



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCES)
3RD YEAR SECOND SEMESTER RESIT
MAIN REGULAR

COURSE CODE: SPB 9303

COURSE TITLE: METHODS OF CHEMICAL ANALYSIS

EXAM VENUE:

DATE:

TIME:

EXAM SESSION:

STREAM:

INSTRUCTIONS:

1. Answer question 1 (Compulsory) in section A and ANY other 2 questions in Section B.
2. Candidates are advised not to write on the question paper.
3. Candidates must hand in their answer booklets to the invigilator while in the examination room.

SECTION A

Question 1 (30 Marks)

- a. Describe the principle behind spectroscopic techniques (2 Marks)
- b. Explain using a labeled diagram the two basic processes of light-matter interaction that can induce transfer of an electron between two quantized energy states (2 Marks)
- c. List the various regions of the electromagnetic spectrum, and the corresponding spectroscopy technique (5 marks)
- d. A 7.25×10^{-5} M solution of potassium permanganate has a transmittance of 44.1% when measured in a 2.10 cm cell at a wavelength of 525 nm. Calculate;
 - (i) the absorbance of this solution (2 marks)
 - (ii) the molar absorptivity of KMnO_4 (2 marks)
- e. Substances A and B have retention times of 16.40 and 17.63 min, respectively, on a 30.0-cm column. An unretained species passes through the column in 1.30 min. The peak widths (at base) for A and B are 1.11 and 1.21 min, respectively. Calculate
 - (i) the column resolution (2 marks)
 - (ii) the average number of plates in the column (2 marks)
 - (iii) the plate height (2 marks)
 - (iv) the length of column required to achieve a resolution of 1.5 (2 marks)
 - (v) the time required to elute substance B on the column that gives an R_s value of 1.5. (2 marks)

- f. Describe the various types of atomizers used in atomic absorption spectroscopy (4 marks)
- g. Describe the various applications of inductively coupled plasma optical emission spectroscopy (3 marks)

SECTION B

Question 2 (20 marks)

- a. List the six phenomena upon which optical spectroscopic methods are most often based (3 marks).
- b. Describe the six types of photon transducers (6 marks).
- c. Describe the different steps that occur during atomization in atomic absorption spectroscopy (7 marks)
- f. Calculate;
 - i) the wavenumber of a beam of infrared radiation with a wavelength of $5.00\ \mu\text{m}$ (2 marks).
 - ii) Calculate the energy in joules of one photon of radiation with the above wavelength (2 marks).

Question 3 (20 Marks)

- a. Describe the five components of typical spectroscopic instruments in the IR and UV regions (5 marks)
- b. Using a well labelled block diagram, discuss in detail the various components of a mass spectrometer (10 marks).
- c. Using a well labelled block diagram, discuss the various components of a typical gas chromatography instrument. (5 marks)

Question 4 (20 Marks)

- a. Describe suitable sources for ultraviolet (UV)/visible (vis), infra red (IR) and atomic absorption (AA) instruments (5 marks)
- b. Using a well labelled block diagram, discuss in detail the various components of a mass spectrometer (10 marks).
- c. Using a well labelled block diagram, discuss the various components of a typical gas chromatography instrument. (5 marks)

Question 5 (20 marks)

- a) Describe the various Mass Analyzers for Mass Spectrometry (10 marks)
- b) Using a well labelled block diagram, discuss in detail the various components of a typical HPLC instrument. (10 marks)