

**KIBABII UNIVERSITY**  
**UNIVERSITY EXAMINATIONS**  
**2020/2021 ACADEMIC YEAR**

**SECOND YEAR FIRST SEMISTER EXAMINATION**  
**FOR THE DEGREE**  
**OF**  
**BACHELOR OF EDUCATION (SCIENCE)**

**COURSE CODE:** SCH 229

**COURSE TITLE:** CHEMICAL ANALYSIS AND STRUCTURE DETERMINATION

**DATE:** 21/1/2022

**TIME:**11-1PM

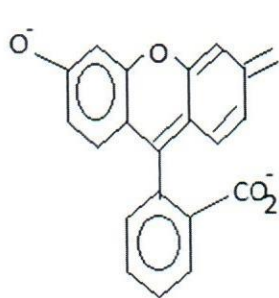
**INSTRUCTION:** Answer question one and any other two questions. Start an answer on a new page in the answer booklet

**(SUPPLEMENTARY EXAMINATIONS)**

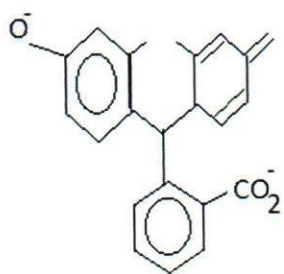
This paper contains 5 printed pages

### QUESTION ONE (30marks)

a) The structures bellows shows two similar molecules;



A



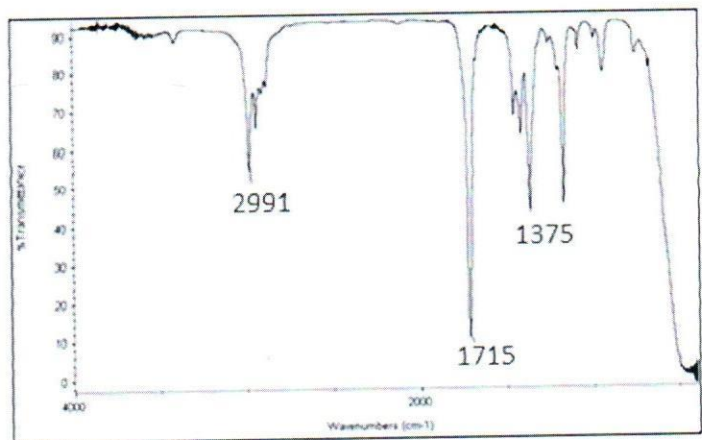
B

Explain why A fluoresces in UV light

(4marks)

b) A transmittance IR for  $C_4H_8O$ . Assign functional groups to the peaks shown in red and name the homolous series the molecule belongs

(5marks)



c) The UV spectrum of propanone,  $C_3H_6O$  showed three peaks at  $\lambda_{max}$  at 280nm, 188nm and 154nm. Identify the specific transitions for the peaks

(3marks)

d) Cyclohexane shows absorption at 1.43  $\delta$  in its  $^1H$  NMR spectrum. How many Hertz away from TMS is this on a spectrometer operating at 300 MHz

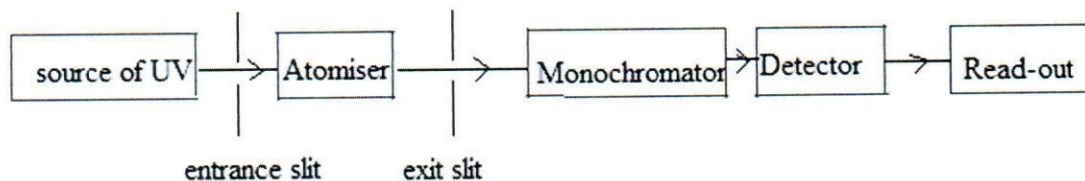
(2marks)

e) Explain the factors that enhance molecular fluorescence

(6marks)

f) Discuss the difference between AES and AAS as illustrated by flowchart below (3marks)

AAS



AES



g) Four compounds were separated on a chromatographic column whose length was 24.7 cm. The following results were obtained

Compound	Retention time/min	Width of peak/min
A	14.1	0.41
B	13.3	1.07
C	5.4	1.16
D	21.6	1.72

i) Assume increasing concentration as affinity for mobile phase increases and sketch the chromatogram with a poor resolution for the second and third peaks (3marks)

ii) Calculate the plate height for the first compound (2marks)

h) State 2 uses of XRD (2marks)

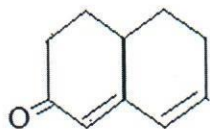
## QUESTION 2 (20 marks)

a) Why is IR spectroscopy referred to as finger print technique (2marks)

d) Discuss the fourier transform IR and its advantage over the normal scanning IR technique (4marks)

f) Explain why the  $\lambda_{\max}$  of  $\text{RCHCHCHCH}=\text{CH}_2$  in methanol is 385nm while in diethylether is 375nm (4marks)

g) Calculate the  $\lambda_{\max}$  of the molecules A and B below using the Woodward Fieser rules (2marks)



g) One gram of a solute is contained in 100ml of an aqueous solution. Calculate the amount remaining in the aqueous phase after a single extraction with 30ml of organic solvent and after three successive extractions with 10ml of organic solvent.  $D=10$  (3marks)

h) Discuss the following terms

i) coupling constant (2marks)

ii) anisotropy (2marks)

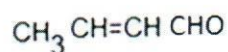
### QUESTION 3 (20 marks)

a) State the difference between Hypochromic effect and Hyperchromic effect (2marks)

b) Explain the variation in the value of  $\lambda_{\max}$  for  $\text{CH}_3\text{X}$ ; where X-C1(173)  $m\mu$ , Br (204)  $m\mu$  I (258)  $m\mu$ . (3marks)

c) State the advantages of double beam UV-VIS spectrophotometer to a single channel one (3marks)

d) Consider the molecule below;



i) identify the chromophore and auxochrome (2marks)

ii) describe the electron transitions in UV-VIS band (3marks)

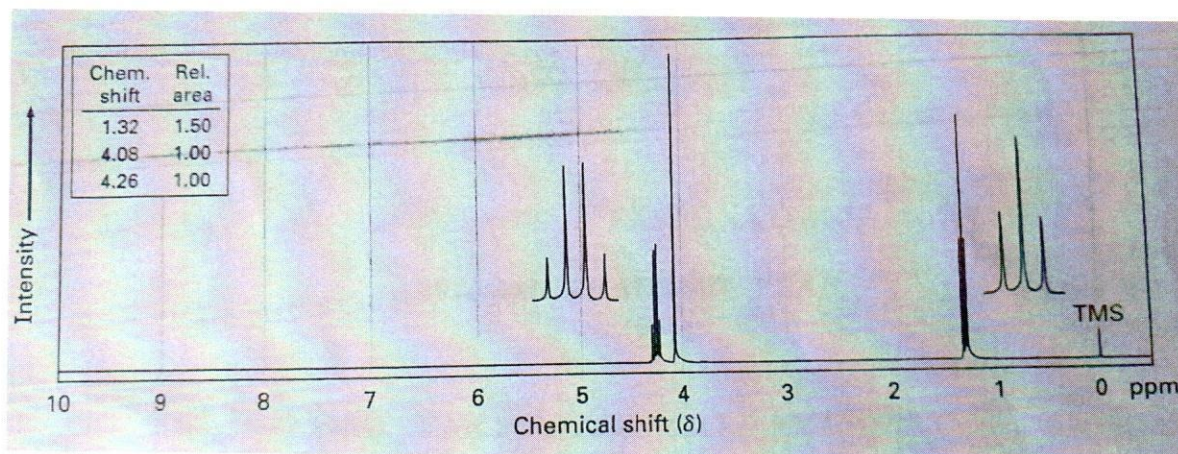
f) 10 ml of water containing iron was treated with a reagent which forms a colored complex containing iron. The resulting solution diluted to 100ml using deionized water. This solution gave an absorbance of 0.27 at 510 nm. To another 10 ml of the water sample 5ml of 0.2mg/ml iron solution was added and the solution made to 100ml using deionized water. This solution gave an absorbance of 0.32. Calculate the concentration of iron in water in mg/ml (7marks)

### QUESTION 4 (20marks)

a) Discuss zeeman effect in NMR analysis (3marks)

b) Calculate the frequency at which a phosphorus nucleus would absorb in a M.F of 1.4 ( $h=6.6 \times 10^{-34}$ ,  $B_n=5.5 \times 10^{-27}$ , and  $g_i$  for  $^1\text{H} = 2.261$ ) (3marks)

c) The compound whose  $^1\text{H}$  NMR spectrum is shown below has a formula  $\text{C}_4\text{H}_7\text{O}_2\text{Cl}$  and has an IR absorption peak at  $1740\text{ cm}^{-1}$ . Propose its structure. (5marks)



f) Show the difference between the nmr spectra of  $\text{CH}_3\text{CH}_2\text{Cl}$  and  $\text{CH}_3\text{CH}_2\text{OH}$  (4marks)

g) Show the possible fragments of  $\text{CH}_3\text{CH}_2\text{CH}_3$  using an electron impact ionization method (5marks)

### QUESTION 5 (20marks)

a) Sketch the flowchart to show the parts of a mass spectrometer (4marks)

b) Briefly describe MALDI in a mass spectrometer (4 marks)

c) Identify three differences between AAS and AES. (3marks)

d) Briefly discuss the XRD (5marks)

e) Discuss photophorescence and its use in the construction industry (4marks)