



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL & PHYSICAL SCIENCES
UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF EDUCATION
SCIENCE
4th YEAR 2ND SEMESTER 2015/2016/ ACADEMIC YEAR
REGULAR - RESIT

COURSE CODE: SCH 410

COURSE TITLE: TECHNIQUES IN ORGANIC CHEMISTRY LABORATORY

EXAM VENUE: LAB 1

STREAM: (BEd. Science)

DATE: 4/05/2016

EXAM SESSION: 11.30-1.30

TIME: 2.00 HOURS

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 One (30 marks)

- a) Describe the regions of the electromagnetic spectrum where UV-VIS and IR occur [1MK].
- b) Give two factors that affect the retention time of a sample in HPLC [1MKS]
- c) List five types of GC detectors and state an application for each. [5MKS]
- d) State the principle of operation of Infrared spectrometry [2MKS]
- e) Define Retention Index (RI) of an alkane and calculate (RI) for n-hexane, n-nonane and pentane [4MKS]
- f) State five factors that make GC method the most popular method for separating and analysing compounds [5MKS]
- g) With the aid of diagrams describe three microscale techniques involving simple distillation, fractional distillation and a Buchner funnel. [6MKS]
- h) Differentiate between Infrared and UV-VIS Spectroscopy techniques in terms of application [2MKS]
- i) Draw the molecular orbital structure and indicate how ΔE for the transition of interest is obtained [3MKS]
- j) State the reason why wavelengths below 200nm cannot easily be studied in instrumental analysis [1MKS]

Section B: This section contains FOUR questions. Answer ONLY TWO questions.

Question Two (20 marks)

- a) State three most commonly used solid support (stationary phase) in TLC. [3MKS]
- b) State the most effective way of identifying a compound using TLC. [2MKS]
- c) Give two advantages of using the TLC technique and explain how the developing chamber is [4MKS]
- d) Explain why the TLC tank must be vapour saturated before elution exercises starts. [1MKS]
- e) Explain two advantages of an MSD Mass Selective Detector over TCD, ECD, FID and NPD detectors. [4MKS]
- f) Draw the five vibrations that are observed for a methane CH_4 molecule. [5MKS]
- g) Describe how the R_f (retention factor) value for each spot should be calculated and state the formula. [1MKS]

Question Three (20 marks)

- (a) The following table shows absorbance vs concentration (ppb) of standard serial dilutions to be used to determine the concentration of Magnesium in an unknown sample of skimmed milk using a UV-VIS analysis.

Concentration	0		100	200	300	400	500	unknown
Absorbance	0.25		0.5	1.5	2.0	2.5	3.0	1.25

- i. Plot a graph of Absorbance vs Concentration from the data presented in the table above [6MKS].
 - ii. Derive the equation of the line showing the gradient and intercept [2MKS].
 - iii. Use the equation above to calculate the concentration of Mg in the unknown sample [2MKS].
- (b) State the vibrations that change the dipole moment of a molecule. [2MKS]
- (c) State three types of electronic transitions that can be considered in UV-VIS spectroscopy. [2MKS]
- (d) Describe the following terms used in HPLC Analysis
- i. Polar interactions
 - ii. Hydrogen bonding interactions [4MKS]
- (e) What factors does IR spectroscopy depend on [2MKS]

Question Four (20 marks)

- (a) Explain the differences between a single beam and a double beam spectrophotometer and describe the functions of the main components (Use schematic block diagrams) [10MKS]
- (b) State the vibrations that change the dipole moment of a molecule. [2MKS]
- (c) Give wavelength of electromagnetic radiation is involved in causing vibrations in molecules and state how mass influences the vibration. [2MKS]
- (d) A compound with a molecular formula $C_4H_4O_2$ has a strong sharp absorbance near 3300cm^{-1} , absorbances in the $2800\text{-}3000\text{ cm}^{-1}$ region and a sharp absorbance near 2200cm^{-1} . It also has a strong broad absorbance in the region $2500\text{-}3600\text{ cm}^{-1}$ and a strong peak in the range $1700\text{-}1780\text{ cm}^{-1}$ region. State five strategies leading to identifying the compound and give the structural formula of the compound. [6MKS]

Question Five (20 marks)

- (a) State the main purpose of the carrier gas in GC [1MK]
- (b) Explain the three factors that are affected by the mobile phase in GC. [3MKS]

(c) Explain the principles of operation of the following detectors and give the detection limits for each.

- i. TCD
- ii. NPD
- iii. MSD
- iv. FID
- v. ECD

[10MKS]

(d) Give the equation showing the deactivation of a support material using dimethyldichlorosilane (DMSO)

[3MKS]

(e) Sketch the three stretching patterns of the CO₂ molecule and state if they are IR active

[3MKS]