



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2009/2010

SUPPLEMENTARY/SPECIAL EXAMINATION FOR THE DEGREE OF
MASTER OF SCIENCE IN ANALYTICAL CHEMISTRY

SCH 555: ANALYTICAL SPECTROSCOPY II

DATE: THURSDAY 30TH SEPTEMBER 2010 TIME: 9.00 A.M. - 12.00 NOON

INSTRUCTIONS:

Answer **ALL** questions.

1.
 - a) Explain how double resonance NMR works and where necessary, use illustrations. (5 marks)
 - b) Differentiate between spin-spin relaxation and spin lattice relaxation (4 marks)
 - c) Explain how discrete electron multiplier detector works. How does it differ from continuous electron multiplier detector? (4 marks)
 - d) Predict (the appearance of high resolution NMR spectrum for the following compounds in each case, indicate the total number of peaks and their ratio for each chemical shift group
 - i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO CH}_3$
 - ii) CH_3CHOH (4 marks)
2.
 - a) Explain how spin-spin coupling peaks can be distinguished from chemical shift peaks. (4 marks)
 - b) The NMR spectrum given in the following figure is for a pure organic compound containing a single atom of chlorine. Identify the compound and give your reasons. (3 marks)

- c) Explain the following terms:
- i) Magnetic anisotropy
 - ii) Chemical shift
 - iii) Off-resonance decoupling
- (6 marks)
- d) Explain how fast atom bombardment works and the types of samples that require this type of ionization? (4 marks)
3. a) Compare and contrast chemical ionization and matrix assisted laser desorption ionization (MALDI) (5 marks)
- b) Explain how NMR radiation emitted by the sample is identified. (4 marks)
- c) Explain with illustration two ways of simplifying complex NMR spectra (4 marks)
- d) You are given a pure organic sample whose structure and molecular mass is unknown. Explain a technique you would use to determine the molecular mass and structure of the compounds. (5 marks)

4. a) Explain how MS-MS instruments work and their advantages over MS instruments. (4 marks)
- b) i) In NMR spectroscopy it is important to maintain a constant magnetic field during the analysis. Why? (2 marks)
- ii) A high resolution NMR instrument operated at a proton frequency of 500 MHz. What is the field strength of the magnet in the instrument in Tesla? Note magnetic moment for a proton is 5.585, Planck's constant is 6.623×10^{-34} J s, Bohr magneton is 5.05×10^{-27} J T⁻¹. (5 marks)
- c) Explain two ways of introducing samples into the ionization source in mass spectroscopy and the conditions under which each method would be necessary. (3 marks)
- d) Differentiate between ferromagnetism and paramagnetism? (4 marks)