



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) $\frac{1}{2}$ (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,
- Area under the GC peaks
 - GC peak height
 - Area under GC peak
 - 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,
- Dye 1 has $\lambda_{\max} = 225 \text{ nm}$ 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 $\lambda_{\max} = 225 \text{ nm}$ and absorbance reading of 0.223 when the molar absorptivity is $0.114 \text{ mol}^{-1} \text{ cm}^{-1}$. Calculate the concentration of the dye in the solution if the path length is 1 cm.