W1-2-60-1-6

JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS 2022/2023

END OF SEMESTER EXAMINATIONS FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICINAL CHEMISTRY

TPS 3103: INSTRUMENTAL METHODS OF ANALYSIS
DATE: FEBRUARY 2023 **TIME: 3 HOURS**

QUESTION ONE (25 MARKS)

a) Differentiate between planar and column chromatography and state an example of each **4 Marks**

b) Define the chromatogram and employ it to explain the theory of chromatography **6 Marks**

c) Explain how sample components separate by size exclusion chromatography? **5 Mark**

d) Acetaminophen and aspirin are analgesics that should be used in prescribed quantities. Using reversed phase HPLC describe steps that would be involved in quantitative analysis of blood containing the analgesics assuming aspirin is less polar **10 marks**

QUESTION TWO (25 MARKS)

a) Using a sketch of a TLC chromatogram, write brief notes on following

i. Five steps encountered in TLC **5 marks**
ii. Interpretation of the chromatogram **5 marks**

b) Employ three factors to differentiate between Supercritical fluid chromatography and Gas liquid chromatography **6 marks**

c) Discuss electrophoretic mobility of ions by capillary zone electrophoresis technique **5 marks**

d) What is the working principle of supercritical fluid chromatography **4 marks**

QUESTION THREE (25 MARKS)

a) Explain the working of a UV detector and Electron capture detector **6 marks**

b) Discuss the importance of a chromatogram with respect to the number of theoretical plates and plate height **5 marks**

c) Sketch a bloc diagram of a Gas-liquid chromatograph and explain the major components **10 marks**

d) Highlight four applications of GC-MS and HPLC in medicinal Chemistry **4 marks**

QUESTION FOUR (25 MARKS)

a) Explain, the principle of ion exchange chromatography **4 marks**

b) Explain three factors that affect chromatographic separations in ion exchange chromatography **3 marks**

c) Separation is carried out using GC and HPLC. GC column length is 30 cm and the compounds elute in 5 minutes with $W_{1/2}$ = 5 seconds. HPLC column length was 25 cm and the compounds elute in minutes with $W_{1/2}$ = seconds. For each column calculate

i. The number of theoretical plates **2marks**

ii. The plate height **3 marks**

iii. Which of the two columns will give a better separation. Explain your answer **2 marks**

d) Discuss mass spectrometry based on the following

i. Ionization **4 marks**

ii. Analyzer **4 marks**

iii. Detection **3marks**

QUESTION FIVE (25 MARKS)

a) With reference to absorption and emission spectroscopy, explain spectroscopic methods of analysis **2 marks**

b) Identify **three** factors that are associated with the internal energy within an atom or molecule **3 marks**

c) Distinguish between atomic absorption and molecular absorption **4 marks**

d) Explain the difference between the following two categories of spectroscopy **4 marks**

i. Electronic spectroscopy

ii. Vibrational spectroscopy

e) **i.** Describe the principle of operation of an FTIR and its application in medicinal chemistry **6 marks**

ii. Identify two factors you will consider in enhancing sensitivity of FTIR **2 marks**

ii. Write short notes on sample preparation in FTIR analysis **4 marks**

QUESTION SIX (25 MARKS)

a) Describe the principle of operation and application of Atomic Absorption Spectroscopy **8 marks**

b) i. Using a sketch describe the three zones of a flame in relation to AAS **4 marks**

ii. Explain background and spectral interferences in atomic spectroscopic techniques **5 marks**

e) With an aid of a block diagram, discuss the principle of operation of a UV-Vis spectrometer **8 marks**