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DATE: SATURDAY 26TH JANUARY, 2013

NATIONAL OPEN UNIVERSITY OF NIGERIA
END OF SEMESTER EXAMINATION
JANUARY 2013

COURSE TITLE: ORGANIC SPECTROSCOPY

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

INSTRUCTION: ANSWER ANY FOUR QUESTIONS **TIME: 2 Hours**

QUESTION 1

(a) State Beer- Lambert's Law

(b) Calculate the molar absorptivity, ε, of the molecule with concentration ($9.54^{[?][?]}$ 10^{-5} mol dm^{-3}); path length (1 cm); absorbance (1.25); λ_{max} = 263 nm

(c) Calculate the concentration (in mol dm^{-3}) of a solution of compound X with the following data:

Absorbance = 0.0103, ε = 30900 (mol^{-1} cm^{-1}), path length = 1 cm, λ_{max} =530 nm.

(d) If the concentration of a solution of a compound X is 2.0×10^{-4} mol dm^{-3}. What is the Concentration (in mg/mL) of the solution of compound X, if the molar mass of X is 120 g/mol? (18 marks)

QUESTION 2

(a) Define the following terms;

i. Auxochrome ii. Bathochromic shift iii. Hyperchromic shift iv. Chromophore

(b) i. List the types of electronic excitations that may occur in organic compounds.

ii. State the excitation among the ones listed in 2b (i) above that occurs in all molecules with multiple bonds and with conjugated structures.

(c) List the factors governing absorption of radiation in the UV/Vis region. (18 marks)

QUESTION 3

(a) Describe the preparation of a solid sample for Infrared spectroscopy measurement.

(b) State the rules governing transitions in the infrared region of the electromagnetic spectrum.

(c) Explain the factors determining the intensity of absorption signals in IR-Spectroscopy.
(d) After obtaining the spectrum of an unknown compound, a strong absorption in the region 1820. -1 650 cm^{-1} was observed,
(i) State the functional group that is absorbed at this wavelength.
(i) List the groups of compounds that contain this functional group. (18 marks)

QUESTION 4

(a) What do you understand by the term 'chemical shift'?.
(b) Explain the following concepts:
i. Spin–spin splitting
ii. Shielding and deshielding
iii. Coupling constant
(c) State the relationship between magnetic moment and spin of the nucleus when placed in an applied magnetic field. (18 marks)

QUESTION 5

(a) Discuss briefly the principles of Mass Spectrometry.
(b) i. What is the full meaning of IHD with respect to mass spectrometry?
ii. What information could be obtained from IHD?
(c) i. List the methods of sample ionization in mass spectrometry.
ii. Discuss the fragmentation pattern for methanol in mass spectrometry.
(18 marks)

QUESTION 6

(a) Discuss the instrumentation of UV visible spectroscopy.
(b) Explain how solvent and substituents can affect UV absorbance.
(c) Highlight the differences between a continuous wave IR spectrometer and the FT-IR instruments. (18 marks)