

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL

**EXAMINATION FOR THE AWARD OF DEGREE
OF BACHELOR OF EDUCATION (ARTS & SCIENCE)**

CHEM 324: PHYSICAL METHODS OF STRUCTURE DETERMINATION

STREAM: BED (ARTS & SCI)

TIME: 2 HOURS

DAY/DATE: TUESDAY 17/11/2020

5.00 P.M. – 7.00 P.M.

INSTRUCTIONS: ANSWER ALL QUESTIONS**QUESTION ONE (30 MARKS)**

- 1.a (i) Calculate the molar refraction of ethyl acetate if the refractive index and density are 1.3701 and 0.901 g cm^{-3} respectively. Compare with the value of molar refraction obtained from the data given in Table 1 (9 marks)

Table 1: Atomic and group refractions

Atoms and groups	Refraction	Atoms and groups	Refraction
H	1.100	S (C=S) thiocarbonyl	7.97
C	2.418	N (Primary aliphatic amine)	2.322
F	1.0	N (Sec. aliphatic amine)	2.499
Cl	5.967	N (tertiary aliphatic amine)	2.840
Br	8.865	N (primary aromatic amine)	3.21
I	13.900	N (Sec. aromatic amine)	3.59
O(C=O)Carbonyl	2.211	N (tertiary aromatic amine)	4.36
O(O-H) hydroxyl	1.525	N (amide)	2.65
O (C – O) ether, ester	1.643	NO ₂ aromatic nitro	7.30
S (S – H) mercapto	7.69	C \equiv N	5.459

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- (ii) The absorptivity of two compounds A and B at their absorption maximum of 345 nm and 420 nm are $214 \text{ Lg}^{-1} \text{ cm}^{-1}$ and $172 \text{ Lg}^{-1} \text{ cm}^{-1}$ respectively. Compound A absorbs at 420 nm ($\epsilon = 8.2 \text{ Lg}^{-1} \text{ cm}^{-1}$) while compound B does not absorb at 345 nm. Calculate the concentration of the two compounds in a solution if the measured absorbance value in a 1.00 cm cell are 0.65 at 345 nm and 0.437 at 420 nm respectively (6 marks)
- (iii) The concentration of an analyte in the test sample was determined by standard additional method. To 3ml of the sample solution taken in separate 25 ml flasks, 0 ml, 5 ml and 10 ml of standard solutions of the analyte of $2.5 \times 10^{-4} \text{ M}$ were added and made upto 25ml. The absorbance value recorded at a chosen wavelength were 0.18, 0.32, and 0.46 respectively. Calculate the concentration of the analyte in the test sample. (5 marks)
- b (i) Explain with a neat sketch the electronic transitions in molecules (5 marks)
- (ii) Give a brief explanation on the various factors which affect the absorption spectral bands in organic compounds (5 marks)

QUESTION TWO (20 MARKS)

- 2.a (i) Write a note on the different types of molecular vibrations in diatomic and polyatomic molecules (5 marks)
- (ii) Explain the terms group frequency and finger print region with reference to IR spectra. What is their significance? (5 marks)
- b. (i) Give a note on sample preparation methods for recording the IR spectra (5 marks)
- (ii) Explain the principle in the DRIFTS, ATR and NIR spectroscopic techniques (5 marks)

QUESTION THREE (20 MARKS)

- 3.a (i) Discuss the theory of Raman spectroscopy (5 marks)
- (ii) Justify the statement “IR and Raman spectroscopic techniques are considered as complementary techniques” (5 marks)
- b. Write a note on the applications of Raman spectrometry (10 marks)
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