – I

Name of the Course : Generic Elective-Economics

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 five questions.
3. Answers may be written either in English or Hindi; but the same medium should be used throughout the paper.

छात्रों के लिए निर्देश

1. इस प्रश्न-पत्र के मिलते ही ऊपर दिए गए निर्धारित स्थान पर अपना अनुक्रमांक लिखिए।

2. किन्हीं पाँच प्रश्नों के उत्तर दें।
3. इस प्रश्न-पत्र का उत्तर अंग्रेजी या हिंदी किसी एक भाषा में दीजिए, लेकिन सभी उत्तरों का माध्यम एक ही होना चाहिए।

1. (a) Distinguish between movements along the demand curve and shifts in the demand curve. Explain the effects of shifts in demand curve on the market equilibrium. (9)
- (b) Following table shows supply to an office per month by three firms. Calculate market supply schedule. (9)

Price In Rs.	Quantity Supplied		
	Firm A	Firm B	Firm C
1.0	1	0	1
1.5	2	2	4
2.0	3	4	7
2.5	4	6	10
3.0	5	8	13

- (क) मांग वक्र के साथ होने वाली गतिविधियों और मांग वक्र में होने वाले बदलावों के बीच अंतर बताइए। मांग वक्र में होने वाले बदलावों का बाजार संतुलन पर पड़ने वाले प्रभावों की व्याख्या कीजिए।

- (b) Define law of diminishing returns. In this context show the relation between total product, marginal product and average product with help of diagram. (9)

- (क) लाभ अधिकतमीकरण के प्राथमिक उद्देश्य को प्राप्त करने के लिए सभी उद्योगों में फर्मों को क्या बुनियादी निर्णय लेने चाहिए?
- (ख) घटते प्रतिफल के नियम को परिभाषित कीजिए। इस संदर्भ में आरेख की सहायता से कुल उत्पाद, सीमांत उत्पाद और औसत उत्पाद के बीच संबंध दर्शाइये।

7. (a) What happens to the market supply curve when there is an increase in demand in the short run versus the long run? Use diagrams to illustrate the shifts in supply and equilibrium prices. (9)
- (b) Explain the difference between a firm's revenue and its profit. Which of these do firms aim to maximize? (9)

- (क) जब अल्पावधि बनाम दीर्घावधि में माँग में वृद्धि होती है तो बाजार आपूर्ति वक्र का क्या होता है? आपूर्ति और संतुलन कीमतों में बदलाव को दर्शाने के लिए आरेखों का उपयोग कीजिए।

(b) Perfect substitute and compliments goods are two extreme examples of consumer preferencess. Discuss using indifference curves. (9)

(क) मान लीजिए किसी विशेष वस्तु के लिए बाजार को निम्नलिखित मांग और आपूर्ति समीकरणों द्वारा वर्णित किया गया है :

$$Q_d = 500 - 2P$$

$$Q_s = 3P - 100$$

(i) संतुलन मूल्य और मात्रा ज्ञात कीजिए।

(ii) संतुलन पर उपभोक्ता अधिशेष और उत्पादक अधिशेष की गणना कीजिए।

(iii) यदि सरकार 80 की मूल्य सीमा लगाती है, तो बाजार में परिणामी कमी या अधिशेष की गणना कीजिए।

(ख) पूर्ण प्रतिस्थापन और पूरक वस्तुएँ उपभोक्ता वरीयताओं के दो चरम उदाहरण हैं। उदासीनता वक्रों का उपयोग करके चर्चा कीजिए।

6. (a) What are the basic decisions that firms must make in all industries to achieve the primary objective of profit maximisation? (9)

(ख) निम्न तालिका तीन फर्मों द्वारा प्रति माह एक कार्यालय को की जाने वाली आपूर्ति को दर्शाती है। बाजार आपूर्ति अनुसूची की गणना कीजिए।

Price In Rs.	Quantity Supplied		
	Firm A	Firm B	Firm C
1.0	1	0	1
1.5	2	2	4
2.0	3	4	7
2.5	4	6	10
3.0	5	8	13

2. (a) Define indifference curves? What are the assumptions on which indifference curve analysis is based? (9)

(b) Using indifference curves, explain how an increase in consumers' real income, while holding relative prices constant, impacts the demand for an inferior good. (9)

(क) उदासीनता वक्र को परिभाषित कीजिए? वे कौन-सी मान्यताएँ हैं जिन पर उदासीनता वक्र विश्लेषण आधारित है?

(ख) उदासीनता वक्रों का उपयोग करते हुए, स्पष्ट कीजिए कि सापेक्ष कीमतों को स्थिर रखते हुए उपभोक्ताओं की वास्तविक आय में वृद्धि, घटिया माल की माँग को कैसे प्रभावित करती है।

3. (a) Discuss the concept of consumer surplus and how it is related to a buyer's willingness to pay. Use a graph to illustrate how a change in price affects consumer surplus and explain the implications of this change for buyers. (9)

(b) If apples are inferior goods, with the help of a diagram explain the decomposition of price effect in to income effect and substitution effect for apples. (9)

(क) उपभोक्ता अधिशेष की अवधारणा पर चर्चा कीजिए और यह खरीदार की भुगतान करने की इच्छा से कैसे संबंधित है। एक ग्राफ का उपयोग करके यह दर्शाइये कि मूल्य में परिवर्तन उपभोक्ता अधिशेष को कैसे प्रभावित करता है और खरीदारों के लिए इस परिवर्तन के निहितार्थों की व्याख्या कीजिए।

(ख) यदि सेब घटिया माल हैं, तो आरेख की सहायता से सेब के लिए मूल्य प्रभाव के आय प्रभाव और प्रतिस्थापन प्रभाव में विघटन की व्याख्या कीजिए।

4. (a) Define perfect competition. Draw a demand curve of a firm in a perfectly competitive market. (9)

(b) Differentiate between variable cost and fixed cost. In this context, explain the relationship between marginal cost and average cost with the help of a diagram. (9)

(क) पूर्ण प्रतिस्पर्धा को परिभाषित कीजिए। पूर्ण प्रतिस्पर्धी बाजार में किसी फर्म का माँग वक्र बनाइये।

(ख) परिवर्तनीय लागत और स्थिर लागत के बीच अंतर कीजिए। इस संदर्भ में, आरेख की सहायता से सीमांत लागत और औसत लागत के बीच संबंध की व्याख्या कीजिए।

5. (a) Suppose the market for a particular good is described by the following demand and supply equations :

$$Q_d = 500 - 2P$$

$$Q_s = 3P - 100$$

(i). Find the equilibrium price and quantity.

(ii) Calculate the consumer surplus and producer surplus at equilibrium.

(iii) If the government imposes a price ceiling of 80, calculate the resulting shortage or surplus in the market. (9)

analysis and outline its pros and cons over classical methods. (7)

(b) Write short note on (5)

1. Elution

2. Resolution

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1082 I

Unique Paper Code : 2512042301

Name of the Paper : Analytical Instrumentation-I

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

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. Use of scientific calculator is allowed.
 3. Attempt any 5 questions in all.
 4. Question no. 1 is compulsory.
 5. All questions carry equal marks
-
1. (a) Absorbance of a standard 2 ppm sample in a 1cm cuvette is 0.30. (2)

Calculate the concentration of an unknown solution (same absorbing species) if the absorbance in the same cuvette is 0.75.

- (b) What is the difference between colorimetry and spectrophotometry? (2)
 - (c) How is the R_f value defined in the context of chromatography? (2)
 - (d) Polar molecules show low R_f value in paper chromatography. Give a reason. (2)
 - (e) Write down the two factors affecting the column efficiency in column chromatography. (2)
 - (f) Differentiate between classical and instrumental method. (2)
2. (a) Explain the factors affecting the choice of analytical method. (7)
- (b) What features of HPTLC address the limitations found in standard TLC? (5)
3. (a) What are the shortcomings and challenges associated with using Beer Lambert's law in UV-VIS spectrometry? (7)

(b) Explain the principle of paper chromatography and discuss its applications in separating and analyzing mixtures. (5)

4. (a) Compare and contrast thin layer chromatography with column chromatography in terms of methodology and applications. (7)
- (b) The intensity of incident light on a sample is 0.60 W/m^2 and the intensity of light entering the detector is 0.40 W/m^2 . Determine the transmittance and absorbance. (5)
5. (a) Explain how GPC can be used to determine the molecular weight distribution of polymers. Why is this information important? (7)
- (b) What are the dispersing elements used in UV-Vis spectroscopy applications? Which one is preferred? Give two reasons. (5)
6. (a) Define extraction. Describe any one type of sample extraction technique. (7)
- (b) Define band broadening in chromatography. Write the equation and explain the terms involved in Van Deemter equation. (5)
7. (a) Describe the instrumental method of quantitative

1459

8

Enthalpy of dissociation of $\text{H}_2(\text{g})$

$$\Delta_{\text{diss}}\text{H} = 435.93 \text{ kJ mol}^{-1}$$

Enthalpy of sublimation of C (graphite)

$$\Delta_{\text{sub}}\text{H} = 716.68 \text{ kJ mol}^{-1}$$

(5)

(c) Define the Joule-Thomson coefficient. Show that it is zero for an ideal gas. (5)

(3500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1459

I

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. Question No. 1 is compulsory.
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.

1. Answer any five questions. Each question carry equal marks (3×5)

(a) Comment: All natural processes are irreversible in nature.

(b) Entropy favors melting and energy favors freezing of water. Discuss.

(c) Differentiate between residual entropy and third law entropy.

(d) The equilibrium constant for the reaction $\text{SO}_3(\text{g}) \rightleftharpoons \text{SO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$ is 0.18 at 900 K. What will be the equilibrium constant for the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ at 900 K.

(e) Arrange the following in increasing order of pH.
 $\text{KNO}_3(\text{aq})$, $\text{C}_6\text{H}_5\text{COONH}_4(\text{aq})$, $\text{NH}_4\text{Cl}(\text{aq})$,
 $\text{CH}_3\text{COONa}(\text{aq})$

(c) Calculate the pH of an aqueous solution obtained by mixing 25 mL of 0.2 M HCl with 50 mL of 0.25 M NaOH. $K_w = 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 25°C . (5)

6. (a) Derive the relation between the pH of the solution and the relative amounts of the acid and salt present in it. (5)

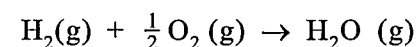
(b) Calculate the bond enthalpy of C—H from the following data at 298 K:

Enthalpy of combustion of methane

$$\Delta_c H = -890.36 \text{ kJ mol}^{-1}$$

Enthalpy of combustion of C (graphite)

$$\Delta_c H = -393.51 \text{ kJ mol}^{-1}$$

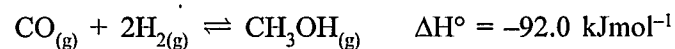


$$\Delta_r H = -285.85 \text{ kJ mol}^{-1}$$

(c) 25 mL of 4×10^{-5} M solution of $\text{Ba}(\text{NO}_3)_2$ is mixed with 500 mL of 5×10^{-5} M solution of Na_2SO_4 . Will a precipitate of BaSO_4 be formed? $K_{\text{sp}}(\text{BaSO}_4) = 1.08 \times 10^{-10} \text{ M}^2$. (5)

5. (a) Endothermic reactions are entropy driven processes. Explain. (5)

(b) The following reaction has attained equilibrium



What will happen if

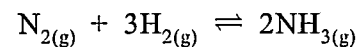
(i) Volume of the reaction vessel is suddenly reduced to half.

(ii) The partial pressure of hydrogen is suddenly doubles. (5)

(f) Explain any two limitations of the first law of thermodynamics which led to the formulation of the second law.

2. (a) Five moles of an ideal gas at 293 K are expanded are expanded isothermally from an initial pressure of 0.4053 MPa to a final pressure of 0.1013 MPa against a constant external pressure of 0.1013 MPa. Calculate q , w , ΔU and ΔH . (5)

(b) What is the effect of increasing pressure on the equilibrium?



What are the conditions for getting maximum yield of NH_3 by Haber's process? (5)

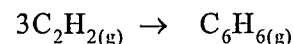
(c) At 298 K, the solubility product of $\text{Bi}(\text{OH})_3$ is 4.0×10^{-31} . Calculate its solubility. (5)

3. (a) State Kelvin – Planck statement of second law of thermodynamics. Express the following rate of change in terms of state functions :

(i) H with respect to temperature in a system held at constant pressure.

(ii) S with respect to temperature in a system held at constant pressure. (5)

- (b) Calculate the enthalpy change of the following reaction :



Given: Enthalpy of combustion of $\text{C}_2\text{H}_{2(g)} = -1.30 \text{ MJmol}^{-1}$

Enthalpy of combustion of $\text{C}_6\text{H}_{6(g)} = -3.302 \text{ MJ mol}^{-1}$

Write the reaction involved too. (5)

- (c) What are buffer solutions? When a small quantity of acid is added to an aqueous solution of ammonium acetate, the pH of the solution remains unchanged, whereas when the same acid is added to an aqueous solution of sodium chloride, the pH of the solution changes enormously. Explain. (5)

4. (a) Prove that change in Gibbs free energy is non-PV work at constant temperature and pressure. (5)

- (b) Show that the degree of dissociation (α) for the dissociation PCl_5 into PCl_3 & Cl_2 at pressure P is given by :

$$\alpha^2 = \left[\frac{K_p}{p + K_p} \right] \quad (5)$$

Concentration of HCl solution = 0.100 N

Mass of silver deposited in the coulometer = 0.1209 g

Movement of the boundary = 7.50 cm

Cross-section of the tube = 1.24 cm²

- (c) Define ionic mobility and show that, the ionic mobility of a solution (1:1 Electrolyte) at infinite dilution is given by

$$u_+^\circ + u_-^\circ = \frac{\lambda_+^\circ}{F} + \frac{\lambda_-^\circ}{F}$$

Where, u° is ionic mobility and λ° is molar ionic conductance. (5,5,5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1151 I

Unique Paper Code : 2172012303

Name of the Paper : DSC: Chemical Equilibrium, Ionic Equilibrium, Conductance and Solid State

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

Semester : III

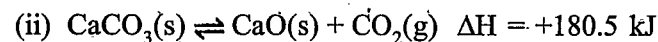
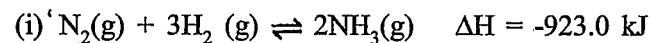
Duration : 3 Hours

Maximum Marks : 90

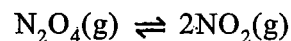
Instructions for Candidates

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

1. (a) State the Le Chatelier's principle. For the equilibrium reactions given below, discuss how the equilibrium will shift with the change in temperature and pressure :



(b) The dissociation of N_2O_4 is given by the equation:



- (i) If α is the degree of dissociation of N_2O_4 and P is the total pressure of the system, show that

$$K_p = \frac{4\alpha^2 P}{1 - \alpha^2}$$

- (ii) Calculate K_c and K_x of the given reaction for which $K_p = 0.157 \text{ atm}$ at 27°C and 1 atm pressure.

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

- (i) Degree of advancement of reaction
- (ii) Free energy of mixing and spontaneity
- (iii) Buffer capacity (5,5,5)

2. (a) Show that the exact equation to calculate $[\text{H}_3\text{O}^+]$ in an aqueous solution containing a salt formed from a strong acid and a weak base is given by:

(b) Draw and discuss the titration curves obtained in the conductometric titration of:

(i) mixture of CH_3COOH and HCl versus NaOH in aqueous medium

(ii) HCl versus NaOH in aqueous medium

- (c) A cell with electrodes that are 1.80 cm^2 in surface area and 0.50 cm apart is filled with 0.01 M MgCl_2 solution. Molar conductivity of 0.01 M solution of MgCl_2 is $195 \text{ S cm}^2 \text{ mol}^{-1}$ at 25°C . How much current will flow when the potential difference between the two electrodes is 5.0 V ? (5,5,5)

8. (a) What is transference number? Derive the expression $t \propto v$ for an ion where, "t" is the transference number and "v" is the absolute velocity of the ion.

- (b) Calculate the transport numbers of H^+ and Cl^- ions from the following data obtained from the moving boundary method using cadmium chloride as the indicator electrolyte (Atomic mass of $\text{Ag} = 108 \text{ g mol}^{-1}$):

- (c) (i) Calculate the degree of hydrolysis of 0.10 M solution of sodium acetate at 25°C. $K_a = 1.75 \times 10^{-5}$ and $K_w = 1.008 \times 10^{-14}$.

- (ii) Explain why a solution containing a strong base and its salt does not act as a buffer solution?

OR

- (c) Why methyl orange cannot be used as indicator for titrating a weak acid against a strong base? Discuss the pH metric titration curve of a strong acid with strong base. (5,5,5)

7. (a) When a conductance cell was filled with 0.02 M KCl (with specific conductance $0.002768 \text{ S cm}^{-1}$) it had a resistance of 82.4 ohm at 25°C. When filled with 0.05 N K_2SO_4 it had a resistance of 326 ohm. Calculate:

- (i) Cell constant
- (ii) Conductance
- (iii) Specific Conductance
- (iv) Equivalent conductance of 0.05 N K_2SO_4

$$K_h = \frac{([H_3O^+] - \frac{K_w}{[H_3O^+]}) ([H_3O^+])}{(c + \frac{K_w}{[H_3O^+]} - [H_3O^+])}$$

where k_h and c have their usual meanings.

- (b) Calculate the concentrations of H_3O^+ , CN^- , HCN and OH^- in a 0.01 M solution of HCN in water, given K_a (HCN) as 6.8×10^{-10} and K_w as 1.0×10^{-14} at 25°C. Indicate and justify the approximations used in the calculations.

- (c) The solubility product of magnesium hydroxide, $\text{Mg}(\text{OH})_2$ at 25°C is $1.4 \times 10^{-11} \text{ M}^3$. Calculate the solubility of magnesium hydroxide in grams per litre. (Molar Mass of Mg = 24, O = 16, H = 1) (5,5,5)

3. (a) What do you understand by the terms "symmetry elements" and "symmetry operations"? Explain the following symmetry elements and associated operations:

- (i) Plane of Symmetry/Mirror Plane
- (ii) Proper Rotation Axis

(b) What are Miller Indices? Determine the Miller indices of the planes that intersect the crystallographic axes at the distance given below:

(i) (1a, 3b, -c)

(ii) (2a, 3b, 4c)

(c) A first-order reflection from the (111) planes of a cubic crystal were observed at a glancing angle of 11.2° when Cu (K_α) X-rays of wavelength 154 pm were used. What is the length of the side of the unit cell? Calculate the angle at which the same crystal will give a reflection from the (123) planes. (5,5,5)

4. (a) What is the effect of temperature change on the equilibrium constant? Derive a relation between K_p and T starting from the Gibbs Helmholtz equation.

(b) Explain the following :

(i) The molar conductivities of the alkali metal ions increase on going from Li^+ to Cs^+ .

(ii) Acetate ions have lower conductivity than chloride ions.

(c) State and explain Kohlrausch's law. Illustrate how this law is used for the calculation of molar ionic conductance at infinite dilution of weak electrolytes. (5,5,5)

5. (a) Describe the powder method to determine the crystal structure. Explain why it is not possible to deduce the position of hydrogen atoms from X-ray diffraction.

(b) Draw the planes for which the Miller indices are (112) and (200).

(c) What are Weiss indices? What are the corresponding Miller indices of the Weiss indices of crystal planes given below :

(i) (2a, 2b, 2c)

(ii) (a, b, ∞c) (5,5,5)

6. (a) Deduce the relation between K_h , K_a and K_w for a salt of a weak acid and a weak base. Also, find the pH of the hydrolyzed salt solution.

(b) What is pH scale? Calculate the pH of a solution obtained by mixing 25 mL of 0.2 M HCl with 50 mL of 0.25M NaOH. Take $K_w = 10^{-14}$.

(c) Write short note on **any one** of the following :

(i) Ion exchange method for separation of lanthanides

(ii) Lanthanide contraction and its consequences
(5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1075

I

Unique Paper Code : 2172012301

Name of the Paper : DSC 7: Chemistry of d and f
Block Elements & Quantitative
Inorganic Analysis (NEP-
UGCF-2022)

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 :

(a) (i) The factors responsible for formation of a large number of complexes by transition metals.

(ii) Actinides have a greater tendency to form complexes than lanthanides. (5)

(b) Electronic spectra of Ln^{3+} complexes are similar irrespective of change of ligand. (5)

(c) The coordination numbers of the elements of second and third transition series tend to be greater than for the first transition series. (5)

2. Explain why :

(a) (i) Fewer number of oxidation states are available at each end of the first transition series than in the middle?

(ii) Which is more effective for washing a precipitate in the gravimetric analysis: using two portions of 50 mL or ten portions of 10 mL of each? Justify your answer. (2+3)

6. (a) (i) What are silicones? What are the chain building and chain stopping units in silicones?

(ii) Identify the industries from the following which use silicones:

Rubber, Glass, Oil, Cement (5)

(b) Match the uses with the polymers

Gemstones	montmorillonites
Textiles	orthosilicates
Fertilizers	polyphosphazenes
Paints	phosphates
Corrosion protection	Borates

(5)

(ii) A M^{2+} ion of first transition series has been observed to have four unpaired electrons. Calculate its magnetic moment using spin only formula,

(iii) What is the effect of curie temperature in ferromagnetism? $(2.5 \times 3 = 7.5)$

5. (a) (i) Write a short note on borates.

(ii) Discuss the primary differences in the general properties of inorganic and organic polymers (any three). (2.5×2)

(b) (i) What is the structural difference between pyroxines and amphiboles?

(ii) Draw the structures of following ions :



(c) (i) Mention the criteria while selecting a wash solution in the gravimetric analysis.

(ii) Transition metals in high oxidation states are generally available as fluorides or oxides? (5)

(b) Lanthanides predominantly exhibit a +3 oxidation state while actinides exhibit other than +3 oxidation states. (5)

(c) (i) Transition elements and their compounds act as good catalysts.

(ii) Absorption spectra of transition metal ions are broad. (5)

3. (a) (i) Write the number of unpaired electrons in Ce^{4+} (At. No.=58) and Eu^{3+} (At. No.=63).

(ii) Why aqueous solutions of Eu^{3+} is pale pink while Ce^{4+} is orange red? (5)

(b) Calculate the magnetic moment of Europium (III) ($L=3$). Explain the discrepancy between observed (3.4-3.6 BM) and calculated value. (5)

(c) Explain (any one) :

(i) Micac are harder than clay.

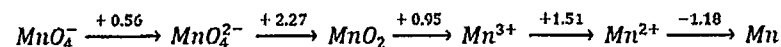
(ii) Structure of cyclic phosphazene (trimer).

(2.5)

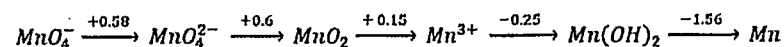
(d) Advantages and disadvantages of digestion in gravimetric analysis. (2.5)

4. (a) Given below are the Latimer diagrams of Mn (Reduction potential, E° in Volt) in acidic medium and basic medium :

Acidic medium:



Basic medium:



Answer the following questions with the help of above diagrams :

(i) Write the balanced half reaction for the reduction of MnO_4^- to Mn^{2+} in acidic medium. Find the standard reduction potential for the reaction.

(ii) In which of the medium, acidic or basic Mn(III) is more stable? Justify your answer.

(iii) Using the given Latimer diagram for manganese in acidic medium, construct the Frost diagram to determine the most stable oxidation state of manganese. Explain your reasoning based on the diagram.

(2+1.5+4=7.5)

(b) (i) Explain the reason for the validity of spin only expression to calculate the magnetic moment for ions of first transition series.

6. Describe the application of bioreactors in the treatment of industrial wastewater. Provide a step-by-step explanation of their operation and benefits.

(15)

(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1078

I

Unique Paper Code : 2182012301

Name of the Paper : Environmental Chemistry
(DSCC-7)

Name of the Course : **B.Sc. Hons. Environmental
Sciences – Core**

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. Answer any **four** questions.
3. **All** Questions carry equal marks.

1. (a) Explain the structural forms of DNA and their biological significance. (8)

P.T.O.

- (b) Define post-translational modifications, list their types, and briefly describe their significance in protein functionality. (7)

2. Write short notes on the following (any three) :

(5×3=15)

- (a) Nernst equation and its relevance to electrochemical cells.
- (b) Restriction enzymes and their types.
- (c) Composting as a solid waste treatment method.
- (d) Bio-control of plant pathogens.

3. Differentiate between the following (any three) :

(5×3=15)

- (a) Euchromatin and Heterochromatin
- (b) Genomic and cDNA libraries

- (c) Bioventing and Biosparging

- (d) Aliphatic hydrocarbons and Substituted hydrocarbons

4. (a) What do you understand by bioremediation?

Discuss its potential and limitations in the treatment of heavy metal contamination. (8)

- (b) List the steps involved in using plants or microbes for environmental remediation and mention precautions required. (7)

5. (a) Elaborate on the role of microbial transformations in copper extraction. (8)

- (b) Discuss the relationship between PGPR bacteria and biofertilizers in enhancing soil fertility. (7)

5. (a) Determine the hybridization of the central atom and the shape of the following molecules:
 $\text{XeOF}_4, \text{NO}_3^-, \text{ClO}_4^-, \text{SF}_4, \text{CO}_2$ 5
- (b) (i) Explain on the basis of Molecular orbital theory why N_2 is diamagnetic and O_2 is paramagnetic. 3
- (ii) Differentiate between bonding and antibonding molecular orbitals ? 2
- (c) Write the Born-Landé equation for calculating the lattice energy of an ionic crystal and explain the various terms involved. 5
6. (a) (i) Calculate the percentage of ionic character in HCl molecule, given that the bond length is $1.275 \text{ \AA}$ and the observed dipole moment is 1.03 D. 2.5
- (ii) What is resonance ? Draw the resonance structures of CO_3^{2-} 2.5
- (b) Write a short note on the following: $2 \times 2.5 = 5$
- (i) Lattice energy
- (ii) Hydration energy
- (c) Explain Fajan's rules and based on these rules compare the covalent character of the following compounds. 5
- (i) NaCl and CuCl
- (ii) AgCl and AgI

[This question paper contains 4 printed pages]

Your Roll No. :,.....

Sl. No. of Q. Paper : 3516 I

Unique Paper Code : 2174001001

Name of the Paper : Atomic Structure and Chemical Bonding

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

Semester : I/III/V

Time : 2 Hours Maximum Marks : 60

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **four** questions out of six.
- (c) **All** question carry equal marks.
1. (a) (i) Why are electronic configurations with half-filled and fully filled orbitals more stable than the other configurations. Explain with suitable example. 3
- (ii) Differentiate between the terms 'shell' and 'subshell.' 2
- (b) (i) Write the significance of $\Psi(x)$ and $\Psi^2(x)dx$, where Ψ is representing an electronic wave-function. 2.5

- (ii) What are some special properties which must be fulfilled by acceptable wave function ? 2.5
- (c) (i) Calculate the wavelength of electron (mass = 10^{-30} kg) moving with kinetic energy 10^{-14} J ($h = 6.626 \times 10^{-34}$ Js) 2.5
- (ii) What do you understand by the Aufbau Principle ? Why is the 4s orbital filled before the 3d orbital ? 2.5
2. (a) Write the time-independent Schrodinger wave equation (three dimensional) for the electron in a hydrogen atom in Cartesian coordinates and explain all the terms involved. What three quantum numbers are derived from its solution ? 5
- (b) State and explain the Pauli Exclusion principle and the Heisenberg uncertainty Principle. 5
- (c) The Lyman series of emission lines in the hydrogen atom's emission spectrum corresponds to electronic transitions from excited states to the $n = 1$ orbit. Calculate the wavelength of the lowest energy line in the Lyman series and specify the region of the electromagnetic spectrum in which it occurs. 5
3. (a) Draw the radial probability distribution curves for the 1s, 2s and 2p orbitals, labeling the nodes present and the most probable distance for each. 5

- (b) Write a short note on the following : ($2 \times 2.5 = 5$)
- (i) Bohr's theory and its limitations
- (ii) Radial and angular parts of a wave function and their significance
- (c) Give the values of all four quantum numbers for the 2s, 5p and 4d orbitals. 5
4. (a) Draw Born Haber cycle and the enthalpy of formation (ΔH_f°) for MgF_2 using the following data- 5
- Enthalpy of sublimation of Mg = 146.4 KJ/mol
 Ionization energy 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
 Lattice energy of MgF_2 = -2922.5 KJ/mol
- (b) What do you understand by the term VSEPR theory ? Write the postulates of VSEPR theory. 5
- (c) (i) What is Madelung constant ? Is the Madelung constant same or different for NaCl and CsCl ionic structures ? 3
- (ii) Why is the bond order of O_2^+ is more than that of O_2 ? 2

BBr_3 , BCl_3 , BF_3

Explain giving reason.

(c) Discuss the structures of:

(i) Ca-EDTA complex

(ii) iodine heptafluoride (4,4,4)

6. (a) Silicon analogues of alkene and alkyne are not known. Give reason.

(b) Discuss the similarities between halogens and pseudohalogens. Give reasons.

(c) What are silicones? Silicones are water repellent and resistant to the attack by oxidising agents. Give reasons. (4,4,4)

7. Give reasons for the following:

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

(b) Which has greater XOX bond angle? Cl_2O or F_2O

(c) Which is more soluble? MgSO_4 or BaSO_4 (4,4,4)

8. Write short notes on:

(a) Zone refining

(b) Solution of alkali metal in liquid ammonia

(c) Interhalogen compounds (4,4,4)
(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5842

I

Unique Paper Code : 32171301

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

Name of the Course : **B.Sc. (H) Chemistry - CBCS-
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 **six** questions in all.

3. **Question number 1** is compulsory.

1. Explain the following, giving suitable reasons:

(a) Lithium forms predominantly the monoxide, sodium forms peroxide whereas potassium, rubidium and cesium form superoxides.

P.T.O.

- (b) Ionisation enthalpies of group 14 elements show irregular trends.
- (c) Using Ellingham diagram, explain why the slope of most of the lines move in upward direction with increase in temperature.
- (d) Helium and Neon do not form clathrate compounds.
- (e) C^{4+} ion doesn't exist in solid or solution state. (3×5)
2. (a) What is diagonal relationship? Giving examples explain how boron resembles silicon.
- (b) Carbon shows much greater tendency for catenation in comparison to silicon and nitrogen.
- (c) Name the peroxo acids of sulphur. Discuss their structure and give the oxidation state of 'S' in them. (4,4,4)
3. (a) Name the hydrides of group 16 elements and discuss the variation in their properties with reference to:
- (i) Thermal stability
- (ii) Reducing character

- (b) Give the principle and procedure of Van Arkel De Boer process.
- (c) Explain how diborane is an electron deficient compound? Draw its structure and discuss the bonding involved. (4,4,4)
4. (a) Arrange the following in the increasing order of their acidic strength. Justify your answer.
- (i) HCl, HBr, HI, HF
- (ii) $HClO_2$, HClO, $HClO_3$, $HClO_4$
- (b) Draw and discuss the structure of P_4O_{10} and give the mechanism for its hydrolysis.
- (c) Give the chemical reaction involved on heating for the following, give explanation for your answer.
- (i) Lithium nitrate
- (ii) Potassium nitrate (4,4,4)
5. (a) Explain: Carbon is a non-metal, but one of its allotropic forms, namely Graphite is a good conductor of electricity.
- (b) Arrange the following in order of their increasing Lewis acid strength:

8. Explain the difference between (any three) :

- (i) Lithium metal battery and Lithium ion battery
 - (ii) Carburizing and Cementation
 - (iii) Direct and Indirect fertilizers
 - (iv) Galvanizing and Tinning
 - (v) Varnish and Lacquer
- (5,5,5)

(1500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1282

I

Unique Paper Code : 2173012002

Name of the Paper : DSE/GE: Inorganic Materials of
Industrial Importance

Name of the Course : B.Sc. (H) 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 any **six** questions in all.
3. **All** questions carry equal marks.

P.T.O.

1. (a) Fill in the blanks :

(i) Individual solar cells can be combined to form modules commonly known as _____.

(ii) Protective power of a surface coating will increase with _____ in porosity.

(iii) The composition of soda lime glass is _____.

(iv) There are _____ pentagons and _____ hexagons in C_{60} .

(v) _____ coating protects iron sacrificially.

(vi) Superphosphate is an example of _____ fertilizer.

(vii) Emulsion paints are considered eco-friendly because they have _____ as thinner.

6. (a) What are fertilizers? How they can be classified on the basis of their application?

Outline the safety measures to be followed during the storage and packing of fertilizers.

(b) Discuss the 0D, 1D, 2D, and 3D nanomaterials with examples.

(c) Describe briefly the principle, working and applications of a polymer cell. (5,5,5)

7. Write short note on (any three) :

(i) Setting of cement

(ii) Triple Superphosphate

(iii) Emulsifying Agents

(iv) Semi and Super conductor oxides

(v) Carbon Nanotubes (5,5,5)

- (c) Define pigment volume concentration (PVC) and critical pigment volume concentration (CPVC)? How does they affect the properties of a paint formulation? (5,5,5)

5. (a) Explain the manufacture, properties and applications of potassium nitrate fertilizer.
- (b) Why it is important to prepare surface before surface coating? Describe the procedure of electroplating?
- (c) Describe the role of the following (any two) additives in a paint formulation :
- (i) Filler
 - (ii) Anti-skinning agent
 - (iii) Drier
- (5,5,5)

- (viii) The percentage of pigment volume in the total volume of non-volatile components of the paint is called _____.

(b) Write one word for the following :

- (i) A battery that cannot be recharged and must be discarded after single use.
- (ii) Photons are absorbed in this layer to create an electron-hole pair in a solar cell that generates the electric current.
- (iii) Name the process of applying the zinc coating to the iron sheet.
- (iv) Full form of CAN fertilizer.
- (v) The very rapid chalking of the paint film.

(vi) The unpigmented dispersion or solution of resin in oil and/or thinners.

(vii) Substances added to the soil in order to improve its chemical, mechanical or biological properties.

2. (a) Define the terms 'Nanomaterials' 'Nanoscience' and 'Nanotechnology'. Why nanomaterials are better than bulk materials?

(b) Explain the reactions taking place in different parts of the rotary kiln during manufacture of cement. What is the role of gypsum here?

(c) Write the discharging and charging reactions of a lead storage battery and explain its working. Why is this battery still popular despite its bulk and weight? (5,5,5)

3. (a) Discuss the composition, properties and applications of any two the glasses :

(i) Photosensitive glass

(ii) Lead glass

(iii) Safety Glass

(b) What is a fuel cell? How does a fuel cell differ from a conventional cell?

(c) What are fullerenes? Why are they called Buckminster fullerenes? Explain the structure of the best known fullerene. (5,5,5)

4. (a) What are the enamels? What are the constituents of an enamel? Where do they typically find their uses?

(b) Explain the working of a dry cell along with the redox reactions taking place.

- (c) Explain the application of neutron activation analysis in material studies. (5,5,5)
8. (a) Explain the primary, secondary, and tertiary treatments in effluent treatment plants.
- (b) Identify and explain the role of moderators in a nuclear reactor.
- (c) Discuss the Three Mile Island nuclear disaster and the lessons learned from it. (5,5,5)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1281 I

Unique Paper Code : 2173012001

Name of the Paper : DSE/GE: Nuclear and
Environmental Chemistry

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

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.
-
1. (a) Define the binding energy of nucleus and explain its significance.
 - (b) Differentiate between α -decay and β -decay with suitable examples.

- (c) What are the major chemical components of photochemical smog? How does it form?
(5,5,5)
2. (a) Describe the Greenhouse effect and its environmental implications.
- (b) What is a scintillation counter? Explain its principle.
- (c) Briefly explain the process of carbon dating.
(5,5,5)
3. (a) Discuss the significance of the hydrological cycle in maintaining ecological balance.
- (b) What are Venturi scrubbers, and how do they help in air pollution control?
- (c) Explain the liquid drop model of the nucleus and its applications.
(5,5,5)
4. (a) Describe the Chernobyl disaster and its environmental consequences.
- (b) Explain the methods of estimation and control of SO_x and NO_x in air pollution.

- (c) Given a polluted water sample, outline a step-by-step methodology to measure *BOD* and *COD*.
(5,5,5)
5. (a) Calculate the half-life of a radioactive isotope if 75% of the sample decays in 12 hours.
- (b) Analyze the effects of ozone depletion on human health and the environment.
- (c) Design a schematic for a fast breeder reactor and explain its working.
(5,5,5)
6. (a) Discuss the chemical and photochemical reactions in the atmosphere, giving examples.
- (b) Explain the principles and applications of reverse osmosis in water treatment.
- (c) Evaluate the environmental implications of improper disposal of nuclear waste.
(5,5,5)
7. (a) Explain the significance of the Curie as a unit of radioactivity.
- (b) What is the concept of neutron emission in radioactive decay? Provide an example.

- (c) Giving an example, explain the limitations of Williamson's ether synthesis. (5×3=15)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1462

I

Unique Paper Code : 2172582301

Name of the Paper : DSC – Organic Chemistry

Name of the Course : **B.Sc. (Prog.) Applied Life
Science with Agro
Chemicals & Pest
Management**

Semester : III

Duration : 2 Hours

Maximum Marks : 60

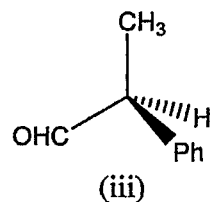
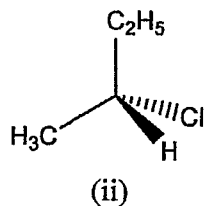
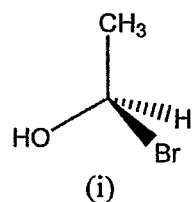
Instructions for Candidates

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

1462

2

1. (a) Assign the priority and designate R- / S- to the following :



- (b) Attempt any two :

- (i) What is hyperconjugation? What are its important consequences?
 - (ii) Explain the Substitution reactions with one example each. Substitution reaction
 - (iii) What is carbocation? Explain the stability of primary, secondary, and tertiary carbocations.
- (c) (i) What is hyperconjugation? How will you explain stability of methylated alkenes based on hyperconjugation?

1462

7

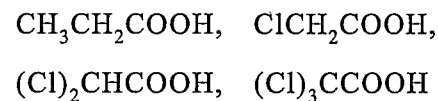
- (ii) Hydroboration-oxidation reaction

(5×3=15)

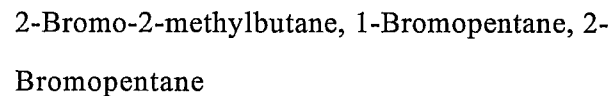
5. (a) Carry out the following conversion : (Any two)

- (i) Propene to Propan-1-ol
- (ii) 2-Bromobutane to But-2-ene
- (iii) Pent-2-ene to Pentane

- (b) (i) Arrange the following carboxylic acids in increasing order of their acidic strength and justify your answer.



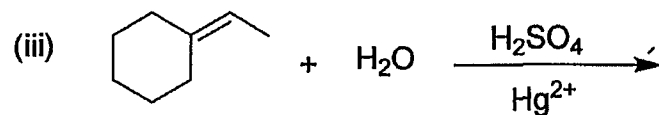
- (ii) Arrange the compounds of each set in order of reactivity towards $\text{S}_\text{N}2$ displacement :



P.T.O.

(ii) Explain the mechanism of S_N2 reaction with a suitable example.

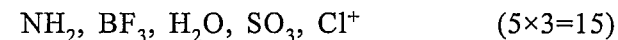
(b) Giving reason, write the major product formed in the following reactions.



(c) Explain and write the following reaction with a suitable example

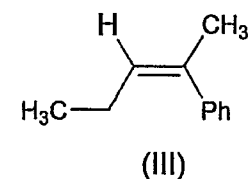
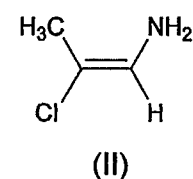
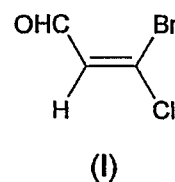
(i) Cope Elimination

(ii) Identify Electrophile and Nucleophiles



2. (a) Define conformations. Write all possible conformations of n-butane. Arrange them in increasing order of stability, with explanation.

(b) (i) Assigning the priority order, explain how will you designate E-/Z nomenclature in the following :

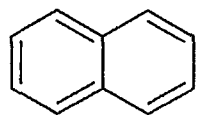


(ii) Which of the two: trans-but-2-ene-or trans-pent-2-ene is more non polar?

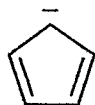
1462

4

(c) Identify Aromatic and non-aromatic and explain the reason.



i



ii



iii



iv



v

(5×3=15)

3. (a) Explain the reaction (Any two)

(i) Nitration of Bromobenzene with mechanism

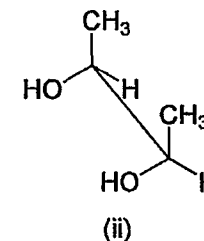
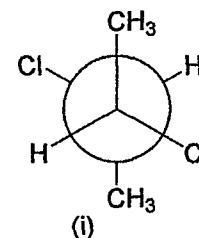
(ii) Friedel Craft Acylation of Benzene with Mechanism

(iii) Explain Electrophilic Aromatic Substitution with one example

1462

5

(b) Convert the below conformer to Fisher Projection



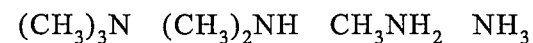
(c) Explain Why (Any two)

(i) Phenol is more acidic than Alkyl alcohol?

(ii) Grignard reagents should be prepared under anhydrous conditions?

(iii) Alkyl halides, though polar, are immiscible with water? (5×3=15)

4. (a) (i) Arrange the following amines in the increasing order of their basicity and justify your answer.



P.T.O.

1542

8

- (i) Carbonyl stretching in dimeric and monomeric forms of carboxylic acids.
- (ii) C-H stretching in alkanes and alkynes.

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1542

I

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 / V

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

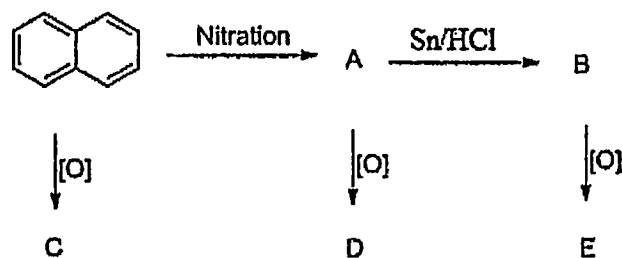
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions carry equal marks.
3. Answer any **four** questions in all.
4. Attempt all parts of a question together.

P.T.O.

1542

2

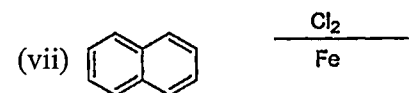
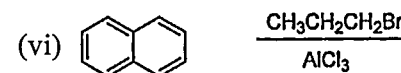
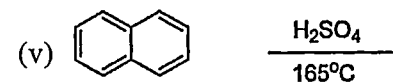
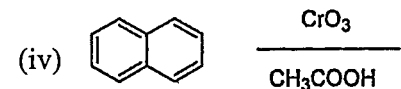
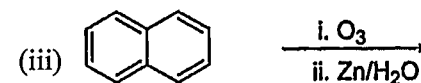
1. (a) Deduce the structures of A, B, C and D in the following reaction : (5)



- (b) Write short note on Medicinal values of curcumin and azadirachtin. (5)
- (c) Assign the fundamental vibrational modes of the following molecules : (5)
- HCl, N₂, O₂, CH₄, CHCl₃, H₂O
2. (a) Calculate λ_{max} for the following compounds using Woodward Fieser rules : (4×3)

1542

7

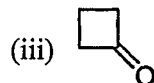
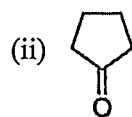
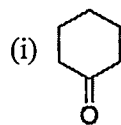


- (b) What are Exocyclic and Endocyclic conjugated double bonds. Explain with suitable examples. (4)
- (c) Give the approximate IR bands for the following characteristics absorptions: (4)

P.T.O.

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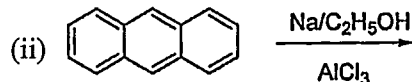
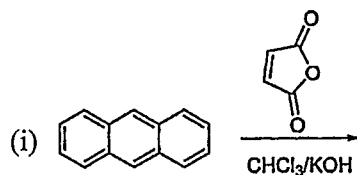
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(b) Define antibiotics with suitable examples and explain how they work in the body? (4)

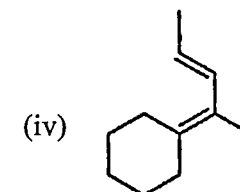
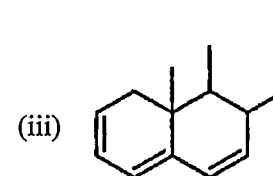
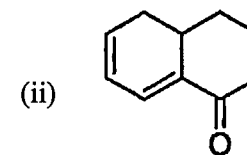
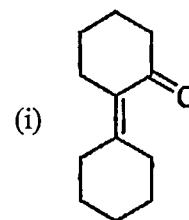
(c) Explain why is C_1-C_2 bond length in naphthalene shorter than C_2-C_3 bond length. (5)

6. (a) Complete the following reactions : (7×1)



1542

3



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

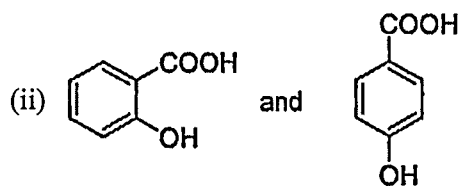
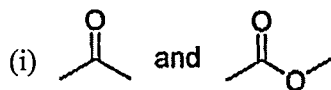
Base value for acyclic /heteroannular diene = 214 nm, Homoannular diene = 253 nm

Increment for each substituent

P.T.O.

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

- (b) Why anthracene undergoes electrophilic substitution reaction at C₉, C₁₀ position? (3)
3. (a) How will you distinguish the following pair of compounds using IR spectroscopy : (4)



- (b) Define Antimalarial agents with suitable examples and give their mode of action. (4)

- (c) Give the resonating structures of anthracene and comment on its aromatic behavior. (4)
- (d) Define chromophore and auxochrome with suitable examples. (3)
4. (a) For which isomer, π to π^* transition occurs at high wavelength and higher extinction coefficient: Cis-stilbene or trans-stilbene. (3)
- (b) Describe Haworth's method for the synthesis of Anthracene. (4)
- (c) Give method of preparation of Aspirin and explain its uses. (5)
- (d) Define bathochromic and hypsochromic shift with suitable examples. (3)
5. (a) The carbonyl stretching absorptions for the following carbonyl compounds are 1720, 1745, 1785 cm⁻¹. Match the absorptions with the appropriate structure and give a reason for each. (6)

6227

4

(b) Sunscreen lotion

(c) Lipsticks

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6227 I

Unique Paper Code : 32173910

Name of the Paper : SEC: Chemistry of Cosmetics
& Perfumes

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

Semester : III/V

Duration : 2 Hours

Maximum Marks : 38

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. (a) Name the various creams used for skin benefits.
Describe the method for the preparation of cold
creams.

(b) What is hair dye? What is the role of ammonia in the preparation of permanent hair dye?

(c) Define Shampoo? Discuss the role of different ingredients used in the preparation of shampoos.

(3, 3, 3.5)

2. (a) Differentiate between deodorants and antiperspirants?

(b) Define cosmetics. How do we classify cosmetic products on the basis of their utilisation?

(c) What are the ideal characteristics of nail polish? Name the solvents used to remove nail polish.

(3, 3, 3.5)

3. (a) What is the difference between tooth paste and

tooth powder? Write the formulation of tooth powder.

(b) Name and discuss the role of preservatives and antiseptic agent used in the preparation of medicated powder.

(c) What are flavors? Discuss the different types of flavouring substance used in the cosmetic industry.

(3, 3, 3.5)

4. (a) What is the role of essential oils in cosmetic products? Give examples.

(b) What is the importance of hair sprays and hair gels as cosmetic products

(c) Draw the structure of different layers of skin and explain in brief about them? (3,3,3.5)

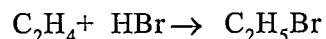
5. Write Short notes on the following: (3,3,3.5)

(a) Talecim powder

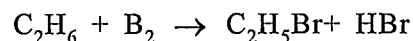
(iii) Microwave radiation and ultrasound are the nonconventional sources of energy in carrying out the chemical transformation. Explain (3, 3, 3.5)

5. (i) Bromoethane may be synthesized by following two routes:

(I) Bromoethane can be produced from the reactants ethene (ethylene) and hydrogen bromide in an addition reaction.



(II) Bromoethane can also be manufactured using the reactants ethane and bromine in a substitution reaction



(a) What is the % atom economy of both the reactions?

(b) What advantages would be there if route (I) was offered as a green Chemistry alternative for the production of Bromoethane.

(ii) Explain why the use of product yield as a way of measuring the efficiency of a chemical reaction is considered to be inadequate in the context of green chemistry.

(iii) Define the term Atom Economy and how it is applied in Green Chemistry. (3, 3, 3.5)

(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 5723

I

Unique Paper Code : 32173908

Name of the Paper : SEC.- Green Method in Chemistry

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

Semester : III/V

Duration : 2 Hours

Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any four questions from the five Questions

1. The first listed of the 12 Principles of Green Chemistry is?

a) Prevent waste

b) Catalysis

P.T.O.

- c) Atom economy
- d) Benign solvent
- (ii) Green chemists reduce risk by?
 - a) Reducing the hazard inherent in a chemical product or process
 - b) Minimizing the use of all chemicals
 - c) Inventing technologies that will clean up toxic sites
 - d) Developing recycled products
- (iii) Which of the following is a challenge for green chemists?
 - a) Awareness of the benefits of green chemistry
 - b) Developing chemicals that are recyclable
 - c) Training for cleaning up chemical spills
 - d) Knowing when to reduce and eliminate hazardous waste
- (iv) Green chemistry is more expensive than traditional chemistry?
 - a) True
 - b) False
- (v) Shortly after mid-night in 1984, a reaction caused poisonous methyl isocyanate gas to leak from a factory in this city,.....causing 3,700 deaths?
(5x1)

- (vi) What is green chemistry? How it is different from conventional chemistry? (4.5)
- 2. Write short notes on
 - (i) Microwave assisted green reactions
 - (ii) Bhopal Gas Tragedy
 - (iii) Biodiesel (3, 3, 3.5)
- 3. (i) Briefly describe what factors should be kept in mind by the chemist, while designing a chemical reaction.
 - (ii) Write the basic Principle of green Chemistry in case of use of catalyst and prevention of hazardous designing safer chemicals.
 - (iii) What are Right fit Azo pigments? How are these azo pigments superior to traditionally used inorganic based pigments? (3,3, 3.5)
- 4. (i) What do you mean by supercritical carbon dioxide? Discuss the chemistry of cleaning action of surfactant assisted supercritical CO₂. What are the environmental benefits?
 - (ii) What are Biocatalysts. Discuss the role of biocatalyst in green chemistry.

anhydride, ester, and acid amide), giving reasons.

- b) Compare the IR Spectra of acetic acid and sodium acetate.
- c) Calculate the vibrational degrees of freedom for benzene and ethyne. (3, 3, 3.5)
5. a) Discuss the different types of Atomizers.
- b) What is the range of IR Vibrational region (both in terms of wavenumber and wavelength). Discuss the two regions of IR spectrum, giving their importance.
- c) Discuss the magnetic anisotropic effect observed in ^1H NMR spectra of acetylene. (3, 3, 3.5)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 6263

I

Unique Paper Code : 42173924

Name of the Paper : SEC: Instrumental Methods of Analysis

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

Semester : III/V

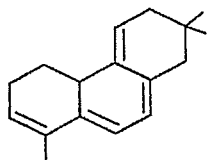
Duration : 2 Hours

Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions carry equal marks. Attempt 4 questions in all.
3. Answer should be numbered in accordance with the number on the question paper.

1. a) What is the principle of Spectroscopy? Which types of transitions are involved in NMR spectroscopy, Infrared spectroscopy and UV Spectroscopy?
- b) Discuss two reasons for considering wavenumber instead of wavelength in IR Spectroscopy. c) Define Fermi resonance observed in IR Spectroscopy. Which type of chemical compounds exhibit such effect? (3, 3, 3.5)
2. a) Define Chemical shift. Name the compound taken as reference. Assign reasons for using it as a reference.
- b) Why is the δ value (Chemical shift) high for aldehydic hydrogen? Assign two reasons.
- c) A compound having molecular formula: C_3H_7Cl , exhibits a septet and a doublet in its 1H NMR spectrum. Determine the structure of the compound. (3, 3, 3.5)
3. a) Calculate λ_{max} for the following compound:



Woodward Fieser rules for conjugated dienes

Base value for acyclic Butadiene system - 217nm

Home annular diene - 253nm

Hetero annular diene - 215nm

Increments

Alkyl substitutions/group or ring residue $\Rightarrow +5$

Exocyclic double bond $\Rightarrow +5$

Extra conjugated double bond $\Rightarrow +30$ per double bond

- b) What is the effect of increasing polarity on $n \rightarrow \pi^*$ transition in spectroscopy?
- c) Compare the UV spectrum of cis and trans stilbene (ϵ and λ_{max}). (3, 3, 3.5)

4. a) Discuss the trend of $>C=O$ absorptions in the IR spectra of acid derivatives (Acid halide, acid

(b) What is the absorbance if the percentage transmittance is 90%? What are the sources of UV and visible radiation in a double beam spectrophotometer?

(c) Why is it desirable to use an element specific source instead of a continuum source in AAS?

(4.5,4,4)

(500)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6045

I

Unique Paper Code : 32177904

Name of the Paper : Discipline Specific Elective-
2: Analytical Methods in
Chemistry

Name of the Course : **B.Sc. (H) Chemistry, BSc.
(Prog) Analytical Chemistry/
Industry 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.
3. Each Question carries equal marks.
4. Use of calculators is permitted.

P.T.O.

1. (a) Discuss the advantages of potentiometric titrations over titrations with visual indicators. Discuss one method by which pK_a values can be determined.
- (b) What are the mechanisms of weight loss and weight gain in TGA?
- (c) Complete the following :
- (i) The colour of the flame observed for potassium is _____.
- (ii) A cuvette used to record electronic spectra in the UV and Visible region is made of _____.
- (iii) The ratio of the distance moved by the solute moved above the origin to the distance the solvent front moved above the origin is known as _____.
- (iv) A _____ is a solution prepared from all the reagents but no analyte. (4.5,4,4)

- (c) What are the ways of extracting metal ions from aqueous solution? Describe the various equilibrium processes involved in the solvent extraction of metal ion from an aqueous solution using a chelating agent (or by complexation).

OR

- (c) Explain the technique involved in counter current extraction method with the help of a diagram. (4.5,4,4)

8. (a) Answer the following :

- (i) Draw and explain the conductometric titration curves for HCl against NH_4OH .
- (i) In the conductometric titration of 15.0 mL HCl with 0.2M NaOH, the equivalence point is 22.5mL. Calculate the molarity of the HCl solution.

(c) Name the different mechanisms in the chromatographic technique. Describe any one mechanism in detail. (4.5,4,4)

7. (a) The distribution coefficient (organic/aqueous) for the extraction of solute 'S' from water into ether is 10.0. For this simple liquid-liquid extraction, the distribution ratio, D and the partition coefficient, K_D are identical. Find out what percentage of 'S' is extracted into ether if 100 mL of water containing 0.20 M solution of solute 'S' is extracted :

(i) As single step extraction using 100 mL of ether.

(ii) Twice with 50 mL portions of ether.

(b) What are the basic techniques of solvent extraction? Describe any one of them.

2. (a) Briefly describe any **three** of the following :

(i) Hollow Cathode Lamp;

(ii) Indicator Electrode;

(iii) Differential Thermal Analysis;

(iv) Elution.

(b) What is the wavelength range of a typical UV-vis spectrophotometer? What are the physical constraints that limit a typical UV-vis spectrophotometer to this visible range?

(c) Discuss the various steps involved in a chemical analysis. (4.5,4,4)

3. (a) What is the frequency and energy of a photon with the wavelength of 450 nm? What are the advantages of diffraction gratings over prisms?

- (b) How can we distinguish between keto and enol tautomers by UV-visible spectroscopy?
- (c) Discuss the basic principle of flame atomic emission spectrometry and also elaborate the role of fuel and oxidant in the determination of metal.
(4.5,4,4)
4. (a) The percentage of silica in the sample of mineral was 3.685, 3.689, 3.685, 3.681 and 3.692. Calculate the mean, median, mode, standard deviation and variance.
- (b) Explain systematic and random errors. How can one reduce systematic errors?
- (c) Give the difference between accuracy and precision with suitable examples. Micheal's scale measures the mass of objects as consistently 2 kg less than their actual mass. How would you describe the scale?
(4.5,4,4)

5. (a) What is the primary principle of conductometric titrations? Why are platinum electrodes in conductometric cell coated with Pt black?
- (b) A TGA experiment shows two distinct weight loss steps for a 200 mg sample. The first step results in a 30% mass loss, and the second step results in a 40% mass loss. Calculate the final mass of the sample.
- (c) How does the use of hollow cathode lamp in AAS allow the use of a cheap monochromator and still gives good results?
(4.5,4,4)
6. (a) What do you understand by terms: 'Confidence limit' and 'Confidence interval' in a set of measurements? Explain 'F' test and give its significance.
- (b) Define the term chromatography. What is the basis of chromatographic separations? What are the different types of chromatographic techniques?

[This question paper contains 7 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **1189** **I**

Unique Paper Code : 2173010009

Name of the Paper : DSE: Applied Organic
Chemistry

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

Semester : V

Time : 3 Hours

Maximum Marks : 90

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **six** questions in **all**.
- (c) **All** questions are of **15** marks each.

1. (a) Fill in the blanks - 5
- (i) Isoniazid is
 - (ii) Cholesterol, belongs to the class of
 - (iii) Ranitidine is an
 - (iv) Cortisone is a hormones.
 - (v) Ergosterol is used for preventing

P.T.O.

- (b) Define analgesic drugs using suitable example and describe their mode of action.

5

- (c) What is the medicinal use of Turmeric, write structure of the active ingredient of curcumin.

5

2. (a) Define "Ziegler Natta" catalysts ? Give the mechanism of polymerization of propene using the same.

5

- (b) Give the name of the plant from which natural rubber is isolated ? Outline the process in brief for isolating the rubber from this plant.

5

- (c) Give the name of the monomer(s) for the preparation of the following polymers :

5

(i) PVC

(ii) Buna-S

(iii) Cellulose

(iv) Nylon-66

(v) Neoprene

3. (a) α Naphthyl amine on heating with H_2SO_4 at 160°C gives compound (A). Benzidine on diazotization produces compound (B). Coupling reaction of compound (A) and Compound (B) gives Compound (C), Compound (C) is a direct red dye and absorbs 498 nm in UV spectroscopy.

Write the complete sequence of reaction from (A) to (C) with all the reagents used in the reactions. 5

- (b) Give one synthesis of Indigo dye and explain it is fixed to the fabric ? 5
- (c) Define a. Chromophore, b. Auxochrome with examples. 5
4. (a) What is Colour Index (CI) and why is it important in the classification of dyes pigments ? 5
- (b) (i) If a dye is labeled with the generic name **CI Vat Blue 6**, what is its Application Type, Hue, and Identifying Number ?

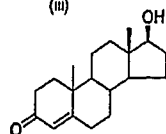
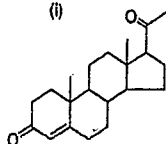
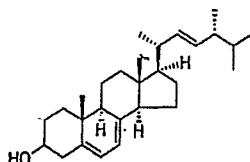
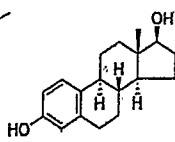
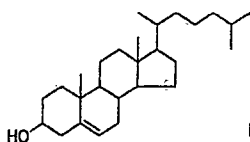
- (ii) Identify the colorant of the above dye and suggest its industrial applications.

5

- (c) Discuss natural edible dyes, providing examples and explain the impact of synthetic food colors on health.

5

5. (a) Write the names and biological important of the following compounds : $2 \times 5 = 10$

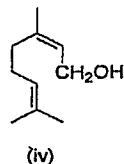
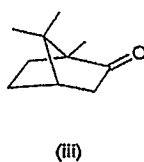
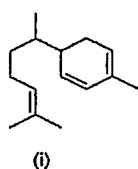


- (b) Out line the step involved in Emde's modification by taking isoquinoline as an example ?

5

6. (a) An acyclic terpenoid (A), $C_{10}H_{16}O$, absorbs two moles of H_2 and with Ag_2O it oxidized to corresponding carboxylic acid (B) without loss of carbon. Hot alkaline $KMnO_4$ treatment followed by CrO_3 oxidation cleaves (A) into oxalic acid, acetone and 4-keto pentanoic acid. Name and deduce the structure (A) and (B). 5

- (b) What is Isoprene rule ? Indicated the isoprene units in the following structure : 5



- (c) What are terpenoids and how are they classified ? Discuss any one process for the isolation of essential oil. 5
7. (a) Calculate the number and weight average molecular weights of polymer of sample containing 10 moles of molecular weight 10,000 of polymer A, 80 moles of molecular weight 50,000 of polymer B and 10 moles of molecular weight 1,00,000 of polymer C. 5

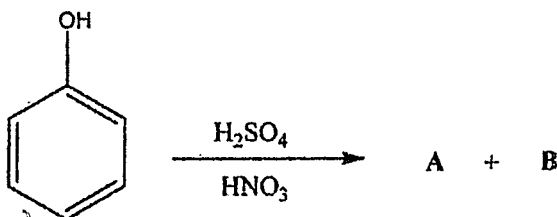
(b) Discuss the process of Vulcanization and draw the structure of vulcanized rubber.

5

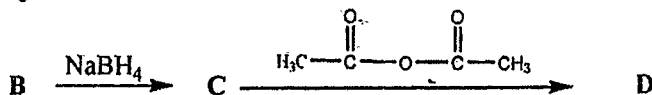
(c) What are syndiotactic, atactic and isotactic polymers ? Explain using one example. 5

8. (a) Complete the reaction. Write the structures and names corresponding to A,B, C and D. Give pharmaceutical use of the resulting drug. 5

(i)



(ii)



(b) Match the following :

5

(i) Vitamin C (a) Antimalarials

(ii) Azadirachtin (b) Zantac

(iii) Ranitidine (c) Rheumatoid arthritis

- (iv) Ibuprofen (d) Limonoids
(v) Chloroquine (e) Scurvy
- (c) Discuss the significance of the ideal properties of antacids and the combination of antacids. 5

7. (a) A pentapeptide A having empirical composition Lys, Phe, Thr, Leu, Asp gave DNP-Thr on treatment with DNFB followed by hydrolysis. Treatment of A with carboxypeptidase released Asp. Treatment of A with trypsin gave a tripeptide, (Lys, Leu, Thr) and a dipeptide (Asp, Phe). Elucidate the sequence of amino acids in A.
- (b) Write down three irreversible steps in the glycolysis process. Write all the structures and the name of enzymes involved.
- (c) Give the synthesis of proline by phthalimide malonic ester method. (4.5, 4, 4)
8. (a) Define saponification value and give its significance. Calculate the saponification value of glyceryl tripalmitate having molecular weight 806 (molecular weight of KOH = 56).
- (b) Write short notes on any two of the following:
- Genetic code
 - Reversion and rancidity
- (c) Using Haworth projection draw the structures of the following:
- α -D-Glucopyranosyl- β -D-fructofuranoside
 - 4-O-(β -D-Galactopyranosyl)- α -D-Glucopyranose (4.5, 4, 4)

(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 5824

I

Unique Paper Code : 32171501

Name of the Paper : DSC (Organic Chemistry-IV) Biomolecules

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

Semester : V

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

- Write your Roll No. on the top immediately on receipt of this question paper.
 - Attempt Six questions. All parts of a question should be attempted together.
 - Each question carries 12.5 marks.
- (a) 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.

P.T.O.

- (b) What is iodine number? What is its significance?
- (c) Give the complete name and structure of dAMP and UDP (4.5, 4, 4)
- 2 (a) Which form of alanine would you expect to predominate under (i) Strongly acidic solution (ii) Strongly basic solution (iii) At its isoelectric point. Indicate which part of the dipolar ion behaves as a potential acid or potential base and also find out the isoelectric point of alanine ($pK_{a1}=2.3$, $pK_{a2}=9.7$)
- (b) How will you convert:
- (i) D-glucose to the D-arabinose
- (ii) D-glucose to D-fructose
- (c) Discuss the secondary structure of proteins. (4.5, 4, 4)
3. (a) Explain, why D-glucose and D-fructose give the same osazone? Give the mechanism of osazone formation for D-glucose.
- (b) Draw the complementary DNA sequence of the given fragment specifying the direction 5'-ATGC-3'
- (c) Explain the term rancidity of oils and fats. How many types of rancidity occur in oils and fats? Discuss. (4.5, 4, 4)

4. (a) Differentiate between nucleosides and nucleotides? Give the structure of guanosine-5'-triphosphate.
- (b) Write down the reaction of glucose with (i) HNO_3 (ii) HIO_4
- (c) Provide the full form and structure of ATP. Explain, why ATP is called the universal currency of cellular energy. (4.5, 4, 4)
5. (a) How will you synthesize the dipeptide Gly-Val using Merrifield resin. Discuss its advantages over other methods?
- (b) Differentiate between competitive and non-competitive enzyme inhibition using suitable examples.
- (c) List four important characteristics of Watson and Crick model of DNA. (4.5, 4, 4)
6. (a) What is fermentation? Write down the fate of pyruvate in alcoholic and lactate fermentation with enzymes involved.
- (b) Explain Dansyl Chloride method of N-terminal analysis. What is the advantage of this method over other methods of N-terminal analysis?
- (c) Discuss replication of DNA. (4.5, 4, 4)

3516

5. (a) Determine the hybridization of the central atom and the shape of the following molecules:
 $\text{XeOF}_4, \text{NO}_3^-, \text{ClO}_4^-, \text{SF}_4, \text{CO}_2$ 5
- (b) (i) Explain on the basis of Molecular orbital theory why N_2 is diamagnetic and O_2 is paramagnetic. 3
- (ii) Differentiate between bonding and antibonding molecular orbitals ? 2
- (c) Write the Born-Landé equation for calculating the lattice energy of an ionic crystal and explain the various terms involved. 5
6. (a) (i) Calculate the percentage of ionic character in HCl molecule, given that the bond length is $1.275 \text{ \AA}$ and the observed dipole moment is 1.03 D. 2.5
- (ii) What is resonance ? Draw the resonance structures of CO_3^{2-} 2.5
- (b) Write a short note on the following: $2 \times 2.5 = 5$
- (i) Lattice energy
- (ii) Hydration energy
- (c) Explain Fajan's rules and based on these rules compare the covalent character of the following compounds. 5
- (i) NaCl and CuCl
- (ii) AgCl and AgI

[This question paper contains 4 printed pages]

Your Roll No. :,.....

Sl. No. of Q. Paper : 3516 I

Unique Paper Code : 2174001001

Name of the Paper : Atomic Structure and Chemical Bonding

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

Semester : I/III/V

Time : 2 Hours Maximum Marks : 60

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **four** questions out of six.
- (c) **All** question carry equal marks.
1. (a) (i) Why are electronic configurations with half-filled and fully filled orbitals more stable than the other configurations. Explain with suitable example. 3
- (ii) Differentiate between the terms 'shell' and 'subshell.' 2
- (b) (i) Write the significance of $\Psi(x)$ and $\Psi^2(x)dx$, where Ψ is representing an electronic wave-function. 2.5

- (ii) What are some special properties which must be fulfilled by acceptable wave function ? 2.5
- (c) (i) Calculate the wavelength of electron (mass = 10^{-30} kg) moving with kinetic energy 10^{-14} J ($h = 6.626 \times 10^{-34}$ Js) 2.5
- (ii) What do you understand by the Aufbau Principle ? Why is the 4s orbital filled before the 3d orbital ? 2.5
2. (a) Write the time-independent Schrodinger wave equation (three dimensional) for the electron in a hydrogen atom in Cartesian coordinates and explain all the terms involved. What three quantum numbers are derived from its solution ? 5
- (b) State and explain the Pauli Exclusion principle and the Heisenberg uncertainty Principle. 5
- (c) The Lyman series of emission lines in the hydrogen atom's emission spectrum corresponds to electronic transitions from excited states to the $n = 1$ orbit. Calculate the wavelength of the lowest energy line in the Lyman series and specify the region of the electromagnetic spectrum in which it occurs. 5
3. (a) Draw the radial probability distribution curves for the 1s, 2s and 2p orbitals, labeling the nodes present and the most probable distance for each. 5

- (b) Write a short note on the following : ($2 \times 2.5 = 5$)
- (i) Bohr's theory and its limitations
- (ii) Radial and angular parts of a wave function and their significance
- (c) Give the values of all four quantum numbers for the 2s, 5p and 4d orbitals. 5
4. (a) Draw Born Haber cycle and the enthalpy of formation (ΔH_f°) for MgF_2 using the following data- 5
- Enthalpy of sublimation of Mg = 146.4 KJ/mol
 Ionization energy 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
 Lattice energy of MgF_2 = -2922.5 KJ/mol
- (b) What do you understand by the term VSEPR theory ? Write the postulates of VSEPR theory. 5
- (c) (i) What is Madelung constant ? Is the Madelung constant same or different for NaCl and CsCl ionic structures ? 3
- (ii) Why is the bond order of O_2^+ is more than that of O_2 ? 2

6. (a) Explain the method for estimating carbon monoxide (CO) in air and describe its control procedures.
- (b) List the pollutants present in the effluents of fertilizer and petrochemical industries and suggest methods for their treatment.
- (c) What are the advantages and disadvantages of geothermal energy and how can it be harnessed? (4,4,4)
7. (a) Write the potassium dichromate's preparation method, applications, and storage conditions.
- (b) Explain the Contact process for manufacturing sulphuric acid (with a labelled diagram). Write down the application and storage procedure.
- (c) Explain the industrial preparation of hydrochloric acid. Write down its application and storage procedure. (4,4,4)
8. (a) Briefly explain the public health and environmental consequences caused by water pollution.
- (b) Draw a labelled diagram of the biogeochemical cycle of Nitrogen.
- (c) Using a suitable example, explain the metals refining by Mond's process. (4,4,4)

(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper :- 6047

I

Unique Paper Code : 32177909

Name of the Paper : DSE-Industrial Chemicals & Environment

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. Question no. **1** is compulsory.
3. Attempt any **five** questions from the rest.

1. (a) Fill in the blanks (**any six**) :

(i) _____ and _____ are non-renewable sources of energy.

(ii) Bleaching Powder's chemical formula is _____.

(iii) _____ gas is used in food packaging.

(iv) Germanium is purified by _____ method.

P.T.O.

(v) Acid rain is caused by _____ and _____.

(vi) The heating of the Earth's atmosphere due to trapped radiation is known as the _____.

(vii) The chemical formula of borax is _____.

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

(i) Ion exchange method for water purification

(ii) Methods of controlling particulate matter in air

(iii) Manufacture and use of Nitrogen

(c) Define biocatalyst. Explain two industrial applications of the biocatalysts. (6,6,3)

2. (a) How do oxides of Nitrogen cause air pollution? What are the different sources of these oxides?

(b) How is sodium thiosulphate manufactured? What are its main applications, and what precautions should be considered while using it?

(c) Draw a labelled diagram of different regions of the atmosphere showing altitude, temperature variation and chemical species existing in each area. (4,4,4)

3. (a) Name four different greenhouse gases. Explain how they are affecting global warming.

(b) Explain different techniques used for measuring water pollution.

(c) Explain the use of reverse osmosis in water treatment and purification. (4,4,4)

4. (a) Explain the importance of biocatalysis in green chemistry and its applications in the chemical industry.

(b) What is Zone refining, and what are its limitations?

(c) Name the pollutants present in the effluents of each tannery and textile industry. Suggest a method of treatment for the same. (4,4,4)

5. (a) How is bleaching powder manufactured? What are its main applications? How does bleaching powder disinfect water?

(b) Describe a process of converting low-grade coal into an energy-efficient fuel.

(c) Explain how chlorofluorocarbons deplete ozone with the help of reactions. Suggest safer substitutes for chlorofluorocarbons and explain why they are considered safer. (4,4,4)

This question paper contains 3 printed pages]

Roll No.

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S. No. of Question Paper : 1182

Unique Paper Code : 2173010002

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

Name of the Course : B.Sc. Prog.

Semester : V

Duration : 2 Hours

Maximum Marks : 60

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt four questions in all.

All questions carry equal marks.

1. (i) Fill in the blanks :

(a) Ceramics is a type of

(b) TiO_2 is an example of

(c) Urea is an example of a fertilizer.

(d) Nutrients which are required in very small quantity by plants are called

(e) Photosensitive glasses are sensitive in region.

(ii) True or False :

(a) Presence of metallic powders such as Sn, Zn and Al etc. makes paint heat resistance.

P.T.O.

- (b) Fiber glass can neither be spun into yarn nor gathered into a mat.
 - (c) Fertilizers are used to manage pests in the crop.
 - (d) Plasticizers induces cracking in the paint.
 - (e) Use of fertilizers leads to water pollution.
- (iii) Define pigment with *one* example.
- (iv) What is the composition of borosilicate glass and where it is used ?
- (v) Name the raw material used for the manufacturing of Portland cement.

5,5,2,2,1

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

- (a) Photosensitive and Photochromic glass
 - (b) Pigment volume concentration and Critical pigment volume concentration.
 - (c) Chemical vapour deposition and Physical vapour deposition method of surface coating.
- (ii) Define thinner and plasticizer. Also mention their role in the formulation of paint.
- (iii) How will you differentiate between porous and non-porous ceramics. Mention the important properties of ceramics which makes it useful for building construction.

5,5,5

3. (i) Briefly describe the environmental impact of using fertilizers in farming.

- (ii) Define ceramics and explain that why do we need to glaze the ceramic products ?
- (iii) Write down the general characteristics of a good paint.

5,5,5

4. (i) "Slag is an eco-friendly cement". Justify the given statement.
- (ii) What is the role of Nitrogen, Potassium and Phosphorous as a plant nutrient ?
- (iii) What are the different constituents of paint ? Write a brief note.
- 5,5,5
5. (i) How does urea function as an effective fertilizer for plants ? Give *one* method for the manufacture of urea.
- (ii) What is the importance of applying surface coating to the objects ? Discuss the process of carburizing.
- (iii) Define the term Cement. What is the composition of Pozzolana cement ?
- 5,5,5
6. (i) What do you mean by fertilizer ? Why do we need to add them to the soil ?
- (ii) What is the composition of the Lead glass and Fluorosilicate glass ? Write their uses also.
- (iii) What do you mean by Emulsion paint ? Write its different constituents and advantages.
- 5,5,5

1542

8

- (i) Carbonyl stretching in dimeric and monomeric forms of carboxylic acids.
- (ii) C-H stretching in alkanes and alkynes.

(1000)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1542

I

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 / V

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

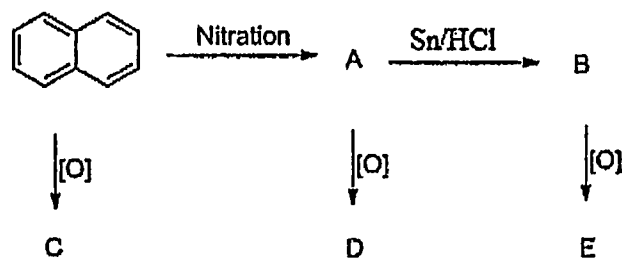
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions carry equal marks.
3. Answer any **four** questions in all.
4. Attempt all parts of a question together.

P.T.O.

1542

2

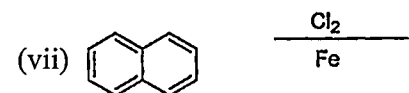
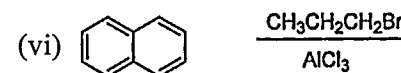
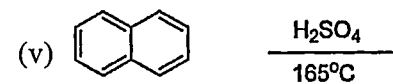
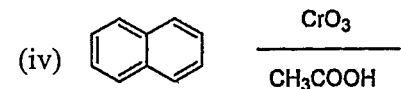
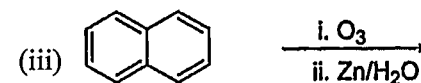
1. (a) Deduce the structures of A, B, C and D in the following reaction : (5)



- (b) Write short note on Medicinal values of curcumin and azadirachtin. (5)
- (c) Assign the fundamental vibrational modes of the following molecules : (5)
- HCl, N₂, O₂, CH₄, CHCl₃, H₂O
2. (a) Calculate λ_{max} for the following compounds using Woodward Fieser rules : (4×3)
- Woodward Fieser rules :

1542

7

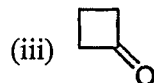
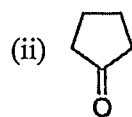
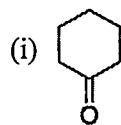


- (b) What are Exocyclic and Endocyclic conjugated double bonds. Explain with suitable examples. (4)
- (c) Give the approximate IR bands for the following characteristics absorptions: (4)

P.T.O.

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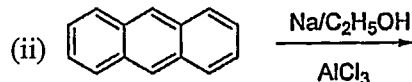
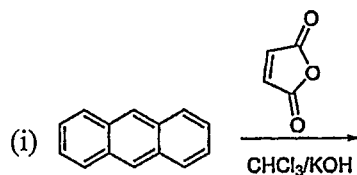
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(b) Define antibiotics with suitable examples and explain how they work in the body? (4)

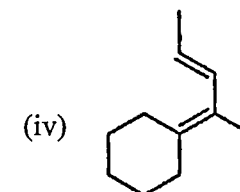
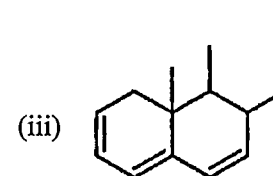
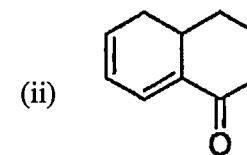
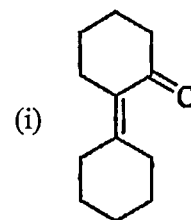
(c) Explain why is C_1-C_2 bond length in naphthalene shorter than C_2-C_3 bond length. (5)

6. (a) Complete the following reactions : (7×1)



1542

3



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

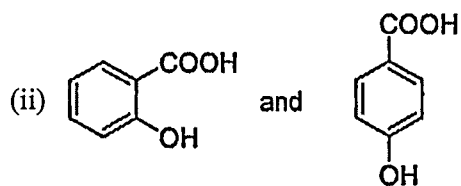
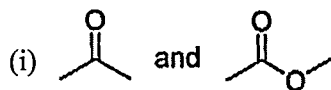
Base value for acyclic /heteroannular diene = 214 nm, Homoannular diene = 253 nm

Increment for each substituent

P.T.O.

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

- (b) Why anthracene undergoes electrophilic substitution reaction at C₉, C₁₀ position? (3)
3. (a) How will you distinguish the following pair of compounds using IR spectroscopy : (4)



- (b) Define Antimalarial agents with suitable examples and give their mode of action. (4)

- (c) Give the resonating structures of anthracene and comment on its aromatic behavior. (4)
- (d) Define chromophore and auxochrome with suitable examples. (3)
4. (a) For which isomer, π to π^* transition occurs at high wavelength and higher extinction coefficient: Cis-stilbene or trans-stilbene. (3)
- (b) Describe Haworth's method for the synthesis of Anthracene. (4)
- (c) Give method of preparation of Aspirin and explain its uses. (5)
- (d) Define bathochromic and hypsochromic shift with suitable examples. (3)
5. (a) The carbonyl stretching absorptions for the following carbonyl compounds are 1720, 1745, 1785 cm⁻¹. Match the absorptions with the appropriate structure and give a reason for each. (6)

6227

4

(b) Sunscreen lotion

(c) Lipsticks

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6227 I

Unique Paper Code : 32173910

Name of the Paper : SEC: Chemistry of Cosmetics
& Perfumes

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

Semester : III/V

Duration : 2 Hours

Maximum Marks : 38

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. (a) Name the various creams used for skin benefits.
Describe the method for the preparation of cold
creams.

6227

2

(b) What is hair dye? What is the role of ammonia in the preparation of permanent hair dye?

(c) Define Shampoo? Discuss the role of different ingredients used in the preparation of shampoos.

(3, 3, 3.5)

2. (a) Differentiate between deodorants and antiperspirants?

(b) Define cosmetics. How do we classify cosmetic products on the basis of their utilisation?

(c) What are the ideal characteristics of nail polish? Name the solvents used to remove nail polish.

(3, 3, 3.5)

3. (a) What is the difference between tooth paste and

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3

tooth powder? Write the formulation of tooth powder.

(b) Name and discuss the role of preservatives and antiseptic agent used in the preparation of medicated powder.

(c) What are flavors? Discuss the different types of flavouring substance used in the cosmetic industry.

(3, 3, 3.5)

4. (a) What is the role of essential oils in cosmetic products? Give examples.

(b) What is the importance of hair sprays and hair gels as cosmetic products

(c) Draw the structure of different layers of skin and explain in brief about them? (3,3,3.5)

5. Write Short notes on the following: (3,3,3.5)

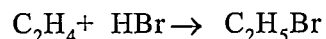
(a) Talecim powder

P.T.O.

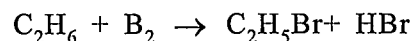
(iii) Microwave radiation and ultrasound are the nonconventional sources of energy in carrying out the chemical transformation. Explain (3, 3, 3.5)

5. (i) Bromoethane may be synthesized by following two routes:

(I) Bromoethane can be produced from the reactants ethene (ethylene) and hydrogen bromide in an addition reaction.



(II) Bromoethane can also be manufactured using the reactants ethane and bromine in a substitution reaction



(a) What is the % atom economy of both the reactions?

(b) What advantages would be there if route (I) was offered as a green Chemistry alternative for the production of Bromoethane.

(ii) Explain why the use of product yield as a way of measuring the efficiency of a chemical reaction is considered to be inadequate in the context of green chemistry.

(iii) Define the term Atom Economy and how it is applied in Green Chemistry. (3, 3, 3.5)

(500)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 5723

I

Unique Paper Code : 32173908

Name of the Paper : SEC.- Green Method in Chemistry

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

Semester : III/V

Duration : 2 Hours

Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any four questions from the five Questions

1. The first listed of the 12 Principles of Green Chemistry is?

a) Prevent waste

b) Catalysis

P.T.O.

- c) Atom economy
- d) Benign solvent
- (ii) Green chemists reduce risk by?
 - a) Reducing the hazard inherent in a chemical product or process
 - b) Minimizing the use of all chemicals
 - c) Inventing technologies that will clean up toxic sites
 - d) Developing recycled products
- (iii) Which of the following is a challenge for green chemists?
 - a) Awareness of the benefits of green chemistry
 - b) Developing chemicals that are recyclable
 - c) Training for cleaning up chemical spills
 - d) Knowing when to reduce and eliminate hazardous waste
- (iv) Green chemistry is more expensive than traditional chemistry?
 - a) True
 - b) False
- (v) Shortly after mid-night in 1984, a reaction caused poisonous methyl isocyanate gas to leak from a factory in this city,.....causing 3,700 deaths?
(5x1)

- (vi) What is green chemistry? How it is different from conventional chemistry? (4.5)
- 2. Write short notes on
 - (i) Microwave assisted green reactions
 - (ii) Bhopal Gas Tragedy
 - (iii) Biodiesel (3, 3, 3.5)
- 3. (i) Briefly describe what factors should be kept in mind by the chemist, while designing a chemical reaction.
 - (ii) Write the basic Principle of green Chemistry in case of use of catalyst and prevention of hazardous designing safer chemicals.
 - (iii) What are Right fit Azo pigments? How are these azo pigments superior to traditionally used inorganic based pigments? (3,3, 3.5)
- 4. (i) What do you mean by supercritical carbon dioxide? Discuss the chemistry of cleaning action of surfactant assisted supercritical CO₂. What are the environmental benefits?
 - (ii) What are Biocatalysts. Discuss the role of biocatalyst in green chemistry.

anhydride, ester, and acid amide), giving reasons.

- b) Compare the IR Spectra of acetic acid and sodium acetate.
- c) Calculate the vibrational degrees of freedom for benzene and ethyne. (3, 3, 3.5)
5. a) Discuss the different types of Atomizers.
- b) What is the range of IR Vibrational region (both in terms of wavenumber and wavelength). Discuss the two regions of IR spectrum, giving their importance.
- c) Discuss the magnetic anisotropic effect observed in ^1H NMR spectra of acetylene. (3, 3, 3.5)

[This question paper contains 4 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 6263

I

Unique Paper Code : 42173924

Name of the Paper : SEC: Instrumental Methods of Analysis

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

Semester : III/V

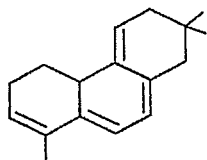
Duration : 2 Hours

Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions carry equal marks. Attempt 4 questions in all.
3. Answer should be numbered in accordance with the number on the question paper.

1. a) What is the principle of Spectroscopy? Which types of transitions are involved in NMR spectroscopy, Infrared spectroscopy and UV Spectroscopy?
- b) Discuss two reasons for considering wavenumber instead of wavelength in IR Spectroscopy. c) Define Fermi resonance observed in IR Spectroscopy. Which type of chemical compounds exhibit such effect? (3, 3, 3.5)
2. a) Define Chemical shift. Name the compound taken as reference. Assign reasons for using it as a reference.
- b) Why is the δ value (Chemical shift) high for aldehydic hydrogen? Assign two reasons.
- c) A compound having molecular formula: C_3H_7Cl , exhibits a septet and a doublet in its 1H NMR spectrum. Determine the structure of the compound. (3, 3, 3.5)
3. a) Calculate λ_{max} for the following compound:



Woodward Fieser rules for conjugated dienes

Base value for acyclic Butadiene system - 217nm

Home annular diene - 253nm

Hetero annular diene - 215nm

Increments

Alkyl substitutions/group or ring residue $\Rightarrow +5$

Exocyclic double bond $\Rightarrow +5$

Extra conjugated double bond $\Rightarrow +30$ per double bond

- b) What is the effect of increasing polarity on $n \rightarrow \pi^*$ transition in spectroscopy?
- c) Compare the UV spectrum of cis and trans stilbene (ϵ and λ_{max}). (3, 3, 3.5)

4. a) Discuss the trend of $>C=O$ absorptions in the IR spectra of acid derivatives (Acid halide, acid

4. (i) Explain Instrumental Errors.
- (ii) What is method of least square curve fitting?
Calculate the slope and intercept for least square line for the data given below :

<i>x</i>	3.4	3.3	3.2	3.2	3.1	3.1	3.1	3.0	3.0
<i>y</i>	4.02	4.25	4.54	4.77	5.04	5.25	5.49	5.72	5.93

(3,5)

5. (i) Write the following numbers in scientific notation :

(a) 0.00428

(b) 270040

(c) 150000000

- (ii) Using the following expressions of the critical constant for a gas

$$P_c = \frac{a}{27b^2} \quad V_c = 3b \text{ and } T_c = \frac{8a}{27Rb}$$

derive the relations $a = \frac{27R^2T_c^2}{64P_c}$, and $b = \frac{RT_c}{8P_c}$.

(3,5)

(200)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5716

I

Unique Paper Code : 32173901

Name of the Paper : SEC: IT Skills for Chemists

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

Semester : III / V – CBCS-LOCF

Duration : 2 Hours

Maximum Marks : 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt 4 questions in all.
3. Q. No. 1 is compulsory and attempt any other three questions.
4. Use of scientific calculator and logarithm table is allowed.

1. Attempt any seven :

- (i) Find the equation of a straight line that passes through the points (-1, -6) and (3, 2).

P.T.O.

- (ii) How many significant figures are present in
- (a) 3.675×10^{-2}
- (b) 1.112650
- (iii) Express *van der Waal's* equation as a function of pressure p .
- (iv) Convert the value of gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ in units of $\text{dm}^3 \text{ atm}^{-1} \text{ mol}^{-1} \text{ K}^{-1}$.
- (v) Write differences between accuracy and precision with example.
- (vi) Evaluate within correct significant figures $X = 62.4 + 19.570$.
- (vii) What is relation between natural log ($\ln$) and log base 10 ($\log_{10}$)?
- (viii) Give the use of following MS EXCEL functions?
- (a) SUM (A3:A10)
- (b) MAX (A2:A8) (2×7)
2. (i) Explain the role of significant figures in experimental measurements by taking the example of potentiometric titration between a strong acid and a strong base.

- (ii) A sample of coal was analyzed for carbon percentage in the sample. The following set of measurements were taken repeatedly to ensure true value: 42.62, 42.73, 42.75, 42.78, 42.79, 42.83, 42.84, 42.87, 42.92, 42.94. Calculate the mean value of carbon percentage, spread and standard deviation. (3,5)
3. (i) Explain Trapezoidal rule for numerical integration.
- (ii) In thermodynamics, it is shown that when a system is heated at a constant pressure from temperature T_1 to temperature T_2 , the entropy change is given by:

$$\Delta S = S(T_2 - T_1) = \int_{T_1}^{T_2} \frac{C_p}{T} dT$$

where C_p is constant pressure heat capacity and T is temperature on Kelvin scale. Using numerical integration, calculate ΔS when 1.00 mol of solid zinc is heated from 20.0 K to 100.0 K using the following data:

T/K	20	30	40	50	60	70	80	90	100
$C_p/\text{JK}^{-1}\text{mol}^{-1}$	1.70	4.966	8.171	11.18	13.60	15.43	16.87	18.11	19.15

(3,5)