

**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**DEPARTMENT OF PURE AND APPLIED SCIENCES**

**JANUARY, 2018 EXAMINATIONS**

***COURSE CODE:*** *CHM 309* ***CREDIT UNIT:*** *2*

**COURSE TITLE:** ORGANIC SPECTROSCOPY **TIME:** 2 HRS

**INSTRUCTION: *Answer question 1 and any other 3 questions***

**Question 1**

(a) What is the expected transition that will arise from absorption of ultra violet and visible light?

(b) State Beer-Lambert law and write a mathematical equation that represents the law. Define all the terms in the equation

(c) Write an expression for the Larmor equation and explain the significant of the equation to NMR spectroscopy

 (d) List the five major components of NMR instrument and highlight their functions

(e) What is spectroscopy ?

(f) Give four examples of molecular spectroscopic methods

(g) What is statistical thermodynamics?

(h) What is the function of monochromator in spectroscopic instrument?

(i) A photon has a frequency of 10 Hz, calculate the energy of the photon

(j) In structure elucidation, what are the major spectroscopic instrument?

(k) Why is the use of computer and computer accessories necessary in the operation most spectroscopic instrument.

(l) Why is symmetric compounds not IR active?

**Question 2**

(a) What is the principle of operation of mass spectrometry

 (b) Sketch a label block diagram of a mass spectrometer

(c) In one sentence (for each) define the following, mass spectrum, base peak and molecular ion

(d) Write an equation to show that the mass to charge ratio (from a mass spectrometer) of ion is related to accelerating voltage and radius transverse by the ion

**Question 3**

(a) The nuclei of some atoms behaves as a small magnet that is spinning. Briefly describe how the nuclei will behave in the presence of an external magnet.

(b) Calculate the number of orientation or number of magnetic quantum state for nuclei having the following spin quantum numbers,

(i) 1 (ii) ½ (iii) 2 (iv) 0

Predict the usefulness of the above nuclei to NMR spectroscopy. Give reason for your answer.

**Question 4**

(a) Identify the three major components of infra red radiation and state the analytical applications of each of them.

(b) What are five basic phenomena that can be observed when light strike a sample?

(c) Highlight the effect of absorption of infra red, ultra violet visible and radio wave on the energy level of a molecule.

(d) Identify two possible electronic transitions that a molecule may experience after absorption of UV visible light. Comment on the energy requirement of each transition

**Questions 5**

(a) List the three methods of ionizing sample for GCMS analysis

(b) State the significant of the underlisted,

i. Area under the GC peaks

ii. GC peak height

iii. Area under GC peak

iv. Retention time in GC spectrum

(c) What is the advantage of coupling GC with MS over either of the instrument.

(d) Two separate dyes were investigated using spectrophotometer. Use the information provided below (and Beer-Lambert equation) to answer the questions that follows,

i. Dye 1 has λmax = 225 nm and absorbance of 0.896 corresponding to concentration of 0.20 M. calculate the molar absorptivity of the dye if the path length is 0.01 cm.

ii. Dye 2 has λmax = 225 nm and absorbance reading of 0.223 when the molar absorptivity is 0.114mol-1cm-1. Calculate the concentration of the dye in the solution if the path length is 1 cm.