



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH 4315: ORGANIC SPECTROSCOPY

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 2HOURS

DATE: Pick Date Sep 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

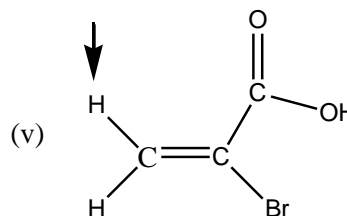
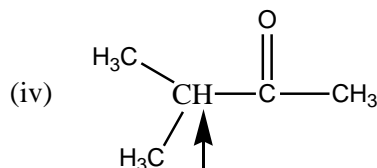
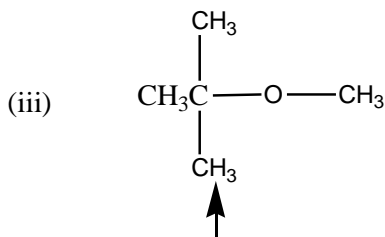
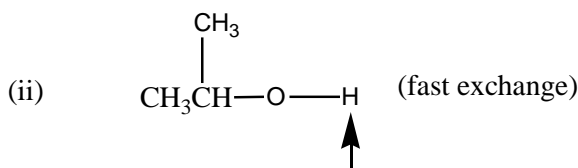
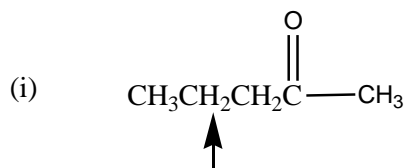
This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

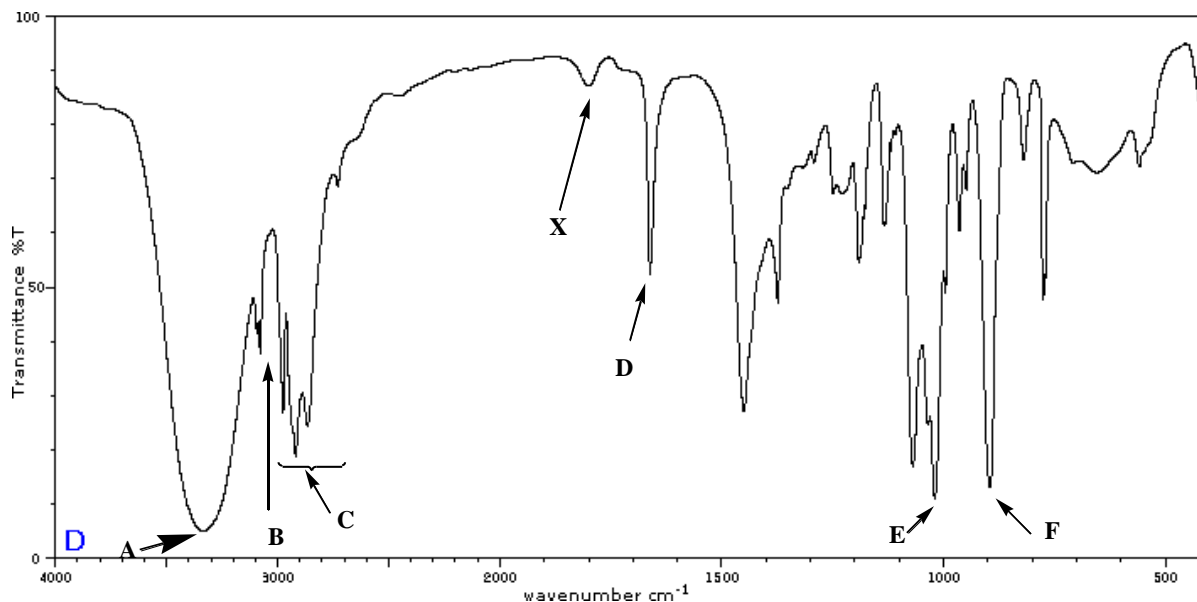
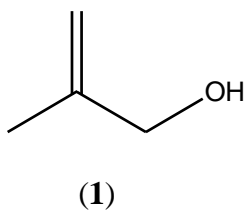
Question ONE

(a) State the four organic spectroscopic techniques utilized in coming up with structure of organic molecules and outline pieces of information which may be obtained from each of the stated techniques. **[8 marks]**

(b) Give the expected spin multiplicity (singlet, triplet, etc) of the indicated protons in each of the following molecules. **[5 marks]**



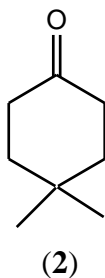
(c) The IR spectrum of 2-methyl-2-propen-1-ol (**1**) is shown below.



- Identify the bonds responsible for the labelled absorption peaks A-F.
- Account for the peak marked X.

[6 marks]
[1 mark]

(d) Compound (**2**) is a cyclic ketone.



- Identify magnetically distinct groups of carbon and hydrogen atoms in the molecule.
 - Provide a sketch of expected ^1H NMR spectrum of the compound clearly indicating the protons which are responsible for the signals.
- (e) Define the following terms as applied in mass spectrometry:-
- Base peak
 - Molecular ion

[4 marks]
[4 marks]
[2 marks]

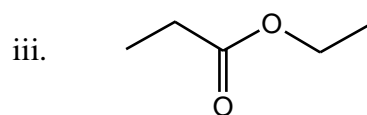
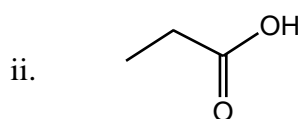
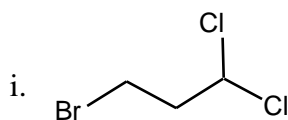
Question TWO

(a) Discuss how electronic effects influence chemical shift (δ) values observed in proton NMR spectroscopy.

[8 marks]

(b) Make use of Schoolery rules (Provided tables) to predict the chemical shifts (δ) for all the protons in discrete magnetic environment in each of the following molecules and state their spin multiplicities:

[12 marks]



Question THREE

(a) State two broad modes of bond vibration in IR spectroscopy and identify with reason the vibration mode which occur at higher wave number.

[3 marks]

(b) Differentiate the following pairs of terms as applied in IR spectroscopy

[4 marks]

i. Fermi resonance and overtones

ii. Combination bands and difference bands

(c) Explain how the following factors affect carbonyl stretching vibration frequency in IR spectroscopy of carbonyl compounds:

i. Conjugation

[2 marks]

ii. Ring size

[2 marks]

iii. α -substitution

[2 marks]

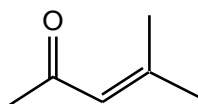
(d) Use compound three to answer the following questions:

i. Identify the functional groups in compound 3.

[2 marks]

ii. Suggest the IR absorptions bands that would be registered by the molecule clearly indicating the bonds vibration leading to the listed absorptions.

[5 marks]



(3)

Question FOUR

(a) Describe the following rules as applied in MS spectrometry:

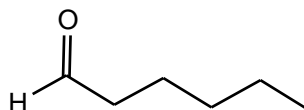
[6 marks]

- i. Nitrogen rule
- ii. Bromine and Chlorine rule

(b) Make use of hexanal to outline the MS fragmentation mechanisms and patterns of aldehydes clearly indicating the m/z of the listed fragments.

[14 marks]

[H-1, C-12, O-16]



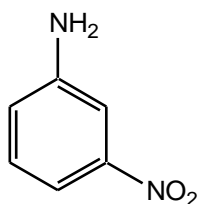
Question FIVE

(a) What is an auxochrome as applied in UV spectroscopy of organic molecules? Give four examples.

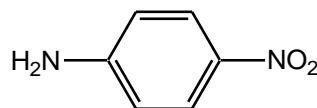
[3 marks]

(b) Which of the following two molecules has a larger UV λ_{max} absorption? Account for your answer.

[4 marks]



A



B

(c) Make use of Woodward-Fieser rules to determine the expected UV absorption λ_{max} for the following organic molecules: -

[13 marks]

