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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF CHEMISTRY

COURSE CODE: SCH 229

COURSE TITLE: CHEMICAL ANALYSIS AND STRUCTURE DETERMINATION

DURATION: 2 HOURS

DATE: 6/10/2021

TIME: 2:00-4:00 PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

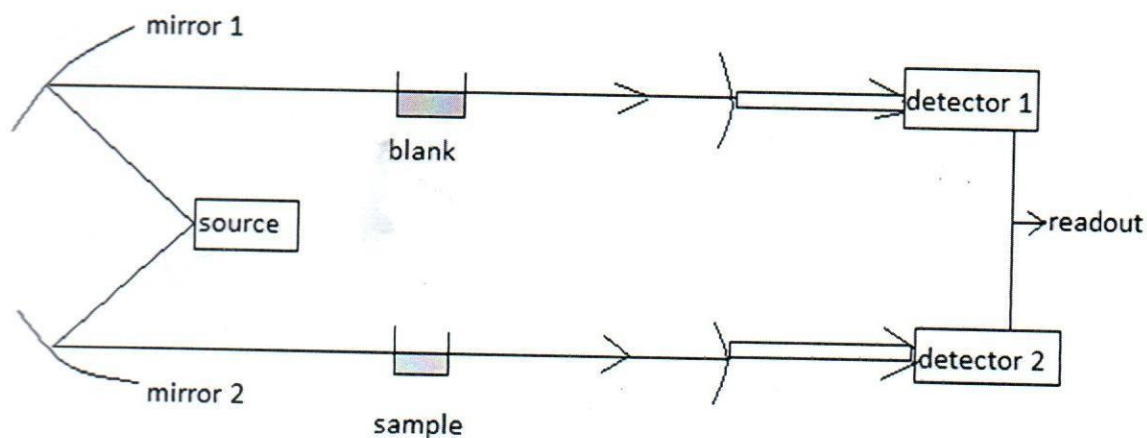
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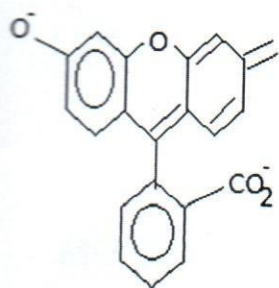
KIBU observes ZERO tolerance to examination cheating

Question one (30 marks)

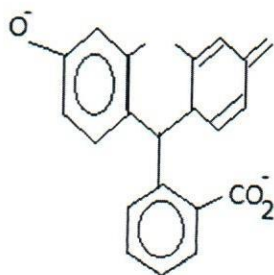
a) Use the scheme below to discuss non dispersive infra red spectroscopy **(4 marks)**



b) Explain which of the molecules A and B fluorescence **(4marks)**



A



B

c) State 3 limitations of UV-VIS **(3 marks)**

d) Why is it important for the magnetic field to be constant in the NMR analysis **(2marks)**

e) Explain the difference between the photomultiplier and continuous dynode electron multiplier in mass spectrometer **(4marks)**

f) Sketch the scheme for AAS **(3marks)**

g) Discuss the difference between

i) zeeman effect and magnetic susceptibility **(2marks)**

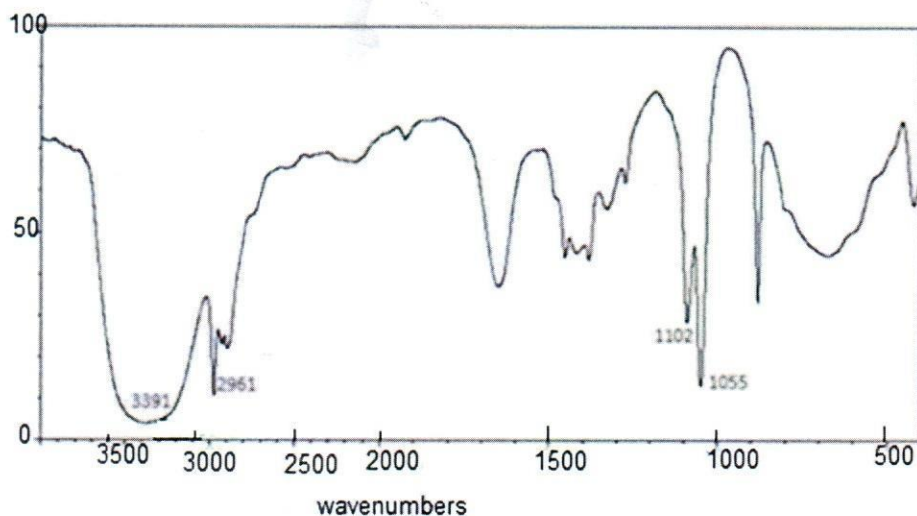
ii) photoluminescence and chemiluminiscence **(2marks)**

h) Briefly explain the difference between EDX and XRD, stating the uses of each technique (6marks)

Question 2 (20 marks)

a) Briefly explain why some molecules are not IR active (4marks)

b) The spectra below was determined from a molecule C_2H_6O .



i) Assign functional groups to the wavenumbers in red (4marks)

ii) Predict the structure of the molecule with reasons (2marks)

d) Briefly explain the mode of separation in paper chromatography (2marks)

e) Show that the distribution coefficient of benzoic acid is not equal to its distribution ratio (3marks)

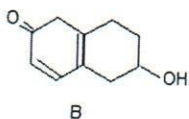
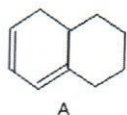
f) Calculate the fraction of chelate extracted when 25 ml of 4.3×10^{-2} M of the metal chelate shaken with 2 successive 5ml portions of chloroform. The distribution coefficient is 4.4 (5marks)

Question 3(20 marks)

a) The UV spectrum of propanone, C_3H_6O showed three peaks at λ_{max} at 280nm, 188nm and 154nm. Identify the specific transitions for the peaks (3marks)

b) Briefly explain bathochromic and hypsochromic shifts in UV spectroscopy (4marks)

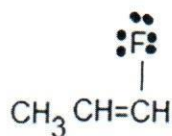
c) Calculate the λ_{\max} of the molecules A and B below using the Woodward Fieser rules (2marks)



d) A certain colourless sample was found to have molecule, $C_{15}H_{32}Br_8$ with λ_{\max} on 270nm. This sample was reacted with a certain reagent and its colour changed to blue. Predict the new λ_{\max} and explain this change (3marks)

e) A mixture of iodobutane and chlorobutane was synthesized in a laboratory. The mixture was separated by HPLC and interphased with UV-VIS spectroscopy as a detector. The first sample A was read at λ_{\max} 295nm, while the second one, B at λ_{\max} 264nm. Explain the identity of A and B and state how you may confirm the two. (4marks)

f) Consider the molecule below;



- i) identify the chromophore and auxochrome (2marks)
- ii) describe the electron transitions in UV-VIS band (2marks)

Question 4 (20 marks)

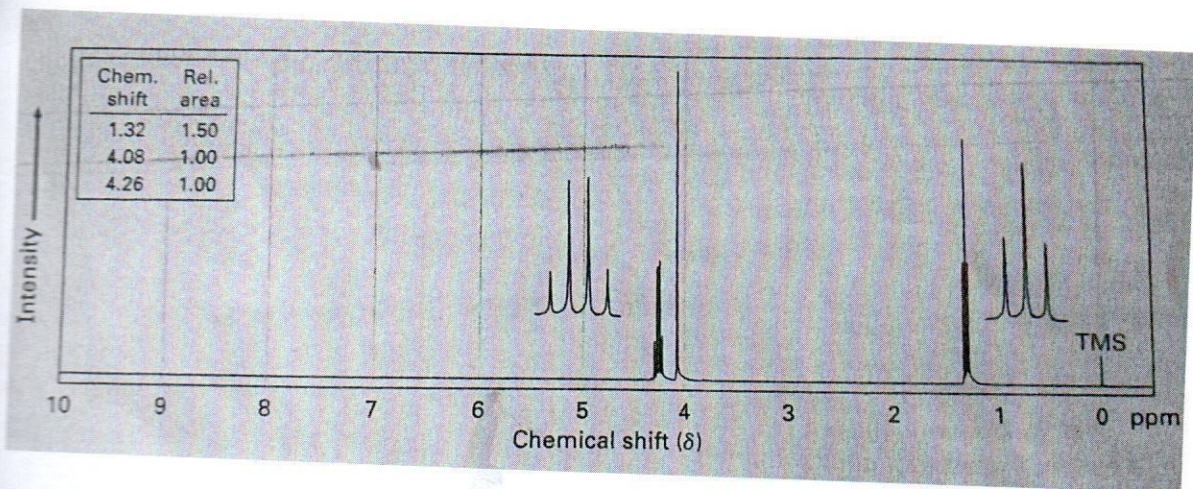
a) Calculate the frequency at which a proton nucleus would absorb in a M.F of 1.4 ($h = 6.6 \times 10^{-34}$, $B_n = 5.5 \times 10^{-27}$, and g_i for $^1H = 5.585$) (2marks)

b) Cyclohexane shows absorption at 1.43 δ in its 1H NMR spectrum. How many Hertz away from TMS is this on a spectrometer operating at; 200MHz (2marks)

c) What is meant by

- i) chemical shift (2marks)
- ii) spin-spin splitting (2marks)

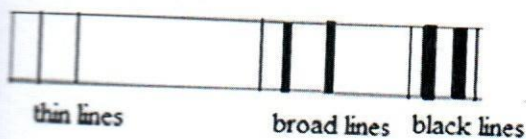
d) The compound whose 1H NMR spectrum is shown below has a formula $C_4H_7O_2Br$ and has an IR absorption peak at 1740 cm^{-1} . Propose its structure. (4marks)



e) Show the difference between the NMR spectra of $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{OH}$ (2 marks)

f) 10 ml of water containing copper was treated with a reagent which formed a deep blue colored complex containing copper. The resulting solution diluted to 100ml using deionized water. This solution gave an absorbance of 0.357 at 460 nm. To another 10 ml of the water sample 5ml of 0.2mg/ml copper solution was added and the solution made to 100ml using deionized water. This solution gave an absorbance of 0.42. Calculate the concentration of copper in water in mg/ml (4marks)

g) Explain why some lines are broader than others on the AAS spectrum below; (2marks)

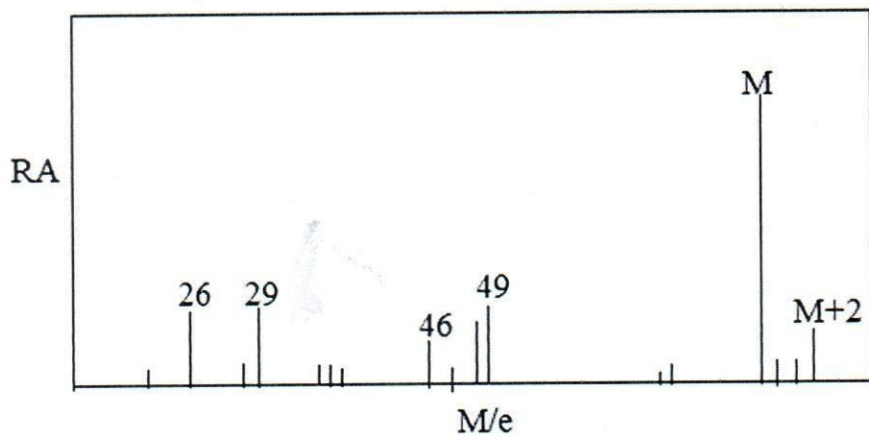


Question 5 (20 marks)

a) Sketch a diagram to show the parts of a mass spectrometer (5marks)

b) Discuss three inlet systems for a mass spectrometer (6marks)

c) Study the mass spectrum of chloroethane below and answer the questions that follow.
Chloroethane has a RAM of 64.5



i) Assign possible fragments for 26, 28, 46 and 49 .

(4marks)

ii) Explain the significance of M and M+2

(2marks)

d) Use Boltzmann-Maxwell equation to indicate the relative fraction of atoms in excited state in AAS **(3marks)**