LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

THIRD YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (GENERAL) &BACHELOR OF EDUCATION (SCIENCE)

CHEM 322: PHYSICAL METHODS OF STRUCTURE DETERMINATION

STREAM: R ***TIME: 2 HRS***

DAY: TUESDAY [11.30A.M – 1.30P.M] ***DATE: 16/04/2024***

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS

Attempt **All** Questions

QUESTION ONE (30 MARKS)

a) State **two** general requirements that must be met if an analyte is to absorb electromagnetic radiation **(2 Marks)**

b) Explain the following terms as used in electronic absorption spectroscopy: **(4 Marks)**

i. Chromophore

ii. Auxochrome

c) Explain **two** selection rules for electronic transitions **(4 Marks)**

d) Describe **two** features of an electronic spectrum **(4 Marks)**

e) Distinguish between transmittance and absorbance **(4 Marks)**

f) (i) What is the criterion for molecules to absorb infrared radiation? **(1 Mark)**

(ii) State **two** types stretching vibrations and **three** types bending vibrations **(5 Marks)**

(iii) What is the significance of the fingerprint region of IR spectrum **(2 Marks)**

g) Explain the significance of the following terms as used in Nuclear Magnetic Resonance **(4 Marks)**

(i) Peak intensity

(ii) Multiplicity of each hydrogen atom

QUESTION TWO (20 MARKS)

a) (i) State Beer-Lamberts law **(2 Marks)**

(ii) Determine the concentration of glycogen-iodine complex if the transmission of light is 40%. The absorption coefficient is 0.20 at 450 nm. The size of the cuvette is 2 cm **(4 Marks)**

(iii) State **three** limitations of Beer-Lambert law **(3 Marks)**

b) (i) State **four** types of transitions between quantized energy levels that account for molecular UV/Vis spectra. **(4 Marks)**

(ii) From the stated transitions explain why a typical UV-Vis spectrophotometer is used to investigate compounds with double or triple bond but not alkanes **(2 Marks)**

c) (i) Explain the principle of analysis of compounds using mass spectroscopy. **(3 Marks)**

(ii) State two applications of mass spectroscopy **(2 Marks)**

QUESTION THREE (20 MARKS)

a) Distinguish in terms of bond and energy between stretching vibrations and bending vibrations **(4 Marks)**

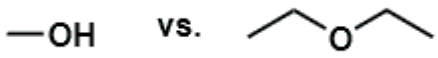
b) Find the number of vibrational modes for the following molecules: **(4 Marks)**

(i) NH_3(non-linear)

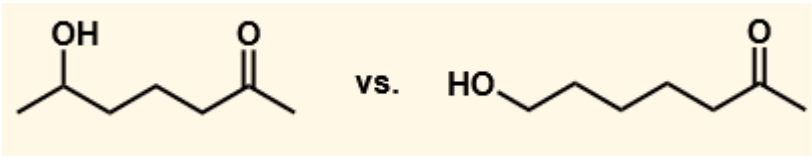
(ii) C_2H_2 (linear)

c) How can the following pairs of compounds be distinguished by their respective IR spectrums? **(4 Marks)**

i)



ii)



d) Define the following terms as used in IR spectroscopy **(3 Marks)**

(i) Combination bands

(ii) Fermi resonance

(iii) Overtones

e) (i) What is the significance of shielding of the nucleus as applied in NMR **(2 Marks)**

(ii) Explain spin-spin splitting **(3 Marks)**