UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY
DIPLOMA: ANALYTICAL CHEMISTRY

MODULE CET2AO5
ORGANIC CHEMISTRY

CAMPUS **DFC**

SUPPLEMENTARY EXAMINATION

DATE: xx/xx/2018 **SESSION: 12:30 –15:30**

ASSESSORS: **Dr MC Fotsing**
Prof DT Ndinteh
Prof PP Govender

EXTERNAL MODERATOR: **Prof RM Gengan**

DURATION: 3 HOURS **FULL MARKS 100**

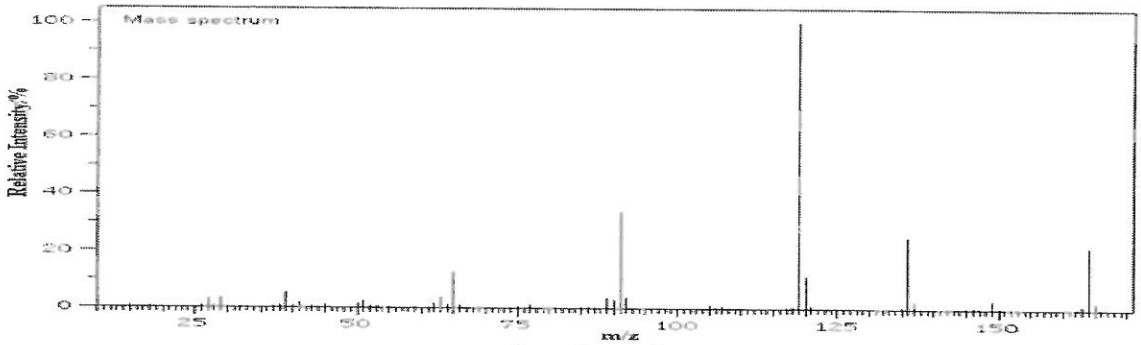
NUMBER OF PAGES: **5**

REQUIREMENTS: **1xANSWER SCRIPT**
DATA SHEET

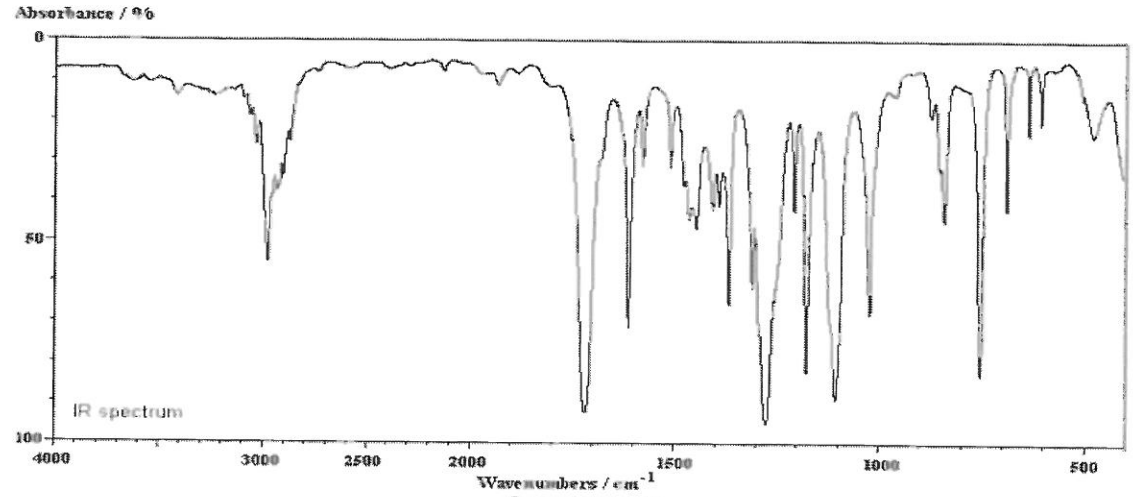
INSTRUCTIONS: **ANSWER ALL QUESTIONS.**
NO PENCIL IS ALLOWED WHEN ANSWERING QUESTIONS.

QUESTION 1

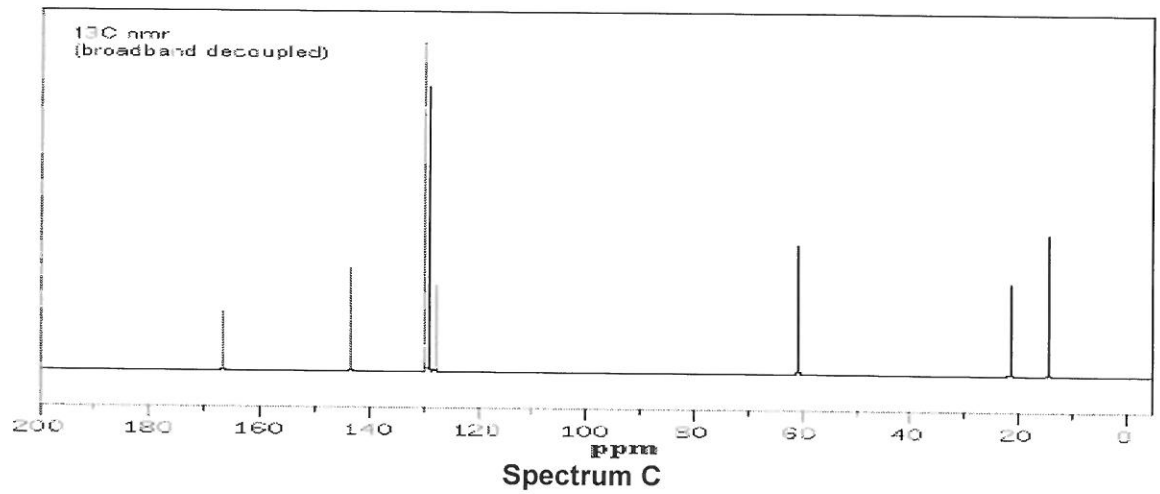
The spectra of an unknown compound are presented below. Identify each spectrum and propose a structure for the unknown compound. Analyse each spectrum and provide a motivation for your answer.



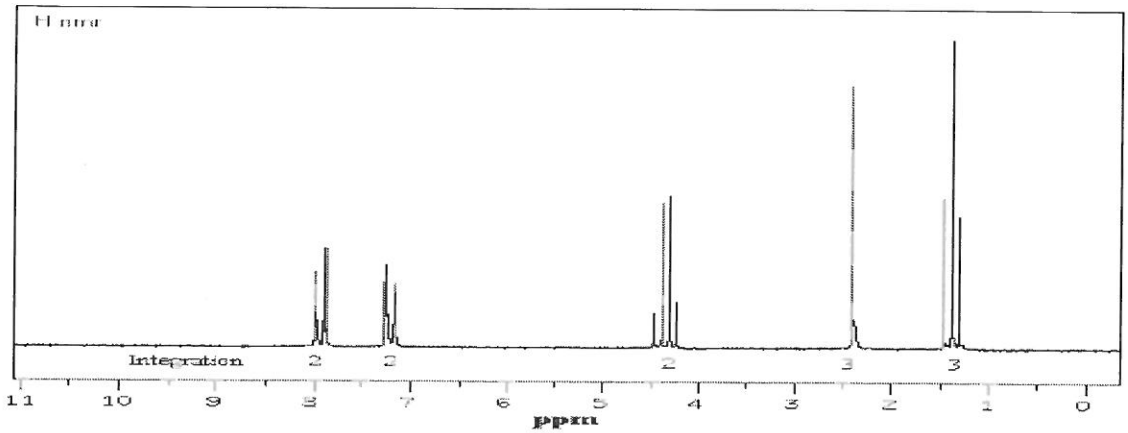
Spectrum A



Spectrum B



Spectrum C



Spectrum D

[20]

QUESTION 2

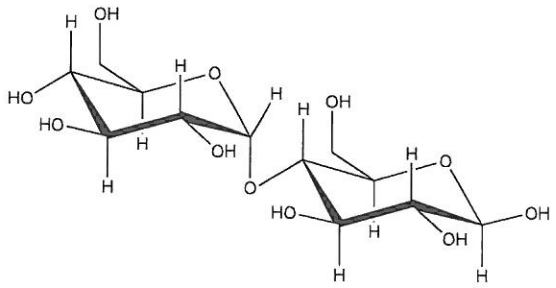
2.1 Describe how you would synthesize the following compounds from **benzene**.

2.1.1 Aniline (2)
2.1.2 Toluene (4)
2.1.3 *p*-Nitro aniline (4)
2.1.4 Trinitrotoluene (4)

[14]

QUESTION 3

3.1 Consider below the formula of maltose, a monomer of glucose:



3.1.1 Classify maltose as a mono-, di-, or polysaccharide. (1)
3.1.2 Classify the glycosidic bond. (2)
3.1.3 Name 3 polysaccharides and state where they can be found in nature. (3)
3.1.4 If the glycosidic bond is hydrolysed, what are the names of the monosaccharides produced? (Remember to include the alpha or beta classification for the anomeric carbon) (2)

[8]

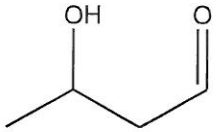
QUESTION 4

4.1 Provide a definition for the following:

4.1.1 Target molecule (2)
4.1.2 Disconnection (2)
4.1.3 Functional group interconversion (2)

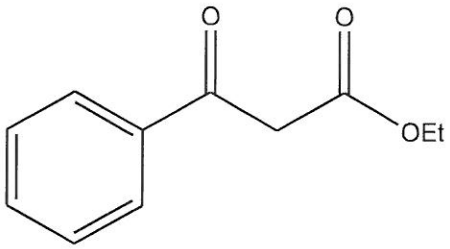
4.2 Outline both the retrosynthesis and synthesis of the following compounds.

4.2.1



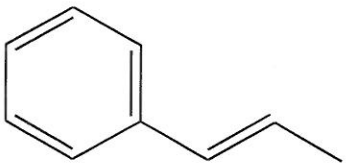
(4)

4.2.2



(4)

4.2.3



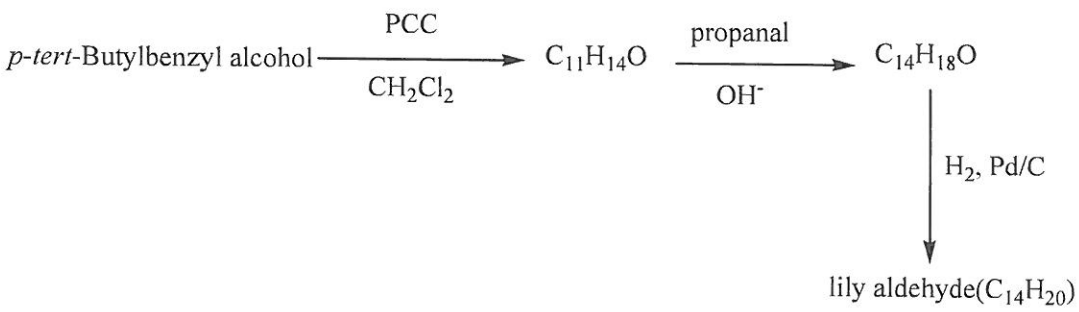
(4)

[18]

QUESTION 5

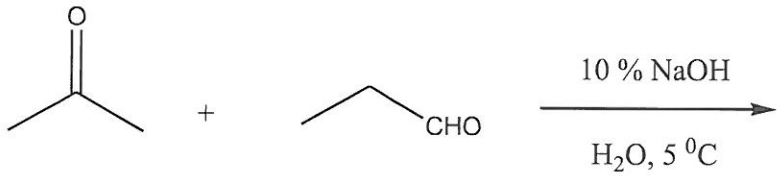
5.1 Use the Wittig reaction to synthesize, (E)-2-phenyl-3-methylpent-2-ene. (4)

5.2 The synthesis of a compound used in perfumes, called lily aldehyde is presented below. Provide all the missing structures. (10)



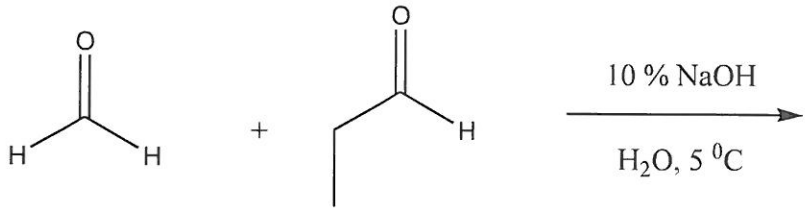
5.3 Provide the products for the following reactions.

5.3.1



(4)

5.3.2



(4)

[22]

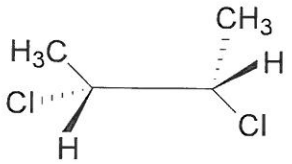
QUESTION 6

6.1 Draw the most stable chair conformation of *trans*-ethyl-3-methycyclohexane. (2)

6.2 The SN2 reaction of (R)-2-chlorobutane with hydroxide produces only one enantiomer of butanol, while the SN1 reaction gives a racemic mixture of products.

6.2.1 What is an enantiomer? (2)
6.2.2 Why does this reaction only produce one enantiomer? (2)
6.2.3 What is a racemate and briefly describe how it can be separated. (6)

6.3 Name the following compound and explain whether a solution of this compound would rotate plane-polarised light or not. (8)



[20]

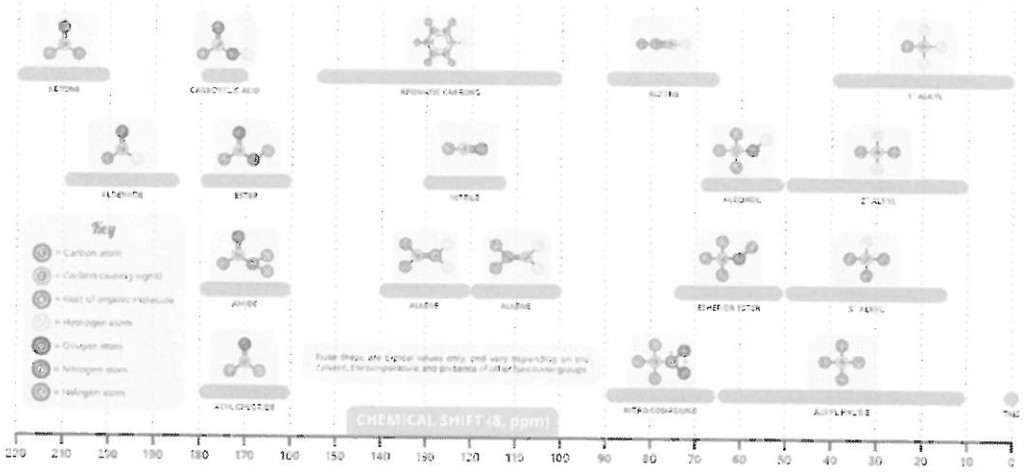
TOTAL MARKS = 102

Infrared Spectroscopy Table

Functional Group	Frequency (cm-1)	intensity
water OH Stretch	3700-3100	strong
alcohol OH stretch	3600-3200	strong
carboxylic acid OH stretch	3600-2500	strong
N-H stretch	3500-3350	strong
≡C–H stretch	~3300	strong
=C-H stretch	3100-3000	weak
-C-H stretch	2950-2840	weak
-C-H aldehydic	2900-2800	variable
C≡N stretch	~2250	strong
C≡C stretch	2260-2100	variable
C=O aldehyde	1740-1720	strong
C=O anhydride	1840-1800, 1780-1740	weak, strong
C=O ester	1750-1720	strong
C=O ketone	1745-1715	strong
C=O amide	1700-1500	strong
C=C alkene	1680-1600	weak
C=C aromatic	1600-1400	weak
CH_2 bend	1480-1440	medium
CH_3 bend	1465-1440, 1390-1365	medium
C-O-C stretch	1250-1050 several	strong
C-OH stretch	1200-1020	strong
NO_2 stretch	1600-1500 and 1400-1300	strong
C-F	1400-1000	strong
C-Cl	800-600	strong
C-Br	750-500	strong
C-I	~500	strong

A GUIDE TO ^{13}C NMR CHEMICAL SHIFT VALUES

Nuclear Magnetic Resonance (NMR) is a commonly used technique for organic compound structure determination. In ^{13}C NMR, applying an external magnetic field causes the nuclei spin to flip. The environment of the carbon atom in the molecule affects where the signal is seen on the resultant spectrum.



^{12}C 99% ^{13}C 1%

Only 1% of carbon atoms are carbon-13, atoms which have one more neutron than carbon-12. NMR doesn't work for carbon-12, as its nucleus doesn't have a 'spin'. The frequency required to 'flip' a carbon-13 nucleus is around a quarter of that required to flip an hydrogen nucleus in H-NMR. As the probability of two adjacent carbons in a single molecule being carbon-13 atoms is very low, no splitting of peaks is seen, unlike in H-NMR.