Programme	: Integrated B.Sc. M.Sc. (Chemistry)	**Session**	: 2022-2023
Semester	: III	**Max. Time:**	3 Hours
Course Title	: Organic Chemistry-II: Oxygen Containing Functional Groups	**Max. Marks:**	70
Course Code	: SBS CH 020302 C 4004		

Instructions:

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

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

Question No. 1.

(4X3.5=14)

a) Explain the reactivity behavior of primary, secondary and tertiary alcohols towards copper.

b) With suitable reasons, compare the acidic strength of 2-nitrophenol, 3-nitrophenol and 4-nitrophenol.

c) What happens when oxirane is treated with $LiAlH_4$? Give mechanism also.

d) Illustrate the chemical reactivity of carboxylic acid derivatives towards nucleophilic substitution reactions.

e) How will you prepare benzene from diazonium salt?

f) What happens when 1,2-propanediol is treated with $Pb(Ac)_4$? Discuss with mechanism.

g) Discuss acidic hydrolysis of esters with suitable mechanism.

Question No. 2. (2X7=14)

a) i) Discuss the reactions which occur through SN^i mechanism with suitable examples. **(3.5 marks)**

   ii) What happens when n-butyl chloride and tert-butyl chloride are treated with aq. NaOH solution? Give the mechanism also. **(3.5 marks)**

b) i) What happens when 4-chloroanisole is treated with $NaNH_2$ in liq ammonia? Discuss the reaction with mechanism. **(3.5 marks)**

   ii) Discuss the reactivity pattern of benzyl chloride and cyclohexyl chloride with aq. NaOH. **(3.5marks)**

c) i) What happens when phenyl lithium is treated with carbon dioxide? Give mechanism. **(3.5 marks)**

   ii) Give the importance of Grignard reagent in organic synthesis. **(3.5 marks)**

Question No. 3. (2X7=14)

a) i) What happens when Pinacol is treated with acid? Give suitable mechanism. **(3.5 marks)**

ii) How will you synthesize ethylene glycol starting from ethyl chloride? **(3.5 marks)**

b) i) Discuss the acidic behavior of phenol, 4-chlorophenol and 4-nitrophenol.**(3.5 marks)**
ii) What is Reimer–Tiemann reaction? Discuss it by taking suitable example.**(3.5 marks)**

c) Discuss the following with mechanism: **(3.5 X 2 marks)**

i) Fries rearrangement　　　　　　　　　ii) Williamson's synthesis

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

a) (i) Discuss the aldol condensation reaction with detailed mechanism. **(3.5 marks)**

(ii) Identify A and write a detailed mechanism of the given reaction. **(3.5 marks)**

$$\underset{Ph}{\overset{O}{\overset{\|}{\diagdown}}}\underset{Ph}{\diagup} \xrightarrow[\text{Ethylene glycol}]{\text{Hydrazine, KOH}} A$$

b) (i) Discuss Knoveangeal condensation with detailed mechanism. **(3.5 marks)**

(ii) Discuss Bayer-Villeger oxidation reaction with Mechanism. **(3.5 marks)**

c) (i) Discuss the Beckmann rearrangement with mechanism.**(3.5 marks)**

(ii) What is Michael addition? Explain with suitable example. **(3.5 marks)**

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

a) i) How will you prepare acetic acid from chloroethane? **(3.5 marks)**

ii) What happens when maleic is treated with bromine? Give suitable mechanism also. **(3.5 marks)**

b) (i) What happens when propanoic acid is treated thionyl chloride? Give suitable mechanism also. **(3.5 marks)**

(ii) How will you prepare acetamide from ethanol? **(3.5 marks)**

c) Discuss the following with mechanism: **(3.5 X 2 marks)**

i) Hofmann- bromamide degradation

ii) Curtius rearrangement

CENTRAL UNIVERSITY OF HARYANA

<u>Term End Semester Examinations, January 2023</u>

Programme: M.Sc. Chemistry   Session: 2022-23

Semester: III   Max. Time: 2 Hours

Course Title: Supramolecular Chemistry   Max. Marks: 35

Course Code: SBS CH 010306 DCE 2002

Instructions:

1. *Question no. 1 has four sub parts and students need to answer any two. Each sub part carries 3.5 marks.*

2. *Question no. 2 to 5 have three sub parts and students need to answer any two sub parts of each question. Each sub part carries 3.5 marks.*

Question No. 1.   (2 × 3.5 = 7)

(a) Classify the supramolecular host-guest compounds and briefly explain the different types with examples and scheme. **(3.5 marks)**

(b) Write down the name of the factors that affect the stability of a chelate complex in solution. Explain their role in determining the stability of the complex. **(3.5 marks)**

(c) What are the different types of π-π interactions? Explain these interactions briefly based on the model proposed by Sanders and Hunter. **(1 + 2.5 marks)**

(d) What are informed and emergent complex matters? Give example of a naturally occurring emergent structure. **(2.5 + 1 marks)**

Question No. 2.   (2 × 3.5 = 7)

(a) (i) Can chlorine hydrate be considered as a supramolecular complex? If yes, explain it's type. **(2 marks)**

(ii) What are graphite intercalates? **(1.5 marks)**

(b) Give three examples of naturally occurring macrocycles and write down their structures. **(3.5 marks)**

(c) What are cavitates and clathrates? Explain with examples. **(3.5 marks)**

Question No. 3.   (2 × 3.5 = 7)

(a) Write a short note on (i) rigid lock and key mechanism, and (ii) induced fit mechanism on the enzyme-substrate interaction. **(3.5 marks)**

(b) Consider the binding constants for K^+ ion with (i) [18]crown-6 in water; (ii) [18]crown-6 in methanol and (iii) [2.2.2] cryptand in methanol. Arrange the binding constants in increasing order and justify your answer. **(3.5 marks)**

(c) What is preorganization? Between [18]crown-6 and diaza[18]crown-6, which will be more complementary for K^+ ion and why? **(2 +1.5 marks)**

Question No. 4. $(2 \times 3.5 = 7)$

(a) (i) Write down the structure of carboxylic acid dimers. **(1 marks)**

(ii) What type of supramolecular interaction is present in such dimers and what is the range of the energies for this interaction? **(1.5 marks)**

(iii) Write down the name of an experimental technique which can provide the evidence for the formation of the dimeric structures in carboxylic acids. **(1 mark)**

(b) Write a short note on anion-π interaction. **(3.5 marks)**

(c) (i)Explain how does the enthalpic factor favour the hydrophobic effect. **(2.5 marks)**

(ii) Give an example of a polar, aprotic solvent. **(1 mark)**

Question No. 5. $(2 \times 3.5 = 7)$

(a) (i) EDTA is widely used for the analytical determination of various metal ion concentrations. Why? **(1.5 marks)**

(ii) Arrange the stability constants for the metal complexes of $EDTA^{4-}$ (in aqueous solution) in increasing order for the following metal ions: Na^+, Mg^{2+} and Fe^{3+}. Justify your answer. **(2 marks)**

(b) (i) Write down two well-established synthetic routes for the preparation of crown ethers. **(2.5 marks)**

(ii) Write down the name and structure of the crown ether which is complementary to Cs^+ ion. **(1 mark)**

(c) Write a short note on spherands. **(3.5 marks)**

Programme: M.Sc. (CHEMISTRY)   **Session:** 2022-23

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

Course Title: Physical Chemistry IV

(Solid State & Electrode analytical methods)

**Course Code:** SBS CH 0101310 DSE 4004   **Max. Marks: 70**

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.   (4X3.5=14)

a) What are the characteristics of a Reference electrode? Distinguish polarizable and nonpolarizable electrodes?

b) What is the potential of zero charge (E_{PZC}) and where is it located on the electrocapillary curve?

c) What is the surface excess? Whether the surface excess is equivalent to the amount adsorbed on the electrical double layer, explain.

d) What is Madelung constant? Is the Madelung constant same or different for NaCl and CsCl structures?

e) What is lattice energy? How does the solubility of ionic solid depend upon its lattice energy.

f) What do you mean by reversible electrodes.? To which categories of electrodes Ag/AgCl electrode belongs.

g) Explain perfect and imperfect crystals with suitable examples.

Q 2.   (2X7=14)

a) What is an electrocapillary curve? How will you determine electrical capacitance of an interface from such a curve?

b) Explain constant-capacity curve on the basis of lateral-repulsion model.

c) Discuss contact adsorption process by considering different interactions.

Q3.   (2X7=14)

a) What kind of forces are involved in metal-water interaction and how water molecules get oriented during these interactions, Explain in brief.

b) What is liquid junction potential? How can this be obtained by making use of concentration cells with and without transference?

c) Write Cottrell's equation. Discuss the chemical desorption and electrochemical desorption mechanisms of hydrogen evolution reactions.

Q 4.   (2X7=14)

a) Define and explain nucleation in a phase transition.

b) With the help of a neat diagram, show the variation of free energy in the formation of a critical nucleus.

c) Deduce the relationship for critical nucleus in terms of free energy per unit volume and free energy change per unit area.

Q 5.   (2X7=14)

a) What do you mean by Debye T cube Law? and discuss Einstein and Debye model of lattice heat capacity.

b) Derive the Bragg's law and find out the relation between the wavelength of X-ray and interplanar distance of the crystal for first order diffraction and maximum value of wavelength.

c) Discuss the Debye-Scherrer X-ray method for the structural analysis of crystals.

CENTRAL UNIVERSITY OF HARYANA
Term End Examinations, Jan. 2023

Programme : M.Sc. Chemistry   Session : 2022-2023
Semester : III   Max. Time: 3 Hours
Course Title : Organic Chemistry-IV (Reagents and Reactions)   Max. Marks:70
Course Code : SBS CH 010306DSE 4004

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

Question No. 1.

(4X3.5=14)

a) Write structure and full form of LDA and KHMDS. What happens when 2-methyl hexanone is treated with LDA followed by the reaction with ethyl iodide?

b) Write the products **I** and **II** in the given reaction sequence and give suitable explanation for the formation of these products.
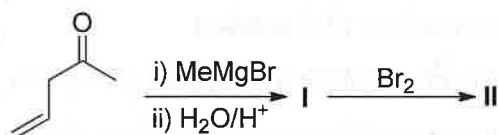
c) What happens *trans* 2-butene is treated with aq. $KMnO_4$ solution? Give suitable mechanism.

d) The reaction of acetophenone with perbenzoic acid in $CHCl_3$ gives the product A. Identify A and write the probable mechanism of the reaction.

e) Discuss chemoselectivity of $NaBH_4$ and LAH.

f) Discuss importance of CBS catalyst by taking suitable example.

g) Write the mechanism for Pinacol-pinacolone rearrangement.

Question No. 2.   (2X7=14)

a) (i) What do you understand by kinetic and thermodynamic controlled enolates? How would you generate such enolates in the reactions? **(3.5 marks)**

(ii) Discuss the importance and mechanism of McMurry reaction. **(3.5 marks)**

b) Complete the given reaction sequences with mechanism: **(3.5 marks x2))**
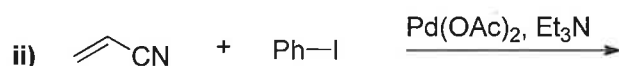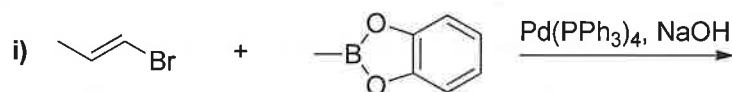
c) (i) Discuss briefly the importance Tebbe's reagent in organic synthesis.(3.5 marks)

(ii) Discuss the reaction of SmI_2 with carbonyl compounds. Give its attractive features.

(3.5 marks)

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

a) (i) What happens when cyclo-1,3-butadiene is treated with DDQ in toluene? Give detailed mechanism of the reaction also. **(3.5 marks)**

(ii) What happens when acetophenone is treated with HTIB in acetonitrile? Give detailed mechanism of the reaction also **(3.5 marks)**

b) (i) Complete the given reaction sequence with mechanism: **(3.5 marks)**
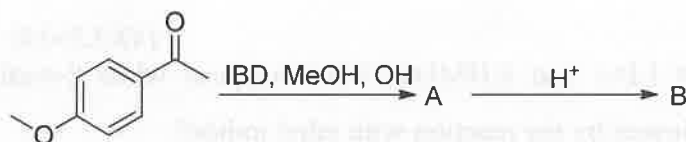
(ii) What happens when 1,2-propanediol is treated with lead tetra acetate? Give mechanism of the reaction also. **(3.5 marks)**

c) (i) Discuss Sharpless epoxidation reaction with mechanism. **(3.5 marks)**

(ii) What happens when 1,2-propanediol is treated with TEMPO in presence of sodium hypochlorite? What will happen if excess of sodium hypochlorite is taken? Give the mechanism involved in the reaction also. **(3.5 marks)**
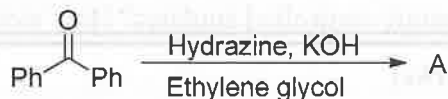
**Question No. 4.**   **(2X7=14)**

a) (i) Predict the product **P** in the given reaction and explain its formation with detailed mechanism. **(3.5 marks)**
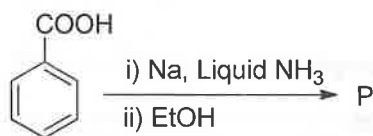
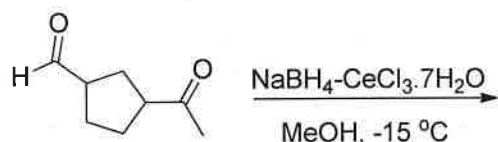(ii) Identify A and write a detailed mechanism of the given reaction. **(3.5 marks)**

b) (i) What happens when we heat separately fumaric acid and maleic acid with deuterated hydrazine in presence of copper sulphate and molecular oxygen in ethanol? **(3.5 marks)**

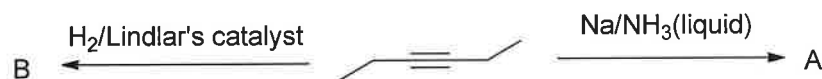(ii) Identify the products A and B and write detailed mechanism of the given reactions.
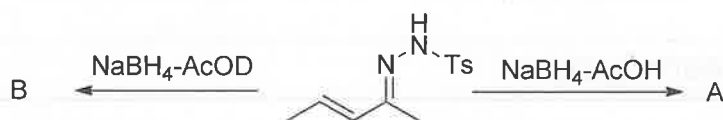
(3.5 marks)

c) (i) With suitable reason, write the product in the given reaction sequence.**(2 marks)**

$$\text{(structure)} \xrightarrow[\text{MeOH, -15 °C}]{\text{NaBH}_4\text{-CeCl}_3.7\text{H}_2\text{O}}$$

(ii) Write the chemical structure and full form of CBS catalyst. **(1.5 marks)**

(iii) Identify the products A and B and write detailed mechanism of the given reactions.

(3.5 marks)

$$\text{B} \xleftarrow[\;]{\text{H}_2/\text{Lindlar's catalyst}} \text{(alkyne)} \xrightarrow[\;]{\text{Na/NH}_3(\text{liquid})} \text{A}$$

Question No. 5.   (2X7=14)

a) i) Identify the products A and B and write detailed mechanism of the given reaction.

(3.5 marks)

$$\xrightarrow{\text{Conc. H}_2\text{SO}_4,\ \text{cold}}$$
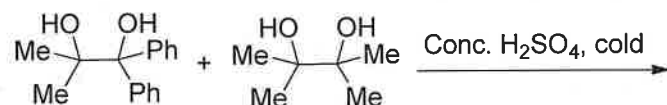
ii) What happens when cyclobutylmethylamine is treated with nitrous acid? Give suitable mechanism also. **(3.5 marks)**

b) (i) What happens when 4,4-dimethylcyclohexa-2,5-dienone is treated with sulfuric acid? Give suitable mechanism also. **(3.5 marks)**

(ii) Discuss the importance of Beckmann rearrangement in organic synthesis. **(3.5 marks)**

c) (i) What happens when benzamide and acetamide are treated with bromine in aqueous NaOH solution? Write the general mechanism involved in the reaction.**(3.5 marks)**

(ii) Discuss Benzil-bBenzilic acid rearrangement with mechanism. **(3.5 marks)**

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

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

Course Title: Inorganic Chemistry – IV (Advanced Inorganic Chemistry)   **Max. Marks: 70**

Course Code: SBS CH 010302 DSE 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) Explain the role of transition metal ions in biology.

  (b) What are the structural changes that occur around the heme group when an iron atom binds an oxygen molecule? Discuss with suitable drawing.

  (c) Which reaction is catalyzed by the enzyme catalase? Discuss the structure of the enzyme and substantiate its function.

  (d) Why DNA polymerase is called a processive molecular machine? Explain briefly.

  (e) What do you mean by artificial photosynthesis?

  (f) Explain the role of ionophores such as valinomycin and nonactin with regard to membrane transport.

  (g) Provide an example of biological tetrapyrrole macrocyclic compound and draw its structure. Discuss some of its special features.

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

  (a) (i) Elaborate the terms "*domed*" and "*ruffled*" associated with iron-porphyrin complexes. Describe the structure and function of myoglobin in biological system. **(4 marks)**

  (ii) Write down the mechanism of hematin formation. **(3 marks)**

  (b) (i) In the cytochrome P450, what do 450 stand for? Write down the mechanism of mono-oxygenase (insertion of oxygen) reaction catalyzed by CYP enzymes. **(6 marks)**

  (ii) What are blue copper proteins? **(1 mark)**

  (c) (i) Discuss the sigmoid curve exhibited by hemoglobin during the transport of molecular oxygen. Does myoglobin exhibit the sigmoid curve? Explain your response with reasoning. **(5 marks)**

  (ii) In which class of protein nitrophorin belongs to? Briefly discuss its function. **(2 marks)**

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

  (a) (i) Delineate the extradiol ring cleavage catalyzed by mononuclear iron dioxygenase enzyme? **(4 marks)**

  (ii) Which enzyme catalyzes the formation of nitric oxide (NO) from L-arginine? Discuss the structure and function of the enzyme. **(3 marks)**

  (b) (i) What are cytochromes? Draw the active site structure of cytochrome c oxidase and describe its functions. **(4 marks)**

(ii) What do you mean by *in vivo* nitrogen fixation? Write down the balanced reaction of reduction of dinitrogen to ammonia and mention the name of the enzyme that catalyzes the reaction. **(3 marks)**

(c) (i) Name the enzyme that catalyzes the interconversion of CO_2 and carbonates? Describe the possible mechanism of interconversion with drawing. **(4 marks)**

(ii) What is the condition of increased level of uric acid in human body known as? How this can be treated? **(3 marks)**

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

(a) Describe the importance of natural photosynthesis in fulfilling the energy requirement of earth. Discuss the process of photosynthesis in detail. **(2+5 marks)**

(b) How would you connect the concept of hydrogen fuel production with artificial photosynthesis? What are the essential concepts to develop it? **(3+4 marks)**

(c) What do you mean by dioxygen activation? Which enzymes catalyze the conversion of methane to methanol? Describe the process in detail with focus to its use in energy. **(1+2+4 marks)**

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

(a) (i) Discuss the role of alkali metal cations in biochemistry with emphasis on the energy-releasing reaction of dephosphorylation of ATP to ADP and dihydrogen phosphate. **(4 marks)**

(ii) Discuss the structure and function of DNA briefly. **(3 marks)**

(b) (i) Make a schematic drawing and delineate the role of the photoresponsive pigment rhodopsin in black and white vision. **(4 marks)**

(ii) Describe the important role of chlorophyll in plant photosynthesis. **(3 marks)**

(c) Write short notes on the following: (i) Neurotransmitters and Hormones (ii) Semiochemistry in the Natural World. **(3½+3½ marks)**

Programme	: M.Sc. Chemistry	**Session**	: 2022-2023
Semester	: III	**Max. Time**	: 2 Hours
Course Title	: Carbohydrate Chemistry and Its Applications	**Max. Marks**	: 35
Course Code	: SBS CH 010304 DCE 2002		

Instructions:

1. Question no. 1 is compulsory and it has four sub-parts and students need to answer any two. Each part carries three and half marks.

2. Question nos. 2 to 5 have three sub-parts and students need to answer any two sub-parts of each question. Each part carries three and half marks.

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

    a) Discuss anomeric effect by taking suitable examples.

    b) Give one synthetic method for glucose?

    c) What are the main differences between homo and heteropolysaccharides?

    d) Discuss the importance of deoxy sugars? Give at least two examples.

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

    a) (i) Discuss the isomeric relationship among D-glucose, D-fructose and D-mannose.

                                                              (1.5 marks)

        (ii) Discuss mutarotation with examples? **(2 marks)**

    b) What happens when D-fructose is treated with phenyl hydrazine in acidic medium? Explain the reaction with mechanism.

                                                              (3.5 marks)

    c) Explain the chemical behavior of D-fructose towards Tollen's reagent. Give mechanism also. **(3.5 marks)**

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

    a) Write the chemical structures of Sucrose and Lactose. Discuss their chemical behavior towards Tollen's reagent. **(3.5 marks)**

    b) (i) What is glycosidic lingage? On hydrolysis, Methyl β-D-glucopyranoside gives a mixture of two pyranoses of D-Glucose. Why? **(2.5 marks)**

        (ii) What will you get on hydrolysis of maltose? **(1 mark)**

    c) Discuss the terms epimer and anomer with suitable examples? **(3.5 marks)**

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

a) Discuss the structural aspects of Cellulose. Discuss its stability, solubility and chemical behavior towards Tollen's reagent. **(3.5 marks)**

b) What are basic differences between Glycogen and Amylopectin? **(3.5 marks)**

c) Discuss the phosphorylation of D-Glucose in glycolysis with mechanism.**(3.5 Marks)**

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

a) What are natural and artificial sweeteners? How do they interact with specific sites on the taste buds? **(3.5 marks)**

b) What are amino sugars? With examples, explain their importance in different fields. **(3.5 marks)**

c) How will you synthesize Saccharin? Comment on its relative sweetness with sucrose also. **(3.5 marks)**

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

Semester: III   Max. Time: 3 Hours

Course Title: Inorganic Chemistry-II: s and p- Block Elements   Max. Marks: 70

Course Code: SBS CH 020301 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 students need to answer any two parts of each question. Each sub part carries seven marks.

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

(a) What are Lewis acids? Which would you expect to be a better Lewis acid among BF_3, BCL_3 and BI_3? Explain.

(b) Explain why carbon has greater catenation tendency than silicon.

(c) What are silanes? Compare their reactivity with alkanes.

(d) Discuss the bonding in diborane. How does B_2H_6 react with excess of ammonia at low and high temperatures?

(e) Differentiate between the process of roasting and calcination.

(f) Mention some uses of noble gases. Which noble gas is most abundant in the universe?

(g) What are clathrate compounds? Why helium and neon do not form clathrate compounds?

Question No. 2.   (2X7=14)

   (a) Discuss briefly:

      i) What is electrolytic reduction? Explain with the help of an example.

      ii) Describe briefly hydrometallurgy. Copper can be extracted by hydrometallurgy but not zinc. Why?

   (b) What are Ellingham diagrams? Discuss briefly their application for reduction of metal oxides using carbon and carbon monoxide as reducing agent.

   (c) Discuss the following:

      i) Electrolytic Kroll process

      ii) Parting process

      iii) Mond's process

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

    (a) What is meant by leveling effect? Explain this effect on the basis of solvent-system concept of acids and bases.

    (b) Explain HSAB principle. Discuss its applications.

    (c) Discuss the effect of solvents on relative strengths of acids and bases.

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

    (a) Describe in detail the structure, preparation and properties of carboranes.

    (b) Discuss briefly:

        i) Pseudohalogens

        ii) Peroxo acids of sulphur

        iii) Phosphazenes

    (c) Explain synthesis, structural aspects and applications of silicones.

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

    a) How is xenon oxytetrafluoride prepared? Describe its reactions with SiO_2 and H_2O.

    b) i) Complete and balance the following reactions:

$$XeF_2 + SO_3 \rightarrow$$

$$XeF_4 + BCl_3 \rightarrow$$

$$XcO_3 + XcF_6 \rightarrow$$

        ii) Draw structures for the following species: a) XeF_5^+ b) XeF_3^+ c) XeO_4

        iii) What are the characteristics of XeF_2 that make it a desirable fluorinating agent for organic compounds.

    c) Discuss the preparation, structure, bonding and properties of XeF_4.

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

Semester: III   Max. Time: 3 Hours

Course Title: Basic Analytical Chemistry   Max. Marks: 70

Course Code: SBS CH 020301 SE 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.   (4X3.5=14)

     a) Give an example of a probability distribution function that can be applied in case you have indeterminate errors. Discuss it's salient features with mathematical expression.

     b) Discuss about one statistical test that can analyze the differences between the spread of data obtained from different sets of experiments.

     c) Discuss the difference between single and double beam instruments in IR spectrometry.

     d) Discuss about the choice of source and detector in UV spectroscopy.

     e) Discuss the basic principle of DSC technique.

     f) What are the important information and inferences that can be obtained from a derivative thermogravimetric (DTG) curve?

     g) Discuss the basic principle of potentiometric titrations.

Q 2.   (2X7=14)

     a) (i) What are the differences between population and sample? **(2 marks)**

         (ii) Write down the number of significant figures in (a) 6090.090, (b) 6.0×10^5. **(2 marks)**

         (iii) Write down the types of transitions involved in the following spectral region: UV, IR and X-ray. **(3 marks)**

     b) (i) What are positive and negative constant errors? Discuss with examples. **(2+2 marks)**

         (ii) What are the differences between accuracy and precision? **(3 marks)**

     c) (i) What is standard deviation? Calculate the standard deviation of the following set of analytical results: 15.67, 15.69, and 16.03 g **(1.5+1.5 marks)**

         (ii) A series of nominally identical samples are taken for analysis. The mean weight of the samples is 9.78 g, with a standard deviation being 0.09 g for very few samples having been weighed. How many samples must be weighed so that the sample mean

has an error 0.02 g from the population mean? Given that the value of the statistical factor at 95% confidence level for an infinite population is 1.960. **(4 marks)**

Q3.   (2X7=14)

a) (i) Which molecules would be IR inactive? Give examples. **(3 marks)**

(ii) How do you determine the number of fundamental vibrational modes in linear and non-linear molecules? Discuss with examples. **(4 marks)**

b) (i) Calculate the wave number of stretching vibration of a carbon-carbon double bond. Given that the force constant is 5×10^5 dynes per cm. **(3 marks)**

(ii) Discuss briefly about the selection rules for allowed transition in spectroscopy. **(4 marks)**

c) (i) What is the wavelength range for IR? **(2 marks)**

(ii) The C—H str vibration in chloroform appears at 3000 cm^{-1}. Calculate the C—D str frequency in CDCl$_3$. **(3 marks)**

(iii) A sample exhibits an absorbance of 0.9 in UV-Visible Spectroscopy. What is the percentage transmittance? **(2 marks)**

Q 4.   (2X7=14)

a) (i) What is a gravimetric analysis? Give an example. **(2+1 marks)**

(ii) Write down the important applications of TGA. **(4 marks)**

b) (i) Write down the basic principle of instrumentation of DTA. **(3 marks)**

(ii) Discuss how the enthalpy of transition can be measured by the DSC technique. **(4 marks)**

c) The thermogram in the following figure shows the change in mass for a sample of calcium oxalate monohydrate. The original sample weighed 24.60 mg and was heated from room temperature to 1000 °C at a rate of 5 °C/min. The following changes in mass and corresponding temperature ranges were observed:

Loss of 3.03 mg from 100–250 °C

Loss of 4.72 mg from 400–500 °C

Loss of 7.41 mg from 700–850 °C

Determine the identities of the volatilization products and the solid residue at each step of the thermal decomposition by calculating the molar masses. **(7 marks)**
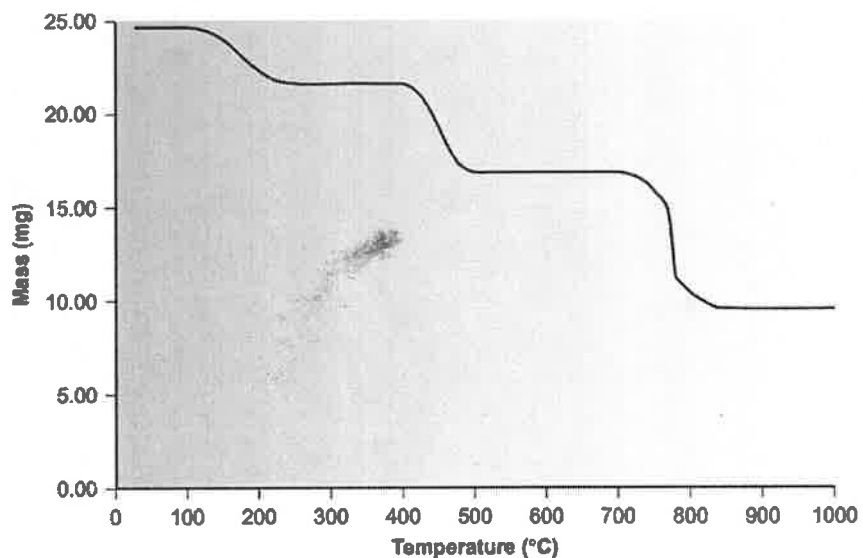
Q 5.   (2X7=14)

a) Explain the following (i) differential titration and (ii) automatic titration. **(3.5+3.5 marks)**

b) (i) Explain the conductometric titration curve for HCl by NH₄OH. **(3 marks)**

   (ii) Write a short note on reference electrode. **(4 marks)**

c) (i) Discuss the basic principle of operation of polarography. **(4 marks)**

   (ii) Explain the conductometric titration curve for a weak acid with a strong base. **(3 marks)**

CENTRAL UNIVERSITY OF HARYANA

Programme: M.Sc. Chemistry   Session: 2022-23

Semester: III   Max. Time: 2 Hours

Course Title: Research Methodology and Software Applications   Max. Marks: 35

Course Code: SBS CH 010314 C 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 sub part carries three and half marks.*

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

(a) Describe briefly: Desriptive *vs* Analytical Research and Applied *vs* Fundamental Research.

(b) Explain the importance of literature review in defining a research problem. Mention two sources from where you can perform literature review.

(c) Discuss the importance of Google Scholar in your research. Would you suggest other researchers to use Google Scholar? Validate your answer with reasons.

(d) What do you mean by a scientific document? Give example of any scientific document and write down its components.

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

(a) Mention briefly your understanding about scientific research. Which are the areas in your society which have been immensely benefited by scientific research?

(b) Write a short note on "Research Methods" and "Research Methodology".

(c) What is a *"Research Proposal"*? Briefly mention the components of a standard *"Research Proposal"*.

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

(a) What are the primary and secondary sources in literature review? Discuss briefly.

(b) Assume that you are writing a research proposal, how would you define and formulate a research problem? Is there any importance of reviews in defining or formulating a research problem?

(c) How would you select a research problem and subsequently develop working hypothesis for it?

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

    (a) What are Sci Finder and Scopus? Write the similarities and dissimilarities between the two.

    (b) Discuss briefly about Research Gate. What are h-index and i-index?

    (c) What do you mean by Journal Access? Discuss about impact factor of journals. How it is calculated?

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

    (a) What is a project report or dissertation report? Write down components of such a report.

    (b) What are Communications, Articles and Reviews? Write the name two publication houses of Chemical Societies.

    (c) What do you mean by ethics and how would you maintain ethics in your research? Discuss in short about predatory journal and publishers.

CENTRAL UNIVERSITY OF HARYANA

Term End Semester Examination, January 2023

Programme: Int. B.Sc.--M.Sc. Chemistry   Session: 2022-2023

Semester: III   Max. Time: 3h

Course Title: GE: Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry -II

Course code: SBS CH 020301 GE 4004.   Max. marks: 70

Instructions

1. Question no. 1 has seven subparts and students need to answer any four. Each subpart carries 3.5 marks.

2. Question 2 to 5 have three subparts and students need to answer any two subparts of each question.

Question 1

     a) Differentiate between reversible electrode and irreversible electrode.

     b) Write down a short note on standard electrodes.

     c) How can you differentiate reducing sugar from non-reducing sugar chemically?

     d) Illustrate the structure of Maltose.

     e) What will be Normality of a solution obtained by mixing 20 ml of 1N HCl solution with 20 ml of 0.8N HCl solution.

     f) Describe Azeotropes.

     g) Illustrate the mechanism of bromination of aniline. (3.5 X 7)

Question 2

     a)   What do you mean by solutions? Define the terms: Normality, Molarity and Molality. (1 + 2 +2+2)

     b)   Derive an expression for Raoult's law. (7)

     c)   Describe the phenomenon of elevation in boiling points and depression in freezing points. (7)

Question 3

a) Derive an expression which correlates the electrode potential (E) with thermodynamic parameters; Gibb's free energy (G) and enthalpy (H).   (7)

b) Discuss the limiting conductance of strong and weak electrolytes. How can we calculate them? (7)

c) How electrochemical series help in comparing the electropositive character of metals and spontanity of a reaction. (7)

Question 4

a) Illustrate the conversion of Diazonium salt into Phenol and halobenzene?   (3.5 X 2)

b) Describe the mechanism of acidic and alkaline hydrolysis of esters.   (7)

c) Describe the Hell – Volhard – Zelinsky reaction in details. (7).

Question 5

a) Discuss the structure of Cellulose.   (7)

b) What are monomeric forms of lactose? How are they joined to each other to form a molecule of lactose?   (1 + 6)

c) i) Write down the chemistry of Ninhydrin test for amino acids. (3.5)

ii) Illustrate the mechanism of Strecker' s synthesis of amino acids.   (3.5)

CENTRAL UNIVERSITY OF HARYANA

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

Semester: Semester-III   **Max. Time: 3 Hours**

Course Title: Inorganic Chemistry-III   **Max. Marks: 70**

Course Code: SBS CH 010301 DSE 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 part carries seven marks.

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

   a) How many degrees of freedom does a chemical compound of N atoms have? Explain.
   b) How can you prepare samples IR Spectroscopy?
   c) ESR spectrum is usually recorded in the first derivative mode. Why?
   d) Describe salient features of instrumentation used in ESR spectrum.
   e) What is electron capturing? How 57Co is converting to 57Fe?
   f) Discuss mechanism of anion-cation reactions in chemiluminescent.
   g) Explain extinction coefficient and molar absorption coefficient.

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

   (a) (i) Briefly discuss types of molecular vibrations. Also draw their sketches. (2 marks)
       (ii) What do mean by fingerprint region? Discuss with suitable examples. (2 marks)
       (iii) What are applications of resonance Raman spectroscopy in elucidation of the active sites of heme and non-heme oxygen carriers? (3 marks)
   (b) (i) Distinguish fac-$ML_3(CO)_3$ and mer-$ML_3(CO)_3$ isomers by using IR/Raman spectroscopy to? (3 marks)
       (ii) Briefly explain polarized Raman spectroscopy. (2 marks)
       (iii) What is the rule of mutual exclusion in vibrational spectroscopy? (2 marks)
   (c) (i) What do you mean by the effect of hydrogen bonding on the stretching frequency of small molecules by taking a suitable example? (3 marks)
       (ii) The CN stretching frequency of three Ag-CN complexes is in the following order:
$$[Ag(CN)_4]^{3-} < [Ag(CN)_3]^{2-} < [Ag(CN)_2]^-$$
       Explain the trend and discuss how M-CN bonding is different than M-CO bonding. (4 marks)

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

   a) Draw the energy level diagram (energy vs. applied magnetic field) for a system with S=3/2 under the various circumstances listed below. Select a particular energy interval as corresponding to the spectrometer frequency, mark the possible ESR transition and note how their number changes. (7 marks)
      (i) with no ZFS
      (ii) with small ZFS
      (iii) with ZFS comparable to the ESR spectrometer frequency

(iv) with ZFS very much larger than the spectrometer frequency

b) (i) Sketch the ESR spectra you would expect for a solution of Cu(II) in water and the same solution after it has been frozen. Assume that only hyperfine coupling to Cu^{63} can be seen. (5 marks)

(ii) Write a short note on electron-nuclear spin coupling with a neat splitting pattern. (2 marks)

c) (i) The ESR spectrum of an organic radical containing two carbon atoms consisted of 12 lines. Identify the radical. (2 marks)

(ii) An unpaired electron couples with two equivalent nuclei of spin one. Predict the ESR hyperfine structure with the energy levels. (3 marks)

(iii) How many ESR lines are possible in the following examples? Assuming the lines do not overlap. (2 marks)

$(CH_3)_2NO^\bullet$
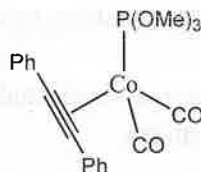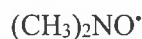
Question No. 4.   (2X7=14)

a) (i) What is quadruple interaction in Mössbauer spectroscopy? (2 marks)

(ii) What is Doppler broadening? A free Mössbauer nucleus of mass 100.6 amu emits radiation of wavelength 0.1 nm. Calculate the recoil velocity and Doppler shift. How can be minimized the recoil energy? (5 marks)

b) (i) Discuss isomer shift. Describe how the electron density of the nuclei affects the chemical/isomer shift in Mössbauer spectroscopy? Also comment isomer shift on covalent character. (4 marks)

(ii) How can you interpret nuclear quadrupole coupling constants? (3 marks)

c) (i) Discuss Mössbauer spectra for the SnF_4. (3 marks)

(ii) The Mössbauer spectrum of $K_4[Fe(CN)_6]$ consists of one line whereas that of $K_3[Fe(CN)_6]$ consists of two lines. Draw these spectra qualitatively and account for their appearance. (4 marks)

Question No. 5.   (2X7=14)

a) (i) Draw and discuss the Jablonski diagram for depicting various photophysical processes. Also discuss reason behind them. (4 marks)

(ii) Discuss the role of photosensitizer during catalytic conversion of hydrogen from water. (3 marks)

b) (i) What is the quantum efficiency? How would you explain very high and very low quantum efficiencies of some photochemical reactions? Explain with suitable examples. (4 marks)

(ii) What do you mean by electronic transitions and intensity of absorption bands? (3 marks)

c) Define and discuss mechanism of the following by taking suitable examples: (i) Franck-Condon principle, (ii) photosubstitution and (iii) predissociation. (3+2+2 marks)

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations January 2023

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 student are required to answer any two parts of each question. Each part carries seven marks.

Q 1.   (4X3.5=14)

   a) Microarray hybridization

   b) Pulse Field Gel Electrophoresis

   c) 2D electrophoresis

   d) Solvents for extraction of metabolome

   e) Bacterial Exometabolome

   f) Explain the term microbiome. How it differs from microbiota?

   g) What is BLAST? Explain its types

Q 2.   (2X7=14)

   a) What is genomics, proteomics and transcriptomics? What are the applications of genomics?

   b) What are the methods of studying microbial genomics? Write a short note on analysis and interpretation of whole genome sequences.

   c) Differentiate between Prokaryotic and Eukaryotic genome. How genes are found in prokaryotes?

Q 3.   (2X7=14)

   a) What do you understand by genome annotation? How do you annotate a genome sequence.

   b) Explain genomic approach to study Human Microbiome Project. Write down the goals and achievements of HMP?

   c) Write a note on various databases used to study microbial genomics and proteomics.

Q 4.   (2X7=14)

   a) What is proteome and what is proteomics and metaproteomics? What are the different protein modifications that proteomics include?

   b) What are the methods that are used in proteomics? What are the different databases of proteomics research?

   c) What are functional and expression proteomics? Elaborate the aims of proteomics.

Q 5.   (2X7=14)

a) What is metabolome and metabolomics? Compare metabolomics to genemics, proteomics and transcriptomics.

b) Describe experimental approaches to targeted and untargeted metabolomics.

c) What is metabolomics? Write in detail the basic steps of bacterial sample preparation for metabolome analysis.

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations January 2023

Programme:	M.Sc. Chemistry	**Session: 2022-23**
Semester:	Third	**Max. Time: 3 H**
Course Title:	Physical Chemistry- III	
	(Statistical Mechanics, Surface and Interface Chemistry)	**Max. Marks: 70**
Course Code:	SBS CH 010309 DSE 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. (4×3.5=14)

    a) Write down conditions of most probable distribution.

    b) Differentiate between canonical and grand canonical ensemble.

    c) Define the physical significance of the partition function in the Ensemble.

    d) Briefly describe the effect of the change of zero point energy on the partition function.

    e) Define spin-orbit coupling in terms of photochemical reactions.

    f) Write a short note on Compton Effect.

    g) Write down the importance of the electrocapillary curve in deriving charge density at the metal electrode and the capacity of the electrified interface.

Q 2. (2×7=14)

    a) Differentiate between MB, BE, and FD statistics.

    b) Briefly define the role of BE statistics for a photon gas entrapped in a 3D box.

    c) Derive an equation for Maxwell distribution law for velocities of gaseous molecules entrapped in a cubical box following micro-canonical ensemble conditions.

Q3. (2×7=14)

    a) Derive the Secure-tetrode equation for the relation between entropy and translational partition function.

    b) Discuss the physical significance of Lagrange undetermined multiplier in deriving MB statistics.

    c) Derive an equation for MB statistics following canonical ensemble.

Q 4.   (2×7=14)

   a) Briefly describe the Jablonski diagram and different terms involved in an excited state.

   b) Write a short note on the Grotthus-Draper law and Stark-Einstein law of photochemical reactions.

   c) Write a short note on different transitions between potential energy surfaces.

Q 5.   (2×7=14)

   a) Derive a basic fundamental equation for thermodynamics of polarizable interface.

   b) Briefly describe the advantages of the BDM model of an electrified interface over Helmholtz and Gouy-Chapman models.

   c) Derive equation giving the relation between surface excess and interfacial tension.

Programme: Integrated B.Sc.- M.Sc. Chemistry   **Session:** 2022-23
Semester: Third   **Max. Time: 3 H**
Course Title: Physical Chemistry-III   **Max. Marks: 70**
Course Code: SBS CH 02 0303 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: (4×3.5=14)

    a) Is it possible to cut through a slab of ice with a knife without separating the slab into two? Explain using the phase diagram of water system.

    b) How will you distinguish between a compound and its eutectic mixture both of which have sharp melting points?

    c) What is an azeotrope? Can the components of azeotrope be separated by simple boiling? Give reasons for your answer.

    d) Order of a reaction may be positive, negative or a fractional value. Comment.

    e) Adsorption of gases on solid surface is not monolayer at high temperature and low pressure. Give reason.

    f) Consider the following general reaction :

$$A+B \rightarrow C+D$$
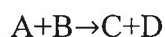
The rate constant value of the above reaction is 5.03×10^{-2} mol^{-1} dm^3 s^{-1} at 289 K and 6.71 mol^{-1} dm^3 s^{-1} at 333 K. Calculate the activation energy; E_a of the reaction.

    g) Most adsorption processes are exothermic in nature. Explain.

Q 2.   Answer the following in brief: (2×7=14)

    a) Draw and discuss the phase diagram of sulphur which exhibits the phenomenon of enantiotropy.

    b) Deduce Gibbs phase rule

       I.   For reactive system   (3)

       II.   For non - reactive system at equilibrium, in which one component ·is absent in one phase, while the other components are present in all phases.   (4)

    c) Draw a well labelled triangular phase diagram of chloroform - acetic acid -water system and explain the various regions in it.

Q3.   (2×7=14)

a) Answer the following

    I.   Phenol and water are partially miscible in each other. What will be your observation on

        (i) No. of phases and Degrees of freedom

        (ii) Composition of each phase

        (iii) Quantities of layers if there is a phase separation,

        as phenol is added progressively to a definite quantity, say 10 mL of water at constant temperature below its CST.   (4)

    II.   Using Duhem-Margules equation and Raoult's law, show that in a binary solution if one component shows positive deviation, then the other component also does so.   (3)

b) Answer the following:

    I.   State and Explain Lever rule   (3)

    II.   The vapour pressures of pure ethylene bromide and propylene bromide are 22.93 kPa and 16.93 kPa at 300 K. These two compounds form a nearly ideal solution. When 3 moles of ethylene bromide and 2 moles of propylene bromide are mixed and allowed to attain equilibrium at 300K, the total pressure is 20.4 kPa. Calculate the mole fractions of the two components in the liquid phase.   (4)
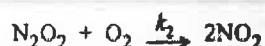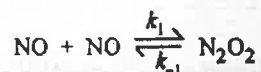
c) Answer the following

    I.   State, explain and deduce the Nernst distribution law and its limitations.   (3)

    II.   Explain CST and steam distillation.   (4)

Q 4. Answer the following   (2×7=14)
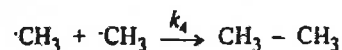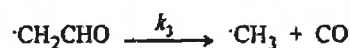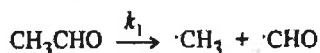
a) Reaction between NO and O_2 follows the mechanism :

$$NO + NO \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} N_2O_2$$

$$N_2O_2 + O_2 \xrightarrow{k_2} 2NO_2$$

Show that, the rate of the reaction is given by :

$$\frac{1}{2}\frac{d[NO_2]}{dt} = k[NO]^2[O_2] \text{ where } k = k_2 K_{eq}$$

How will you account for the decrease in rate constant of reaction with increase in temperature of the reaction system?

b) Thermal decomposition of acetaldehyde occurs via the following sequence of steps in a chain reaction:

$$CH_3CHO \xrightarrow{k_1} \cdot CH_3 + \cdot CHO$$

$$\cdot CH_3 + CH_3CHO \xrightarrow{k_2} CH_4 + \cdot CH_2CHO$$

$$\cdot CH_2CHO \xrightarrow{k_3} \cdot CH_3 + CO$$

$$\cdot CH_3 + \cdot CH_3 \xrightarrow{k_4} CH_3 - CH_3$$

Show that the differential rate law for the above reaction is given by :

$$\frac{d[CH_4]}{dt} = k [CH_3CHO]^{3/2}$$

where $k = k_2(k_1/2k_4)^{1/2}$.

c) Deduce differential and integrated form of rate expressions for zero, first and second order reactions, also deduce expression of half life for each.

Q 5.   Answer the following   (2×7=14)

a) Explain in brief

I.   Discuss mechanisms of catalyzed reactions at solid surfaces.   (4)

II.   Effect of particle size and efficiency of nanoparticles as catalysts.   (3)

b) Explain Freundlich isotherm. Using Freundlich isotherm expressed in terms of mass of solute adsorbed per kg of adsorbent (x) and concentration C in g/dm^3 i.e.,

$$X = kC^{1/n}$$

calculate the mass of acetic acid in grams that 900 g of charcoal would absorb from 0.817 mol/dm^3 vinegar solution. The value of the constants k and n are 0.16 and 2, respectively.

c) Write short note on:

I.   Chemisorption & physisorption   (2)

II.   BET Isotherm   (2)

III. Langmuir Isotherm   (3)