MANAV RACHNA UNIVERSITY

Declared as State Private University vide Haryana Act 26 of 2014

## DEPARTMENT OF CHEMISTRY

*"T3 Examination, June 2022"*

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|---|---|---|---|
| SEMESTER | 2nd | | |
| SUBJECT NAME | PHYSICAL CHEMISTRY-I | DATE OF EXAM | 23-06-2022 |
| BRANCH | CHEMISTRY | SUBJECT CODE | CHH102B-T |
| TIME | 8:30-11:30am | SESSION | MORNING |
| PROGRAM | B.Sc. | MAX. MARKS | 100 |
| NAME OF FACULTY | Dr. Priti Gupta | CREDITS | 4 |
| | | NAME OF COURSE COORDINATOR | Dr. Priti Gupta |

*Note: All questions are compulsory*

| | NO. | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL |
|---|---|---|---|---|---|
| PART-A | 1(A) | The average kinetic energy of the gas molecules is<br>1) inversely proportional to its absolute temperature<br>2) directly proportional to its absolute temperature<br>3)equal to the square of its absolute temperature<br>4) directly proportional to the square root of its absolute temperature | 2 | CO1 | BT2 |
| | 1(B) | What do you mean by RMS velocity? | 2 | CO1 | BT2 |
| | 1(C ) | Calculate the root mean square velocity of oxygen molecule at $27^0$C. | 3 | CO1 | BT3 |
| | 1(D) | Write assumptions of Kinetic molecular theory. | 3 | CO1 | BT1 |
| PART-B | Q2(A) | Define Coefficient of viscosity and explain properly how relative viscosity is determined? | 5 | CO2 | BT3 |
| | 2(B) | A capillary tube of internal diameter 0.21 mm is dipped into a liquid whose density is 0.79gcm-3.The liquid rises in this capillary to a height of 6.30cm.calculate the surface tension of the liquid.(g =980cmsec$^{-2}$ ). | 5 | CO2 | BT4 |
| PART-C | Q3(A) | Determine the Miller indices for a plane when the intercepts along the axes are 3a, 2b and 3c. | 3 | CO3 | BT2 |
| | 3(B) | In a triclinic crystal, a lattice plane makes intercept at a length a, 2b and -3c/2. What are miller indices of the | 4 | CO3 | BT2 |

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| plane? | | | |
| Discuss Bragg's Equation. Describe briefly the experimental setup used to record rotating crystal X-Ray diffraction photograph. | 6 | CO3 | BT2 |
| Give the Minimum symmetry elements, Cell Dimensions and Interfacial angles of the following Crystal systems:<br>1.Monoclinic<br>2.Cubic<br>3.Triclinic | 9 | CO3 | BT1 |
| Discuss Powder method of crystal analysis? | 5 | CO3 | BT3 |
| Describe the following crystal defects:<br>1. Impurity Defect<br>2.Schottky Defect | 5 | CO3 | BT1 |
| What do you understand by Liquid crystals? Classify them according to their molecular arrangements. Discuss their practical applications also. | 8 | CO3 | BT3 |
| Compare the Lewis theory of acids and bases with the Bronsted-Lowry Concept. Also Brief about the concept of Bronsted -Lowry with one example. | 7 | CO4 | BT4 |
| Explain why a solution of a weak acid and its salt behaves as a buffer? Derive the relation between pHof the solution and relative amount of base and the salt present in it. | 8 | CO4 | BT3 |
| What would be the pH of an aqueous solution obtained by mixing 5 gm of acetic acid and 7.5 gm of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid at $25^0C$ is $1.75* 10^{-5}$ | 5 | CO4 | BT3 |
| Find out the pH of 0.002M acetic acid solution if it is 2.3%ionised at this dilution? | 7 | CO4 | BT1 |
| How water can act both as an acid and a base? Explain. | | | |
| Calculate the pH of a buffer solution that is 0.250M in formic acid, HCOOH and 0.100M in sodium formate, HCOONa. Ka for formic acid is $1.8*10^{-5}$ | 5 | CO4 | BT3 |
| What is meant by the term 'Degree of Hydrolysis' and 'Hydrolysis Constant'? Deduce the relation between hydrolysis constant and the dissociation constant of the base in the case of hydrolysis of a salt of a strong acid and a weak base. | 8 | CO4 | BT3 |

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# DEPARTMENT OF CHEMISTRY

*"T3 Examination, June-2022"*

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|---|---|---|---|
| SEMESTER | II | DATE OF EXAM | 27.6.2022 |
| SUBJECT NAME | INORGANIC CHEMISTRY-I | SUBJECT CODE | CHH103B-T |
| BRANCH | Chemistry | SESSION | I |
| TIME | 8:30 am-11:30am | MAX. MARKS | 100 |
| PROGRAM | B.Sc. Chemistry (Hons.) | CREDITS | 4 |
| NAME OF FACULTY | DR. EKTA RAWAT | NAME OF COURSE COORDINATOR | DR. EKTA RAWAT |

*Note: All questions are compulsory.*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL |
|---|---|---|---|---|---|
| PART-A | 1(A) | Name the orbitals for following combinations of quantum numbers and arrange the electrons represented by following sets of quantum numbers in the increasing order of energy:<br>(i) n=4, l=0, m=0, s=+1/2<br>(ii) n=3, l=2, m=0, s=+1/2<br>(iii) n=3, l=1, m=0, s=-1/2<br>(iv) n=3, l=0, m=0, s=-1/2 | 5 | CO1 | BT3 |
| | 1(B) | Does the Heisenberg Uncertainty Principle have significance in daily life? Give examples. | 5 | CO1 | BT2, BT3 |
| PART-B | Q2(A) | Justify the following order of first ionization energies of second period elements:<br>Li<B<Be<C<O<N<F<Ne | 6 | CO2 | BT3 |
| | 2(B) | Define electronegativity and discuss Pauling scale of electronegativity. | 4 | CO2 | BT4 |
| PART-C | Q3(A) | What is Born-Haber cycle? Explain how Born-Haber cycle is used for calculating lattice energy of NaCl. | 2+8=10 | CO3 | BT3 |
| | 3(B) | How electronic configuration of the cation affects the covalency in a given compound? Explain on the basis of Fazan's rule. | 4 | CO3 | BT2, BT3 |
| | 3(C) | The ionic radii of $Rb^+$, $Br^-$ and $I^-$ ions are 1.47, 1.95 and 2.16°A respectively. Predict the most probable type of coordination number of Rb in | 6 | CO3 | BT2,BT3 |

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| | | RbBr and RbI, on the basis of radius ratio rule. | | | |
| | Q4(A) | What is cubic close packing arrangement found in ionic compounds? Draw and discuss structure of NaCl. | 2+6=8 | CO3 | BT3, BT4 |
| | 4(B) | Write a short note on the following properties of ionic solids:<br>(i)High melting and boiling points<br>(ii) Brittleness<br>(iii) Conduction of electricity | 6 | CO3 | BT2 |
| | 4(C) | Discuss in detail the following exceptions in octet rule in the Lewis model:<br>(i) Odd electron species<br>(ii) Incomplete octet | 3+3=6 | CO3 | BT2 |
| PART-D | Q5(A) | What are semiconductors? Why are they so called? How n-type semiconductors are made? | 3+2+5=10 | CO4 | BT3 |
| | 5(B) | Explain valence bond theory of bonding in metals? How it explained the electrical conductivity of metals. | 8+2=10 | CO4 | BT3 |
| | 6(A) | What are defects in non-stoichiometric crystals? Write a short note on Frenkel defect. | 3+5=8 | CO4 | BT3, BT4 |
| | 6(B) | Silver halides have low solubility in water. Explain. | 5 | CO4 | BT3 |
| | 6(C) | What is a hydrogen bond? Discuss two types of hydrogen bonds. | 3+4=7 | CO4 | BT2, BT3 |

MANAV RACHNA UNIVERSITY

# DEPARTMENT OF Chemistry

*"T3 Examination, June-July 2022"*

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|---|---|---|---|
| SEMESTER | II | DATE OF EXAM | 01.07.2022 |
| SUBJECT NAME | Organic Chemistry-I | SUBJECT CODE | CHH 104 B-T |
| BRANCH | Chemistry | SESSION | I |
| TIME | 3.0 hrs | MAX. MARKS | 100 |
| PROGRAM | BSc(H) Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. S.K. Shukla | NAME OF COURSE COORDINATOR | Dr. S.K. Shukla |

*Note: All questions are compulsory.*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | 1 | How to convert n-heptane into toluene | 2 Marks | CO3 | BT3 | |
| | 2 | What happens when dehalogination of vicinal dihalides takes place | 2 Marks | CO3 | BT4 | |
| | 3 | Explain the cracking of alkene | 2 marks | CO3 | BT1 | |
| | 4 | What happens when hypohalous acid reacts with propene? | 2 marks | CO3 | BT4 | |
| | 5 | What happens when ethane undergoes combustion reaction | 2 marks | CO3 | BT2 | |
| | 6 | What is the difference between benzyl, benzal and benzo groups | 2 marks | CO4 | BT2 | |
| | 7 | What happens when benzene undergoes ozonolysis reaction | 2 marks | CO4 | BT4 | |
| | 8 | Write the structure of cyclohexatriene[3]annuline and cyclooctatetraene[8]annuline | 2 marks | CO4 | BT1 | |
| | 9 | What are the major requisites of the compounds to be aromatic. | 2 marks | CO4 | BT1 | |
| | 10 | How to convert Sodium benzoate into benzene | 2 marks | CO4 | BT3 | |
| PART-B | 11 | Explain the geometrical isomerism in dimethylcyclobutane | 3 marks | CO1 | BT2 | |
| | 12 | (a) Why trans form have higher melting point and lower boiling point than its cis isomer form of compound.<br>(b)How to distinguish the cis and trans form by its dipole moment | 4+3 marks | CO1 | BT4 | |
| | 13 | Write a short note on:<br>(a) carbenes and give carbylamine reaction in detail.<br>(b) hyperconjugation | 6 +4 marks | CO2 | BT1 | |

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| PART-C | 14 | What are the limitations of the Wurtz reaction? Give detailed mechanism of the name reaction which solves its limitations. | 6 marks | CO3 | BT2 | |
| | 15 | Give detailed mechanism of chlorination of the alkane. How iodination is different from it. | 5 marks | CO3 | BT3 | |
| | 16 | Write a note on<br>(a) Role of hot potassium permanganate in the reaction of propene<br>(b) Ozonolysis of alkyne<br>(c) Hydration of propyne | 9 marks | CO3 | BT1 | |
| | 17 | What happens when propene react with chlorine at high temperature and follow the free redical mechanism. Represent the mechanism involved | 6 marks | CO3 | BT4 | |
| | 18 | How to convert Acetylene into 1-butyne. | 4 marks | CO3 | BT3 | |
| PART-D | 19 | Deduce the Kekule's structure of the benzene. What are the drawbacks of the Kekule's proposed structure? How resonance theory explains the structure of benzene. | 10 marks | CO4 | BT2 | |
| | 20 | How to convert:<br>(a) Benzene into benzene sulphonic acid. Give detailed mechanism.<br>(b) Benzene in to toluene with the help of aluminium chloride. Explain with detailed mechanism. | 5+5 marks | CO4 | BT4 | |
| | 21 | Explain the directive behavior of toluene in detail. | 4 marks | CO4 | BT2 | |
| | 22 | What will be the orientation of the electrophile when the bezene already have monosubstitution of:<br>(a) carboxylic group<br>(b) chloro group | 6 marks | CO4 | BT3 | |

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MANAV RACHNA UNIVERSITY

# DEPARTMENT OF CHEMISTRY

*"T3 Examination, May-2022"*

*SET-A*

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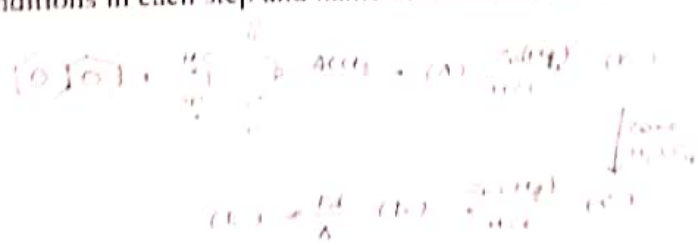
|---|---|---|---|
| SEMESTER | IV | DATE OF EXAM | 23/05/2022 |
| SUBJECT NAME | ORGANIC CHEMISTRY-III | SUBJECT CODE | CHH 207 B4 |
| BRANCH | Chemistry | SESSION | I |
| TIME | 9:00 AM-12:00 Noon | MAX. MARKS | 100 |
| PROGRAM | B.Sc. (H) Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. Megha Bansal | NAME OF COURSE COORDINATOR | Dr. Megha Bansal |

Megha

*Note: All questions are compulsory.*

**Bloom's Level:** L1-Remembering; L2-Understanding; L3-Applying; L4-Analyzing; L5-Evaluating; L6-Creating

| | Q.NO. | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | 1(A) | What happens when primary amines react with $CS_2$ Discuss with the help of suitable chemical reaction. | 5 | CO1 | L2 | 1.1.2 |
| | 1(B) | Diazonium salts undergoes various coupling reaction. Discuss any two coupling reactions with suitable example. | 5 | CO1 | L3 | 1.1.1 |
| | 1(C) | What are ylides. Discuss synthesis of epoxide and cyclopropane by using ylide as starting reagent. | 5 | CO2 | L3 | 1.2.1 |
| | 1(D) | Discuss the mechanism for the formation of benzene sulphonic acid by sulphonation of benzene. Justify that reaction take place via formation of $SO_3$ ion. | 5 | CO2 | L3 | 1.2.2 |
| PART-B | Q2(A) | What happens when:<br>(i) Anthraquinone reacts with alkaline sodium hydrosulphite or zinc<br>(ii) Anthracene undergoes catalytic reduction using nickel at 225 °C | 5 | CO3 | L4 | 5.2.1 |
| | 2(B) | Complete the following reaction by writing suitable reaction conditions in each step and name of all intermediates:<br>  | 5 | CO3 | L2 | 4.1.2 |
| | 2 (C) | Discuss the suitable mechanism for the nitration of naphthalene. Why electrophilic substitution in naphthalene | 10 | CO3 | L3 | 4.1.2 |

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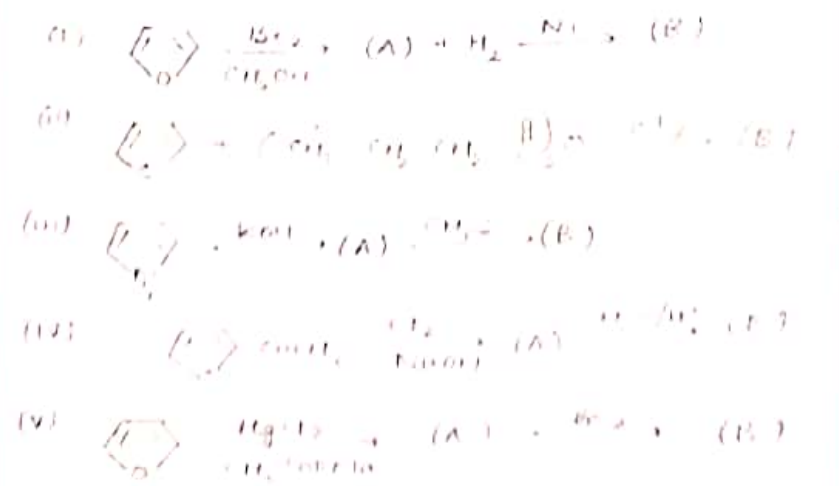
| | occurs at C-1 position. Elaborate the conditions when the same substitution can takes place at C-2 position. | | | | |
| Q 3(A) | 1-naphthol is a weak acid however it is stronger acid than phenol. Explain | 5 | CO3 | L3 | 7.2.1 |
| 3(B) | How polynuclear hydrocarbon shows their carcinogenic effect. Discuss the mechanism of cell destruction. | 5 | CO3 | L4 | 7.2.1 |
| 3 (C) | Anthracene undergoes addition and electrophilic substitution reactions at C-9 and C-10 positions. Justify it with the help of intermediate carbonium ion. Why addition and substitution is less favoured at C-1 and C-2 positions. | 10 | CO3 | L3 | 5.2.1 |
| Q 4(A) | Explain why among furan, pyrrole and thiophene, furan behaves as a conjugated diene | 5 | CO4 | L3 | 4.1.2 |
| 4 (B) | . What happens when<br>(i) Thiophene reacts with conc. $H_2SO_4$ and isatin<br>(ii) Thiophene reacts with Conc. $HNO_3$ at different temperatures | 5 | CO4 | L4 | 7.2.1 |
| 4 (C) | Why pyridine undergoes nucleophilic and electrophilic both substitution. Explain with the help of resonating structures. Write any two nucleophilic and two electrophilic substitution reactions of pyridine. | 10 | CO4 | L3 | 7.2.1 |
| Q 5(A) | Discuss exhaustive methylation in piperidine for the formation of conjugated diene. | 5 | CO4 | L4 | 5.2.1 |
| 5(B) | Justify that in 5-membered heterocyclic compounds electrophilic substitution takes place at 2 & 5 positions with the help of resonating structures by taking a suitable example. | 5 | CO4 | L4 | 4.1.2 |
| 5 (C) | Write the product of the following reactions:<br>  | 10 | CO4 | L4 | 7.2.1 |

PART C

********** END **********

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# DEPARTMENT OF CHEMISTRY

*"T3 Examination, May-2022"*

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|---|---|---|---|
| SEMESTER | IV | DATE OF EXAM | 25.5.2022 |
| SUBJECT NAME | INORGANIC CHEMISTRY-III | SUBJECT CODE | CHH206B-T |
| BRANCH | CHEMISTRY | SESSION | I |
| TIME | 9:00 am-12:00pm | MAX. MARKS | 100 |
| PROGRAM | B.Sc. Chemistry (Hons.) | CREDITS | 4 |
| NAME OF FACULTY | DR. EKTA RAWAT | NAME OF COURSE COORDINATOR | DR. EKTA RAWAT |

*Note: All questions are compulsory.*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL |
|---|---|---|---|---|---|
| PART-A | 1(A) | Draw MO energy level diagram for $NO^+$ and evaluate its bond order and magnetic behavior. | 7 | CO1 | BT3 |
| | 1(B) | Describe the shape of $SnCl_2$ on the basis of VSEPR theory. | 3 | CO1 | BT2, BT3 |
| PART-B | Q2(A) | The ionization energies of the elements of first transition series do not vary much with increasing atomic number. Give reason. | 6 | | BT2, BT3 |
| | 2(B) | Among hydroxides of lanthanides, $La(OH)_3$ is most basic and $Lu(OH)_3$ is least basic. Why? | 4 | CO2 | BT4 |
| PART-C | Q3(A) | On the basis of CFT, predict the geometry of the compound, $K_3[Fe(CN)_6]$. Also calculate magnetic moment of the complex. | 8 | CO3 | BT3 |
| | 3(B) | Differentiate between primary valency and secondary valency. | 4 | CO3 | BT2, BT3 |
| | 3(C) | Write the names of the following coordination compounds according to IUPAC system of nomenclature:<br>(i) $K_4[Fe(CN)_6]$<br>(ii) $Na_3[AgF_4]$<br>(iii) $H[Au Cl_4]$<br>(iv) $[Pt(NH3)_4Cl_2][PtCl_4]$ | 2x4=8 | CO3 | BT2, BT3 |

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| | Q4(A) | On the basis of VBT, predict the number of unpaired electrons and type of hybridization in $[NiCl_4]^{2-}$ and $[NiCN_4]^{2-}$ ions. | 6+6=12 | CO3 | BT3 |
| | 4(B) | Determine the number of unpaired electrons in octahedral complexes of $d^9$ and $d^5$ ions when $\Delta_0>P$ and $\Delta_0<P$. | 4+4=8 | CO3 | BT3, BT4 |
| PART-D | Q5(A) | What is acidity and acidic strength of a Bronsted acid ?<br>Relative order of acidic strength of $H_2O$, $H_2S$, $H_2Se$ and $H_2Te$. Explain? | 3+5=8 | CO4 | BT3 |
| | 5(B) | $HNO_3$, HCl and $H_2SO_4$ appear equally strong in water but their strength differ in $CH_3COOH$ medium. Explain giving appropriate reasons. | 8 | CO4 | BT3 |
| | 5(C) | All Arrhenius acids are also Bronsted acids, but all Arrhenius acids are not Bronsted bases. Why? | 4 | CO4 | BT3, BT4 |
| | 6(A) | What are lewis acid and bases?<br>"Tetrahalides of carbon donot behave as Lewis acids, while the tetrahalides of other elements of group IVA are Lewis acids". Explain | 4+4=8 | CO4 | BT3 |
| | 6(B) | Expalin the following on the basis of HASB principle:<br>(i) $AgI_2^-$ ion is stable while $AgF_2^-$ do not exist.<br>(ii) To predict the nature of bonding in complex ions given in ambidentate ligands. | 5+7=12 | CO4 | BT2, BT3 |

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# DEPARTMENT OF CHEMISTRY

*"T3 Examination, May/ June-2022"*

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|---|---|---|---|
| SEMESTER | IV | DATE OF EXAM | 01.06.2022 |
| SUBJECT NAME | Industrial Chemistry | SUBJECT CODE | CHH 209 B |
| BRANCH | Chemistry | SESSION | 1st |
| TIME | 3.0 hrs. | MAX. MARKS | 100 |
| PROGRAM | B.Sc. Chemistry (H) | CREDITS | 4 |
| NAME OF FACULTY | Dr. Pradeep K. Varshney | NAME OF COURSE COORDINATOR | Dr. Pradeep K. Varshney |

***Note*: All parts are compulsory to attempt. Part A and Part B are of 10 marks each. Part C and Part D are of 40 marks each and you have to attempt ANY FOUR questions.**

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | Q.1(A) | Write any two products of silicate industries. What is the composition of Pyrex glass? | 2 | CO4 | BT1, BT4 | 5.4.1 |
| | 1(B) | What is the importance of industrial forms of glasses? Where bullet resistant glasses are used? | 2 | CO4 | BT3 | 5.4.1 |
| | 1(C) | Essential oils play an important role in cosmetic industries. Explain. | 2 | CO2 | BT3 | 5.4.1, 6.2.1 |
| | 1(D) | Give two examples of substances used as colourants for glass. | 2 | CO1 | BT2 | 5.4.1 |
| | 1(E) | The strength of cement decreases with storage time. Suggest the ways to maintain its strength. | 2 | CO1 | BT5 | 6.2.1 |
| PART-B | Q.2(A) | What are the ingredients used in the preparation of talcum powder. | 2 | CO2 | BT4 | 5.4.1 |
| | 2(B) | What is the role of essential oils in cosmetic industries? Explain. | 2 | CO2 | BT3 | 5.4.1. 6.2.1 |
| | 2(C) | Write any two differences between Deodorants and Antiperspirants. | 2 | CO2 | BT2 | 5.4.1 |
| | 2(D) | Which hair dye is better permanent or demi-permanent and why? | 2 | CO2 | BT2 | 5.4.1 |
| | 2(E) | Which chemicals are used in the preparation of lipsticks? | 2 | CO2 | BT1 | 5.4.1 |
| PART-C | Q.3(A) | Write preparation and properties of RDX. Why is RDX the most dangerous explosive in the nature? Explain. | 10 | CO3 | BT2, BT3 | 5.4.1 |

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| | 3(B) | What are rocket propellants? How many types of propellants are used? Explain the functioning of solid and liquid propellants. | 10 | CO4 | BT1, BT3 | 5.4.1 |
| | 3(C) | What are rocket propellants? How many types of propellants are used? Explain how solid propellants are different from liquid ones in their functioning. | 10 | CO4 | BT1, BT3 | 5.4.1 |
| | 3(D) | Explain the mechanism of enzyme catalysis and how cane sugar can be converted into ethyl alcohol. Discuss merits and demerits of enzymes as catalysts for industrial purposes. | 10 | CO2 | BT2, BT3 | 5.4.1 |
| | 3(E) | Silver and tungsten aren't very good catalysts, but platinum and nickel can be excellent catalysts. Explain why this is in terms of the strength of the adsorption of gases to their surfaces. | 10 | CO3 | BT3 | 5.4.1 |
| PART-D | Q. 4(A) | Explain the advantages and disadvantages of using enzymes as catalysts for industrial purposes. | 10 | CO3 | BT3 | 5.4.1 |
| | 4(B) | Modern Ceramic Industry has grown these days. If you are given a chance to start a business in this area, which product you will plan to develop for creating a profitable business. | 10 | CO2 | BT4, BT5 | 5.4.1 |
| | 4(C) | Rather than finding alternatives to catalytic metals, chemist is researching ways to minimize platinum waste. What structures are chemist and his team developing and why are they effective catalytically? | 10 | CO3 | BT4, BT5 | 5.4.1 |
| | 4(D) | You are working in a steel industry and involved in manufacture of steel. As a chemist how will you explain the following terms with the help of chemical reactions decarbonization, demagnetization, desulphurization dephosphorisation, nitriding, and carburizing? | 10 | CO4 | BT1, BT2 | 5.4.1 |
| | 4(E) | Which types of batteries are used in solar panels as energy storage? While working with a battery industry, your team leader asked to propose a strategy to double the business. What steps you will propose. | 10 | CO2 | BT1, BT3 | 5.4.1 |

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## DEPARTMENT OF CHEMISTRY

*"T3 Examination, May2022"*

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| **SEMESTER** | **4TH** | **DATE OF EXAM** | **3-06-2022** |
| **SUBJECT NAME** | **PHYSICAL CHEMISTRY-III** | **SUBJECT CODE** | **CHH205B-T** |
| **BRANCH** | **B.Sc Chemistry** | **SESSION** | **Morning** |
| **TIME** | **9:00-12:00** | **MAX. MARKS** | **100** |
| **PROGRAM** | **B.Sc.** | **CREDITS** | **4** |
| **NAME OF FACULTY** | **Dr. Priti Gupta** | **NAME OF COURSE COORDINATOR** | **Dr. Priti Gupta** |

*Note: All questions are compulsory*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL |
|---|---|---|---|---|---|
| PART-A | 1(A) | Following is wrong about a phase diagram.<br>(a) It gives information on transformation rates.<br>(b) Relative amount of different phases can be found under given equilibrium conditions.<br>(c) It indicates the temperature at which different phases start to melt.<br>(d) Solid solubility limits are depicted by it. | 2 | CO1 | BT2 |
| | 1(B) | Explain why in a phase diagram of water, solid - liquid line is almost vertical and slightly tilted towards left? | 2 | CO1 | BT3 |
| | 1(C ) | Write the reduced phase rule equation for condensed systems. | 2 | CO1 | BT1 |
| | 1(D) | Define the various curves and points involved in two component system with incongruent melting point with the help of neat diagram. | 4 | CO1 | BT4 |
| PART-B | Q2(A) | State the law of Chemical Equilibrium. How can it be derived on thermodynamic considerations? | 5 | CO2 | BT2 |
| | 2(B) | A mixture of water and bromobenzene distil at 95°C and the distillate contains1.6 times as much bromobenzene as water by mass. At 95°C the vapour pressures of water and bromobenzene are 640mm respectively. Calculate the molecular weight of Bromobenzene. | 5 | CO2 | BT3 |
| PART-C | Q3(A) | "On Progressive dilution, specific conductance of an electrolyte decreases but molar conductance increases ".Discuss. | 5 | CO3 | BT2 |

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| 3(B) | What current strength in amperes will be required to liberate 10 g of iodine from potassium iodide solution in one hour? | 3 | CO3 | BT3 |
| 3(C) | A certain current liberated 1.008 g of hydrogen in 2 hours. How many grams of copper can be deposited by the same current flowing for the same time in CuSO4 solution. (at mass of Cu = 63.5)<br>(a) 31.75 g<br>(b) 63.5 g<br>(c) 127 g<br>(d) 15.875 g | 5 | CO3 | BT4 |
| 3(D) | Describe Hittorf's method for determining the transport no. of Ag+ and $NO_3^-$ in solution of silver nitrate. | 6 | CO3 | BT2 |
| 3(E) | State the principle of Conductometric titrations. Draw the titration curves for:<br>1)Weak acid with a strong base<br>2)Strong acid with a strong base | 8 | CO3 | BT3 |
| 3(F) | Give an account of the ways by which physisorption and chemisorption are distinguished from each other. | 6 | CO3 | BT2 |
| 3(G) | Discuss Freundlich adsorption isotherm of a gas on a solid surface. How will you prove that Langmuir adsorption isotherm is superior to Freundlich adsorption isotherm? | 7 | CO3 | BT2 |
| PART-D 4(A) | Describe how Glass electrode is used for the measurement of pH of aqueous solutions? | 7 | CO4 | BT3 |
| 4(B) | Discuss the principle underlying potentiometric titrations. How would you carry out potentiometric titration of a solution of sodium chloride against silver nitrate solution. | 8 | CO4 | BT2 |
| 4(c) | 1) Write down the electrode and overall cell reaction for the cell :<br>Pt \| $H_2$(1 atm), $H^+$(a = 1) ‖ KCl(a = 1), AgCl(s) \| Ag<br>2)How are the emf of a cell and entropy of the reaction related? | 8 | CO4 | BT3 |
| 4(D) | What are concentration cells ? Describe and discuss concentration cell without transference. | 7 | CO4 | BT2 |
| 4(E) | What is reversible cells? Derive expression for the thermodynamic parameters from the EMF of such a cell. | 5 | CO4 | BT1 |
| 4(F) | Describe the application of EMF measurement in the determination of equilibrium constant of a cell reaction | 5 | CO4 | BT3 |

MANAV RACHNA UNIVERSITY

# DEPARTMENT OF CHEMISTRY

*"T3 Examination, May – 2022"*

| | | | |
|---|---|---|---|
| SEMESTER | VI | DATE OF EXAM | 26.05.2022 |
| SUBJECT NAME | FOOD SCIENCE | SUBJECT CODE | CHH308B |
| BRANCH | B.SC. (HONS.) CHEMISTRY | SESSION | MOR |
| TIME | 9:00 – 12:00 NOON | MAX. MARKS | 100 |
| PROGRAM | B.SC. (HONS.) | CREDITS | 4 |
| NAME OF FACULTY | DR. MEENA KAPAHI | NAME OF COURSE COORDINATOR | DR. MEENA KAPAHI |

***Note: Parts A & B:*** *All the questions are compulsory. Marks are indicated against each question.*

| | | | | | |
|---|---|---|---|---|---|
| | **PART A** | | | | |
| A(i) | Billy is consuming roughly 3,500 calories per day. His basal metabolic rate is 2,500 and he burns about 600 calories from football practice every day. If he continues this behavior, what affects will he see in his weight in one year? | 2 | CO1 | BT3 | |
| A(ii) | In what ways the fats are useful to our body? Explain with appropriate examples. | 2 | CO1 | BT1 | |
| A(iii) | Your roommate ate some spoiled food, and consequently developed severe diarrhea. Explain this condition and how it can be cured? | 5 | CO2 | BT2 | |
| A(iv) | Discuss any two techniques to preserve milk that are normally practiced at homes? How do they help in preservation? | 3,2 | CO3 | BT3 | |
| | **PART B** | | | | |
| B(I) | Socio economic conditions can have a large influence on one health. Justify. | 8 | CO1 | BT2 | |

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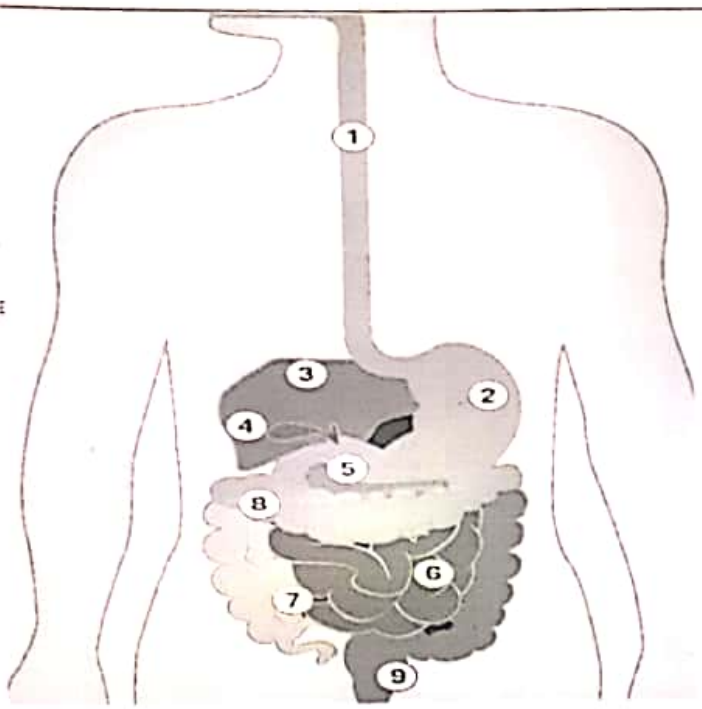
|---|---|---|---|---|---|
| B(ii) |  <br>One egg, whether raw, hard-boiled, or fried, supplies about six grams of protein. In the image above, follow the numbers and discuss the digestion process (mechanical and chemical both) of proteins in our egg at site nos. 2 and 6. | 8 | CO1 | BT3 | |
| B(iii) | How is Vitamin D is associated with healthy bones? What are its sources? What happens due to its deficiency? | 2,8 | CO1 | BT4 | |
| B(iv) | Define the following types of food additives:<br>• Preservatives<br>• Flavour enhancers<br>• Emulsifier<br>• Antioxidants<br>• Antimicrobial agents | 10 | CO3 | BT1 | |
| B(v) | What are the food sources, functions of vitamin A? What happens due to its inadequate intake? | 15 | CO1 | BT1 | |
| B(vi) | What are reasons behind spoilage of food? | 5 | CO2 | BT1 | |
| B(vii) | Discuss the principles of food preservation. Which of the two methods - freezing or boiling would you recommend for preservation to inhibit microbial action/kill microbes? Why? | 5,5 | CO3 | BT5 | |
| B(viii) | Write a note on cyclamate and aspartame describing their advantages and disadvantages. | 5,5 | CO2 | BT1 | |
| B(ix) | Write a note on water intoxication and dehydration condition? | 5,5 | CO1 | BT1 | |

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MANAV RACHNA UNIVERSITY

# DEPARTMENT OF CHEMISTRY

*"T3 Examination, May-2022"*

*SET-A*

| | | | |
|---|---|---|---|
| SEMESTER | VI | DATE OF EXAM | 30/05/2022 |
| SUBJECT NAME | CLINICAL & PHARMACEUTICAL CHEMISTRY | SUBJECT CODE | CHH 311B |
| BRANCH | Chemistry | SESSION | I |
| TIME | 9:00 AM-12:00 Noon | MAX. MARKS | 100 |
| PROGRAM | B.Sc. (H) Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. Megha Bansal | NAME OF COURSE COORDINATOR | Dr. Megha Bansal |

Megha

**Note** *All questions are compulsory.*

**Bloom's Level:** L1-Remembering; L2-Understanding; L3-Applying; L4-Analyzing; L5-Evaluating; L6-Creating

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | 1(A) | In Biuret protein assay one standard 6g/dl was assayed. The absorbance of the standard was 0.400 and absorbance of unknown was 0.350. Calculate concentration of unknown in g/dl. | 5 | CO1 | L2 | 1.1.2 |
| | 1(B) | Calculate the dilution factor needed to make 100meq/L solution from a 3000meq/L. | 5 | CO1 | L3 | 1.1.3 |
| | 1(C ) | Why plasma proteins appear in urine sample. Explain any one method for their detection. | 5 | CO2 | L3 | 1.2.1 |
| | 1(D) | Discuss Chemiluminiscence method for the detection of nitrogen in blood sample. | 5 | CO2 | L3 | 1.2.2 |
| PART-B | Q2(A) | Discuss the importance of isoenzymes, their properties and function. | 5 | CO3 | L4 | 5.2.1 |
| | 2(B) | Identify main class of enzymes with following EC code No.<br>(i) 1.4.1.3 (ii) 4.1.2.13 (iii) 6.3.2.3 (iv) 2.6.1.1 (v) 5.3.1.1 | 5 | CO3 | L2 | 4.1.2 |
| | 2 (C) | Which biochemical reaction is catalyzed by LDH enzyme. How this enzyme can be assayed. It exists in five isomeric forms, which isoforms are overexpressed in the case of Myocardial infarction, anemia, pulmonary edema, hepatic injury, and skeletal muscle injury | 10 | CO3 | L3 | 4.1.2 |
| | Q 3(A) | Explain the enzymatic reaction of AST. Why it is also termed S-GOT. How the enzyme will be assayed. What is the diagnostic significance of AST. | 5 | CO3 | L3 | 7.2.1 |
| | 3(B) | (c) Which enzyme catalyzes the hydrolysis of phosphor-monoesters at acidic pH. Explain biochemical reaction for enzymatic reaction and assay procedure. | 5 | CO3 | L4 | 7.2.1 |

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|---|---|---|---|---|---|
| 3 (C) | Explain with the help of the Lineweaver-Burk plot, why (i) in competitive inhibition Vmax remains unaltered (ii) in non-competitive inhibition Vmax decreased (iii) in uncompetitive inhibition Km decreased. | 10 | CO3 | L3 | 5.2.1 |
| **PART C** | | | | | |
| Q 4(A) | How sugars are classified as reducing and non-reducing. Give Haworth projection each of reducing and non-reducing sugar | 5 | CO4 | L3 | 4.1.2 |
| 4 (B) | Complete the following pathway, write enzymes and cofactors involved: (5)<br>(i) Fructose 1, 6 diphosphate → …….. → ……<br>(ii) 3-phosphoglycerate → …….. → …… | 5 | CO4 | L4 | 7.2.1 |
| 4 (C) | Explain the following: Glycolysis, Glycogenolysis, Gluconeogenesis, Glycogenesis, Lipogenesis. | 10 | CO4 | L3 | 7.2.1 |
| Q 5(A) | How glucose can be estimated in biological samples. Compare available methods and comment on which is the best method. | 5 | CO4 | L4 | 5.2.1 |
| 5(B) | Why OGTT is not recommended for routine tests under ADA guidelines. How this test is performed. | 5 | CO4 | L4 | 4.1.2 |
| 5 (C) | Which ketone bodies are produced by the liver through lipid metabolism. What happens when urinary albumin level increases. Discuss the pathophysiological condition. | 10 | CO4 | L4 | 7.2.1 |

********** END **********

MANAV RACHNA UNIVERSITY

Declared as State Private University vide Haryana Act 26 of 2014

# DEPARTMENT OF CHEMISTRY

*"T3 Examination, MAY-2022"*

| | | | |
|---|---|---|---|
| SEMESTER | VI$^{th}$ | DATE OF EXAM | 30-05-2022 |
| SUBJECT NAME | CHEMICALS & ENVIRONMENT | SUBJECT CODE | CHH310B |
| BRANCH | B.Sc. (Hons.) Chemistry | SESSION | I |
| TIME | 09:00 AM to 12:00 PM | MAX. MARKS | 100 |
| PROGRAM | Bachelor of Science | CREDITS | 4 |
| NAME OF FACULTY | Dr. V. V. Pathak | NAME OF COURSE COORDINATOR | Dr. V.V. Pathak |

***Note**: Part A& B: All questions are compulsory. Questions will be of short answer type, each question carries two marks.*

***Part C:** Attempt any four question. Questions will be of long answer type, each question carries 10 marks.*

***Part D**: Attempt any four question. Questions will be of long answer type, each question carries 10 marks.*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | Q1(A) | Explain cryogenic air separation process for production of oxygen gas. | 2 | CO1 | L2 | |
| | Q1(B) | Why hydrogen gas used as an efficient alternative energy resource? | 2 | CO1 | L2 | |
| | Q1(C) | Explain the occurrence and application of Argon gas. | 2 | CO1 | L1 | |
| | Q1(D) | Describe the process for preparation of caustic soda. | 2 | CO1 | L2 | |
| | Q1(E) | Describe the process for preparation of bleaching powder. | 2 | CO1 | L2 | |
| PART-B | Q2(A) | Differentiate between ferrous and non-ferrous metals. | 2 | CO2 | L1 | |
| | Q2(B) | Explain the properties of semiconductor and its industrial application. | 2 | CO2 | L2 | |
| | Q2(C) | What do you understand by remediation of heavy metal? | 2 | CO2 | L2 | |
| | Q2(D) | Define the term bioaccumulation and biomagnification. | 2 | CO2 | L1 | |

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|---|---|---|---|---|---|---|
| | 2(E) | What do you understand by chemical speciation of metals? | 2 | CO2 | L2 | |
| PART-C | Q3 | Differentiate between natural and artificial ecosystem with examples. Explain the structure and functions of ecosystem. | 10 | CO3 | L2, L3 | |
| | Q3 | Explain the composition of atmosphere with its stratification. | 10 | CO3 | L3, L4 | |
| | Q4 | What do you understand by photochemical reactions? Explain with examples. | 10 | CO3 | L3 | |
| | Q5 | What do you understand by air pollutants? Explain the harmful effects and control measures of major air pollutants. | 10 | CO3 | L3 | |
| | Q7 | Explain following in brief:<br>(i) Nitrogen Cycle<br>(ii) Standards and Air quality Index<br>(iii) Cloud formation<br>(iv) Ozone depletion | (2.5 ×4)= 10 | CO3 | L3, L4 | |
| PART-D | Q8 | Why water is considered as critical resource? Explain the chemistry of water in terms of its physical and Chemical properties. | 10 | CO4 | L3 | |
| | Q9 | What do you understand by eutrophication? Explain the harmful effects of eutrophication. | 10 | CO4 | L3 | |
| | Q10 | Explain the significance of water quality parameters? Explain DO sag curve, Biochemical oxygen demand and Chemical Oxygen demand. | 10 | CO4 | L4 | |
| | Q11 | Explain the various treatment and purification process of water. | 10 | CO4 | L3 | |
| | Q12 | Giving details of various sources of water pollution explain its ill effects on human health. | 10 | CO4 | L3 | |

********** END **********

MANAV RACHNA
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# MANAV RACHNA UNIVERSITY

Declared as State Private University vide Haryana Act 26 of 2014

## DEPARTMENT OF CHEMISTRY

*"T3 Examination, June-2022"*

| | | | |
|---|---|---|---|
| SEMESTER | II | DATE OF EXAM | 23/06/2022 |
| SUBJECT NAME | Physical Chemistry-II | SUBJECT CODE | CHH506B |
| BRANCH | Chemistry | SESSION | I |
| TIME | 08:30-11:30 | MAX. MARKS | 100 |
| PROGRAM | M.Sc. Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. Arpit Sand | NAME OF COURSE COORDINATOR | Dr. Arpit Sand |

*Note: Part A : All questions are compulsory. Questions will be of short answer type*
*Part B: All questions are compulsory. Questions will be of descriptive type or numerical.*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|---|
| PART-A | 1 | Find the number of complexion for arranging four different molecules a,b,c,d, such that two should be energy level $E_1$ and two in energy level $E_2$ | 4 | CO1 | BT3 | 1.3.1 |
| | 2 | Write the mathematical concept of stirling's approximation. Calculate the value of 5 ! and 10 ! | 6 | CO1 | BT3 BT4 | 1.3.1 |
| | 3 | Derive and expression for the equilibrium constant of an ideal gaseous mixture in term of partition function of reactants and products | 5 | CO2 | BT3 | 1.3.2 |
| | 4 | Using the concept of molecular partition function show that for an ideal monoatomic gas, PV=nRT/V. This ideal gas equation. | 5 | CO2 | BT4 | 1.3.3 |
| PART-B | 5 | Explain Miller Indices and deduce expression for 100,001 and 010 | 5 | CO3 | BT3 | 1.3.2 |
| | 6 | Iron (II) Oxide FeO crystal has a cubic structure each edge of the unit cell is 5.0Å. Taking density of the oxide is 4.0 g $cm^{-3}$.Caluclate the number of $Fe^{2+}$ and $O^{2-}$ ions present in each unit cell. | 5 | CO4 | BT4 | 1.3.3 |
| | 7 | What are basic steps in formation of Reciprocal lattice with suitable example and explain MS by Guoy method. | 5+5 | CO4 CO3 | BT4 | 1.3.1 |

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| | | | | |
|---|---|---|---|---|
| Discuss Phase determination method with special reference to Patterson Method. Draw the electron density map of $KO_3$ crystal on the (xy) plane | 5 | CO4 | BT3 BT4 | 1.3.1 |
| Draw the displacement ellipsoid plot (50%) of the molecular structure of $Ni(CO)_4$ | 5 | CO4 | BT2 BT3 | 1.3.2 |
| Discuss the condition for general reflection with the help of table | 5 | CO4 | BT2 BT3 | 1.3.2 |
| With reference to conditions for special reflections groups, Glide planes, screw axes | 5 | CO5 | BT4 | 1.3.3 |
| Discuss the collision theory of bimolecular reactions in details | 6 | CO5 | BT3 BT4 | 1.3.1 |
| In the temperature range of 250 to 450K,the pre exponential factor A, for the reaction $Cl(g)+H_2(g) \longrightarrow HCl(g)+H(g)$ is found to be equal to $1.20\times 10^{10}$ $dm^3\ mol^{-1}\ S^{-1}$. If M (Cl) =35.453 g $mol^{-1}$ M ($H_2$) =35.453 g $mol^{-1}$ d (Cl) =200 pm d($H_2$)=150 pm, determine the value of steric factor | 4 | CO4 CO5 | BT3 | 1.3.1 |
| What are the shortcomings of Lindemann Theory? How are they overcome by Hinshelwood Theory? | 5 | CO5 | BT4 | 1.3.2 |
| Consider the following Lindemann mechanism for the unimolecular decomposition of a molecule A in the presence of species M (which may be any molecule such as inert gas like helium or even A itself<br>$A+M \xrightarrow{k_1} A^*+M$ (activation)<br>$A^*+M \xrightarrow{k_{-1}} A+M$ (deactivation)<br>$A^* \xrightarrow{k_2} P$ (decomposition reaction)<br>Using Steady state approximation (s.s.a) derive the rate law for the formation of product. | 5 | CO5 | BT5 | 1.3.3 |
| For the first order isomerization of an organic compound at 130°C. The activation energy is 108.4JK $^{-1}$ mol $^{-1}$ and the rate constant is $9.12\times 10^{-4}$ $S^{-1}$. Calculate the standard entropy of activation | 10 | CO5 | BT3 BT4 | 1.3.2 |
| What are the shortcomings of Hinshelwood Theory? How are they overcome by RRK theory of unimolecular reaction? | 10 | CO5 | BT5 | 1.3.3 |

********** END **********

# COMMON ANTILOGARITH TABLE

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Mean Difference | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 00 | 1000 | 1002 | 1005 | 1007 | 1009 | 1012 | 1014 | 1016 | 1019 | 1021 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 01 | 1023 | 1026 | 1028 | 1030 | 1033 | 1035 | 1038 | 1040 | 1042 | 1045 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 02 | 1047 | 1050 | 1052 | 1054 | 1057 | 1059 | 1062 | 1064 | 1067 | 1069 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 03 | 1072 | 1074 | 1076 | 1079 | 1081 | 1084 | 1086 | 1089 | 1091 | 1094 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 04 | 1096 | 1099 | 1102 | 1104 | 1107 | 1109 | 1112 | 1114 | 1117 | 1119 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 05 | 1122 | 1125 | 1127 | 1130 | 1132 | 1135 | 1138 | 1140 | 1143 | 1146 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 06 | 1148 | 1151 | 1153 | 1156 | 1159 | 1161 | 1164 | 1167 | 1169 | 1172 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 07 | 1175 | 1178 | 1180 | 1183 | 1186 | 1189 | 1191 | 1194 | 1197 | 1199 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 08 | 1202 | 1205 | 1208 | 1211 | 1213 | 1216 | 1219 | 1222 | 1225 | 1227 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 09 | 1230 | 1233 | 1236 | 1239 | 1242 | 1245 | 1247 | 1250 | 1253 | 1256 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| 10 | 1259 | 1262 | 1265 | 1268 | 1271 | 1274 | 1276 | 1279 | 1282 | 1285 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| 11 | 1288 | 1291 | 1294 | 1297 | 1300 | 1303 | 1306 | 1309 | 1312 | 1315 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| 12 | 1318 | 1321 | 1324 | 1327 | 1330 | 1334 | 1337 | 1340 | 1343 | 1346 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| 13 | 1349 | 1352 | 1355 | 1358 | 1361 | 1365 | 1368 | 1371 | 1374 | 1377 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 14 | 1380 | 1384 | 1387 | 1390 | 1393 | 1396 | 1400 | 1403 | 1406 | 1409 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 15 | 1413 | 1416 | 1419 | 1422 | 1426 | 1429 | 1432 | 1435 | 1439 | 1442 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 16 | 1445 | 1449 | 1452 | 1455 | 1459 | 1462 | 1466 | 1469 | 1472 | 1476 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 17 | 1479 | 1483 | 1486 | 1489 | 1493 | 1496 | 1500 | 1503 | 1507 | 1510 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 18 | 1514 | 1517 | 1521 | 1524 | 1528 | 1531 | 1535 | 1538 | 1542 | 1545 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 |
| 19 | 1549 | 1552 | 1556 | 1560 | 1563 | 1567 | 1570 | 1574 | 1578 | 1581 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| 20 | 1585 | 1589 | 1592 | 1596 | 1600 | 1603 | 1607 | 1611 | 1614 | 1618 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| 21 | 1622 | 1626 | 1629 | 1633 | 1637 | 1641 | 1644 | 1648 | 1652 | 1656 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| 22 | 1660 | 1663 | 1667 | 1671 | 1675 | 1679 | 1683 | 1687 | 1690 | 1694 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| 23 | 1698 | 1702 | 1706 | 1710 | 1714 | 1718 | 1722 | 1726 | 1730 | 1734 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| 24 | 1738 | 1742 | 1746 | 1750 | 1754 | 1758 | 1762 | 1766 | 1770 | 1774 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| 25 | 1778 | 1782 | 1786 | 1791 | 1795 | 1799 | 1803 | 1807 | 1811 | 1816 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 |
| 26 | 1820 | 1824 | 1828 | 1832 | 1837 | 1841 | 1845 | 1849 | 1854 | 1858 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 4 |
| 27 | 1862 | 1866 | 1871 | 1875 | 1879 | 1884 | 1888 | 1892 | 1897 | 1901 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 4 |
| 28 | 1905 | 1910 | 1914 | 1919 | 1923 | 1928 | 1932 | 1936 | 1941 | 1945 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 29 | 1950 | 1954 | 1959 | 1963 | 1968 | 1972 | 1977 | 1982 | 1986 | 1991 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 30 | 1995 | 2000 | 2004 | 2009 | 2014 | 2018 | 2023 | 2028 | 2032 | 2037 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 31 | 2042 | 2046 | 2051 | 2056 | 2061 | 2065 | 2070 | 2075 | 2080 | 2084 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 32 | 2089 | 2094 | 2099 | 2104 | 2109 | 2113 | 2118 | 2123 | 2128 | 2133 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 33 | 2138 | 2143 | 2148 | 2153 | 2158 | 2163 | 2168 | 2173 | 2178 | 2183 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 |
| 34 | 2188 | 2193 | 2198 | 2203 | 2208 | 2213 | 2218 | 2223 | 2228 | 2234 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 35 | 2239 | 2244 | 2249 | 2254 | 2259 | 2265 | 2270 | 2275 | 2280 | 2286 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 36 | 2291 | 2296 | 2301 | 2307 | 2312 | 2317 | 2323 | 2328 | 2333 | 2339 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 37 | 2344 | 2350 | 2355 | 2360 | 2366 | 2371 | 2377 | 2382 | 2388 | 2393 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 38 | 2399 | 2404 | 2410 | 2415 | 2421 | 2427 | 2432 | 2438 | 2443 | 2449 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 |
| 39 | 2455 | 2460 | 2466 | 2472 | 2477 | 2483 | 2489 | 2495 | 2500 | 2506 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 |
| 40 | 2512 | 2518 | 2523 | 2529 | 2535 | 2541 | 2547 | 2553 | 2559 | 2564 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 |
| 41 | 2570 | 2576 | 2582 | 2588 | 2594 | 2600 | 2606 | 2612 | 2618 | 2624 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 |
| 42 | 2630 | 2636 | 2642 | 2649 | 2655 | 2661 | 2667 | 2673 | 2679 | 2685 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 6 |
| 43 | 2692 | 2698 | 2704 | 2710 | 2716 | 2723 | 2729 | 2735 | 2742 | 2748 | 1 | 1 | 2 | 3 | 3 | 4 | 4 | 5 | 6 |
| 44 | 2754 | 2761 | 2767 | 2773 | 2780 | 2786 | 2793 | 2799 | 2805 | 2812 | 1 | 1 | 2 | 3 | 3 | 4 | 4 | 5 | 6 |
| 45 | 2818 | 2825 | 2831 | 2838 | 2844 | 2851 | 2858 | 2864 | 2871 | 2877 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 |
| 46 | 2884 | 2891 | 2897 | 2904 | 2911 | 2917 | 2924 | 2931 | 2938 | 2944 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 |
| 47 | 2951 | 2958 | 2965 | 2972 | 2979 | 2985 | 2992 | 2999 | 3006 | 3013 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 |
| 48 | 3020 | 3027 | 3034 | 3041 | 3048 | 3055 | 3062 | 3069 | 3076 | 3083 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 6 |
| 49 | 3090 | 3097 | 3105 | 3112 | 3119 | 3126 | 3133 | 3141 | 3148 | 3155 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 6 |
| 50 | 3162 | 3170 | 3177 | 3184 | 3192 | 3199 | 3206 | 3214 | 3221 | 3228 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 |
| 51 | 3236 | 3243 | 3251 | 3258 | 3266 | 3273 | 3281 | 3289 | 3296 | 3304 | 1 | 2 | 2 | 3 | 4 | 5 | 5 | 6 | 7 |
| 52 | 3311 | 3319 | 3327 | 3334 | 3342 | 3350 | 3357 | 3365 | 3373 | 3381 | 1 | 2 | 2 | 3 | 4 | 5 | 5 | 6 | 7 |
| 53 | 3388 | 3396 | 3404 | 3412 | 3420 | 3428 | 3436 | 3443 | 3451 | 3459 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 |
| 54 | 3467 | 3475 | 3483 | 3491 | 3499 | 3508 | 3516 | 3524 | 3532 | 3540 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 |
| 55 | 3548 | 3556 | 3565 | 3573 | 3581 | 3589 | 3597 | 3606 | 3614 | 3622 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 7 |
| 56 | 3631 | 3639 | 3648 | 3656 | 3664 | 3673 | 3681 | 3690 | 3698 | 3707 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 57 | 3715 | 3724 | 3733 | 3741 | 3750 | 3758 | 3767 | 3776 | 3784 | 3793 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 58 | 3802 | 3811 | 3819 | 3828 | 3837 | 3846 | 3855 | 3864 | 3873 | 3882 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 8 |
| 59 | 3890 | 3899 | 3908 | 3917 | 3926 | 3936 | 3945 | 3954 | 3963 | 3972 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 |
| 60 | 3981 | 3990 | 3999 | 4009 | 4018 | 4027 | 4036 | 4046 | 4055 | 4064 | 1 | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 8 |
| 61 | 4074 | 4083 | 4093 | 4102 | 4111 | 4121 | 4130 | 4140 | 4150 | 4159 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 62 | 4169 | 4178 | 4188 | 4198 | 4207 | 4217 | 4227 | 4236 | 4246 | 4256 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 63 | 4266 | 4276 | 4285 | 4295 | 4305 | 4315 | 4325 | 4335 | 4345 | 4355 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 64 | 4365 | 4375 | 4385 | 4395 | 4406 | 4416 | 4426 | 4436 | 4446 | 4457 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 65 | 4467 | 4477 | 4487 | 4498 | 4508 | 4519 | 4529 | 4539 | 4550 | 4560 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 66 | 4571 | 4581 | 4592 | 4603 | 4613 | 4624 | 4634 | 4645 | 4656 | 4667 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 9 | 10 |
| 67 | 4677 | 4688 | 4699 | 4710 | 4721 | 4732 | 4742 | 4753 | 4764 | 4775 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 |
| 68 | 4786 | 4797 | 4808 | 4819 | 4831 | 4842 | 4853 | 4864 | 4875 | 4887 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 |
| 69 | 4898 | 4909 | 4920 | 4932 | 4943 | 4955 | 4966 | 4977 | 4989 | 5000 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 |
| 70 | 5012 | 5023 | 5035 | 5047 | 5058 | 5070 | 5082 | 5093 | 5105 | 5117 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 11 |
| 71 | 5129 | 5140 | 5152 | 5164 | 5176 | 5188 | 5200 | 5212 | 5224 | 5236 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 10 | 11 |
| 72 | 5248 | 5260 | 5272 | 5284 | 5297 | 5309 | 5321 | 5333 | 5346 | 5358 | 1 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 11 |
| 73 | 5370 | 5383 | 5395 | 5408 | 5420 | 5433 | 5445 | 5458 | 5470 | 5483 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 11 |
| 74 | 5495 | 5508 | 5521 | 5534 | 5546 | 5559 | 5572 | 5585 | 5598 | 5610 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 12 |
| 75 | 5623 | 5636 | 5649 | 5662 | 5675 | 5689 | 5702 | 5715 | 5728 | 5741 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 12 |
| 76 | 5754 | 5768 | 5781 | 5794 | 5808 | 5821 | 5834 | 5848 | 5861 | 5875 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 11 | 12 |
| 77 | 5888 | 5902 | 5916 | 5929 | 5943 | 5957 | 5970 | 5984 | 5998 | 6012 | 1 | 3 | 4 | 5 | 7 | 8 | 10 | 11 | 12 |
| 78 | 6026 | 6039 | 6053 | 6067 | 6081 | 6095 | 6109 | 6124 | 6138 | 6152 | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 13 |
| 79 | 6166 | 6180 | 6194 | 6209 | 6223 | 6237 | 6252 | 6266 | 6281 | 6295 | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 13 |
| 80 | 6310 | 6324 | 6339 | 6353 | 6368 | 6383 | 6397 | 6412 | 6427 | 6442 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 |
| 81 | 6457 | 6471 | 6486 | 6501 | 6516 | 6531 | 6546 | 6561 | 6577 | 6592 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 |
| 82 | 6607 | 6622 | 6637 | 6653 | 6668 | 6683 | 6699 | 6714 | 6730 | 6745 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 |
| 83 | 6761 | 6776 | 6792 | 6808 | 6823 | 6839 | 6855 | 6871 | 6887 | 6902 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 13 | 14 |
| 84 | 6918 | 6934 | 6950 | 6966 | 6982 | 6998 | 7015 | 7031 | 7047 | 7063 | 2 | 3 | 5 | 6 | 8 | 10 | 11 | 13 | 14 |
| 85 | 7079 | 7096 | 7112 | 7129 | 7145 | 7161 | 7178 | 7194 | 7211 | 7228 | 2 | 3 | 5 | 7 | 8 | 10 | 11 | 13 | 15 |
| 86 | 7244 | 7261 | 7278 | 7295 | 7311 | 7328 | 7345 | 7362 | 7379 | 7396 | 2 | 3 | 5 | 7 | 8 | 10 | 11 | 13 | 15 |
| 87 | 7413 | 7430 | 7447 | 7464 | 7482 | 7499 | 7516 | 7534 | 7551 | 7568 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 15 |
| 88 | 7586 | 7603 | 7621 | 7638 | 7656 | 7674 | 7691 | 7709 | 7727 | 7745 | 2 | 4 | 5 | 7 | 9 | 11 | 12 | 14 | 16 |
| 89 | 7762 | 7780 | 7798 | 7816 | 7834 | 7852 | 7870 | 7889 | 7907 | 7925 | 2 | 4 | 5 | 7 | 9 | 11 | 12 | 14 | 16 |
| 90 | 7943 | 7962 | 7980 | 7998 | 8017 | 8035 | 8054 | 8072 | 8091 | 8110 | 2 | 4 | 6 | 7 | 9 | 11 | 13 | 15 | 17 |
| 91 | 8128 | 8147 | 8166 | 8185 | 8204 | 8222 | 8241 | 8260 | 8279 | 8299 | 2 | 4 | 6 | 8 | 9 | 11 | 13 | 15 | 17 |
| 92 | 8318 | 8337 | 8356 | 8375 | 8395 | 8414 | 8433 | 8453 | 8472 | 8492 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 15 | 17 |
| 93 | 8511 | 8531 | 8551 | 8570 | 8590 | 8610 | 8630 | 8650 | 8670 | 8690 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 94 | 8710 | 8730 | 8750 | 8770 | 8790 | 8810 | 8831 | 8851 | 8872 | 8892 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 95 | 8913 | 8933 | 8954 | 8974 | 8995 | 9016 | 9036 | 9057 | 9078 | 9099 | 2 | 4 | 6 | 8 | 10 | 12 | 15 | 17 | 19 |
| 96 | 9120 | 9141 | 9162 | 9183 | 9204 | 9226 | 9247 | 9268 | 9290 | 9311 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 19 |
| 97 | 9333 | 9354 | 9376 | 9397 | 9419 | 9441 | 9462 | 9484 | 9506 | 9528 | 2 | 4 | 7 | 9 | 11 | 13 | 15 | 17 | 20 |
| 98 | 9550 | 9572 | 9594 | 9616 | 9638 | 9661 | 9683 | 9705 | 9727 | 9750 | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 20 |
| 99 | 9772 | 9795 | 9817 | 9840 | 9863 | 9886 | 9908 | 9931 | 9954 | 9977 | 2 | 5 | 7 | 9 | 11 | 14 | 16 | 18 | 20 |

# LOGARITHMS

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Mean Difference | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 0000 | 0043 | 0086 | 0128 | 0170 | 0212 | 0253 | 0294 | 0334 | 0374 | 4 | 8 | 12 | 17 | 21 | 25 | 29 | 33 | 37 |
| 11 | 0414 | 0453 | 0492 | 0531 | 0569 | 0607 | 0645 | 0682 | 0719 | 0755 | 4 | 8 | 11 | 15 | 19 | 23 | 26 | 30 | 34 |
| 12 | 0792 | 0828 | 0864 | 0899 | 0934 | 0969 | 1004 | 1038 | 1072 | 1106 | 3 | 7 | 10 | 14 | 17 | 21 | 24 | 28 | 31 |
| 13 | 1139 | 1173 | 1206 | 1239 | 1271 | 1303 | 1335 | 1367 | 1399 | 1430 | 3 | 6 | 10 | 13 | 16 | 19 | 22 | 26 | 29 |
| 14 | 1461 | 1492 | 1523 | 1553 | 1584 | 1614 | 1644 | 1673 | 1703 | 1732 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 |
| 15 | 1761 | 1790 | 1818 | 1847 | 1875 | 1903 | 1931 | 1959 | 1987 | 2014 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 22 | 25 |
| 16 | 2041 | 2068 | 2095 | 2122 | 2148 | 2175 | 2201 | 2227 | 2253 | 2279 | 3 | 5 | 8 | 11 | 13 | 16 | 18 | 21 | 24 |
| 17 | 2304 | 2330 | 2355 | 2380 | 2405 | 2430 | 2455 | 2480 | 2504 | 2529 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 22 |
| 18 | 2553 | 2577 | 2601 | 2625 | 2648 | 2672 | 2695 | 2718 | 2742 | 2765 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 19 | 21 |
| 19 | 2788 | 2810 | 2833 | 2856 | 2878 | 2900 | 2923 | 2945 | 2967 | 2989 | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 20 |
| 20 | 3010 | 3032 | 3054 | 3075 | 3096 | 3118 | 3139 | 3160 | 3181 | 3201 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 19 |
| 21 | 3222 | 3243 | 3263 | 3284 | 3304 | 3324 | 3345 | 3365 | 3385 | 3404 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 22 | 3424 | 3444 | 3464 | 3483 | 3502 | 3522 | 3541 | 3560 | 3579 | 3598 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 15 | 17 |
| 23 | 3617 | 3636 | 3655 | 3674 | 3692 | 3711 | 3729 | 3747 | 3766 | 3784 | 2 | 4 | 6 | 7 | 9 | 11 | 13 | 15 | 17 |
| 24 | 3802 | 3820 | 3838 | 3856 | 3874 | 3892 | 3909 | 3927 | 3945 | 3962 | 2 | 4 | 5 | 7 | 9 | 11 | 12 | 14 | 16 |
| 25 | 3979 | 3997 | 4014 | 4031 | 4048 | 4065 | 4082 | 4099 | 4116 | 4133 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 15 |
| 26 | 4150 | 4166 | 4183 | 4200 | 4216 | 4232 | 4249 | 4265 | 4281 | 4298 | 2 | 3 | 5 | 7 | 8 | 10 | 11 | 13 | 15 |
| 27 | 4314 | 4330 | 4346 | 4362 | 4378 | 4393 | 4409 | 4425 | 4440 | 4456 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 13 | 14 |
| 28 | 4472 | 4487 | 4502 | 4518 | 4533 | 4548 | 4564 | 4579 | 4594 | 4609 | 2 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 |
| 29 | 4624 | 4639 | 4654 | 4669 | 4683 | 4698 | 4713 | 4728 | 4742 | 4757 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 |
| 30 | 4771 | 4786 | 4800 | 4814 | 4829 | 4843 | 4857 | 4871 | 4886 | 4900 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 11 | 13 |
| 31 | 4914 | 4928 | 4942 | 4955 | 4969 | 4983 | 4997 | 5011 | 5024 | 5038 | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 12 |
| 32 | 5051 | 5065 | 5079 | 5092 | 5105 | 5119 | 5132 | 5145 | 5159 | 5172 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 11 | 12 |
| 33 | 5185 | 5198 | 5211 | 5224 | 5237 | 5250 | 5263 | 5276 | 5289 | 5302 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 12 |
| 34 | 5315 | 5328 | 5340 | 5353 | 5366 | 5378 | 5391 | 5403 | 5416 | 5428 | 1 | 3 | 4 | 5 | 6 | 8 | 9 | 10 | 11 |
| 35 | 5441 | 5453 | 5465 | 5478 | 5490 | 5502 | 5514 | 5527 | 5539 | 5551 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 |
| 36 | 5563 | 5575 | 5587 | 5566 | 5611 | 5623 | 5635 | 5647 | 5658 | 5670 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 10 | 11 |
| 37 | 5682 | 5694 | 5705 | 5717 | 5729 | 5740 | 5752 | 5763 | 5775 | 5786 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |
| 38 | 5798 | 5809 | 5821 | 5832 | 5843 | 5855 | 5866 | 5877 | 5888 | 5899 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |
| 39 | 5911 | 5922 | 5933 | 5944 | 5955 | 5966 | 5977 | 5988 | 5999 | 6010 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 |
| 40 | 6021 | 6031 | 6042 | 6053 | 6064 | 6075 | 6085 | 6096 | 6107 | 6117 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 9 | 10 |
| 41 | 6128 | 6138 | 6149 | 6160 | 6170 | 6180 | 6191 | 6201 | 6212 | 6222 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 42 | 6232 | 6243 | 6253 | 6263 | 6274 | 6284 | 6294 | 6304 | 6314 | 6325 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 43 | 6335 | 6345 | 6355 | 6365 | 6375 | 6385 | 6395 | 6405 | 6415 | 6425 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 44 | 6435 | 6345 | 6454 | 6464 | 6474 | 6484 | 6493 | 6503 | 6513 | 6522 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 45 | 6532 | 6542 | 6551 | 6561 | 6571 | 6580 | 6590 | 6599 | 6609 | 6618 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 46 | 6628 | 6637 | 6646 | 6656 | 6665 | 6675 | 6684 | 6693 | 6702 | 6712 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 7 | 8 |
| 47 | 6721 | 6730 | 6739 | 6749 | 6758 | 6767 | 6776 | 6785 | 6794 | 6803 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 |
| 48 | 6812 | 6821 | 6830 | 6839 | 6848 | 6857 | 6866 | 6875 | 6884 | 6893 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 8 |
| 49 | 6902 | 6911 | 6920 | 6928 | 6937 | 6946 | 6955 | 6964 | 6972 | 6981 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 8 |
| 50 | 6990 | 6998 | 7007 | 7016 | 7024 | 7033 | 7042 | 7050 | 7059 | 7067 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 51 | 7076 | 7084 | 7093 | 7101 | 7110 | 7118 | 7126 | 7135 | 7143 | 7152 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 52 | 7160 | 7168 | 7177 | 7185 | 7193 | 7202 | 7210 | 7218 | 7226 | 7235 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 7 |
| 53 | 7243 | 7251 | 7259 | 7267 | 7275 | 7284 | 7292 | 7300 | 7308 | 7316 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 |
| 54 | 7324 | 7332 | 7340 | 7348 | 7356 | 7364 | 7372 | 7380 | 7388 | 7396 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

MANAV RACHNA
Vidyanobellishet

MANAV RACHNA UNIVERSITY
Declared as State Private University vide Haryana Act 26 of 2014

# DEPARTMENT OF CHEMISTRY

*"T3 Examination, June-2022"*

| | | | |
|---|---|---|---|
| SEMESTER | II | DATE OF EXAM | 27.06.2022 |
| SUBJECT NAME | Inorganic Chemistry-II | SUBJECT CODE | CHH507B |
| BRANCH | M.Sc Chemistry | SESSION | 2021-2022 (I) |
| TIME | 3 hours | MAX. MARKS | 100 |
| PROGRAM | M.Sc Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. Roopa Rani | NAME OF COURSE COORDINATOR | Dr. Roopa Rani |

***Note**: Attempt all questions*

| Q.NO. | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL | PI |
|---|---|---|---|---|---|
| 1 | Write the mechanism of the acid hydrolysis when the inert ligand is a pi donor. | 5 | CO1 | L4 | |
| 2 | Explain the concept of lability and inertness as per VBT. | 5 | CO1 | L3 | |
| 3 | State the applications of trans effect for the synthesis of:<br>a) Cis and trans $[PtCl_2(PR_3)_2]$<br>b) Synthesis of cis $[Pt(NH_3)_2Br_2]$ | 6 | CO2 | L6 | |
| 4 | Explain any two methods of $CO_2$ reduction in details. | 4 | CO2 | L4 | |
| 5 | How Marcus – Hush theory explained the concept of electron transfer reactions? State the utility of Frank Condon principle in it. | 10 | CO3 | L4,L5 | |
| 6 | Explain the following factors for electron transfer reaction (with suitable example):<br>a) Nature of bridging ligands<br>b) Formation of precursor complex | 10 | CO3 | L6 | |
| 7 | What do you mean by mixed valence complexes and internal electron transfer reaction? Explain taking one suitable example. | 10 | CO3 | L5 | |

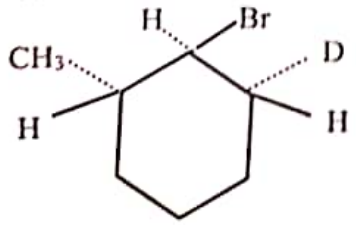
| | | | | | |
|---|---|---|---|---|---|
| 8 | Explain the complete mechanism of outer electron transfer reaction with suitable example. Depict graphical representation too. | 10 | CO3 | L4 | |
| 9 | Explain the mechanism of excited state electron transfer reaction using the example of $[Fe(bpy)_3]^{3+}$ complex. | 10 | CO4 | L5 | |
| 10 | What do you mean by excited state and its life time? How it is useful to explain the electron transfer reaction? | 10 | CO4 | L5 | |
| 11 | Explain the correlation between optical and thermal electron transfer reaction. | 10 | CO4 | L3 | |
| 12 | Justify the statement that the role of spin-spin coupling and spin-orbit coupling decides the fate of electron transfer reaction. | 10 | CO4 | L6 | |
| ********** END ********** | | | | | |

# MANAV RACHNA UNIVERSITY
## DEPARTMENT OF CHEMISTRY
*"End Semester Examination, June 21-22"*

**Semester: II**
**Subject: Organic Chemistry-II**
**Branch: Chemistry**
**Course Type: Hard Core**
**Time: 3 hrs**
**Max.Marks: 100**

**Date of Exam: 29/06/2022**
**Subject Code: CHH508 B**
**Session: 8:30 to 11:30 AM**
**Course Nature: Hard**
**Program: MSc**
**Signature: HOD/Associate HOD:**

***Note**: All Questions are compulsory*

| | CO | BT | *Marks* |
|---|---|---|---|
| 1. (a) What will be the major product of reaction of 2-methyl-2-butene with each of the following reagents:<br>(i) HBr in the absence of peroxide<br>(ii) $BH_3$ /THF, followed by $H_2O_2$ / Hydroxide ion<br>(iii) $Hg(OAc)_2$, H2O Followed by $NaBH_4$ | CO1 | BT3 | 6 marks |
| (b) Both Hydroboration and Oxymercuration-demercuration reactions of alkene results in the formation of alcohol. How two reactions differ from each other, explain with the support of proper example. | CO1 | BT3 | 4 marks |
| 2. (a) A hydrocarbon which has a molecular formula $C_6H_{12}$, was subjected to ozonolysis giving equivalent amounts of ethyl methyl ketone ($CH_3CH_2COCH_3$) and acetaldehyde ($CH_3CHO$). Assign structure to alkene and show the reaction mechanism. | CO1 | BT3 | 5 marks |
| (b) Explain the mechanism of Michael Addition reaction and discuss its synthetic importance. | CO1 | BT3 | 5 marks |
| 3 (a) When the deuterium labeled compound given below is subjected to dehydrohalogenation using Sod. Ethoxide in ethanol, the only product is 3-methylcyclohexene. This product does not contain deuterium. Provide an explanation for this result.<br>  <br> | CO1 | BT4 | 5 marks |
| 3 (b) When 1-iodo-1-methylcyclohexane is treated with NaOCH2CH3 as the base, the more highly substituted alkene product predominates. When KOC(CH3)3 is used as the base, the less highly substituted alkene predominates. Give the structures of the two products and offer an | CO1 | BT4 | 5 marks |

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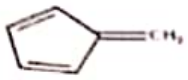
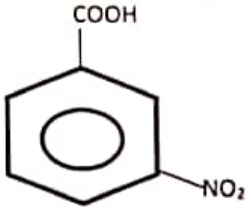
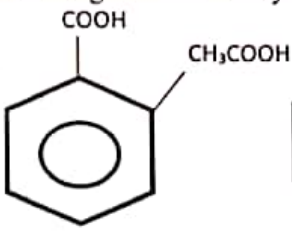
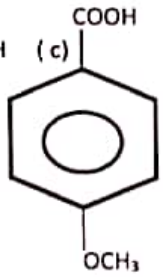
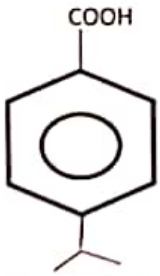
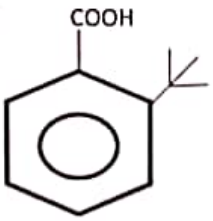
|---|---|---|---|
| explanation.<br><br>Q 4. a. Account for the high dipole moment of following compounds:<br>(i) (ii)<br>   <br>(iii)<br>  | CO2 | BT3 | 4 marks |
| Q 4. b. With the help of Frost circle diagram explain which of the molecules are aromatic, antiaromatic or non aromatic: (i) Cyclobutadiene (ii) Benzene (iii) Cyclopentadiene anion | CO2 | BT2 | 6 marks |
| Q 5. A. Draw frost circle diagram and show the electron distribution in MO's of the following to explain its aromaticity:<br>(i) Cyclopentadienyl anion<br>(ii) Cycloheptatriene cation & anion<br>(iii) Cyclopropenyl cation | CO2 | BT2 | 6 marks |
| Q5 b. Arrange the following in the increasing order of acidity:<br>(i)<br>(a)  (b)  (c)  <br>(ii) (a)  (b)  | CO2 | BT3 | 4 marks |
| Q5 C. Although Pyrrole, Furan & Thiopene do not contain any benzene ring still they are considered to be aromatic. Explain with the help of their structures. | CO2 | BT3 | 5 marks |
| Q 6 a. Arrange the following in the order of stability based on hyperconjugative structure molecules have. Give Suitable reason for your answer. | | | |

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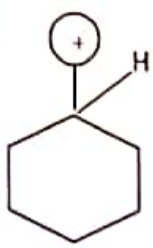
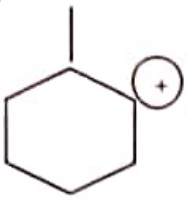
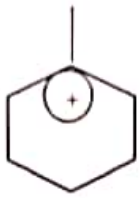
|---|---|---|---|
| (i)  (ii)  (iii)  | CO3 | BT3 | 5 marks |
| Q 6 b. Answer each of the following with reference to the corresponding substituent constants considering both inductive and resonance electronic contributions (σI and σR). Illustrate your answer showing resonance structures for substituted benzoic acids, where appropriate. | CO3 | BT4 | 6 marks |
| i) The σmeta and σpara values for the $-CO_2CH_3$ group are both positive with σpara > σmeta.<br><br>ii) The values of σmeta for the methoxy substituent ($-OCH_3$) is positive, whereas the values for σpara is negative.<br><br>iii) The picryl (2,4,6-trinitrophenyl) substituent, $-C_6H_2(NO_2)_3$ is relatively large with the ortho nitro groups sterically interfering with atoms in the ortho positions on an adjacent aromatic ring. Predict the sign and relative magnitude of σmeta and σpara for the picryl substituent. | | | |
| Q 6 C What is meant by steric inhibition of resonance? Explain why a substituent such as nitro bonded to ortho or para position has a much greater effect on the acidity of a phenol than a benzoic acid. | CO3 | BT3 | 4 marks |
| Q 7 a Give reason for your answer on the basis of structure:<br>(i) Imidazole is more basic than Pyrazole<br>(ii) Pyridazine is more basic than Pyridine | CO4 | BT3 | 5 marks |
| Q 7. b. Oxazole shows order of reactivity for its positions as C4 > C5 > C2. Give proper explanation for the same and discuss why oxazole is aromatic in nature. | CO4 | BT3 | 5 marks |
| Q 7. C. With the help of one green method, explain the synthesis of Benzoxazole. Also discuss why the nitration occurs here at 6$^{th}$ position and amination at 2$^{nd}$ position. | CO4 | BT3 | 5 marks |
| Q 8. a. An aromatic heterocyclic compound is used for the treatment of fungal infections. Identify the compound and discuss its important physical properties. Also explain why 2$^{nd}$ position in this molecule is different in terms of reactivity from 4$^{th}$ & 5$^{th}$ Position. | CO4 | BT4 | 5 marks |
| Q 8.b. The heterocyclic compound found in Vitamin B1, otherwise highly stable undergoes substitution reaction under specific conditions. Identify the heterocyclic compound and give one example of the substitution | CO4 | BT4 | 5 marks |

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|---|---|---|---|---|
| | reaction. | | | |
| Q. 8 c | Identify the heterocyclic compound having applications as antifungal & anti inflammatory agent. Explain the basis on which it is aromatic and give its two important methods of synthesis. This compound undergoes electrophilic addition reaction at Nitrogen atom. Give reason for the same with the help of suitable example. | CO4 | BT4 | 5 marks |

MANAV RACHNA UNIVERSITY

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# DEPARTMENT OF CHEMISTRY

*"T3 Examination, July-2022"*

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| SEMESTER | II | DATE OF EXAM | 01.07.2021 |
| SUBJECT NAME | Molecular Spectroscopy | SUBJECT CODE | CHH 509B |
| BRANCH | Chemistry | SESSION | 2021-2022 (I) |
| TIME | 08:30 - 11:30 | MAX. MARKS | 100 |
| PROGRAM | M.Sc Chemistry | CREDITS | 4 |
| NAME OF FACULTY | Dr. Jaya Tuteja | NAME OF COURSE COORDINATOR | Dr. Jaya Tuteja |

*Note: All Questions are compulsory*

| Q.NO. | | QUESTIONS | MARKS | CO ADDRESSED | BLOOM'S LEVEL |
|---|---|---|---|---|---|
| PART-A | Q1(a) | What are the conditions for the substance to be raman active? | 2 | CO1 | BT2 |
| | Q1(b) | How hydrogen bonding change the position of absorption in the Infra-red spectroscopy? | 3 | CO1 | BT3 |
| | Q1(c) | What do you understand by the term "Chromophore"? | 2 | CO1 | BT3 |
| | Q1(d) | Briefly explain Raman Scattering? | 3 | CO1 | BT2 |
| PART-B | Q2(a) | A $^1$H-NMR spectrum of compound X contains a singlet, a triplet and a quartet. Which of the following compounds might X be?<br>-$CH_3CHClCHClCH_3$<br>- $CH_3CCl_2CH_2CH_3$<br>-$CH_3CH_2CH_2CHCl_2$<br>- $CH_3CH_2CHClCHCl_2$ | 3 | CO2 | BT3 |
| | Q2(b) | What is the effect of hydrogen bonding and rapid exchange in $^1$H-NMR spectroscopy? | 3 | CO2 | BT2 |
| | Q2(c) | Aromatic protons are more deshielded than ethlylenic protons, despite being both are $sp^2$ hybridized C atom, Explain? | 4 | CO2 | BT5 |
| PART-C | Q3(a) | Why is coupling between bonded 13C's not a factor in CMR spectroscopy? | 3 | CO3 | BT3 |
| | Q3(b) | How off-resonance decoupling helps in interpreting carbon NMR spectrum? | 4 | CO3 | BT4 |
| | Q3(c) | How many sets of non-equivalent carbons are there in:<br>a) ethylmethyl ketone<br>b) ethylacetoacetate<br>c) benzoyl chloride | 3 | CO3 | BT5 |

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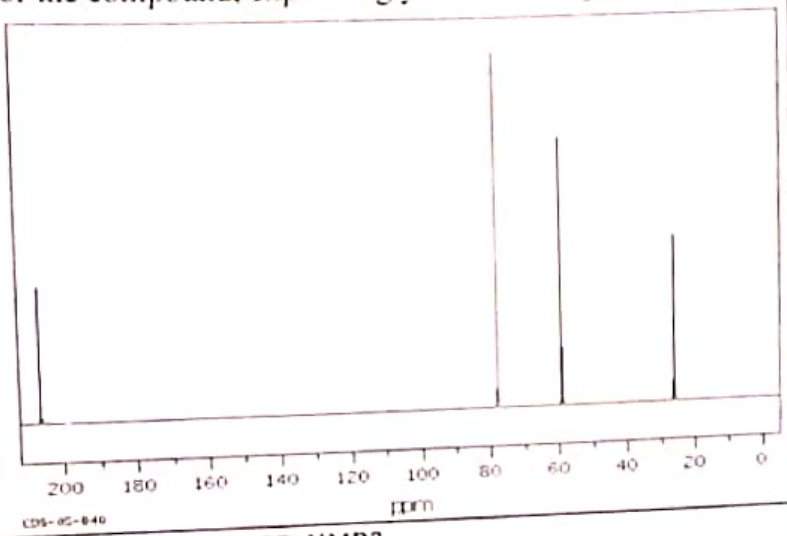
|---|---|---|---|---|
| **Q4(a)** | What do you understand by the simplification of $^{13}C$-NMR Spectroscopy? | 5 | CO3 | BT4 |
| **Q4(b)** | What does Dept stand for in organic chemistry? | 5 | CO3 | BT5 |
| **Q5(a)** | An isomer of methyl propanoate has the following C-13 NMR spectrum. Work out the probable structural formula for the compound, explaining your reasoning.   | 5 | CO3 | BT6 |
| **Q5(b)** | Give a brief not on 2D-NMR? | 5 | CO3 | BT4 |
| **Q6(a)** | What are the four stages of a mass spectrometry? Explain the types of mass analyzers in detail. | 5 | CO4 | BT3 |
| **Q6(b)** | How do we choose the ionization technique for hypernated mass spectrometry? | 5 | CO4 | BT5 |
| **Q7** | An Organic compound with molecular mass 150 gave the following spectral data:<br>**UV:** 235 $\lambda_{max}$ & 336<br>**IR:** 3020, 2960, 2820, 2740, 1600, 1567, 1528, 1695, 820 $cm^{-1}$<br>**PMR** (ppm): δ 2.98 (6H, s), 6.65 (2H, d), 7.7 (2H,d), 9.72 (1H, s) | 10 | CO1, CO2, CO3, CO4 | BT6 |
| **Q8** | An Organic compound $C_6H_{10}O_2$ gave the following spectral data:<br>**UV:** $\lambda_{max}$ 250nm<br>**IR:** significant absorption bands at 3000-2900, 1705 and 1180 $cm^{-1}$.<br>**PMR:** δ 2.2 (6H, s) and 2.7 (4H, s)<br>**CMR (proton decoupled):** 3 singlets at δ 28, 36 and 208<br>**CMR (orr-resonance decoupled)MS:** one quartet at δ 28; one triplet at δ 36 and one singlet at δ 208<br>**MS:** Prominent peaks at m/e 217 (M·), 99 and 43.<br>Deduce the structure of the organic compound? | 15 | CO1, CO2, CO3, CO4 | BT6 |
| **Q9** | Provide a structure of the compounds consistent with the following spectra. Show your work and assign all relevant peaks in $^{1}H$-NMR spectra, $^{13}C$-NMR spectra. Interpret functionality from IR and show the fragmentation of Mass wherever possible? | 15 | CO1, CO2, CO3, CO4 | BT6 |

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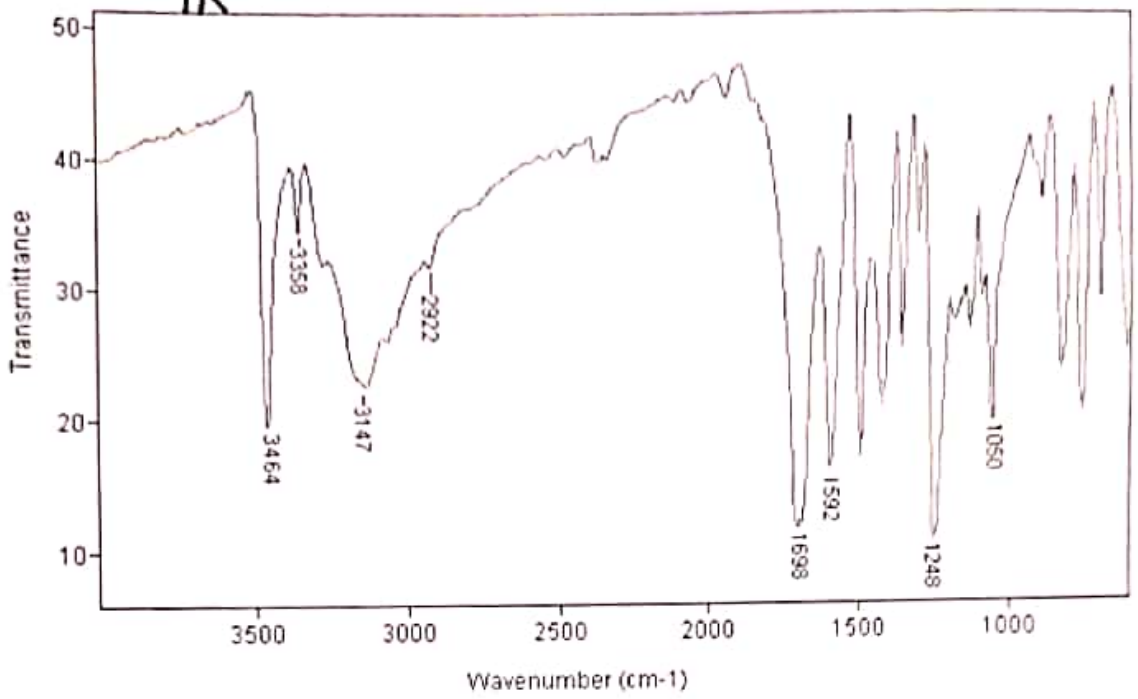
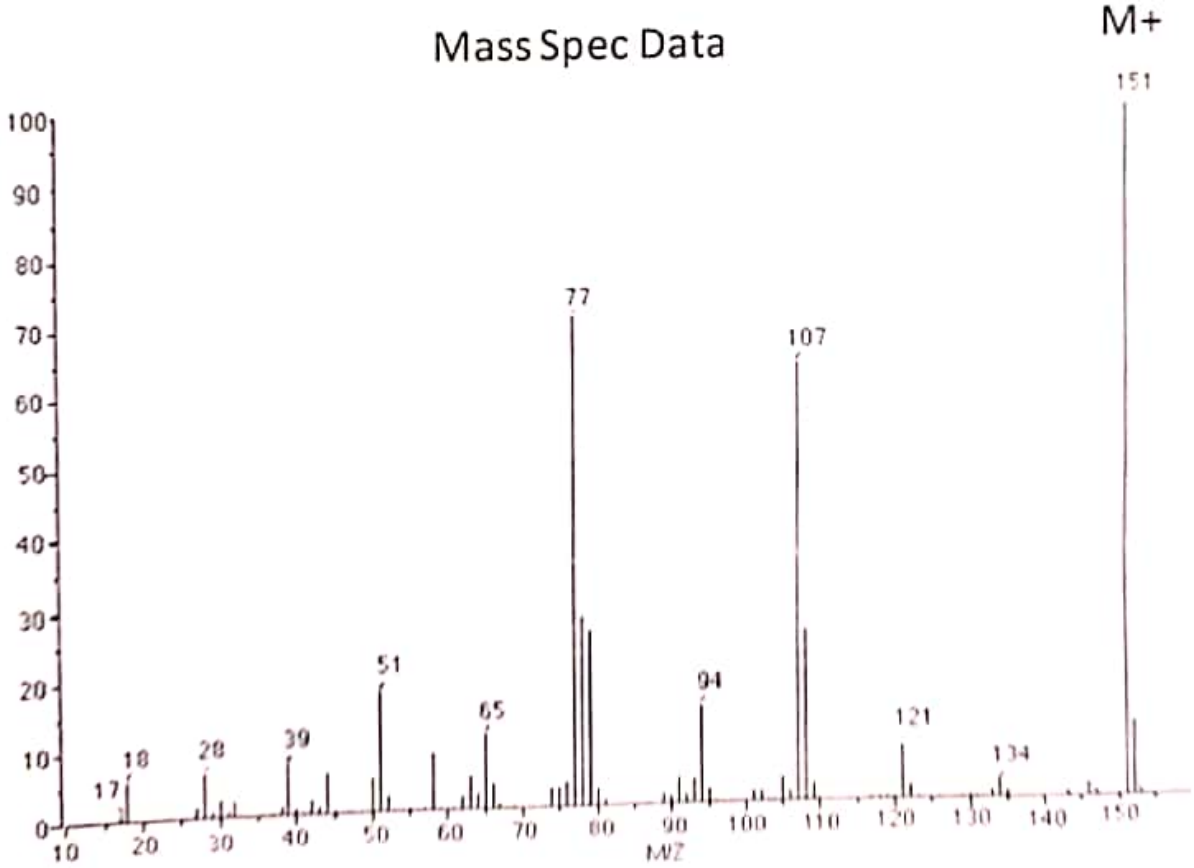
# Q9: Spectral Data

IR




Mass Spec Data

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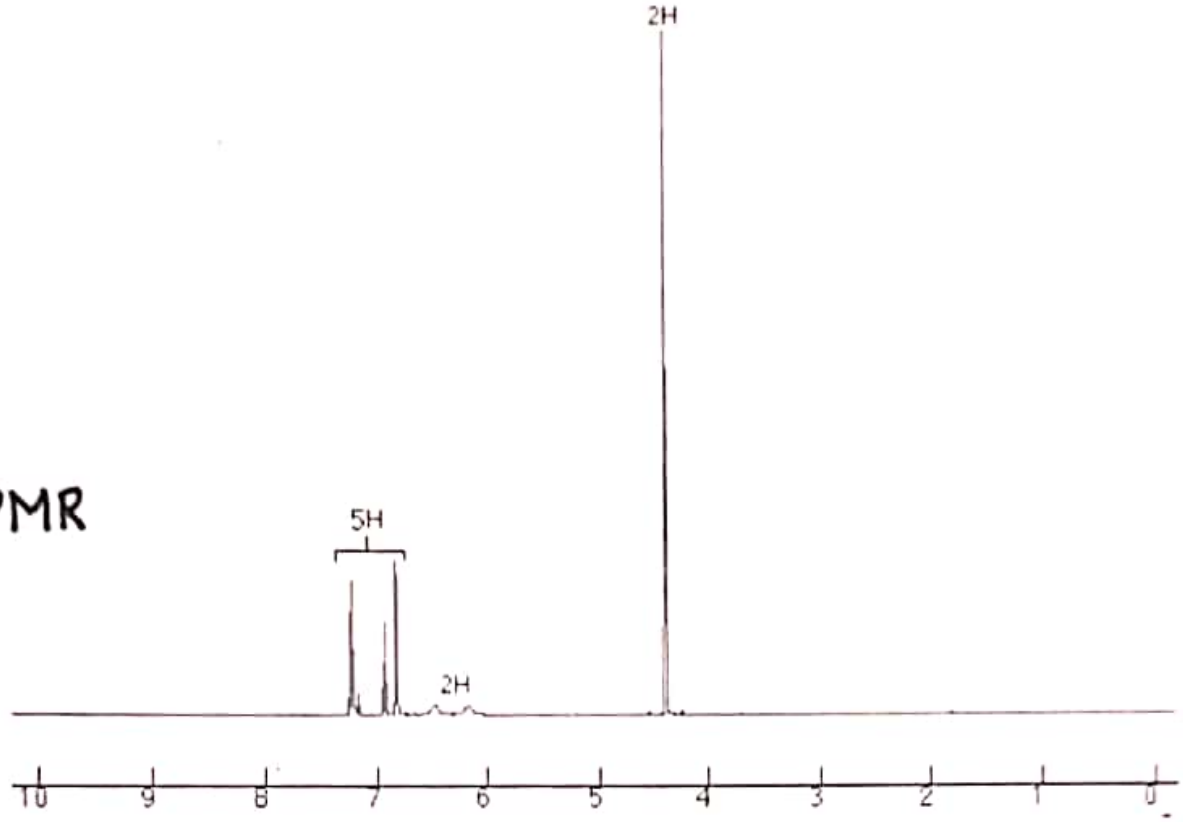
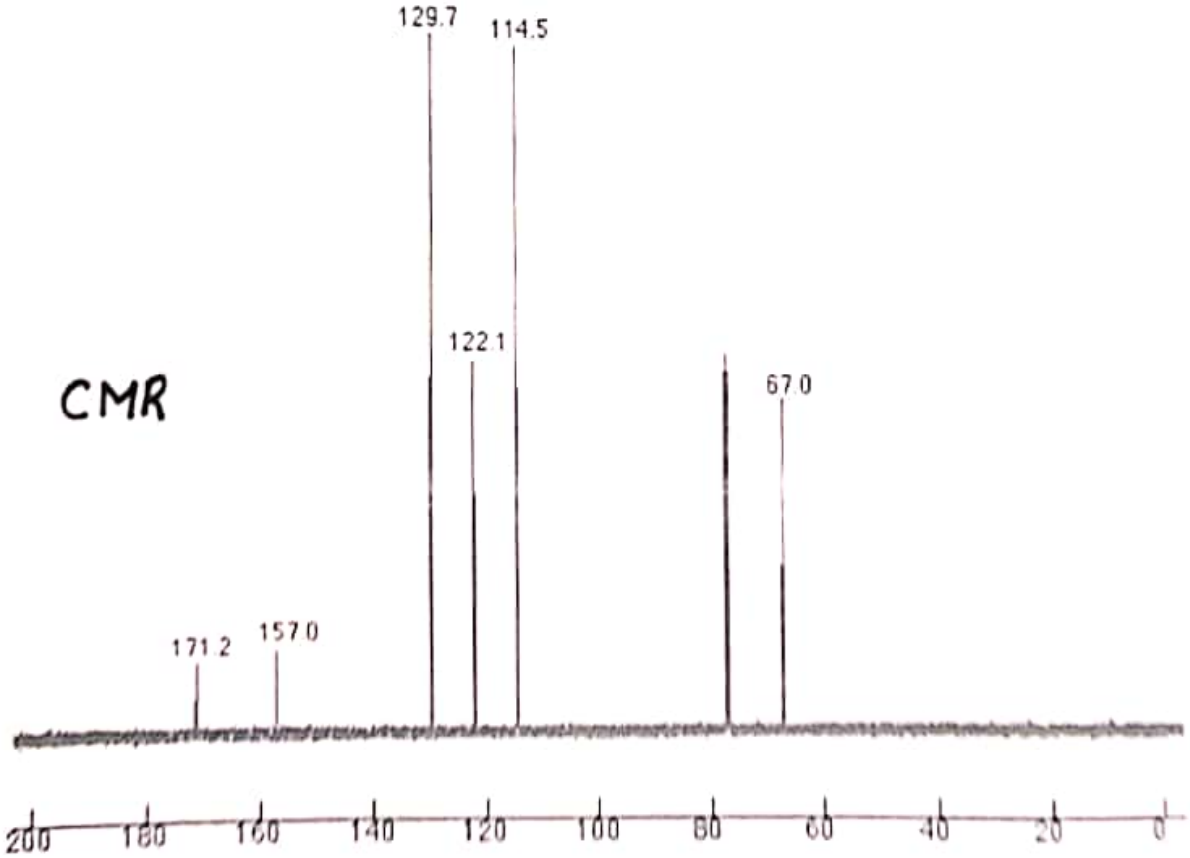
PMR




CMR

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