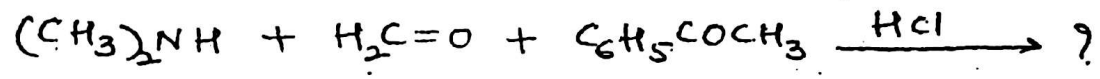
(2½ Hours) **[Total Marks : 60**

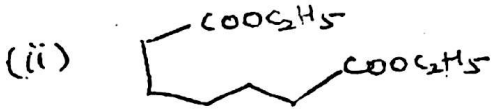
N. B. : (1) **All** questions are **compulsory.**
(2) **Figures** to the **right** indicate **full** marks.

1. (A) Answer any **two** of the following :–
(a) Complete the following reaction and provide a suitable mechanism **4**



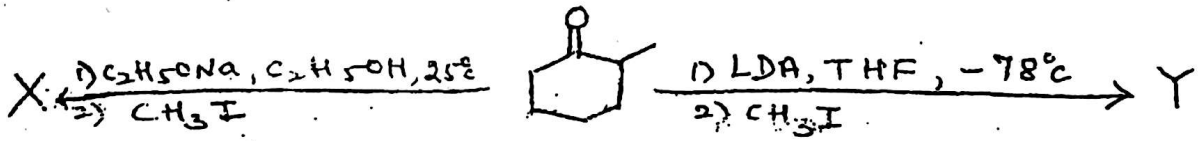
(b) Explain the mechanism of Robinson's annulation **4**
(c) Predict the products and name the following reactions **4**

(i) $CH_2(COOC_2H_5)_2 + CH_2=CH-COCH_3 \xrightarrow[2)\ H_3O^+]{1)\ NaOC_2H_5}$?

(ii)  ?

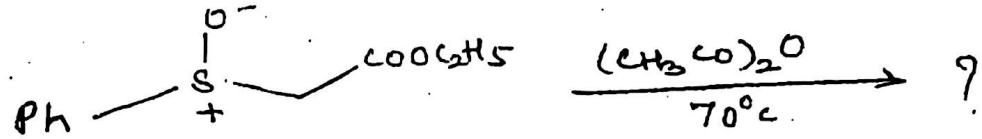
(d) What is haloform reaction? Explain the mechanism with a suitable example. **4**

(B) Answer any **one** of the following :–
(a) Give one example and explain the mechanism of α-bromination of carboxylic acids. **4**
(b) Give the structures of X and Y and explain their formation under the given reaction conditions. **4**



2. (A) Answer any **two** of the following :–
(a) Explain the following rearrangements with one example each **4**
(i) olefin metathesis
(ii) Cope rearrangement

(b) Complete the following reaction and give its mechanism. **4**



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(c) Give complete equations to represent the following rearrangements 4
(i) Von Richter
(ii) Sommelet-Hauser

(d) What is Wolff rearrangement? Explain its mechanism. 4

(B) Answer any **one** of the following :–

(a) Predict the products and name the reactions 4

(i)  $\xrightarrow{\text{Conc } H_2SO_4}$?

(ii) $PhCOPh + N_3H \xrightarrow{H_2SO_4}$?

(b) What is Favorskii rearrangement? Explain its mechanism. 4

3. (A) Answer any **two** of the following :–

(a) Explain the effect of solvent polarity on $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions in UV spectroscopy with suitable examples. 4

(b) How are the following compounds distinguished using IR spectroscopy? 4
(i) $CH_3CH_2C \equiv CH$, $CH_3C \equiv C\,CH_3$ and $CH_3C \equiv N$
(ii) o- and p- hydroxybenzaldehydes

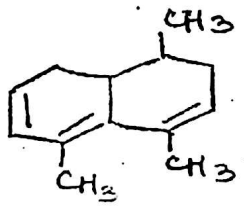
(c) Which of the following will react faster with OH^- ion under S_N2 reaction conditions. Why? 4
(i) CH_3Br or CH_3I
(ii) CH_3CH_2I in C_2H_5OH or DMSO
(iii) $(CH_3)_3C–Cl$ or CH_3Cl

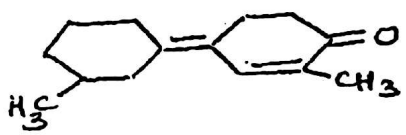
(d) (i) What is 'tele' substitution? Give one example. 4
(ii) Write the 'benzyne' mechanism for the reaction of chlorobenzene with sodamide in liquid ammonia.

(B) Answer any **one** of the following :–

(a) (i) 't-butoxide ion is a weaker nucleophile than ethoxide ion'. Explain. 4
(ii) Explain vibrational coupling in IR spectroscopy.

(b) Calculate the λ max of the following compounds 4

(i) 

(ii) 

[Note : Increments for alkyl substituents on enone chromophore α = 10 nm, β = 12 nm, γ and higher = 18 nm]

4. (A) Answer any **two** of the following :–

(a) What is vicinal coupling in NMR spectroscopy? Discuss any two factors affecting vicinal coupling constant. **4**

(b) Explain the following in NMR spectroscopy **4**
(i) Chemical shift
(ii) Deshielding of aldehydic protons

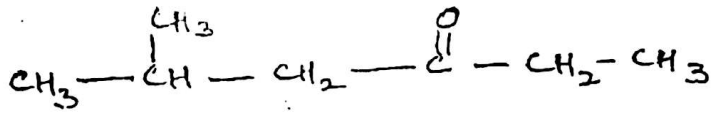
(c) What are isotopic peaks? How is the molecular formula of an organic compound determined on the basis of isotopic abundance in mass spectrometry? **4**

(d) Give the fragmentation pattern of the following in mass spectrometry. **4**
(i) butanal (ii) benzoic acid

(B) Answer any **one** of the following :–

(a) An organic compound has molecular formula $C_6H_{12}O_2$. It showed the following spectral data. **4**
Mass m/z : 116, 59, 57
IR (cm^{-1}) : 1730
NMR δ (ppm) : 1.2 (9H, s), 3.70 (3H, s)
Deduce the structure of the compound.

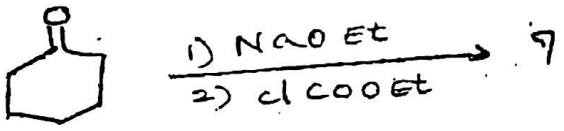
(b) (i) Explain 'Nitrogen rule' in mass spectrometry **4**
(ii) Mention the number of signals and splitting pattern expected in the NMR spectrum of



5. (A) Answer any **four** of the following :– **12**

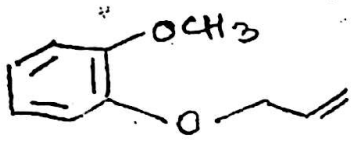
(a) What is Claisen condensation? Explain its mechanism

(b) Predict the product and write the mechanism of the following reaction.



(c) Explain the mechanism of Demjanov rearrangement

(d) Complete the following reactions

(i)  $\xrightarrow{\Delta}$?

(ii)  $\xrightarrow[2)\ H_2O]{1)\ OH^-}$

(iii) $C_6H_5-\underset{\underset{CH_3}{|}}{CH}-CON_3 \xrightarrow{\Delta}$?

(e) Explain the following terms :–
(i) Neighbouring group participation
(ii) Ambident nucleophile (with an example)

(f) Explain the $B_{AC}2$ mechanism of ester hydrolysis

(g) Explain long range coupling in NMR spectroscopy with a suitable example.

(h) Explain the following in mass spectrometry.
(i) base peak
(ii) molecular ion peak
(iii) metastable ion peak.
