CHEM 437

CHUKA   UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 437: ORGANIC SPECTROSCOPY

STREAMS: B.Sc.   **TIME: 2 HOURS**

DAY/DATE: TUESDAY 02/02/2021   **8.30 A.M. – 10.30 A.M.**
INSTRUCTIONS:

QUESTION ONE (30 Marks)

1a).   The accompanying data were obtained in a slope –ratio investigation of the complex
        formed between Ni^{2+} and 1-cyclopentene-1-dithiocarboxylic acid (CDA). The
        measurements were made at 530nm in 1.00cm cells

$C_{CDA} = 1.0 \times 10^{-3}M$		$C_{Ni} = 1.0 \times 10^{-3}M$	
C_{Ni}, M	A_{530}	C_{CDA}, M	A_{530}
5.0×10^{-6}	0.051	9.0×10^{-6}	0.031
1.20×10^{-5}	0.123	1.50×10^{-5}	0.051
3.50×10^{-5}	0.359	2.70×10^{-5}	0.092
5.0×10^{-5}	0.514	4.0×10^{-5}	0.137
6.0×10^{-5}	0.616	6.0×10^{-5}	0.205
7.00×10^{-5}	0.719	7.00×10^{-5}	0.240

(i) Determine the formula of the complex.   (8 marks)

(ii) Find the molar absorptivity of the complex.   (2 marks)

b) Describe and compare different causes of deviations from Lambert –Beers law   (10 marks)

c) (i). Explain the following terms as used in IR:

    (I) Harmonics

    (II) Fundamentals frequency

    (III) Over tones   (6 marks)

(ii).   The molecular heterotope 35Cl-37Cl has a fundamental band at $623cm^{-1}$ in the gaseous state. Calculate the wave numbers of the second overtone and the second harmonics.

                                                                                                (4 marks)

QUESTION TWO (20 MARKS)

2 (a) Describe the principle of infrared spectroscopy.   (10 marks)

   (b)   The examination of an absorption band located around $3900cm^{-1}$ expressed by a sample of HCl in the gaseous state reveals that the band is the result of a superimposition 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 $4cm^{-1}$. Explain how might this phenomenon be interpreted. Use calculations to illustrate your answer   (5 marks)

(c). List ten (10) differences between Raman spectra and infrared spectra   (5 marks)

QUESTION THREE (20 MARKS)

3a (i). Write short notes on Mclafferty Rearrangements   (3 marks)

   (ii). The mass spectrum possess a strong parent peak at m/z 122 (35%) plus peaks at m/z 92 (65%), 91 (100%) and m/z 65 (15%), in addition there are metastable peaks at 46.5 and 69.4 mass unit. Deduce the compound structure.   (7 marks)

b).   For each of the following compounds, calculate the number of multiplets for each band and their relative areas.

    (i) $Cl(CH_2)_3Cl$ (ii) $CH_3CH\ Br\ CH_3$

    (iii) $CH_3CH_2OCH_3$ (iv) $CH_3CH_2OCH_3$

    (V) $CH_3CH_2CH_2I$ (10 marks)