CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

CHEM 437: ORGANIC SPECTROSCOPY

STREAMS: BSC CHEM **TIME: 2 HOURS**

DAY/DATE: FRIDAY 17/04/2020 **11.30 A.M. – 1.30 P.M.**

INSTRUCTIONS:

- **Answer question ONE and any other TWO questions.**

USEFUL DATA

The tables are attached

QUESTION ONE (30 MARKS)

1. (a) The examination of an absorption band located around 2900 cm^{-1} expressed by a sample of HCI in the gaseous state reveals that the band is the result of a super imposition of two forms of vibration, one of which is clearly more intense than the other. These two series are separated by an approximate distance of $2cm^{-1}$. Explain how might this phenomenon be interpreted use calculations to illustrate your answer. (5 marks)

   (b) List nine advantages of Raman spectroscopy. ($4\frac{1}{2}$ marks)

   (c) Use woodwards rules to determine the $\lambda -$ maximum of the following organic compounds given below

QUESTION TWO (20 MARKS)

2. (b) List four infrared radiation sources which are used in infrared spectrophotometer. (2 marks)

QUESTION THREE (20 MARKS)

3. (a) Deduce the complete structural formula of the compound from the mass spectrum in the figure below

($4\frac{1}{2}$ marks)

(b) Deduce the structural formula of the compound (bp $74^0\ C$) whose mass spectrum is shown below.

(4 marks)

(c) A low melting solid with molecular formula $C_5H_80_4$ gave the mass spectrum shown below. Deduce the structural formula of the compound.

($3\frac{1}{2}$ marks)

(d) (i) A material containing C, H and O in the form of leaflets melting at $40^0\ C$ possess a rather simple mass spectrum with the parent peak at m/e 184 (10%), the base peak at m/e 91, and small peaks at m/e 77 and 65. Metastable peaks appear at m/e 45.0 and 46.5. Deduce the structure of the compound. (3 marks)

(ii) The mass spectrum possesses a strong parent peak at m/e 122 (35%) plus peaks at m/e 92 (65%), m/e 91(100%) and m/e 65 (15%). In addition there are metastable peaks at 46.5 and 69.4 mass units. Deduce the structure of the compound. (5 marks)

QUESTION FOUR (20 MARKS)

(a) The proton NMR spectrum shown in figure 1 is for an organic compound having the empirical formula $C_5H_{10}0_2$. Identify the compound. (11 marks)

(b) The proton NMR spectra shown in figure 2 are for colorless, isomeric liquids containing only carbon and hydrogen. Identify the two compounds. (7 marks)

(c) Calculate the number of multiplets and relative area of the compound $CH_3CH_2OCH_3$. (2 marks)
