Uva Wellassa University of Sri Lanka
Faculty of Applied Sciences
Department of Science and Technology
300 level 1st Semester Examination – August 2019
SCT 329-2 Organic Synthesis and Spectroscopy in Bioprocess Technology

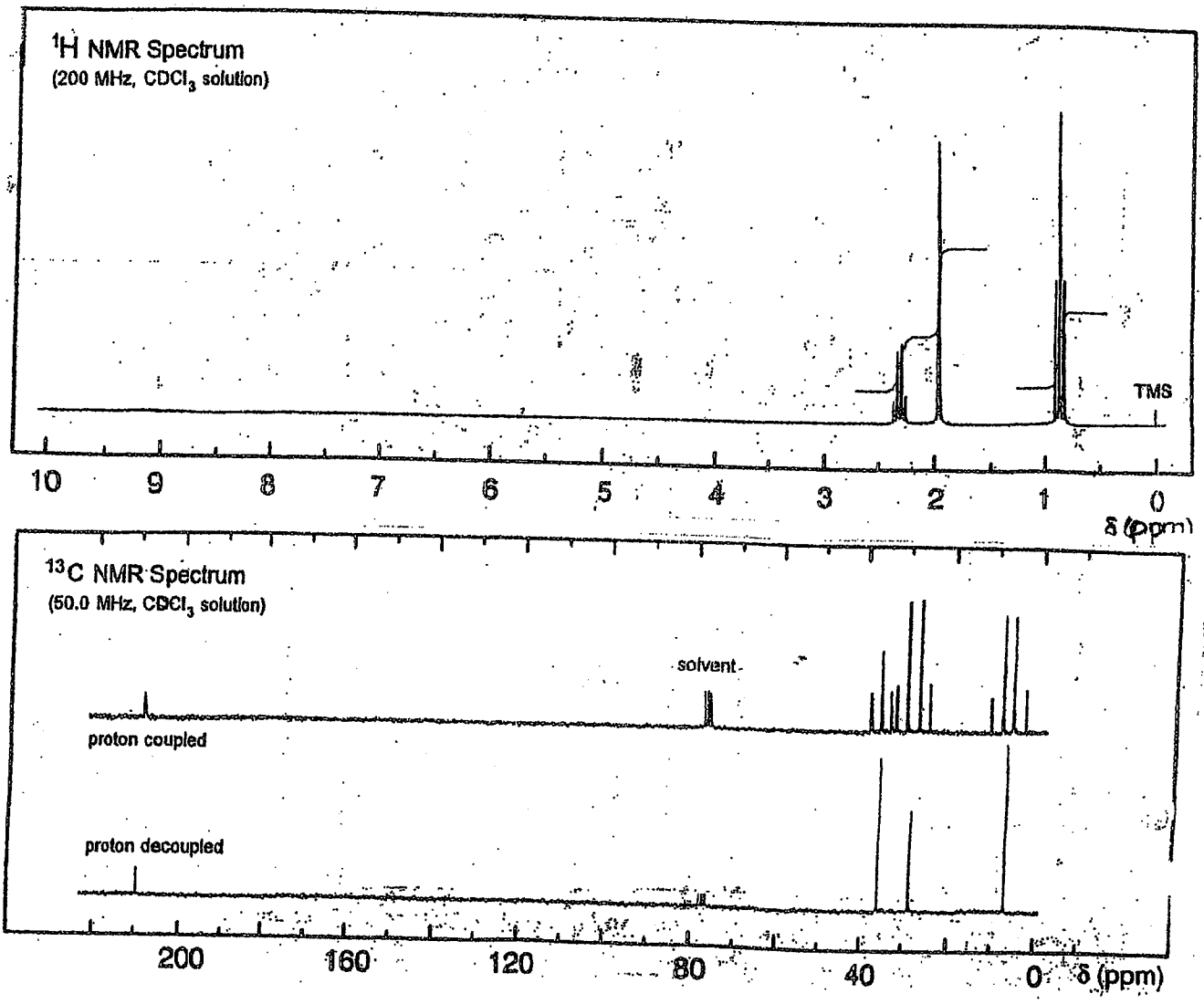
Instructions to candidates
Duration: 02 hour
Number of questions: Six (06) Structured Essay
Mark allocation: 100 marks
Answer all questions

Index No:

(1.) i. List three (03) types of mass spectrometric techniques. (3 marks)

ii. What is the difference between low and high resolution mass spectrometry methods? (2 marks)

iii. Using the following NMR spectra elucidate the structure of the compound '**A**' which has a molecular formula of C_4H_8O.



(5 marks)

11.9

(2.) A. i. List two (02) advantages of pulsed fourier transform NMR spectroscopy method over the classical continous wave method.

(2 marks)

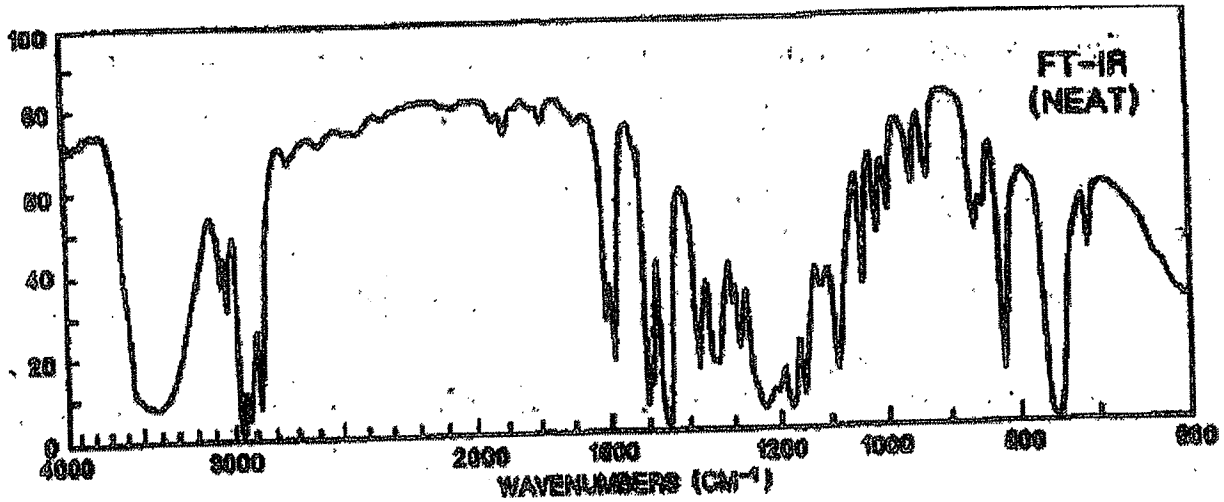
ii. List four (04) factors which will affect the resonance (NMR) positions of most protons.

(4 marks)

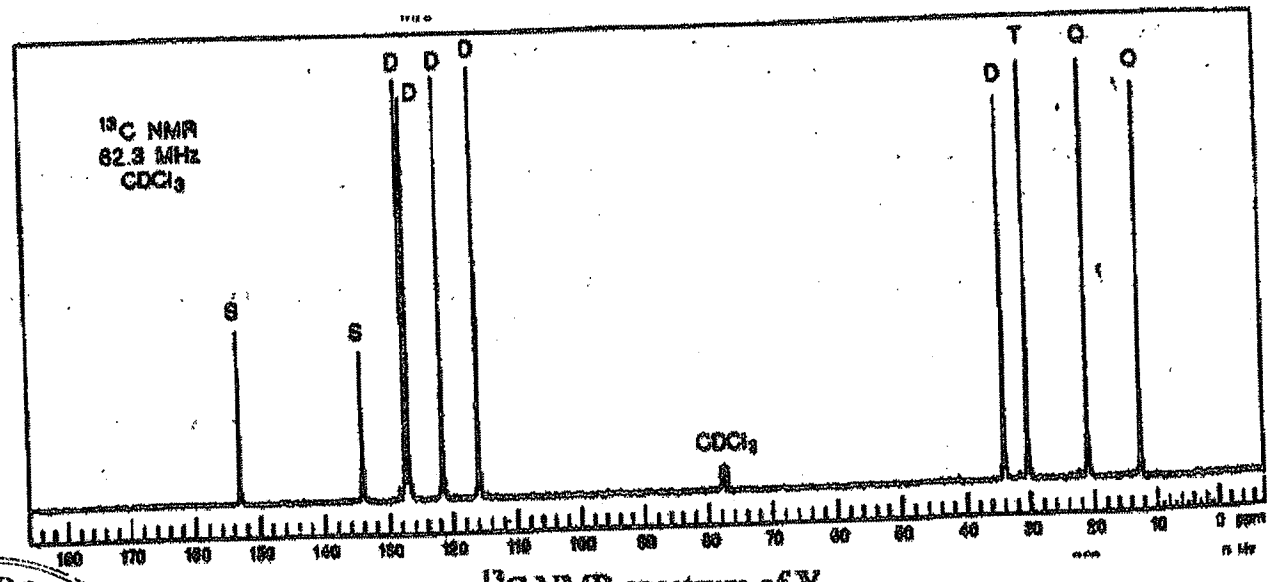
iii. Why ^{13}C signals are weaker than ^{1}H signals? Give two reasons.

(2 marks)

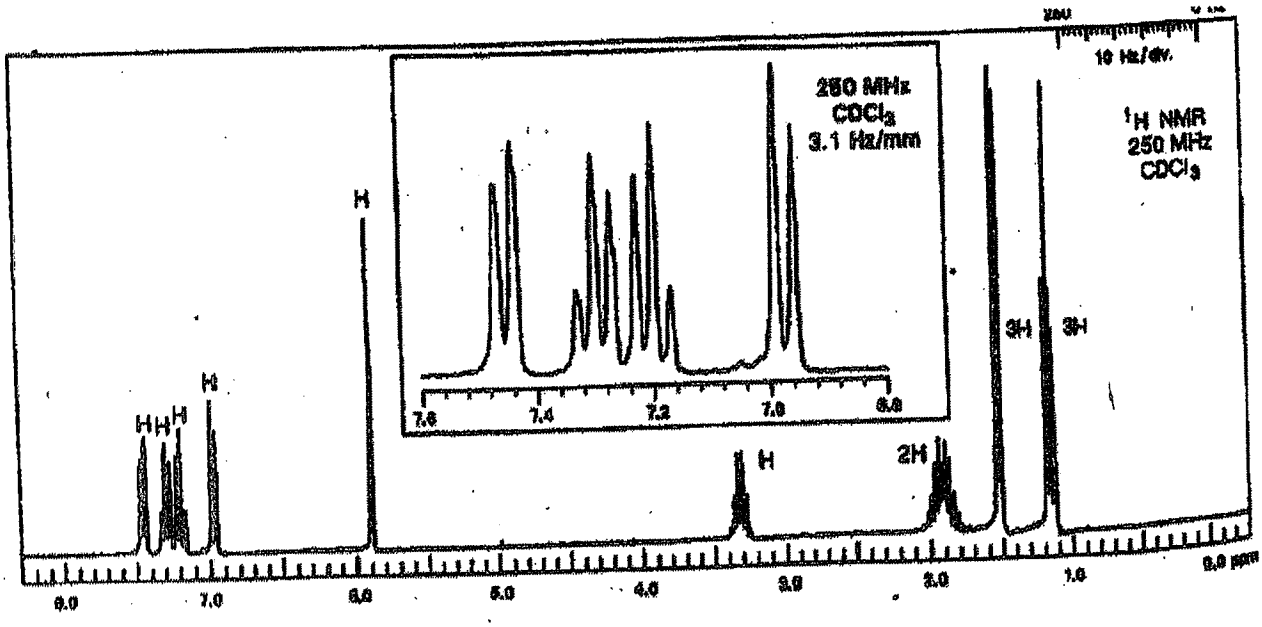
B. An aromatic organic compound 'Y' with the molecular formula $C_{10}H_{14}O$ gives the following IR, ^{13}C-NMR and ^{1}H-NMR spectra.



IR spectrum of Y



^{13}C NMR spectrum of Y



^{1}H NMR spectrum of Y

Analyze the spectra and answer the following questions.

i. What type of oxygen containing functional group is present in 'Y'? How would you detect this functional group from its IR spectrum?

(2 marks)

ii. What is the evidence in the ^{13}C-NMR spectrum to support that 'Y' is aromatic?

(1 marks)

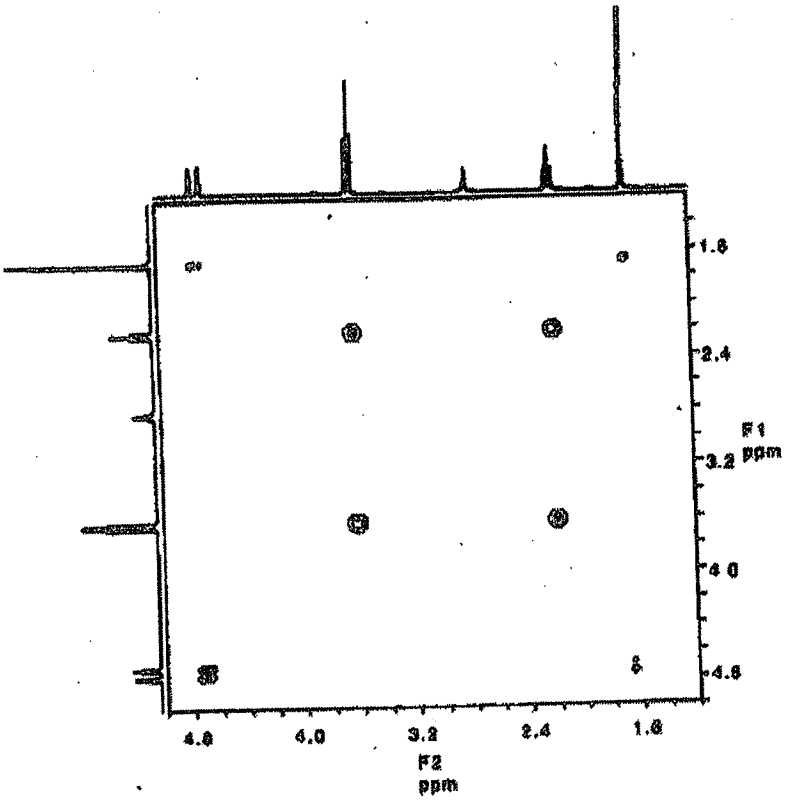
iii. Based on the ^{1}H- and ^{13}C- NMR data draw the partial structure of the aromatic ring showing the substitution pattern.

(4 marks)

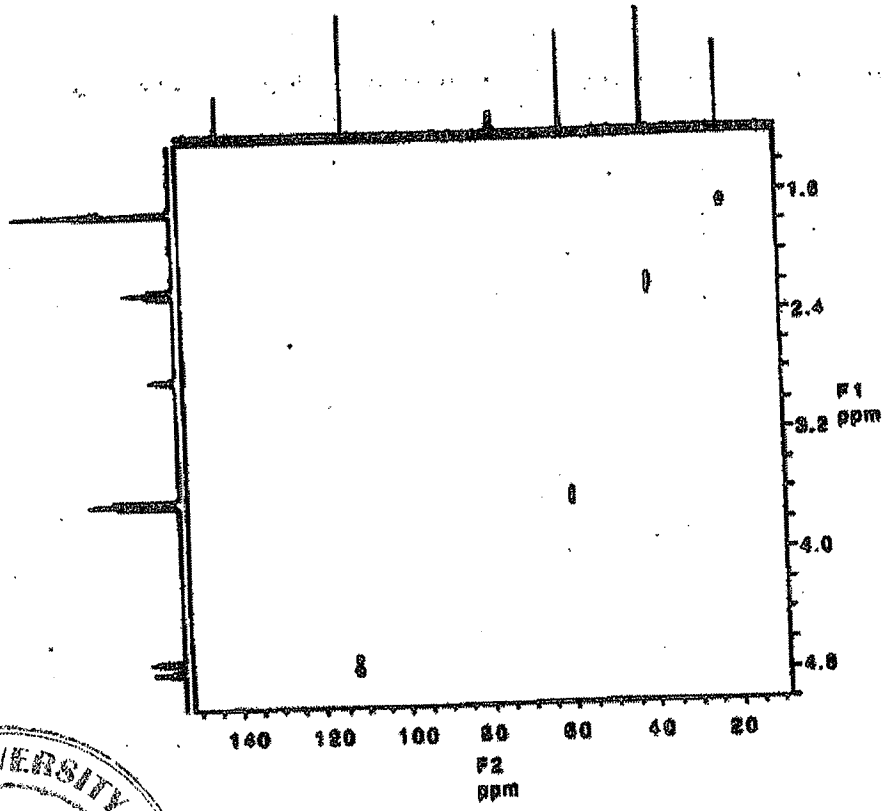
iv. Based on NMR spectra determine the structure(s) of the substitute(s) and draw the complete structure of the molecule 'Y'.

(5 marks)

(3.) The compound 'Z' has the molecular formula $C_5H_{10}O$ and gives the following COSY and HSQC spectra.



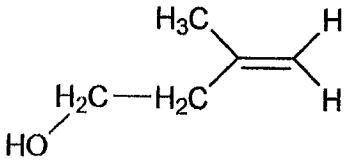
[Chemical shifts of protons: δ 1.7, 2.2, 2.8 (exchangeable), 3.6, 4.7, and 4.8 ppm]



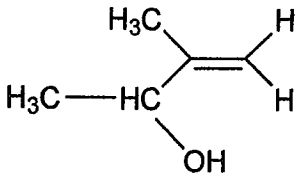
[Chemical shifts of carbons: δ 23, 40, 60, 112 and 145 ppm]

The molecular 'Z' has one of the following structures:

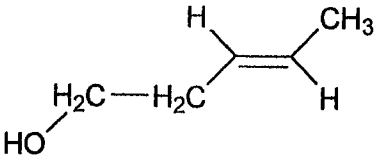
a.)



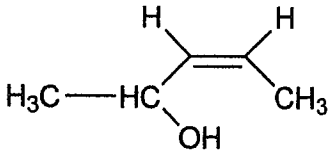
b.)



c.)



d.)

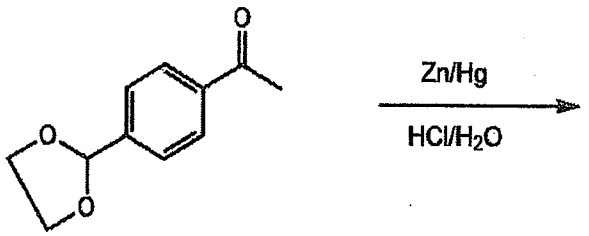


Analyze the COSY and HSQC spectra and determine which structure is the correct one. Write the correct structure and assign the proton and carbon NMR shifts to the structure you have choosen.

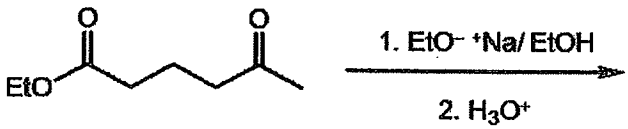
(20 marks)

(4.) Write the products for the following reactions.

(a.)

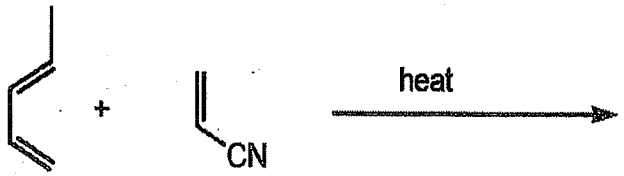


(b.)



(c.)

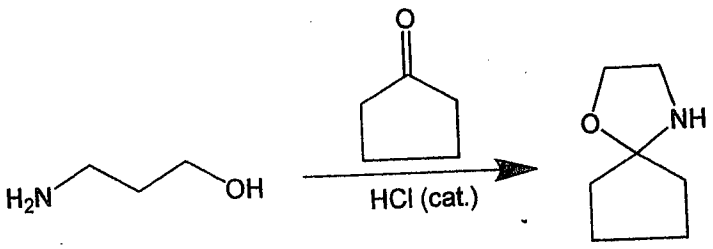
(d.)



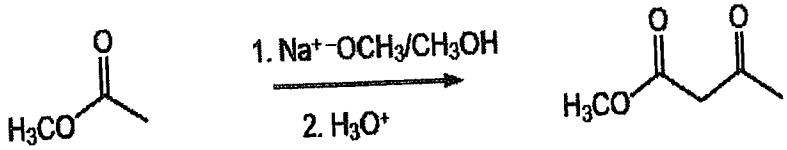
(8 marks)

(5.) Draw the complete mechanisms for the following reactions. Clearly indicate the electron movement with curved arrows.

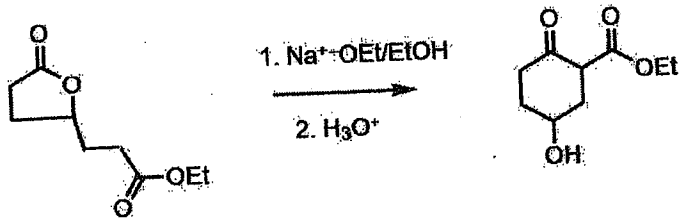
(a.)



(b.)



(c.)



(16 marks)

(6.) Pyridinium Chlorochromate (PCC) is a mild oxidation reagent and it is the product of the mixture of Chromium trioxide (CrO3), hydrochloric acid and pyridine. Write the reaction of the formation of Pyridinium Chlorochromate (PCC).

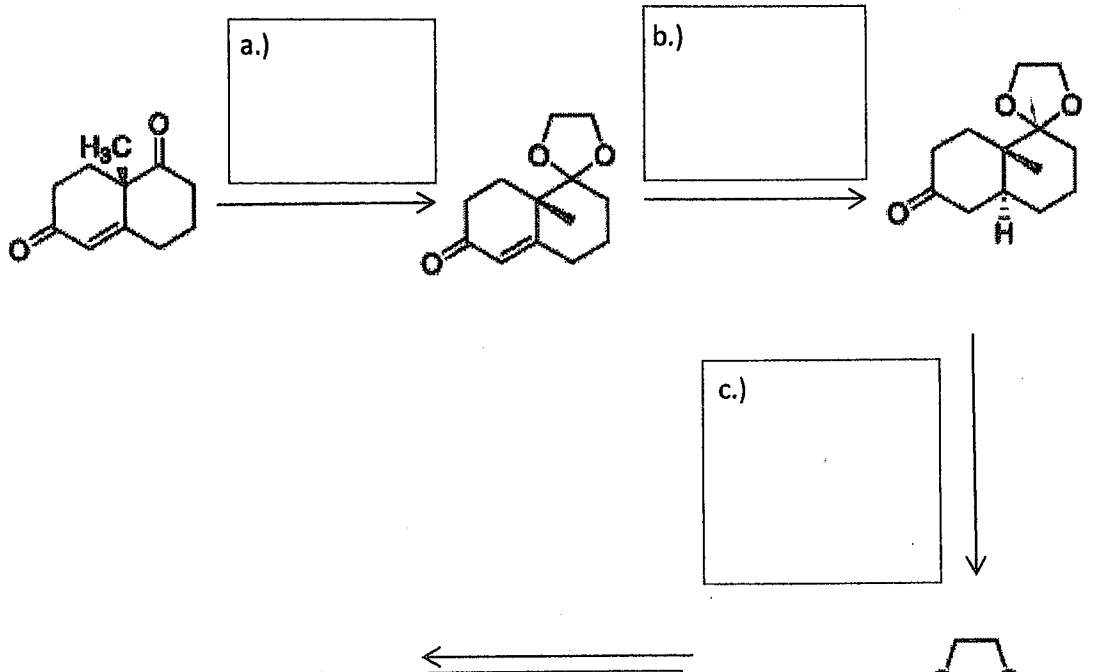
a.) Draw the product of the following reaction.

(2 marks)

b.) Draw the reaction mechanism for above reaction.

(4 marks)

c.) The **Wieland–Miescher ketone** is a common intermediate in the synthesis of more than 50 natural products, predominantly sesquiterpenoids, diterpenes and steroids. Show, how you would carry out these reactions using the given Wieland- Miescher ketone by writing suitable reagents and reaction conditions in given boxes.



(20 marks)