



# UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – I Annual Examination – 2022

Subject: Chemistry (New Course)

Paper: I (Physical Chemistry)

Roll No. ....

Time: 3 Hrs. Marks: 100

**NOTE: Attempt any FIVE questions. All questions carry equal marks.**

- Q 1. a.** What is rate of reaction. Develop a kinetic expression for a third order reaction when three of the reactants have different initial concentrations. Derive its units. (1+17+2)
- Q2. a.** What is entropy? Discuss the significance of entropy. 10
- b.** What is Nernst heat theorem? Give its applications. 10
- Q3. a.** How barometric formula could be used to calculate the effect of altitude on distribution. 15
- b.** Discuss the effect of normalized wave function. 05
- Q4. a.** Determine the activity coefficient of a salt by EMF method. 10
- b.** Discuss the construction working and advantages of alkaline fuel cells. 10
- Q5. a.** Discuss the physical significance of Partition function. 05
- b.** Derive a relationship between Internal energy and partition function. 15
- Q2. a.** What is Debye- Huckle limiting law. How is the activity coefficient determined for dilute solutions of strong electrolytes by this Law? 17
- b.** What is the significance of Debye-Huckle theory. 03
- Q7. a.** What do you understand from the concept of degeneracy? 08
- b.** Describe the experimental methods that are used to study the kinetics of fast reactions. 12
- Q8. a.** What is a concentration cell. Determine the EMF of electrode concentration cell without transference. 15
- b.** Discuss the concept of spontaneous and non-spontaneous reactions with respect to second law of thermodynamics. 05
- Q9.** Write note on any two of the following: (10+10)
- (i) Adiabatic Demagnetization
- (ii) Statistical treatment of entropy
- (iii) Tunnel effect



# UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – I Annual Examination – 2022

Roll No. ....

Subject: Chemistry (New Course)

Paper: II (Inorganic Chemistry)

Time: 3 Hrs.

Marks: 100

**NOTE: Attempt any FOUR questions. All questions carry equal marks.**

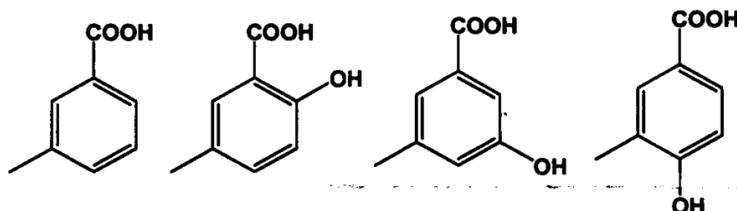
- Q. No.1** a) What are the main postulates of Molecular Orbital Theory? Explain the bonding in the molecules based on MOT. 10
- i)  $[\text{Fe}(\text{CN})_6]^{-4}$  ii)  $[\text{Fe}(\text{Cl})_4]^{-1}$
- b) Discuss the Nuclear and Non-Nuclear applications of lanthanides 15
- Q. No.2** a) Explain geometries the following molecules on the bases of VBT. 15
- i)  $\text{IF}_7$  ii)  $[\text{PaF}_8]^{-3}$  iii)  $[\text{PF}_6]^{-}$  iv)  $\text{N}_2\text{O}$  v)  $\text{BF}_4^{-}$
- b) Give different methods for the preparation of transition Metal complexes giving two examples for each. 10
- Q. No.3** a) Discuss the chemistry of  $\text{Mn}_2(\text{CO})_{10}$ . 10
- b) Define Resonance and discuss the resonance contributing structures of following species: 15
- i)  $\text{CO}_3^{2-}$  ii)  $\text{H}_3\text{N}$  iii)  $\text{NO}_3^{-}$  iv)  $\text{SO}_4^{2-}$  v)  $\text{N}_3^{-}$
- Q. No.4** a) Explain the bonding in Metal Nitrosyls. 10
- b) What are main Postulates of Werner Theory? Discuss structures of coordination compounds on the basis of it. Also discuss its main drawbacks. 15
- Q. No.5** a) Explain the Bridge bond by giving suitable examples. 10
- b) Discuss the chemistry of  $\text{V}(\text{CO})_6$ . 15
- Q. No.6** a) What is meant by Lanthanide Contraction? Discuss its reasons and effects. 15
- b) Elaborate Fajan's rule and its applications. 10
- Q. No.7** Write note on any TWO of the followings: 2x12.5 = 25
- i) Semi Conductors
- ii) 3c-4e bond model
- iii) Geometrical isomerism in metal complexes.



**NOTE: Attempt any FIVE questions. All questions carry equal marks.**

### Q. NO. 1.

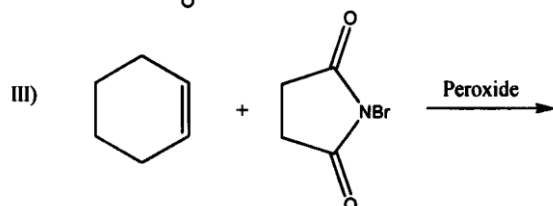
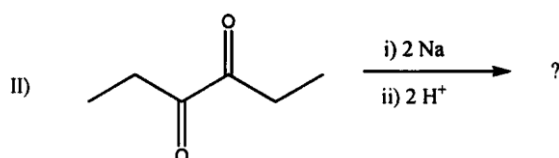
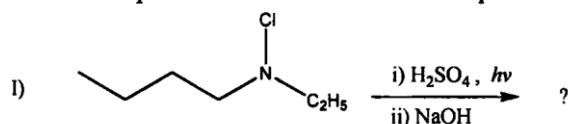
- A) Arrange the following compounds in the increasing order of their acidity. Give reasons for your order. [7]



- B) Which is more acidic, formic acid or benzoic acid? Give reason. [3]  
C) Compare the basicity of compounds of following groups. Justify your answer. [2.5 x 4 = 10]  
I. Ammonia and dimethylamine  
II. o-Toluidine and p-toluidine  
III. CH<sub>3</sub>ONa and CH<sub>3</sub>SNa  
IV. Aniline and Pyridine

### Q. NO. 2.

- A) Explain methods for detection of free radicals. [5]  
B) Predict the major products of following reaction *via* free radical mechanism. Draw complete mechanism for all steps. [5 x 3 = 15]



### Q. NO. 3.

Write a note on the following reactions (reaction, mechanisms and synthetic applications). [10 + 10]

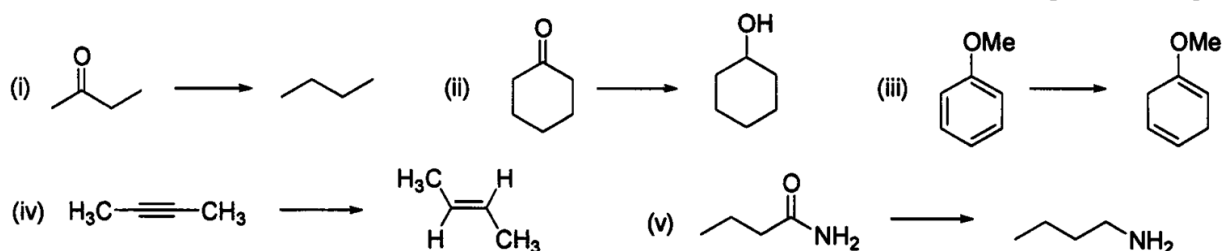
- I. Stobbe condensation  
II. Wittig reaction

### Q. NO. 4.

- A) Explain the Baeyer-Villiger oxidation with complete mechanism and example. [5]  
B) What are disproportionation reactions? Give one example. [5]  
C) Draw the complete mechanism for the hydroxylation of alkene by using iodine and silver acetate (both wet and dry methods). [10]

**Q. NO. 5.**

How would you bring about the following conversions? Write complete mechanisms for all steps involved. [5 X 4 = 20]

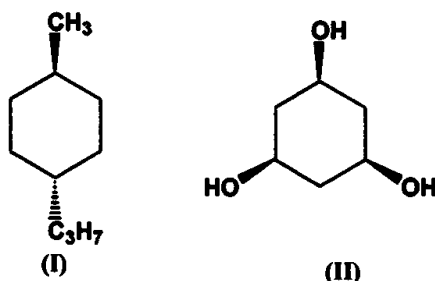
**Q. NO. 6.**

A) Explain the following terms and give examples for each. [10]

- I. Torsional strain
- II. Diastereomers
- III. Conformational isomers
- IV. Racemate
- V. Dihedral angle

B) Give two examples of organic compounds which show optical isomerism without a chiral carbon atom. Explain why these compounds are optically active. [4]

C) Draw all the conformers and describe stability order with reason of the following compounds. [6]

**Q. NO. 7.**

A) Draw both the geometrical isomers for the following compounds and assign Z or E designation to each of them. [6]

- I. 2-Bromo-3-methyl-2-pentene
- II. 3-methyl-3-octene
- III. 1-Iodo-1, 2- dichloroethylene

B) Draw the perspective formulas of the enantiomers of following compounds and label each enantiomer as R or S. [9]

- I. 3-chlorohexane
- II. 2-methyl-1-butanol
- III. 1-Chloro-2-methylbutane

C) Draw the fisher projection of following compounds. [5]

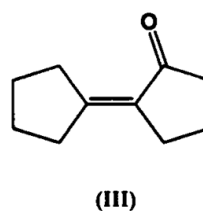
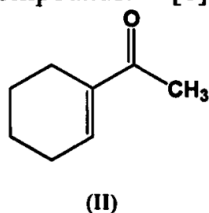
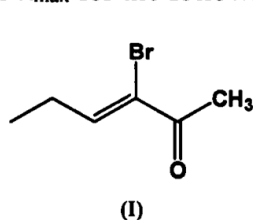
- I. (2S,3S)-3-Chloro-2-butanol
- II. (2S,3R)-2,3-dibromohexane

**Q. NO. 8.**

- A) Explain the following terms used in IR spectroscopy. [8]
- Combination band and difference band
  - Stretching vibrations and bending vibrations
  - Functional group region and fingerprint region
  - Fermi resonance
- B) How will you distinguish between the following pairs of compounds with the help of IR spectroscopy? [8]
- 1-butyne and 2-butyne
  - 2-hexanol and 2-hexanone
  - $\text{CH}_3\text{NH}_2$ ,  $(\text{CH}_3)_2\text{NH}$  and  $(\text{CH}_3)_3\text{N}$
  - n-hexane and cyclohexane
- C) How the hydrogen bonding has influence on infrared spectra of alcohols? [2]
- D) Why the symmetric stretching vibration of  $\text{CO}_2$  is infrared inactive? [2]

**Q. NO. 9.**

- A) Discuss the uses of UV/Visible spectroscopy for stereochemical studies, Kinetic measurement, and determination of reaction mechanism and structure elucidation of organic molecules. [8]
- B) Explain why a polar solvent usually shifts the  $\pi \rightarrow \pi^*$  transition to a longer wavelength and  $n \rightarrow \pi^*$  transition to shorter wavelength? [4]
- C) Predict the  $\lambda_{\text{max}}$  for the following compounds. [6]



- D) What is fine structure in the UV spectrum of benzene? [2]



# UNIVERSITY OF THE PUNJAB

M.A./M.Sc. Part – I Annual Examination – 2022

Subject: Chemistry Paper: IV (ii) [Analytical Chemistry] (New Course)

Roll No. ....

Time: 3 Hrs. Marks: 100

**NOTE: Attempt any FOUR questions. All questions carry equal marks.**

- Q1. a. What is the retardation factor? What are the parameters affecting it? 7, 9, 9  
b. Which types of paper have been used in paper chromatography? What are the advantages and disadvantages of paper chromatography?  
c. Explain the concept of theoretical plates. What is the role of flow rate of mobile phase in the efficiency of column?
- Q2. a. What is the basic principle of solvent extraction? Explain the effect of pH on the efficiency of extraction? 9, 9, 7  
b. Explain the solid phase extraction.  
c. Explain the solvent extraction by flow injection analysis.
- Q3. a. Explain the terms error, deviation and confidence limit. How confidence limit can be calculated for a given set of data? 9, 9, 7  
b. What is student t test? How is it applied?  
c. A water sample was found to contain 102.2, 102.8, 103.1, 102.3 and 102.5 ppm of  $\text{CaCO}_3$ . Calculate the standard deviation, relative standard deviation and standard deviation of mean.
- Q4. a. Explain the source and nebulizer-burner system in atomic absorption spectrophotometry. Why a slot-type burner is used in AAS? 9, 10, 6  
b. Explain the flameless techniques in AAS.  
c. Explain a brief description of preparation of TLC plates.
- Q5. a. Explain the interaction of UV-Vis radiation with organic molecules. 10, 9, 6  
b. Discuss the Beer Lambert law with respect to chemical and instrumental deviations.  
c. What is Beer-Lambert law? Why is absorbance a function of concentration and pathlength?
- Q6. a. Explain the properties of anion and cation exchangers. Also explain the effect of pH on the ion-exchange separations. 9, 8, 8  
b. Give the applications of ion-exchange chromatography in water purification/treatment.  
c. Write a note on gel chromatography.
- Q7. a. Give the basic principle of flame photometry. Explain the role of flame as a source of atomization and excitation. 8, 9, 8  
b. Explain the capillary zone electrophoresis.  
c. In what ways TLC is superior to paper chromatography?



# UNIVERSITY OF THE PUNJAB

**M.A./M.Sc. Part – I Annual Examination – 2022**

**Subject: Chemistry Paper: IV (iii) [Applied Chemistry] (New Course)**

Roll No. ....

Time: 3 Hrs. Marks: 100

**NOTE: Attempt any FOUR questions. All questions carry equal marks.**

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|-----------------|-----|---|----|
| <b>Q. No.1</b>  | (a) | Discuss the chemistry involved in the setting of cement?  | 13 |
|                 | (b) | Describe major raw materials for ordinary Portland cement manufacturing.  | 12 |
| <b>Q. No.2</b>  | (a) | Write down the manufacturing and industrial applications of formic acid.  | 13 |
|                 | (b) | Explain lead chamber process for sulfuric acid manufacturing with the help of flow sheet diagram.   | 12 |
| <b>Q. No.3</b>  | (a) | Describe the basic principle of distillation, how it is carried out at industrial scale?  | 13 |
|                 | (b) | Describes the different procedures by which halogens are introduced in the organic compounds and also describes the different derivatives of chlorines. | 12 |
| <b>Q. No.4</b>  | (a) | How reverse osmosis helps in drinking water treatment?  | 12 |
|                 | (b) | What do you mean by demineralization? Which types of resins are used for this purpose?  | 13 |
| <b>Q. No. 5</b> | (a) | Describe special types of glass and also highlight their significance.  | 12 |
|                 | (b) | Discuss the importance of tank furnace and pot furnace in glass manufacturing.  | 13 |
| <b>Q. No. 6</b> | (a) | Describe different types of detergents and their respective applications.   | 13 |
|                 | (b) | Discuss different additives and builders used in soap manufacturing.  | 12 |
| <b>Q. No.7</b>  |     | Write short notes on any three of the following   | 25 |
|                 | (a) | Soda ash  |    |
|                 | (b) | Cleansing action of soap  |    |
|                 | (c) | Dry process   |    |
|                 | (d) | Phthalic anhydride  |    |
|                 | (e) | Ion exchange resins   |    |