



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF B.SC (SCIENCE)

COURSE CODE: SCH 313*

COURSE TITLE: ANALYTICAL CHEMISTRY II

DURATION: 2 HOURS

DATE: 22/12/2022

TIME: 9:00-11:00AM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 6 printed pages. Please Turn Over



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- a) Separation and purification techniques are very important in analytical chemistry. For each of the following separation techniques state the principle behind it and applications:
- i. Filtration [02]
 - ii. Distillation [02]
 - iii. Solvent extraction [02]
- b) Identify an analytical technique in which the ultimate measurement is weight and briefly discuss the various types of this technique. [03]
- c) An analyst is required to use a primary standard, advice the analyst on the qualities of a good primary standard. [03]
- d) Differentiate among the following terms as used in chromatography:
- i. Chromatogram [02]
 - ii. Elution [02]
 - iii. An effluent [02]
 - iv. Retention time [02]
- e)
- i. State Beer-Lambert's law. [01]
 - ii. A $7.25 \times 10^{-5} \text{M}$ solution of potassium permanganate has a transmittance of 44.1% when measured in a 2.10cm cuvette cell at a wavelength of 525nm. Calculate the Absorbance of this solution and the molar absorptivity of KMnO_4 solution. [04]
 - iii. A solution of KMnO_4 has absorbance of 0.539 when measured at 540nm in a 1.0cm cell. The following calibration data was obtained for the spectrophotometer before the absorbance measurement.

Concentration of KMnO_4 (in mol L ⁻¹)	Absorbance (A)
0.03	0.162
0.06	0.330
0.09	0.499
0.12	0.670
0.15	0.840

Draw a calibration curve for the data above and use it to calculate the concentration of KMnO_4 . [03]

- iv. Discuss sources of error in the absorbance measurements taken above. [02]

2.

- a) What is the difference between **Extraction** and **Washing**? [02]

- b) What is **Supercritical carbon dioxide** (sCO_2)? Explain why it is a popular industrial solvent. [04]
- c)
- i. State "distribution law" [01]
 - ii. Why is distribution constant important? [01]
 - iii. Write an expression to show the concentration of analyte [A] remaining in the aqueous phase after several extractions. [02]
- d) The distribution constant K for Iodine between an organic solvent and water is 85. Find the concentration of Iodine remaining in the water layer after extraction of 10^{-3} mol.L⁻¹ iodine solution with the following quantities of organic solvent. [03]
- i) One portion of 50ml
 - ii) Two portions of 25ml
 - iii) Five portions of 10ml
- e) What are the limitations of Liquid-liquid extraction. [02]
- f) Discuss Soxhlet extraction under the following;
- i. Components and parts [01]
 - ii. Operation [02]
 - iii. Advantages [01]
 - iv. Applications [01]
3. Atomic Absorption spectrometry (**AAS**) is an analytical technique used to determine the concentration of metal atoms/ions in a sample. Discuss this quantitative technique under the following;
- a) Principle [02]
 - b) Instrumentation and calibration. [10]
 - c) Applications. [04]
 - d) Strengths and Limitations. [04]
- 4.
- a) What are the conditions which must be fulfilled by a good precipitate for a good precipitation process? [05]
 - b) Discuss the meaning of the following terms as used in gravimetric analysis:
 - i. Isomorphous inclusion [02]
 - ii. Non-isomorphous inclusion [01]
 - iii. Occlusion [01]
 - iv. Surface adsorbance [02]
 - c) You are required to carry out precipitate analysis. Outline the steps which you will follow during this analysis [07]
 - d) State any two applications of precipitation gravimetry. [02]