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Programme: M.Sc.–I (2022-2023)	**Session: 2022-2023**
Semester: First	**Max. Time: 3 Hours**
Course Title: Reaction Mechanism: Structure and Reactivity	**Max. Marks: 35**
Course Code: SBS CH 010101 DCE 2002	

Instructions:

1. Question no. 1 has four parts and students are required to answer any two. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and student are required to answer any two parts of each question. Each part carries seven marks.

Q.1 a) Write down a short note on Reactive Intermediates.

b) Complete the given reaction required and write the structure of reaction intermediate(s) involved.
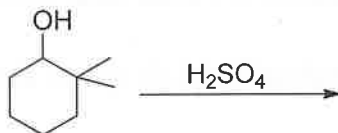
c) What are Carbenes? How do the form? Discuss the stability of different types of carbenes.

d) What is Crossover Experiment? Discuss it by taking suitable example.   (3.5 X 4)

Q.2 a) Which of the following will give faster E_2 elimination reaction and why?

   i) cis-4-tertbutylcyclohexylbromide   ii) trans-4-tertbutylcyclohexylbromide

b) Compare and discuss the acidic strength of Resorcinol, Catechol and Hydroquinone.

c) Describe the effect of temperature on a Chemical Reaction. (3.5 X 3)

Q.3 a) Write the product formed in following reaction sequence and discuss the mechanism also.

$$\underset{\text{OMe}}{\text{(structure)}} \quad \xrightarrow[\text{Low Temp.}]{\text{NaNH}_2,\ \text{NH}_3\ (liq.)} \quad B$$
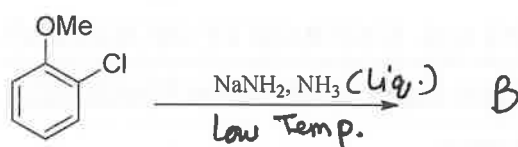
b) What is Barton reaction? Explain it by taking suitable example.

c) Complete the given reaction sequence:

$$\text{(structure with N}_2\text{)} \quad \xrightarrow{\text{hv/Rh(OAc)}_4} \quad P$$
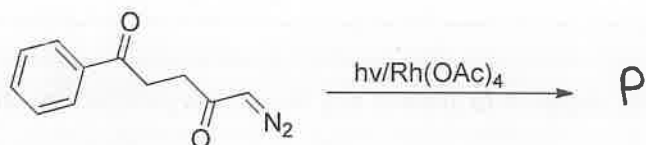
(3.5 X 3)

Q.4 a) Discuss the thermodynamic and kinetic control of chemical reactions.

b) Illustrate the correlation of linear free energy with the chemical reactivity of organic compounds.

c) Write a note on Curtin-Hammett Principle.   (3.5 X 3)

Q.5 a) What are Primary, Secondary and Tertiary Kinetic isotope effects?

b) Describe two methods for the detection of carbocation intermediates.

c) What do you mean by Isotope labelling? Explain it with suitable example.   (3.5 X 3)

Programme: Integrated B.Sc.- M.Sc. Chemistry   **Session:** 2022-23
Semester: I   **Max. Time:** 3 H
Course Title: Physical Chemistry-I   **Max. Marks:** 70
Course Code: SBS CH 020102 C 4004

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and a half Marks.

2. Questions no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries seven marks.

Q 1.   Answer the following in brief: $(4 \times 3.5 = 14)$
     a)   Common ion effect and solubility product.

     b)   Write a short note on Bravais lattices and Crystal systems.

     c)   Explain why X-ray diffraction pattern for solids show relatively sharper peaks as compared to liquids?

     d)   Explain the factors which led van der Waals to modify the ideal gas equation PV = n RT, and hence derive the van der Waal's equation of state.

     e)   A steel ball of density 7.9 g cm^{-3} and 4 mm diameter takes 55 seconds to fall through a distance of one meter through a liquid of density 1.10 g cm^{-3}, Calculate the viscosity of the liquid.

     f)   Show that formation and maintenance of smaller bubbles will need a greater excess pressure than the larger ones.

     g)   Write a brief note on buffer capacity and buffer range.

Q 2.   Answer the following: $(2 \times 7 = 14)$
     a)   What are the postulates of Kinetic theory of gases? Derive Kinetic gas equation.

     b)   i. What do you understand by "Degrees of Freedom of Motion"? Briefly explain the different types of degree of freedom possessed by linear and non-linear molecules. (3.5 marks)

         ii. Distinguish between an ideal gas and a real gas.   (3.5 marks)

     c)   i. Define the law of corresponding states and give its significance.   (3.5 marks)

         ii. Discuss the principles which are widely used for liquefaction of gases on large scale.   (3.5 marks)

Q 3.   Answer the following: $(2 \times 7 = 14)$
     a)   Discuss structure and bonding of water in liquid and solid phase.

b) Discuss:

      I.   Effect of addition of various solutes on surface tension   (3.0 marks)

      II.   Coefficient of Viscosity, and their determination.   (4.0 marks)

c) Explanation of cleansing action of detergents. Also discuss variation of viscosity with temperature for liquids and gases.

Q 4. Answer the following: (2×7=14)

a) Define "crystalline solid" and "amorphous solid". Give three examples of each. How do they differ in isotropic nature?

b) i. Define the different elements of symmetry present in crystals. Define the law of symmetry. Give one example.   (3.5 marks)

    ii. Write a short note on Laue's method for x-ray diffraction by crystals.

                                            (3.5 marks)

c) i. Justify why the lines in the x-ray diffraction pattern of a body-centred cubic lattice are equally spaced?   (3.5 marks)

    ii. Define the terms "crystal lattice" and "unit cell". Why a five-fold axis of symmetry cannot be present in any crystal?   (3.5 marks)

Q 5.   Answer the following: (2×7=14)

a) Derive Henderson equation and write down its applications

b) Drive dissociation constants of mono-, di-and triprotic acids (exact treatment).

c) Write short note on

      I.   Salt hydrolysis   (2.0 marks)

      II.   Solubility and solubility product of sparingly soluble salts (2.0 marks)

      III.   Ionization constant and ionic product of water   (3.0 marks)

CENTRAL UNIVERSITY OF HARYANA

<u>End Semester Examination March 2023</u>

Programme: M.Sc. (Chemistry)   Session: 2022-2023

Semester: I (Regular/Reappear)   Max. Time: 3 Hours

Course Title: Organic Chemistry-I   Max. Marks: 70

Course Code: SBS CH 010102 C 4004

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half marks.

2. Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

Question 1.   **(4 X 3.5 = 14)**

a) What you mean by Optical Purity? Explain it.

b) Arrange the following aldehydes in order of increasing reactivity (electrophilicity). Justify your answer with reasonable explanation.
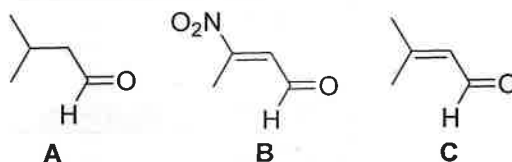
c) Briefly describe the structure and applications of calixarenes.

d) Why benzene does not react with bromine in absence of Lewis acid whereas phenols react rapidly with bromine in absence of Lewis acid.

e) How could paracetamol be synthesized from phenol in the laboratory (steps only)?

Paracetamol

f) When n-BuLi is added to a solution of bromobenzene in anhydrous THF (solvent), a rapid reaction takes place and yield a product of formula $C_{10}H_{14}$. Find out the product and propose a suitable mechanism by which the reaction occurs.

g) Identify the major product(s) in the following transformations. Offer a suitable explanation for your answer. .

$$\text{??} \xleftarrow{\overset{\oplus\ominus}{KOCH_2CH_3}} \text{[Br structure]} \xrightarrow{\overset{\ominus\oplus}{\textit{tert}\text{-BuOK}}} \text{??}$$
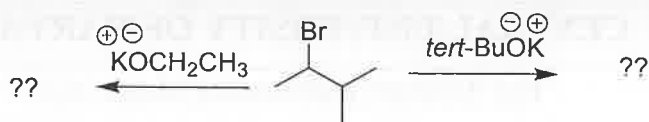
Question 2.   **(2 X 7 = 14)**

a) (i) What is meant by anti-aomaticity? Explain with an example. (3.5 marks)

(ii) What are crown ethers? Explain their nomenclature and applications. (3.5 marks)

b) (i) All C-C bonds in benzene are equivalent. Are they the same in naphthalene? Explain your answer with resonance structures. (3.5 marks)

(ii) Write down a short note on chirality of compounds containing nitrogen and sulphur. (3.5 Marks)

c) Write down the products of following reaction with the help of mechanisms. (2 x 3.5 Marks)
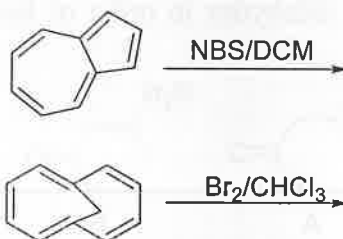
Question 3.   **(2 X 7 = 14)**

a) (i) Why do bulky substituents prefer to occupy equatorial positions on cyclohexane? Explain with the help of relevant conformational diagrams and Newman projections. (3.5 marks)

(ii) What do you mean by Stereospecific reactions? Explain it with example. (3.5 marks)

b) (i) What is *resolution* of enantiomers? Describe two common methods of resolution. (3.5 marks)

(ii) Draw the chair conformations of *cis* and *trans* isomers of 4-*tert*-butylcyclohexyl iodide. Which of these iodides will react faster in an S_N2 reaction and why? (3.5 marks)

c) i) Define the term chirality. Classify the following pairs as identical, diasteriomers or enantiomers. Explain with reason. (3.5 Marks)
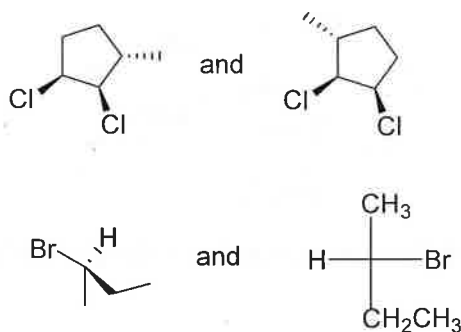
(ii) Write a note on *axial chirality* with an example. (3.5 marks)
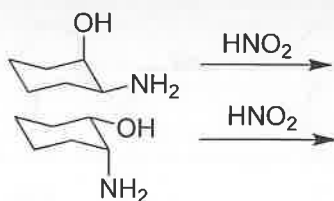
Question 4. (2 X 7 = 14)

a) (i) *"Iodide ion is a stronger nucleophile as compared to fluoride ion in polar protic solvents even though former is a weak base than fluoride ion."* Classify this statement as true or false by giving proper justification. (3.5 marks)

(ii) Why *para*-nitrobenzylchloride (**I**) is reluctant towards S_N1 reaction whereas *para*-methoxybenzylchloride (**II**) is highly reactive even though both substrates have unsaturation at β-carbon atom. Discuss mechanism involved. (3.5 marks)
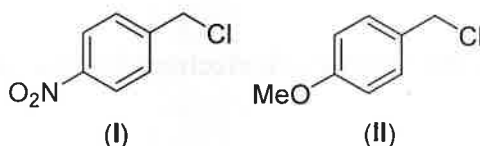
b) (i) 2-Thiosubstituted chlorocyclohexane (**A**) reacts with aqueous solution of ethanol to give an alcohol and an ether due to two nucleophiles, water and alcohol. Explain why the rate of reaction is 70,000 times faster when the thio-substituent *is trans* placed to the chloro substituent? (3.5 marks)

A
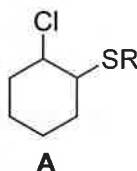
(ii) When *n*-octyl bromide is reacted with aqueous solution of sodium cyanide at room temperature, reaction did not occur even after several days. However, when a small amount of TBAF (*tert*-butyl ammonium fluoride) is added to the reaction mixture, its rate of reaction increased and corresponding product was obtained in good yield. Why does this happen? (3.5 marks)

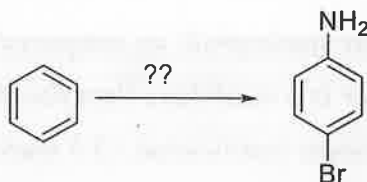c) (i) Find out the product(s) in the following transformation. (3.5 marks)

(ii) Illustrate E1CB reaction with suitable example? Why it is named E1CB? (3.5 marks)

Question 5.   (2X7=14)

a) (i) Sketch the shortest route (steps only) of the following transformations. (3.5 marks)

(ii) Why vinyl and aryl halides do not undergo S_N1 or S_N2 reactions? Explain briefly with proper justifications. (3.5 Marks)

b) (i) Why aniline is more reactive towards electrophiles than phenols and phenoxy ethers? (3.5 marks)

(ii) When trace amount of potassium amide is added to a solution of chlorobenzene and potassium triphenylmethyl (Ph_3CK) in liq. NH_3, a rapid reaction takes place to yield a product of molecular formula $C_{25}H_{20}$. Identify the product and highlight the role and need of potassium amide. (3.5 marks)

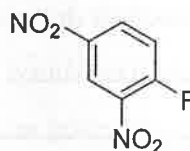c) (i) Arrange the following compound in order of reactivity towards aromatic nucleophilic substitution and after proper justification for your choice. Explain with the justification. (3.5 marks)
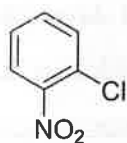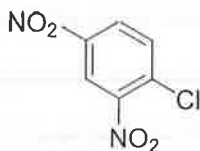
[I]   [II]   [III]

(ii) Describe the nucleophilicity of fluoride and iodide in polar protic solvents in an aromatic substitution reactions? (3.5 Marks)

Programme: Ph.D. Chemistry   Semester: Course work
Course Title: Research Methodology and Computer Applications for Chemistry   Max. Time: 3 Hour
Course Code: SBS CH 030101 C 5016   Max. Marks: 60

Instruction: Attempt any five questions out of the following. Each question carries equal marks.

Q:1 Briefly delineate your understanding about scientific research. What are research methods and methodology? Is there any role of these two in conceptual research? **(3+6+3 marks)**

Q:2 Discuss in detail about the design and components of a research proposal. By selecting a research proposal of your own, write down the objectives the proposal. **(8+4 marks)**

Q:3 (i) How would you define a research problem? Why in research, it becomes necessary to define a problem? Is there any correlation between defining and formulating a research problem? **(4+3+3 marks)**

(ii) What are patents? **(2 marks)**

Q:4 (i) What are primary and secondary sources in literature review? Mention the name of few tools with which you can perform literature review. **(6+2 marks)**

(ii) How literature review helps researchers in identifying gap areas? **(4 marks)**

Q:5 (i) Write down the usefulness of ChemDraw in Chemistry research. **(3 marks)**

(ii) Write down the similarities and dissimilarities between Google Scholar and SciFinder. What is Reaxys? **(3+2 marks)**

(iii) What do you mean by citation index? What are h- and i-10 index? **(2+2 marks)**

Q:6 (i) What do you mean by experiment design? How would you code your samples which are generated from experiments. **(3+2 marks)**

(ii) Discuss and elaborate the laboratory safety rules. **(7 marks)**

Q:7 (i) What do you mean by a scientific document? Discuss the differences between research articles and communications? **(2+4 marks)**

(ii) How would you differentiate between a review and an edited book? What is a dissertation? **(4+2 marks)**

Q:8. (i) Discuss in detail how would you format a thesis. **(9 marks)**

(ii) What are oral presentations and what kind of tools are required to make a standard oral presentation? **(3 marks)**

CENTRAL UNIVERSITY OF HARYANA

Programme: M.Sc. Chemistry

Semester: Semester-I

Course Title: Nuclear Chemistry

Course Code: SBS CH 010102 DCE 2002

Session: 2022-23

Max. Time: 2 Hours

Max. Marks: 35

Instructions:

1. Question no. 1 has four parts and students need to answer any two. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries three and half marks.

Question No. 1.   (2X3.5=7)

  a) Briefly discuss nuclear reactors in India.

  b) Discuss applications of tracer element in analytical fields.

  c) Write a note on "Szilard-Chalmer's effect".

  d) How much energy (in MeV) would be released by the fusion of three $^4He_2$ nuclei to produce $^{12}C_6$?

Question No. 2.   (2X3.5=7)

  a) Write a note on nuclear binding forces?

  b) What are magnetic and electric properties of nucleus?

  c) Briefly discuss nuclear spin and parity.

Question No. 3.   (2X3.5=7)

  a) The reactions in a fusion reactor take place in deuterium-tritium plasma. Why the plasma state is necessary for a fusion reactor?

  b) Discuss the penetration potential of alpha decay, beta decay and gamma ray?

  c) Estimate the nuclear binding energy of $^7Li_3$. Given the following data: Observed atomic mass of $^7Li_3$ = 7.016 u, 1u = 1.66054 x 10^{-27} kg, electron rest mass = 9.11 x 10^{-31} kg, proton rest mass = 1.67 x 10^{-27} kg, neutron rest mass = 1.67 x 10^{-27} kg and c = 2.99 ms^{-1}.

Question No. 4.   (2X3.5=7)

  a) What do you mean by radioactive disintegration series? How much time will be required for a sample of ^3H to lose 75% of its radioactivity? The half-life of tritium is 12.26 years.

  b) What is the average life of radioactive elements? Also discuss sources of radioactive substances.

  c) Write a short note on group displacement law and types of nuclear decay.

Question No. 5.   (2X3.5=7)

  a) Write a note on applications of tracer element in medicines and agriculture.

b) What do you understand by radiocarbon dating? How do scientists use radiocarbon dating to find the age of rocks?

c) Write a note on "chelation therapy".

CENTRAL UNIVERSITY OF HARYANA

Programme: M.Sc. Chemistry **Session: 2022-23**
Semester: Semester-I **Max. Time: 2 Hours**
Course Title: Nuclear Chemistry **Max. Marks: 35**
Course Code: SBS CH 010102 DCE 2002

Instructions:

1. Question no. 1 has four parts and students need to answer any two. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries three and half marks.

Question No. 1. (2X3.5=7)
   a) Briefly discuss nuclear reactors in India.
   b) Discuss applications of tracer element in analytical fields.
   c) Write a note on "Szilard-Chalmer's effect".
   d) How much energy (in MeV) would be released by the fusion of three $^4He_2$ nuclei to produce $^{12}C_6$?

Question No. 2. (2X3.5=7)
   a) Write a note on nuclear binding forces?
   b) What are magnetic and electric properties of nucleus?
   c) Briefly discuss nuclear spin and parity.

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   a) The reactions in a fusion reactor take place in deuterium-tritium plasma. Why the plasma state is necessary for a fusion reactor?
   b) Discuss the penetration potential of alpha decay, beta decay and gamma ray?
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Question No. 4. (2X3.5=7)
   a) What do you mean by radioactive disintegration series? How much time will be required for a sample of ^3H to lose 75% of its radioactivity? The half-life of tritium is 12.26 years.
   b) What is the average life of radioactive elements? Also discuss sources of radioactive substances.
   c) Write a short note on group displacement law and types of nuclear decay.

Question No. 5. (2X3.5=7)
   a) Write a note on applications of tracer element in medicines and agriculture.

b) What do you understand by radiocarbon dating? How do scientists use radiocarbon dating to find the age of rocks?

c) Write a note on "chelation therapy".

CENTRAL UNIVERSITY OF HARYANA

<u>Term End Examinations March 2023</u>

Programme: Integrated B.Sc.-M.Sc. Chemistry   **Session: 2022-23**

Semester: First   **Max. Time: 2 Hours**

Course Title: Computer Applications in Chemistry   **Max. Marks: 35**

Course Code: SBS CH 0209 SE 2002

Instructions:

1. Question no. 1 has four parts and students are required to answer any two. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries three and half marks.

Q 1.   (4X3.5=7)

     a) What do you mean by spreadsheet?

     b) How can you figure out that a given piece of news is a fake news?

     c) Write a short note on "Mendeley".

     d) How can you generate Google Form?

Q 2.   (2X3.5=7)

     a) Briefly explain logical operators by taking suitable examples.

     b) What do you mean by cell address in Excel?

     c) How can you create basic graphs using spreadsheet?

Q3.   (2X3.5=7)

     a) What do you mean by Boolean functions?

     b) What do you mean by Google Scholar?

     c) Write a short note on "feed subscription".

Q 4.   (2X3.5=7)

     a) What is bibliography style?

     b) How can you download citations?

     c) How can you do citation in MS word?

Q 5.   (2X3.5=7)

     a) What are the useful applications of computer in chemistry?

     b) Briefly explain importance of Google Docs.

     c) What do you mean by Track changes in MS Word?

Programme: Integrated B.Sc.-M.Sc. Chemistry **Session: 2022-23**

Semester: I **Max. Time: 3 Hours**

Course Title: GE Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons

Max. Marks: 70

Course Code: SBS CH 020101 GE 4004

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each sub part carries seven marks.

Question No. 1. **(4X3.5=14)**

(a) Show diagrammatically, how many nodes are present in (i) 3s-orbital (ii) 2p orbital (iii) $3d_{xy}$ orbital?

(b) Discuss the principle quantum number and azimuthal quantum number.

(c) What is Wurtz reaction? Discuss its mechanism. Is this method suitable for the synthesis of unsymmetrical alkanes? If not, why?

(d) Arrange in the increasing order of their % ionic character of the hydrogen halides. Given the electronegativity values of H, Cl, Br, I are 2.1, 3.0, 2.8 and 2.4 respectively.

(e) BF_3 is planar but NH_3 is not. Why?

(f) Discuss the conformational analysis of butane.

(g) What are carbanions? Discuss their stability order.
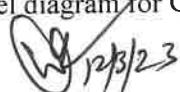
Question No. 2. **(2X7=14)**

(a) (i) What do you understand by 'Aufbau Principle'? What are it's limitation? (3.5 marks)

(ii) Calculate the wavelength associated with an electron of mass m = 9.1×10^{-28} kg which travels with 40 % of the speed of light. (3.5 marks)

(b) (i) Derive the Schrödinger wave equations. (3.5 marks)

(ii) Give the significance of magnetic and spin quantum number. (3.5 marks)

(c) (i) What are the conditions that must be fulfilled by the Ψ for acceptable solution. (3.5 marks)

(ii) In what ways the shapes of $3d_{x^2-y^2}$ and $3d_{z^2}$ differ? (1.5 marks)

(iii) What is the difference between 3d, 4d and 5d orbitals? Explain. (2 marks)

Question No. 3. **(2X7=14)**

(a) (i) Xenon difluoride is a linear molecule, but it has sp^3d^1 hybridization. Why? (3.5 marks)

(ii) Draw the M.O. energy level diagram for C_2. (3.5 marks)

(b) (i) What are the general characteristics of ionic solids? (3.5 marks)

(ii) Explain the Fajan's rule. (3.5 marks)

(c) (i) Which of the two NH_3 and NF_3 will have greater bond angle? (3.5 marks)

(ii) Write the Born-Haber cycle for the lattice energies of $MgCl_2$. (3.5 marks)

Question No. 4. **(2X7=14)**

(a) (i) State Huckel's rule and explain that cyclohexatriene is aromatic but cyclo-octatetrene is not. (3 marks)

(ii) What are carbocations? Discuss their various types. (4 marks)

(b) Explain the following: inductive effect, hyperconjuction, homolytic and heterolytic cleavage. (7 marks)

(c) (i) What is the origin of geometrical isomerism in alkenes? (3.5 marks)

(ii) Explain why rotation about carbon-carbon double bond is hindered? (3.5 marks)

Question No. 5. **(2X7=14)**

(a) (i) Draw the structures and write the correct names of 2-Methyl-2-propylhexane, 4,4-Dimethyl-3-ethylpentane and 1,1-Dimethylpentane. (3 marks)

(ii) Write down the various structural isomers of an alkane with molecular mass 72. Which of them has minimum boiling point? Give reasons. (4 marks)

(b) (i) Straight chain alkanes possess higher boiling points than the corresponding branched chain isomers. (3.5 marks)

(ii) How can you synthesize n-butane from ethyl bromide and pentanoic acid? (3.5 marks)

(c) (i) How will you make use of the following in synthesis of alicyclic hydrocarbons; Dieckmann condensation and Perkin method. (7 marks)

Programme: M.Sc. Chemistry   **Session: 2022-23**
Semester: 1   **Max. Time: 3 Hours**
Course Title: Inorganic Chemistry-I   **Max. Marks: 70**
Course Code: SBS CH 010101 C 4004

Instructions:
1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half marks.
2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries seven marks.

Q 1.   (4X3½=14)
   a) Write down symmetry elements of $[PtCl_4]^{2-}$ ion.
   b) Write a brief note on the electroneutrality principle.
   c) Tetrahedral spin paired complexes are rare. Is this a correct statement? Justify your answer.
   d) Comment on acidic nature of arachno and nido boranes.
   e) What are the number of vertices and the name of the parent deltahedron of the borane B_5H_9?
   f) Briefly discuss the co-planar structure of S_4N_4.
   g) What are isolobal fragments? Give examples.

Q 2.   (2X7=14)
   a) (i) What is the distinction between planes labelled σ_h, σ_v, and σ_d? Discuss by taking suitable examples. **(4 marks)**
      (ii) Where is the C_4 axis in B_5H_9? Also explain it. **(3 marks)**
   b) (i) Draw the possible isomers of $C_2H_2Cl_2$ and determine their point groups. Which of them is polar? **(4 marks)**
      (ii) What do you mean by great orthogonality theorem? **(3 marks)**
   c) (i) Derive the standard reduction formula for the number of times an irreducible representation occurs in a reducible representation. **(4 marks)**
      (ii) How many degrees of vibrational freedom do each of the following possess: $SiCl_4$, BrF_3 and $POCl_3$? **(3 marks)**

Q3.   (2X7=14)
   a) (i) Explain the bonding in $PtCl_4^{2-}$ by Valence Bond theory. What is the hybridization and which types of orbitals are involved in the formation of the hybrid orbitals? **(3 marks)**
      (ii) What will be the differences between magnetic properties and colours of $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$? Explain your answer using crystal field theory. **(4 marks)**
   b) (i) The crystal field splitting energy for the complex $[Co(H_2O)_6]^{2+}$ is 239 kJ/mol. Predict the colour of the complex by calculating the wavelength of absorbed light. Given the value of Planck constant $h = 6.626 \times 10^{-34}$ J s. **(3½ marks)**
      (ii) Between octahedral (Oh) and tetrahedral (Td) geometries, Ni^{2+} complexes have preference for Oh geometry, while Co^{2+} prefers Td geometry. Why? **(3½ marks)**
   c) (i) What is Jahn-Teller distortion? Give one example where such distortion is observed. **(2+1 marks)**

(ii) Is the structure of $K_4[Fe^{II}(CN)_6]$ a completely regular octahedron or a distorted octahedron? Justify your answer. **(2 marks)**

(iii) Draw the crystal field splitting diagram for tetrahedral complexes. **(2 marks)**

Q 4. (2X7=14)

a) (i) The $B_4H_4^{2-}$ anion and P_4, found in white phosphorus, are tetrahedral. What determines there tetrahedral structures? Explain why each adopts a tetrahedral structure and discuss the differences of these two compounds. **(4 marks)**

(ii) Briefly discuss the concept of boranes as ligands. **(3 marks)**

b) (i) Discuss the nature of bonding in P-N compounds using orbitals. **(4 marks)**

(ii) Draw the structure and determine the charge on the cyclic anion $[Si_4O_{12}]^{n-}$. **(3 marks)**

c) (i) What are pseudohalides? How $HCo(CO)_4$ complex can act as a pseudohalide? **(3 marks)**

(ii) Why borazine is more reactive than benzene? **(2 marks)**

(iii) Why does polythiazyl act as a superconductor at very low temperatures (below 0.33 K)? **(2 marks)**

Q 5. (2X7=14)

a) (i) Why 16 electron compounds are found in most of the square planar complexes? Explain using the MO diagram. **(4 marks)**

(ii) What are cluster compounds? Give examples. **(3 marks)**

b) (i) Count the valence electrons in the following compounds and show which of them satisfies the 18 electron rule: $[Re(CO)_5(PF_3)]^+$, $Ti(CO)_6^{2-}$, $Mn_2(CO)_{10}$ and $[IrBr_2(CH_3)(CO)(PPh_3)_2]$. **(4×1½ = 6 marks)**

(ii) Between $[Mn(CO)_6]^+$ and $[Fe(CO)_6]^{2+}$, which will show higher C-O stretching frequency? **(1 mark)**

c) (i) Explain the streochemical control of valence in metal nitrosyl complexes with examples. **(4 marks)**

(ii) The metal-carbonyl complexes are stabilized by synergistic effects. Justify this statement illustrating the different interactions. **(3 marks)**

CENTRAL UNIVERSITY OF HARYANA

Programme: M.Sc. (Chemistry)   Session: 2022-2023

Semester: I   Max. Time: 3 Hours

Course Title: Physical Chemistry-I   Max. Marks: 70
Course Code:(SBS CH 010103 C 4004)

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half marks.

2. Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

Question 1: i) Why least count is important in any analytical analysis? $(4 \times 3.5 = 14)$

ii) If an observer measures 51.3, 55.6, 49.9, and 52.0, then calculate the standard deviation, and relative standard deviation.

iii) Write down the importance of Histogram in analytical analysis.

iv) How fugacity and pressure of a gas are related to each other. Under what conditions they become equal to each other?

v) Why it is very difficult to find the activation energy of a chain reaction? What is the apparent activation energy of a chain reaction?

vi) How does quantum mechanics support the Bohr concept of quantization of energy?

vii) Write the conditions of well behave wave function.

$(2 \times 7 = 14)$

Question-2: A) Write a short note on the following i) Importance and method to find Coefficient of variance in analytical analysis ii) Importance of running a blank sample during analysis.

B) Differentiate between determinate and indeterminate errors.

c) Draw a graph of a function $y = 4x + 3$ and find the slope of the graph.

Question-3: A) Discuss in detail the equation of state method for the determination of the fugacity of gases.

B) Briefly explain the phase diagram of Na_2SO_4 + water system. Also discuss different areas, lines, and points in its phase diagram.

c) Calculate the ionic strength of a solution containing 0.11 M K_2SO_4 and 0.021 M $La(SO_4)_3$.

Unit-III

Question-4: A) Discuss in detail the kinetics of the photochemical decomposition of ethane molecule.

B) Discuss in brief the Rice-Herzfeld mechanism of decomposition of organic molecules.

c) Discuss the kinetics of photochemical H_2 + Br_2 chain reactions.

Unit-IV

Question-5: A) Derive Schrodinger Wave Equation based on postulates of quantum mechanics.

B) Find the eigen values and eigen function of the particle in the 3-D box.

c) Write a short note on the following: i) Ladder operator ii) Hamiltonian operator.

Programme: Integrated B.Sc.-M.Sc. (Chemistry)   Session: 2022-23

Semester: I   Max. Time: 3 Hours

Course Title: Organic Chemistry-I   Max. Marks: 70

Course Code: SBS CH 020103 C 3104

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each sub part carries seven marks.

Question No. 1.   **(4X3.5=14)**

(a) Explain the term hybridization. Why does carbon undergo hybridization?

(b) What do you mean by inductive effect? How does it help in explaining relative strength of acids and bases?

(c) What is Wurtz reaction? Discuss its mechanism. Is this method suitable for the synthesis of unsymmetrical alkanes? If not, why?

(d) Distinguish between conformation and configuration.

(e) Explain the term geometrical isomerism. State the necessary condition for a molecule to exhibit geometrical isomerism?

(f) Why cyclopropenyl cation is aromatic, while cyclopropene is not aromatic?

(g) Explain Diels-Alders reaction.

Question No. 2.   **(2X7=14)**

(a) What is resonance effect? Discuss its types. How does resonance effect help in explaining:

i) Low reactivity of vinyl and aryl halides towards nucleophilic substitution reactions.

ii) Relative acid strength of alcohols and phenols.   (7 marks)

(b) What is hyperconjugation? Why it is called "no bond resonance" and explain the relative stabilities of alkenes on the basis of hyperconjugation.   (7 marks)

(c) Give reasons for the following:

(i) Allyl and benzyl halides are more reactive than alkyl halides towards nucleophilic substitution reactions.   (3.5 marks)

(ii) Vinyl and aryl halides are less reactive than alkyl halides towards nucleophilic substitution reactions.   (3.5 marks)

Question No. 3. (2X7=14)

(a) Distinguish between enantiomers and diastereomers with suitable examples. (7 marks)

(b) Assign R or S configuration to each chiral centre in the following: (7 marks)

(a)   (b)   (c)   (d)
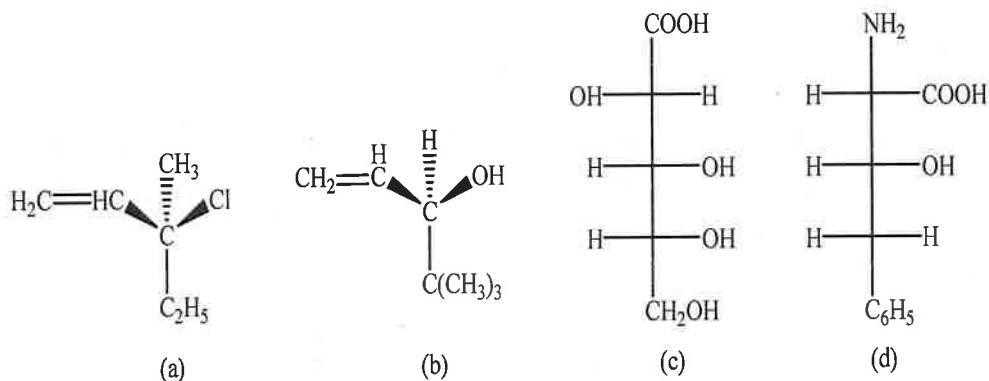
(c) Explain conformational analysis of cyclohexane and their relative stabilities. (7 marks)

Question No. 4. (2X7=14)

(a) Explain the following reactions of alkenes:

(i) Oxymercuration-demercuration

(ii) Hydroboration oxidation

(iii) Ozonolysis (7 marks)

(b) Discuss the mechanism of anti-Markovnikov's rule of addition of HBr to unsymmetrical alkenes. (7 marks)

(c) Discuss Hofmann elimination with mechanism? How does it differ from Saytzeff elimination? (7 marks)

Question No. 5. (2X7=14)

(a) (i) Write the products obtained by reduction of but-2-yne with Lindlar's catalyst and alkali metal in liquid ammonia. (3.5 marks)

(ii) What is Friedel-Craft's reaction? Write the limitations of Friedel-Craft's alkylation. (3.5 marks)

(b) (i) Explain the mechanism of nitration of benzene. (3.5 marks)

(ii) Why halogens are ortho/para directing though they are deactivating in nature? (3.5 marks)

(c) (i) Define aromaticity and state Huckel's rule. (3.5 marks)

(ii) Chlorination of o-xylene gives a mixture of two monochloro products but chlorination of p-xylene gives only one product. How would you explain this? (3.5 marks)