



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied and Health Sciences

Pure and Applied Sciences

UNIVERSITY EXAMINATION FOR:

MSc of Technology in Applied Chemistry (Analytical Option)

ABT 5105: Bioinstrumentation and Bio-analytical techniques.

SPECIAL/ SUPPLEMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 3 HOURS

DATE: Sep 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of six questions. Answer four questions

Do not write on the question paper.

Question ONE

a) Explain the following terms

- i. Isocratic elution (2 marks)
- ii. Gradient elution (2 marks)
- iii. Reversed phase packing (2 marks)

b) In structural analysis of biochemical by mass spectroscopy it is advantageous to obtain spectra with both electron impact (EI) and field ionization (FI) sources. Briefly explain why this is advantageous. (6 marks)

c) State the reason(s) for the following observation in instrumentations:

Fluorescence occur at a longer wavelength than the excitation wavelength. (3 marks)

d) A certain inorganic cation has an electrophoretic mobility of $4.31 \times 10^{-4} \text{ cm}^2 \text{ s}^{-1} \text{ v}^{-1}$ and electroosmotic flow of $1.0 \text{ cm}^2 \text{ s}^{-1} \text{ v}^{-1}$. This same ion has a diffusion coefficient of $9.8 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$. If this ion is separated by capillary zone electrophoresis with a 50.0-cm capillary, what is the expected plate count N at applied voltages

- i. 5.0 Kv? (4 marks)
- ii. 30.0 kV? (4 marks)

e) Determine how long will it take in minutes for the, cation X, to reach the detector after the field is applied? For each case (2 marks)

Question TWO

a) Flame atomic absorption spectroscopy is a popular technique for the determination of elements.

i) Using calcium chloride, describe the process taking place in the flame. (2 marks)

ii) Discuss the chemical interferences experienced and how they can be minimized. (6 marks)

iii) Describe two non-flame procedures used to analyze elements (4 marks)

b) A student was given a 20 μg sample comprising of various elements and was asked to analyze all the elements in the sample. What analytical technique would be the most appropriate for analysis of this sample? Give the advantages and the limitations of this technique? (8 marks)

c) Discuss how change in energy for an isolated ^{13}C NMR compare with that of ^1H NMR (4 marks)

Question THREE

(i) Explain the principle behind radiation densitometry technique of analysis. (8 marks)

(ii) Explain how isotope dilution method of analysis is carried out. (10 marks)

(iii) 10mg of a labeled analyte, with specific activity of 18870cpm was added to the Mixture analyzed. After thorough mixing, 1.5mg of the pure analyte was separated and its specific activity was found to be 1550cpm. What was the amount of the analyte in the original sample? (7marks)

Question FOUR

- a) What is the principle separation by capillary zone electrophoresis? **(5 marks)**
- b) Explain how a neutral sample could be separated by micelle electro kinetic chromatography **(5 marks)**
- c) In a HPLC gradient elution separation, what should be changed in regard to solvents A (starting solvent) and B when the following situations develop;
- i. The bands are bunched together near t_m **(3 marks)**
 - ii. The bands continue to elute for a considerable time after completion of gradient **(4 marks)**
 - iii. To improve sensitivity how would the gradient steepness be altered **(4 marks)**
 - iv. To improve resolution how would the gradient be altered? **(4 marks)**

Question FIVE

- a) Raman spectroscopy is widely used in the characterization of amino acids
- i. Describe the process of Raman scattering. **(8 marks)**
 - ii. What type of radiation is used **(2 marks)**
 - iii. What effect (e.g. energy levels) is measured? **(2 marks)**
 - iv. Using a block diagram describe the major components of Raman scattering instruments **(8 marks)**
- b) Discuss how ionization efficiency in EI depend on the energy of the ionizing electron? **(5 marks)**

Question SIX

- i. Discuss analysis of antibodies using enzyme linked immunosorbent assay **(10 marks)**
- ii. Explain any two desorption methods of sample ionization **(10 marks)**
- iii. Discuss the differences between Raman spectroscopy and Infrared spectroscopy **(5 marks)**

