

**2021**  
**(JUNE)**  
**CHEMISTRY**  
**HONOURS**  
**CHE-308**  
**EIGHT PAPER**  
**(Inorganic Chemistry and Physical Chemistry)**  
**Theory**

**Full Marks: 50**

*The figures in the margin indicates full marks for the questions*

*Symbol used in questions have their usual meanings.*

*Answer all the questions.*

**SECTION-A**

**(Inorganic Chemistry)**

1. Either,

- a) How do you correlate limiting radius ratio with the structure of the compound?
- b) Giving structure explain the existence of ZnS as zinc blende and wurtzite structure.
- c) How do different factors affect the magnitude of the lattice energy? 3+4+3=10

**Or**

- d) Discuss the Orgel diagram of Ti(III) and Co(II) octahedral ion. Give the significance of the diagram on the electronic spectra of Ti(III) and Co(II) octahedral complexes. 5+5=10

2. Either,

- a) What happens when (NPCl<sub>2</sub>) reacts with
  - i) NH<sub>3</sub>
  - ii) Benzene
  - iii) aqueous ether. Also write the reactions involved.
- b) How the structure of (NPCl<sub>2</sub>)<sub>3</sub> is different from benzene?
- c) Give the difference between sheet silicates and 3D silicates?
- d) How does zeolites find uses as catalyst and water softening agents? 3+1+3+3=10

**Or**

- e) Describe a method for the measurement of magnetic susceptibility. Derive the various term symbol for p<sup>2</sup> configuration. 4+6=10

3. Either,

- a) How are different ligands in an organometallic compound classified on the basis of hapticity? Discuss briefly the application of organometallic compounds in heterogeneous catalysis.
- b) What happens when S<sub>4</sub>N<sub>4</sub> undergoes
  - i) hydrolysis
  - ii) oxidation
  - iii) reduction. 4+3+3=10

**Or**

- c) Explain the simultaneous TGA-DTA curve for CuSO<sub>4</sub>.5H<sub>2</sub>O.
- d) Explain metalloporphyrins and their role in biological system. 5+5=10

**SECTION-B**  
**(Physical Chemistry)**

4. Either,

- a) The molarity of a solution is given by the relation  $M = (1000 \times w_B)/(M_B \times V)$ , where  $w_B$ ,  $M_B$  and  $V$  are the weight of the substance, molecular mass of the substance and volume respectively. Write algorithm to calculate the molarity of the solution.
- b) List the symmetry elements, identify the point group and construct the group multiplication table for chloroform molecule. 4+6=10

**Or**

- c) What is molar polarizability? Show that molar polarizability is independent of temperature with a relevant equation.
  - d) What is vibrational spectroscopy? What are vibrational energy and fundamental frequency of harmonic oscillator? 5+5=10
5. a) What are reversible and irreversible cells? Give one example of each type. Derive the expression to calculate the emf of concentration cell without transference. 3+3+4=10

**Or**

- b) Explain Raman effect, Raman scattering, Stoke's line and Anti-Stoke's line. How does Raman spectroscopy differ from Infrared spectroscopy? 4+6=10

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**2021  
(JUNE)  
CHEMISTRY  
HONOURS**

**CHE-309**

**NINTH PAPER  
(Organic Chemistry and Physical Chemistry)  
Theory**

**Full Marks: 50**

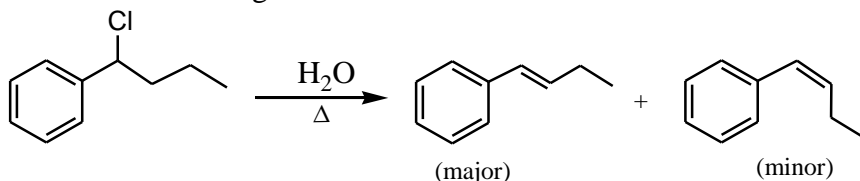
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*Answer all the questions.*

**SECTION-A  
(Organic Chemistry)**

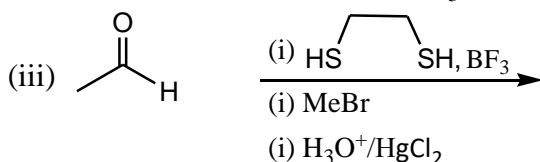
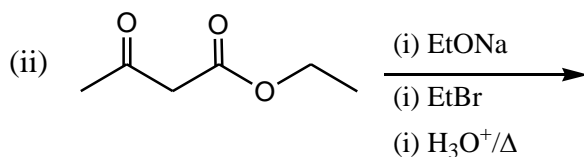
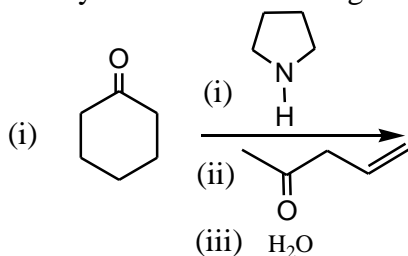
1. What are  $\alpha$ -elimination and  $\beta$ -elimination reactions? Explain with plausible mechanism the following reaction:



**Or**

What are syn-elimination and anti-elimination reactions? Elimination of HBr on treatment with sodium ethoxide from cis-1-bromo-2-methylcyclohexane is much faster than that from the trans-isomer. Give reason. 10

2. a) What is active methylene group? Give the product and write the reaction steps for any two of the following reactions.



Either,

- b) Outline the synthesis of either Phenolphthalein or Methyl orange.  
 c) Compare the basic character of Pyridine, Piperidine and Pyrrole.

**Or**

- d) Write the synthesis of Sulphadiazine.  
 e) What happens when pyridine is treated with sodamide? Write the product and mechanism of the reaction. 5+2+3=10

3. Either,

- a) Write the basic principle of preparatory thin layer chromatography.  
 b) In the mass spectrometry of 2-methylpentane, why does the isopropyl cation form the base peak?  
 c) What is first order nmr spectra? Identify the spin system of ethylbromide. 3+3+4=10

**Or**

- d) The carbon atom of acetylene is more electronegative than the carbon atom of ethylene but the acetylenic protons have lower chemical shift value than the ethylenic protons. Give reason.  
 e) An organic compound ( $C_5H_{10}O$ ) shows the following spectral data. Deduce the structure of the compound and explain the spectral data.

IR ( $cm^{-1}$ ) : 1715

UV-VIS: 160 nm ( $\epsilon_{max}$  10,800), 280 nm ( $\epsilon_{max}$  100)

$^1H$ NMR( $\delta_H$ ) : 2.45 (2H,t); 2.09 (3H,s) ; 1.61 (2H, m) ; 0.96 (3H,t)

Mass (m/z) : Prominent peaks at 86, 71, 43, 3+7=10

### **SECTION-B**

#### **(Physical Chemistry)**

4. a) The emf of the concentration cell with transference  
 $Pt | H_2(1 \text{ atm}) | HCl(a_{\pm} = 0.009048) : HCl(a_{\pm} = 0.01751) | H_2(1 \text{ atm}) | Pt$   
 at 298 K is 0.02802 V. The emf of the corresponding cell without transference is 0.01696 V. Calculate the liquid junction potential,  $E_j$   
 b) Taking an example of an ionic surfactant, discuss the formation of a spherical micelle.  
 c) Establish the integrated rate law of an opposing reaction where both the forward and backward reactions are first-order. 3+2+5=10
5. a) Explain the differences between canonical, micro-canonical and grand canonical Ensemble.  
 b) Determine the characteristic rotational temperature and the rotational partition function for HCl gas at 3000 K given that the moment of inertia of hydrogen molecule at this temperature is  $4.6033 \times 10^{-48} \text{ kg m}^2$ . 5+5=10

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