CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: M.Sc. Chemistry | **Session: 2021-22**

Semester: First | **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 students need to answer any two parts of each question. Each part carries seven marks.

Q 1. (4X3.5=14)

a) For the data set: 4, 7, 9, 11, 5, 17, 19, and 9. Find median, mode, range, and average.

b) For the data set: 5.7, 31.4, 35.2, 41.6, 54.3, and 17.8. Find average, standard deviation, and relative standard deviation.

c) Find mean ionic activity for 0.3 m NaCl solution whose mean activity coefficient at 25 ^{0}C is 0.614.

d) Write a short note on the Cooling Curve and the Thaw-Melt method.

e) Write down the limitations of collision theory? How these limitations were removed in the ACT?

f) Write a short note on the apparent activation energy of the chain reaction.

g) Define the following in brief: Hermitian operator, Ladder operator, and Dirac delta function.

Q 2. (2X7=14)

a) i) Express $\log_a\left(\frac{x^3\sqrt[5]{y^2}}{\sqrt{z^3}}\right)$ in terms of $\log_a x \,.\, \log_a y \,.\, \log_a z$ (3 marks)

ii) If $\log_5 P = a$ and $\log_2 q = a$ then prove that $\frac{P^4q^4}{100} = 100^{2a-1}$ (4 marks)

b) Derive 2nd and 4th Maxwell relations.

c) Write a short note on the Clausius-Clapeyron equation and partial molar quantity in terms of Gibbs free energy.

Q3. (2X7=14)

a) Discuss in detail the method of determination of fugacity from the equation of state.

b) Discuss in the detail the phase diagram of the $Na_2SO_4.H_2O$ system. Also discuss different lines, points, and areas in this phase diagram.

c) i) Discuss how thermodynamic square helps in deriving four Maxwell relations. (3)

ii) Define the following in brief: Metastable curve, Eutectic point, congruent melting point, and quadrupole point. (4)

Q 4. (2X7=14)

a) Discuss in detail activated complex theory. Also, write down the advantages of ACT on collision theory.

b) Discuss in detail the Rice-Herzfeld mechanism of decomposition of acetaldehyde molecule. How this mechanism is different from the mechanism of pyrolysis of acetaldehyde molecule?

c) Discuss in detail the mechanism and rate of reaction of photochemical H_2-Cl_2 chain reaction.

Q 5. (2X7=14)

a) i) What will happen if the wall of the 1D box is suddenly removed? (3 marks)

ii) Calculate the standard deviation in x in terms of the 1D box. (4 marks)

b) Prove the concept of quantization of energy in the case of a one-dimensional box.

c) i) Derive SWE based on postulates of quantum mechanics. (4 marks)

ii) Write down the method to find the expectation value of any observable quantity in quantum mechanics. Also, find the expectation value of x and x^2. (3 marks)

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: M.Sc. Chemistry **Session: 2021-22**
Semester: First **Max. Time: 3 Hours**
Course Title: Organic Chemistry-I **Max. Marks: 70**
Course Code: SBS CH 01 01 02 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 needs to answer any two parts of each question. Each part carries seven marks.

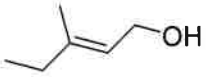
Q 1. (4X3.5=14)

a) Draw the π-molecular orbital picture of 1,3,5-hexatriene. Mark the HOMO and LUMO.

b) Draw four canonical structures possible for acrylic acid. Compare the energies of the drawn canonical structures.

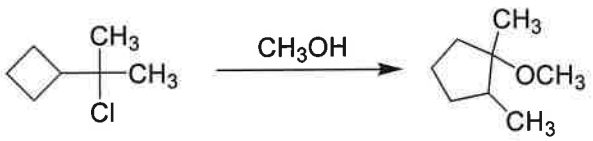
c) What is known as 'chiral pool approach' in synthesis? Illustrate with an example.

d) (a) Draw the expected product of Sharpless epoxidation of following allylic alcohol using (+)-diethyl tartrate as the chiral catalyst.

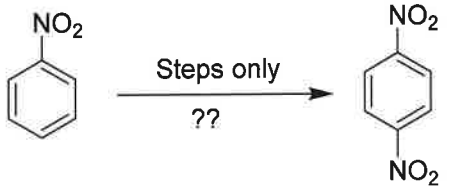


e) What are the essential conditions for a compound to be chiral? Does the presence of a stereocenter is always essential for a compound to be chiral. Explain.

f) Propose a mechanism for the following reaction.



g) Write down the shortest route (steps only) for the following transformation.



Q 2. (2X7=14)

a) (i) Which is more acidic among p-cyanophenol and m-cyanophenol? Explain your answer with the help of resonance structures. (3.5 marks)

(ii) Draw the step-wise mechanism of acid catalyzed and base-catalysed enolisation of acetone. (3.5 marks)

b) (i) Explain sacrificial hyperconjugation and isovalent hyperconjugation with suitable examples. (3 marks)

(ii) Describe the generation and homoaromaticity of homotropyilum (cyclooctatrienyl) cation. (4 marks)

c) (i) What are cyclodextrins? Describe their nomenclature and uses. (3.5 marks)

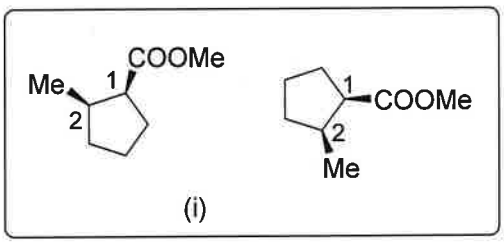
(ii) Compare catenanes and rotaxanes. (3.5 marks)

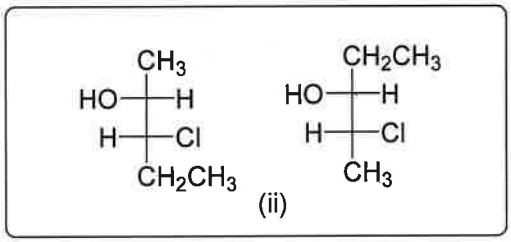
d) (i) Write a short note on alkene-metal π-complexes. (3 marks)

(ii) Explain the structure, nomenclature and uses of crown ethers. (4 marks)

Q3. (2X7=14)

a) (i) Label the following compounds as homomers, constitutional isomers, enentiomers or diastereoisomers. Assign R/S configuration to the stereogenic centers. (4 marks)

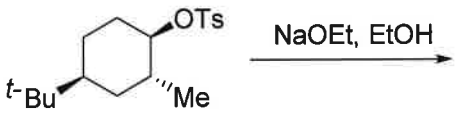




(II) What are enantiotopic and diastereotopic faces? Explain with the help of example. (3 marks)

b) (i) Draw all possible conformers (Newman) of n-butane and relate their energy. Also, explain why antiperiplanar is more stable than synperiplanar conformation? (4 marks)

(ii) Write the major product in the following reactions: (3 marks)



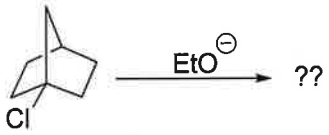
(c) (i) What do you mean by resolution? Write down the various methods of the resolution. (5 marks)

(ii) What are A-values? (2 marks)

Q4. (2X7=14)

a) (i) When optically active 2-bromo octane is hydrolyzed under low hydroxyl ion concentration, partially racemized product was obtained. Explain (2 marks)

(ii) What will happen when following compound will be subjected under S_N2 reaction condition? Explain with justification. (2.5 marks)



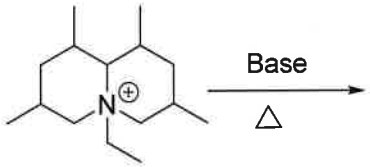
(iii) Why aliphatic nucleophilic substitution reactions do not proceed well with vinyl bromides? (2.5 marks)

b) (i) Describe S_N2`reactions with suitable examples (2 marks).

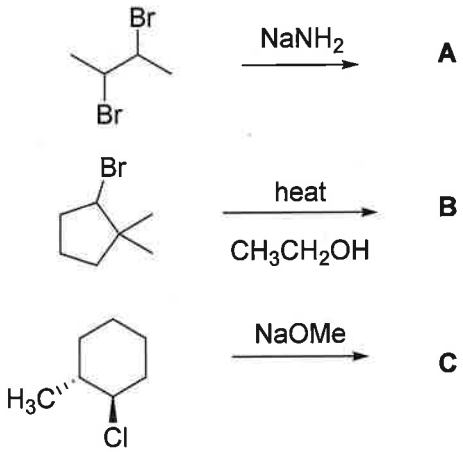
(ii) Treatment of 2-bromo propanoic acid (optically active) with dil NaOH results in a substitution product with complete retention of configuration whereas with strong NaOH it give inverted product. Explain (3 marks)

(iii) Why quaternary ammonium salt is required in phase transfer catalysis reactions. Explain with an appropriate example. (2 marks)

c) (i) Write down the possible products in the following transformation. Identify the major product and provide an explanation to support it. (2 marks)



(ii) Write down the products **A**, **B**, and **C** in the following reactions. (3 marks)

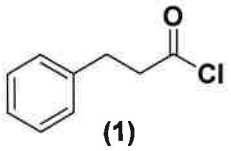


(iii) Describe the E1cb reaction with an example. (2 marks).

Q5. (2X7=14)

a) (i) Why iodination of benzene is difficult? Explain (2 marks)

(ii) 3-Phenylpropanoyl chloride (**1**) reacts with $AlCl_3$ to give a ketone of a molecular formula C_9H_8O. Write the probable structure for the ketone with a mechanism of its formation. (2 marks)



(1)

(iii) What is *ipso* substitution reaction? Illustrate an *ipso* substitution reaction taking a suitable example. (2 marks)

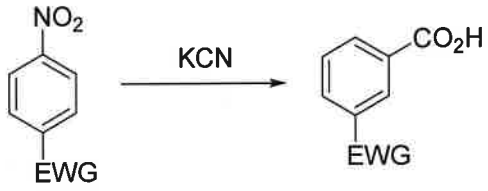
b) (i) What is Meisenheimer complex? (1 mark)

(ii) When 1-fluoro-2,4-dinitrobenzene and 1-bromo-2,4-dinitrobenzene undergo nucleophilic aromatic substitution with nucleophile, they give their corresponding products. Explain in which case reaction will proceed with faster rate and why? (3 marks)

(iii) When chlorobenzene was treated with aqueous ammonia at 200°C for several hours it produced aniline, however, when *p*-nitrochlorobenzene was treated with aq. NH_3, it simply afforded the corresponding product under heating (78°C) for few hours only. Explain why did this happen? (3 marks)

c) (i) When trace amount of potassium amide is used to a solution of chlorobenzene and potassium triphenylmethyl ($Ph_3C^-K^+$) in liq. NH, a rapid reaction takes place to yield a product of formula $C_{25}H_{20}$. Find out the product formation with its mechanism. What is the role of potassium amide and why it is needed? (3 marks)

(ii) Find out the name of the following reaction and propose a stepwise mechanism for product formation. (3 marks)



(iii) Describe the step-wise scheme for the synthesis of phenol from benzene. (1 mark)

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations- April 2022

Programme: Integrated B.Sc.-M.Sc. Chemistry **Session:** 2021-22

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

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

Atomic Structure and Chemical Bonding-I

Course Code: SBS CH 020101 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 needs to answer any two parts of each question. Each part carries seven marks.

Q. 1. (4x3.5=14)

a) What do you understand by (n+l) rule? Arrange 3s, 4d and 5p orbitals in terms of (n+l) rule.

b) Why are alkali metals strong reducing agents?

c) Calculate the effective nuclear charge for 3p electron in phosphorus atom.

d) What is screening effect? How does it govern the ionization energy of an atom?

e) How will you account for the smaller bond order of NO compared to NO^+ on the basis of molecular orbital theory?

f) What is radius ratio rule? Discuss its limitations.

g) Write Born-Lande equation and give the significance of terms associated with it.

Q. 2.

a) What are quantum numbers? Discuss the physical significance of quantum numbers. (7)

b) Discuss the following:

(i) Aufbau Principle

(ii) Physical significance of ψ and ψ^2 (3, 4)

c) (i) What do you mean by Heisenberg's Uncertainty Principle? Write its significance.

(ii) What do you understand by radial and angular wave functions? How will you represent the complete wave function in terms of radial and angular wave functions? (3, 4)

Q. 3.

a) Discuss Slater's rule and its applications. Find out the effective nuclear charge for a 3d electron in zinc. (7)

b) How do the following properties change on moving down the group?

(i) Ionization energy (2)

(ii) Electron affinity (1.5)

(iii) Ionic radius (1.5)

(iv) Electronegativity (2)

c) (i) Which has lower electron affinity and why (F or Cl)?

(ii) Which has larger size and why (N or O)?

(iii) Which has higher IE_1 and why (P or S)? (2, 2, 3)

Q. 4.

a) (i) Density of ice is less than water. Why?

(ii) What are Frenkel and Schottky defects? Give examples (3, 4)

b) (i) Calculate the lattice energy of sodium chloride when Madelung constant is 1.748, internuclear distance is 0.2814 nm and Born exponent is 9.

(ii) Write a brief note on band theory of solids. (3, 4)

c) Discuss the weak chemical forces present in solids. (7)

Q. 5.

a) Discuss molecular orbital theory? Explain on the basis of molecular orbital theory that N_2 molecule is diamagnetic while O_2 molecule is paramagnetic. (7)

b) What do you understand by Standard Electrode Potential? Discuss its applications to inorganic reactions. (7)

c) Using VSEPR theory, explain the structure of SF_4, ClF_3, H_2O, ICl_2^-, IF_7. (7)

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: Integrated B.Sc.-M.Sc. Chemistry **Session: 2021-22**

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

Course Title: GE (Minor Chemistry): Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons **Max. Marks: 70**

Course Code:

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.

Q 1. (4X3.5=14)

a) Write the reason for extra stability of half-filled and completely filled orbitals.
b) Define the term node. How many radial and angular nodes are present in 4d and 5p orbitals?
c) Differentiate Markownikoff's and Anti-Markownikoff' rule.
d) What do you mean by hyperconjugation? Explain with example.
e) Write a short note on isomerism.
f) Describe the various types of molecular bonding.
g) Define the term aromaticity. Select aromatic compounds amongst the following:
   i) Benzene
   ii) Furan
   iii) cyclopentadienyl anion
   iv) cyclopentadienyl cation

Q 2. (2X7=14)

a) (i) Explain Hund's rule. Also, explain the arrangement of electrons in Cu atom.
   (ii) Draw the radial distribution function curves for 1s, 2s and 2p orbitals of H-atom. (4, 3)
b) (i) Explain the spectrum of the Hydrogen atom.
   (ii) Calculate the radius of the third orbit of hydrogen atom (a_o = 0.53 A). (5, 2)
c) (i) Calculate the energy of radiation emitted when an electron in hydrogen atom makes a transition from an energy level with n = 3 to a level n = 2.
   (ii) Write a short note on the following:
   (a) Principal Quantum number
   (b) Dual nature of matter (3, 4)

Q3. (2X7=14)

a) Illustrate the phenomenon of resonance. How does it differ from hyperconjugation and electrometric effect?
b) What do you mean by enantiomers and diastereomers? Write down their important characteristic features.
c) Write down the various concepts of acidity and basicity. Compare acidity of following compounds:
   i) Phenol ii) Ethanol iii) Benzoic acid (4, 3)

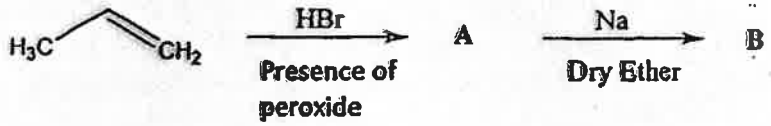
Q 4. (2X7=14)

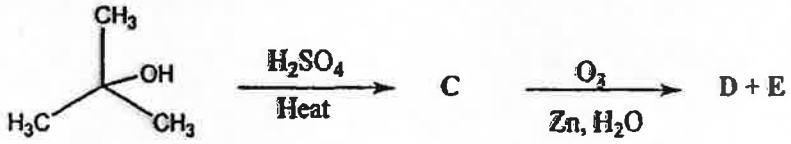
a) Carry out the following chemical conversions:
   i) Propene to Propan-1-ol
   ii) Acetylene to But-1-ene (3.5×2)

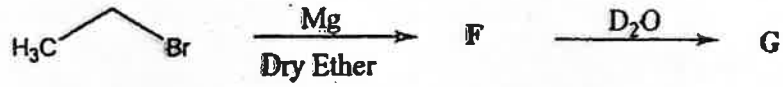
b) Explain the following:

(i) Ozonolysis
(ii) Wurtz reaction (3.5×2)

a) Predict the product (s) in the following reaction sequences:

(i) 

(ii) 

(iii) 

(2, 3, 2)

Q 5. (2X7=14)

a) Write notes on the following:

i) VSEPR Theory ii) Hybridization Theory (3.5×2)

b) Define the term dipole moment. Write down the methods for calculating the dipole moment along with the examples. Also, mention the application of dipole moment.

c) What are the postulates of molecular orbital theory? Calculate bond order for the following molecules:

i) O_2

ii) CO

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: M.Sc. Chemistry | **Session: 2021-22**
Semester: I | **Max. Time: 3 Hours**
Course Title: Chemistry for Biologists | **Max. Marks: 70**
Course Code: SBS CH 010101 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 part carries seven marks.

Q 1. (4X3.5=14)

a) Define the terms entropy (S) and Gibbs free energy (G) of a system. Also, write their units.
b) What do you mean by rate constant and order of the reaction?
c) Define chirality. Comment on the chirality of 1-chlorobutane and 2-chlorobutane.
d) What do you mean by coupling constant? Differentiate cis and trans isomers of but-2-ene on the basis of coupling constant.
e) What do you mean by chemical bonding? Define ionic bonding, covalent bonding and coordinating bonding with suitable examples.
f) Write a short note on Woodword -Fischer rule for conjugated alkenes.
g) What you mean by chemical shift? Write down the factors affecting the value of chemical shift.

Q 2. (2X7=14)

a) (i) What is catalysis? Discuss the general characteristics of catalytic reaction.
(ii) Explain enzyme inhibition. (3, 4)

b) (i) Define equilibrium constant and derive the relationship between *Kc* and *Kp* for the following reaction

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

(ii) For the ammonia formation, the reference equation is

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ K_c is 2.4×10^{-3} at 1000 K. What are the values of K_c for the following balanced equations?

$$\frac{1}{3}N_2(g) + H_2(g) \rightleftharpoons \frac{2}{3}NH_3(g)$$

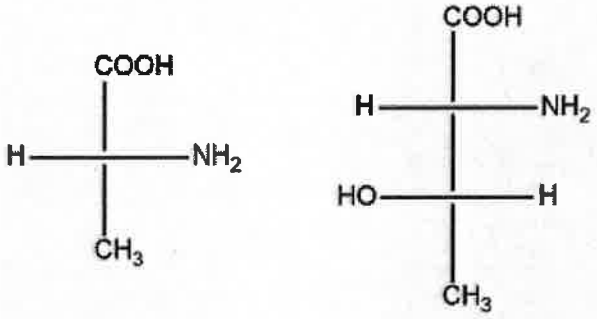
$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

(iii) What are buffer solutions? How a solution of weak acid and its salt behaves as a buffer? (2, 2, 3)

c) (i) State Le Chatelier's principle. Explain the effect of change in temperature on equilibrium for an endothermic reaction.
(ii) Calculate the entropy change in the evaporation of one mole of water at 100 °C. (Heat of vaporization of water at 100 °C is 2259.4 J/g) (4, 3)

Q3. (2X7=14)

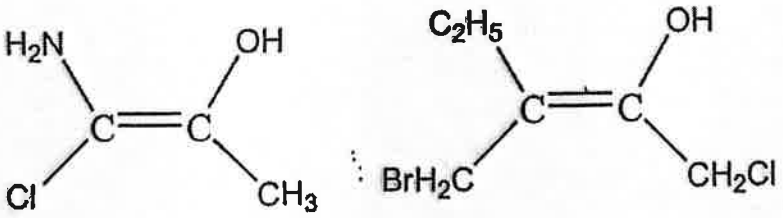
a) (i) Define the stereoselective and stereospecific reactions. Give two examples of each.
(ii) Assign R/S configuration to the stereogenic centers present in the given structures.



(5, 2)

b) (i) What are enantiotopic and diastereotopic atoms? Explain by taking suitable examples.
(ii) What are isomers? Explain configurational isomers by giving examples. (3, 4)

c) (i) Draw all possible conformations (Newman) of n-butane and relate their energies. Also, explain why antiperiplanar is more stable than synperiplanar conformation.
(ii) Assign E or Z notations to the following compounds:



(5, 2)

Q 4. (2X7=14)

a) Define the term hyperconjugation with examples. Discuss the structure of following compounds on the basis of hybridization:
i) Phosphorous pentachloride ii) Carbon tetrachloride. iii) Sulphur hexaflouride.

b) Why resonance peak in UV spectroscopy is called band? Define the terms, bathochromic shift, hyperchromic shift and hypochromic shift with examples.

c) Differentiate the following compounds on the basis of ^1H NMR spectroscopy:

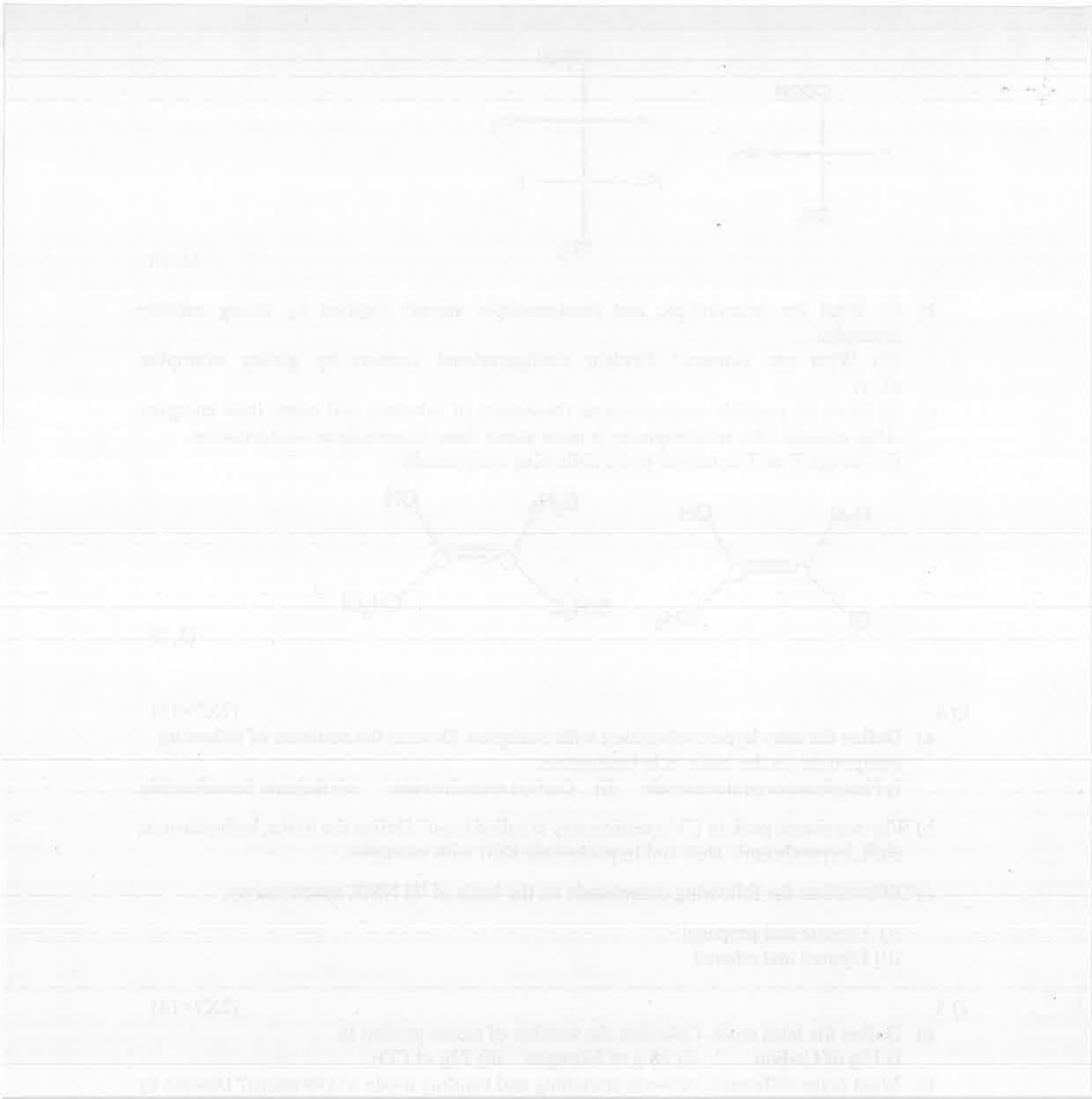
(i) Acetone and propanal
(ii) Ethanol and ethanal

Q 5. (2X7=14)

a) Define the term mole. Calculate the number of atoms present in
i) 12g of Carbon. ii) 28 g of Nitrogen iii) 22g of CO_2

b) What is the difference between stretching and bending mode of vibrations? Discuss by giving suitable examples.

c) Illustrate the phenomenon of anisotropy, shielding and deshielding in NMR spectroscopy. How do they affect the value of chemical shift in organic compounds?



CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: Integrated B.Sc.-M.Sc. Chemistry **Session: 2021-22**
Semester: I **Max. Time: 3 Hours**
Course Title: Physical Chemistry-I: States of Matter & Ionic Equilibrium **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 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.

Q 1. (4X3.5=14)

a) Phenolphthalein is not a suitable indicator for a strong acid-weak base titration. Give reason.
b) Why solubility of AgCl decreases if $AgNO_3$ is added to its saturated solution?
c) Why NaCl crystal turns yellow on heating in sodium vapours?
d) The average velocity of a gas is 400 m/s. Calculate its root mean square velocity at same temperature.
e) Discuss the three physical states of matter.
f) Discuss briefly the theory of liquids.
g) Calculate the parachor of acetone having surface tension 28.83 dyne/cm at 20 °C and density 0.791g/ml at 20 °C.

Q 2. (2X7=14)

a) (i) What are buffer solutions? How a solution of weak acid and its salt behaves as a buffer? Derive Henderson equation to calculate pH of the solution.
(ii) What would be the pH of a solution obtained by mixing 5 gram of acetic acid and 7.5 gram of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid is 1.75×10^{-5}. (4, 3)

b) (i) Derive an expression for hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base. Also derive expression for calculation of pH of hydrolysed solution.
(ii) What would be the pH of 0.01 M solution of NH_4Cl in water at 25 °C? (Kb for $NH_4OH = 1.81\times10^{-5}$) (5, 2)

c) (i) Calculate the pH values of a solution obtained by mixing 25ml of 0.2 M HCl with 50ml of 0.25 M NaOH.
(ii) Define solubility product of a substance. Also, calculate the solubility in grams per litre of $Al(OH)_3$ in water at 25 °C if $K_{sp} = 8.5\times10^{-32}$ (3, 4)

Q3. (2X7=14)

a) (i) Write the Millar indices for the planes with the following intercepts
0a, 1b, 2c
3a, 2b, 4c
1/2a, 1/4b, ∞c
a, 1/3b, 1/4c
(ii) Derive the Braggs equation in X-ray crystallography. (4, 3)

b) (i) Explain the laws of crystallography.
(ii) Discuss briefly Schottky and Frenkel defects by giving examples. (3, 4)

c) (i) Calculate the interplanar distance (d_{hkl}) for a cubic system between the set of planes 110. Assuming that **a** is the edge length of the unit cell.
(ii) Explain briefly the screw axis and glide plane symmetry elements. (3, 4)

Q 4. (2X7=14)

a) Discuss the correlation between collision number and collision frequency.
b) Define mean free path and explain the effect of temperature and pressure on mean free path.
c) Write the kinetic gas equation and deduce the following gas laws from it:
i) Boyle's law ii) Charle's law (2 x 3.5)

Q 5. (2X7=14)

a) What you mean by compressibility factor? What is effect of T and P on compressibility curve of real gases?
b) What are real gases? Why do they show their deviation from ideality?
c) Write short notes on the following:
i) Intermolecular forces in liquids.
ii) Structure of liquids. (4,3)

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: Master of Computer Applications **Session: 2021- 2022**
Semester: First **Max. Time: 3 Hours**
Course Title: Fundamentals of Computer Science **Max. Marks: 70**
Course Code: SBS CS 01 01 01 E 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 student need to answer any two parts of each question. Each part carries seven marks.

Q 1. **(4X3.5=14)**

a) How trackball works.

b) What is memory? Discuss its basic units.

c) Discuss about ALU & CPU.

d) What is memory? Explain about E-ROM.

e) How booting process is done?

f) Discuss about Templates.

g) What are various type of Computers? Explain about main frame Computers.

Q 2. **(2X7=14)**

a) What do you mean by computer? Discuss the various input and output devices in detail.

b) Discuss the working of magnetic tape and magnetic disk.

c) What is printer? Discuss various types of printers and their working.

Q3. **(2X7=14)**

a) Explain the concept of Volatile and Non Volatile Memory with help of example.

b) Discuss the primary and secondary memory. What are specific use of these memories?

c) Explain the following:

- RAM
- ROM

Q 4. **(2X7=14)**

a) What is operating system? Also discuss about Graphics operating system.

b) Explain the features of operating system in detail.

c) Discuss the functions of operating system.

Q 5. **(2X7=14)**

a) What do you mean by mail? Why mail merging is used.

b) Explain about various formatting features of Word Processing tools.

c) Discuss the Power Point Slide in detail also write its advantages.

CENTRAL UNIVERSITY OF HARYANA

End Term Examinations, April 2022

Programme	**: M.Sc. Chemistry**	**Session**	**: 2021-2022**
Semester	**: I**	**Max. Time**	**: 2 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 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)**

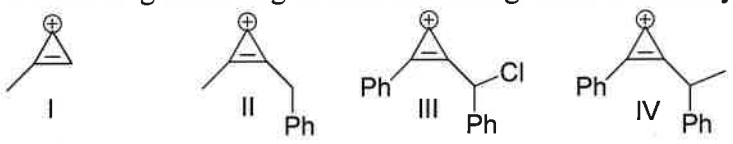
a) Explain the difference between an intermediate and a transition state.
b) Draw the energy profile diagram for a two-step highly exothermic reaction in which intermediate is more stable.
c) What are the factors that affect the stability of carbocations?
d) What are stereospecific reactions? Explain by taking suitable example.

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

a) How does a catalyst affect the rate of a chemical reaction? Explain it by taking suitable example.
b) What happens when acrolin is treated separately with CH_3SH and CH_3MgX followed by acidification? Give suitable explanation also.
c) Explain the acidic character with relative strengths of the following:
i) Salicylic acid and 4-hydroxybenzoic acid (2 Marks)
ii) Methanol, acetonitrile and nitromethane (1.5 Marks)

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

a) What happens when 4-Chlorotoluene is treated with $NaNH_2$ in liquid ammonia? Explain the reaction with suitable mechanism.
b) What are carbenes? How are they generated in the reactions? Discuss the types with shapes and relative stabilities.
c) i) Arrange the following according to their increasing order of stability: (2 Marks)



ii) Draw the orbital picture of benzyne. How is it different from benzene? (1.5 Marks)

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

a) What happens when 1, 3-butadiene is treated with HBr at temperatures, 40 and -80 °C separately? Discuss the formation of products with suitable reasons.
b) What do you understand by exergonic and endergonic reactions? Draw the free energy profile diagram for a two-step exergonic reaction in which first step is rate determining.
c) Explain Curtin Hammett Principle by taking suitable example.

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

a) What is isotope effect? How does isotope labeling help in establishing the mechanism of acidic hydrolysis of ethyl acetate?

b) What do you understand by primary and secondary kinetic isotope effects? Discuss with examples.

c) The Claisen rearrangement is an intramolecular reaction. Justify with suitable reason and mechanism.

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations April 2022

Programme: M.Sc. Chemistry **Session: 2021-22**
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 magnetic properties of nucleus?
b) Write note on fuel cycle and waste management.
c) Why is water a suitable material for a moderator?
d) Discuss applications of tracer elements in medical field.

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

a) What are nuclear binding forces? Discuss region of the more stable nuclei of elements.
b) What are theories of nuclear composition?
c) Calculate the binding energy per nucleon of the following: (i) $^{18}O_8$, (ii) $^{23}Na_{11}$ and (c) $^{40}Ca_{20}$.

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

a) What are the two classes of radioactive nuclei that constitute the main portion of waste from a nuclear fission reactor? What are the reasons for their hazardous nature?
b) One fusion reaction is:
$^2H + {}^2H \rightarrow {}^3H + {}^1H + 4.0$ MeV
What is the source of the 4.0 MeV when two low-energy deuterons react in this way? Why does power generation from this reaction requires a plasma?
c) Estimate the nuclear binding energy of $^{16}O_8$. [Given: Observed atomic mass of $^{16}O_8$ = 15.99 u, 1u = 1.66054×10^{-27} kg, electron rest mass = 9.11×10^{-31} kg, proton rest mass = 1.67×10^{-27} kg, neutron rest mass = 1.67×10^{-27} kg and c = 2.99 ms^{-1}]

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

a) Derive the equation of the decay constant of a radioactive substance. After 24.0 days, 2.00 milligrams of an original 128.0 milligram sample remains, what is the half-life? (2 marks).
b) What is nuclear fission? Write an equation for the reaction when a nucleus of ^{235}U(Z=92) absorbs a neutron, splitting into the nuclei ^{141}Ba(Z=56) and ^{92}Kr(Z=36)?
c) What do you mean by group displacement law and radioactive growth? Discuss.

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

a) What is carbon dating? How can you determine age of an object by using radioactive element?

b) Briefly explain ionizing radiations. Also discuss uses of isotopes.

c) What do you understand by somatic and genetic radiation effects? Explain.

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations April 2022

Programme: M.Sc. Chemistry **Session: 2021-22**

Semester: I **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 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 symmetry elements and symmetry operations? Explain with examples.

(b) Make a drawing of the allene $H_2C{=}C{=}CCl_2$ and sketch the symmetry elements that are present in it. What is the point group of this allene?

(c) Discuss electroneutrality principle with examples.

(d) What do you mean by basal and apical atoms in boranes?

(e) Can a phosphorus atom in P_4 molecule be replaced by a CH group? If yes, explain it.

(f) Polymeric sulfur nitride behaves as a metal. Explain it.

(g) What do you mean by coplanar model of tetrasulfur tetranitride?

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

(a) (i) What are σ_h, σ_v and σ_d mirror planes? Discuss each of these symmetry elements by taking suitable examples. **(5 marks)**

(ii) Match the symmetry elements and symmetry operations in the following table: **(2 marks)**

Symmetry Elements	Symmetry Operations
(i) C_n	(a) Reflection
(ii) S_n	(b) Inversion
(iii) σ	(c) n-fold improper rotation
(iv) i	(d) n-fold rotation

(b) (i) Draw the structure of H_2O molecule and show all the symmetry elements present in it. What is the point group of H_2O molecule? **(4 marks)**

(ii) Make a drawing of CH_2Cl_2 and $CHCl_3$ molecules. What is the principal axis of rotation present in these molecules? **(2 marks)**

(iii) Mention whether the following statement is true or false: **(1 mark)**

A molecule is dissymmetric and may be chiral either if it is asymmetric or if it has no other symmetry than proper rotation.

(c) (i) A part of the character table of a point group is provided below. Using the "Great Orthogonality Theorem", determine the four missing characters in the table. A proper analysis is required. **(5 marks)**

	E	X_1	X_2	X_3
Γ_1	1	1	1	1
Γ_2	1	1	-1	-1
Γ_3	1	-1	1	-1
Γ_4	?	?	?	?

(ii) Which of the following point groups are chiral? **(2 marks)**

C_1, C_i, D_n, D_{nd}

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

(a) (i) What is the difference between crystal field theory and ligand field theory? Draw the crystal field splitting diagram of an octahedral complex and label it. **(5 marks)**

(ii) What is tetragonal distortion? **(2 marks)**

(b) (i) What is the geometry of $[Ni(CN)_4]^{2-}$? Draw the crystal field splitting diagram for this complex. **(4 marks)**

(ii) The ligand-field splitting parameters Δ_O for Cr^{3+} are 13,700 cm^{-1}, 17,400 cm^{-1}, 21,500 cm^{-1} for the ligands Cl^-, H_2O and NH_3, respectively. Explain this trend. **(3 marks)**

(c) Which orbitals of carbon and oxygen atoms participate in bonding of CO? Draw the molecular orbital diagram of CO molecule and mark properly. Also draw the electronic configurations of the MOs. **(7 marks)**

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

(a) (i) What do you mean by polyhedral skeletal electron pair theory? **(2 marks)**

(ii) Draw structure and write down STYX for: B_5H_9 and B_5H_{11}. **(3 marks)**

(iii) Show that the observed bicapped square-antiprismatic structure of the boron cage in $[B_{10}H_{10}]^{2-}$ is consistent with Wade's rules. **(2 marks)**

(b) (i) What is borazine? Discuss preparation and properties of borazine. Why borazine is more reactive than benzene? **(5 marks)**

(ii) What do you understand by theory of Craig and Paddock for pi-bonding in phosphazenes? **(2 marks)**

(c) (i) Define pseudohalides and tecto silicates by giving examples. **(4 marks)**

(ii) Complete the following reactions: **(3 marks)**

$$Na_2[B_9C_2H_{11}] + FeCl_2 \xrightarrow{THF}$$

$$S_4N_4 + HBF_4 \rightarrow$$

$$SCl_2 + NH_3 \rightarrow$$

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

(a) (i) What are metal carbonyls? Give their classification briefly with examples. **(2 marks)**

(ii) What would be the order of IR active CO stretching frequency in the following complexes: $Ni(CO)_4$, $[Co(CO)_4]^-$, $[Fe(CO)_4]^{2-}$, $[Mn(CO)_4]^{3-}$? Justify the answer. **(3 marks)**

(iii) What do you mean by synergistic effect? Discuss with a suitable example. **(2 marks)**

(b) (i) Write method of preparation of $Fe(CO)_5$ and also discuss nucleophilic attack on it. **(3 marks)**

(ii) Identify the transition metal in the following compounds using EAN rule; $[M_4H_4(CO)_{12}]$ and $[(\eta^4\text{-}C_4H_4)_2M_2(CO)_3]_2$. **(2 marks)**

(iii) Determine the total number of metal-metal bond in $[Co_4(CO)_{12}]$ and $[(\eta^5\text{-}C_5H_5)Mo(CO)_2]_2$ compounds. **(2 marks)**

(c) (i) Write a short note on trinuclear metal cluster. **(2 marks)**

(ii) Discuss bonding in $[Re_2Cl_8]^{2-}$ ion in detail. Explain the reason for blue color of $[Re_2Cl_8]^{2-}$ ion. **(5 marks)**