

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

CHEM 453: INSTRUMENTAL ANALYSIS

STREAMS: BSC

TIME: 2 HOURS

DAY/DATE: TUESDAY 16/04/2019

11.30 A.M. – 1.30 P.M.

INSTRUCTIONS:

- Answer question ONE and any other TWO questions

QUESTION ONE (30 MARKS)

- (a) List three important properties of super critical fluids. (3 marks)
- (b) Give three variables that determine the choice of the super critical fluid. (3 marks)
- (c) Write two advantages and two disadvantages of size exclusion chromatography. (2 marks)
- (d) Briefly discuss the following briefly
- (i) Capillary zone electrophoresis (2 marks)
 - (ii) Micellar electro kinetic chromatography (3 marks)
- (e) (i) List three factors that affect nebulization in flame emission spectrum. (3 marks)
- (ii) Discuss the following interferences with respect to flame emission spectrum.
- (I) Spectra interferences
 - (II) Self-absorption (4 marks)
- (f) Draw the schematic diagram of the hollow cathode lamp and describe it. (4 marks)
- (g) Give four critical requirements for hyphenated techniques. (2 marks)

- (h) Identify the compound with the molecular formula $C_9H_{10}O$ that gives the IR and NMR spectra shown in appendix one. (4 marks)

QUESTION TWO (20 MARKS)

- (a) Briefly discuss the effect of pressure on super critical fluid. (3 marks)
- (b) Draw a schematic diagram of a capillary electrophoresis system. (4 marks)
- (c) Using a diagram discuss electro osmotic flow. (3 marks)
- (d) Discuss the typical temperature program for a graphite furnace atomizer using a diagram. (5 marks)
- (e) Explain the term plasma in plasma emission spectroscopy. (2 marks)
- (f) Briefly explain why mercury is important in electrodes for polarography. (3 marks)

QUESTION THREE (20 MARKS)

- (a) Give four advantages of super critical fluid extraction. (3 marks)
- (b) Briefly discuss two detector uses for capillary electrophoresis. (4 marks)
- (c) Using a diagram discuss flame emission spectrum. (5 marks)
- (d) Discuss the two important steps before a polarogram is obtained. (4 marks)
- (e) Discuss the following atomizers with reference to the atomic absorption spectrometers.
- (i) Flame atomizes
 - (ii) Electro thermal atomizers (4 marks)

QUESTION FOUR (20 MARKS)

- (a) Briefly explain the following
- (i) Differential pulse polarography
 - (ii) Stripping voltammetry (6 marks)
- (b) Draw the components of a mass spectrometer. (4 marks)
- (c) Define a chemical shift in an NMR. (2 marks)

(d) (i) Calculate the ratio of the different kind of protons in a compound with an integral ratio of 6:4:18:4 (going from left to right across the spectrum)

(ii) Determine the structure of a compound that would give the relative integrals in the observed order. (4 marks)

(e) Predict the structure of a molecule with a molecular formula C_4H_5O peak at $m/z = 72$ and an IR absorption at 1725 cm^{-1} (2 marks)

(f) Explain the observation in IR spectroscopy that C=C bond absorbs at 1650 cm^{-1} and C \equiv C bond absorbs at 2250 cm^{-1} (2 marks)
