

**2021
(JUNE)
CHEMISTRY
HONOURS**

CHE-309

NINTH PAPER

(Organic Chemistry and Physical Chemistry)

Theory

Full Marks: 50

The figures in the margin indicates full marks for the questions

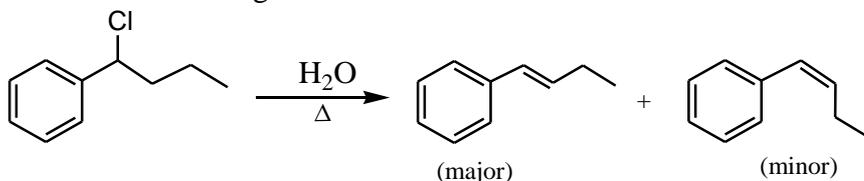
Symbol used in questions have their usual meanings.

Answer all the questions.

SECTION-A

(Organic Chemistry)

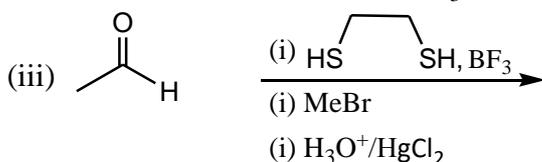
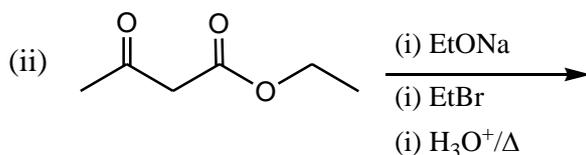
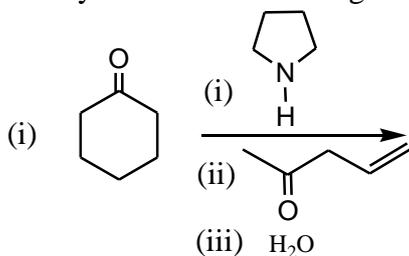
1. What are α -elimination and β -elimination reactions? Explain with plausible mechanism the following reaction:



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 forms 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 (ϵ_{max} 10,800), 280 nm (ϵ_{max} 100)

1H NMR(δ_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
 $Pt | H_2(1 atm) | HCl(a_{\pm} = 0.009048) : HCl(a_{\pm} = 0.01751) | H_2(1 atm) | Pt$
 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
