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# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS  
2019/2020 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER  
MAIN EXAMINATIONS

FOR THE DEGREE (SCIENCE)

**COURSE CODE: SCH 420**

**COURSE TITLE: SCIENTIFIC INSTRUMENTATION**  
**DURATION: 2 HOURS**

**DATE: 10<sup>TH</sup> NOVEMBER, 2020**

**TIME: 9:00AM-12:00PM**

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## 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 3 printed pages. Please Turn Over



KUU observes ZERO tolerance to examination cheating

### QUESTION ONE (30 marks)

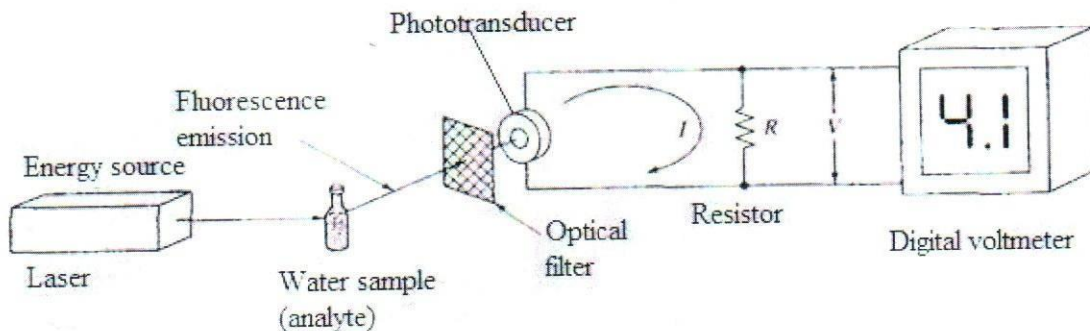
- i. Explain what is meant by the following: (4 marks)
  - I. Quantitative method of analysis
  - II. Qualitative method of analysis
- ii. Define the term instrument as is used in analytical chemistry. (1 mark)
- iii. State any four fundamental properties of an electromagnetic radiation as a wave. (4 marks)
- iv.
  - I. Define the term calibration with regard to instrumental methods. (1 marks)
  - II. Name the three most common methods of calibration. (3 marks)
- v. What is the wavelength of a photon that has three times as much energy as that of a photon whose wavelength is 500 nm? ( $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$ ,  $c = 3.00 \times 10^8 \text{ m/s}$ ) (3 marks)
- vi. Differentiate between the following: (4 marks)
  - I. Absorption and emission
  - II. Photoluminescence and chemiluminescence
- vii. State the use of the following devices in electrochemical methods of analysis. (3 marks)
  - I. Potentiostat
  - II. Galvanostat
  - III. Potentiometer
- viii. State three conditions that must be met for an electric current to develop in an electrochemical cell. (3 marks)
- ix. A compound had a molar absorptivity of  $3.03 \times 10^3 \text{ L cm}^{-1}\text{mol}^{-1}$ . What concentration of the compound would be required to produce a solution that has a transmittance of 9.53% in a 2.50-cm cell? (4 marks)

### QUESTION TWO (20 marks)

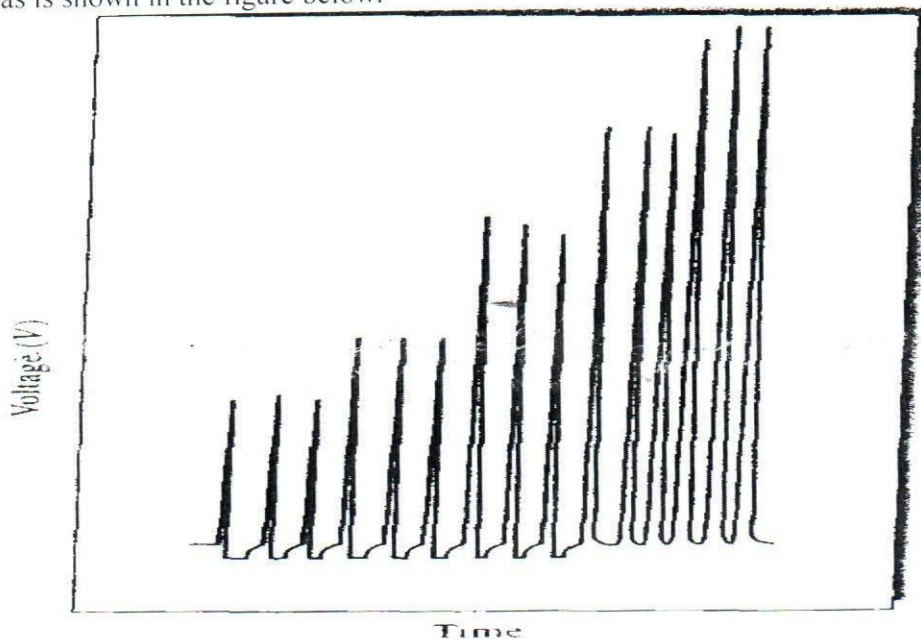
- i. A detector is a form of a transducer. Explain what you understand by the term transducer. (2 marks)
- ii. State five properties of an ideal transducer. (5 marks)
- iii. With respect to transducers, explain what you understand by the term dark current. (1 mark)
- iv. Radiation transducers are classified into two: photon transducers and thermal transducers. Explain the difference between the two types of transducers. Give two examples of each type of transducer. (8 marks)
- v. Explain why photo transducers are not used in infrared spectroscopy. (2 marks)
- vi. The human eye was used as a detector in early spectroscopic instruments. Give two limitations of the eye as a detector. (2 marks)

**QUESTION THREE (20 marks)**

- i. Below is a block diagram of a fluorometer used for measurement of molecular fluorescence intensity of a sample of water containing traces of quinine. Describe how the data inter conversions occur from the Laser source to the digital voltmeter. (10 marks)



- ii. A 25.0 ml sample containing  $\text{Cu}^{2+}$  gave an instrument signal of 23.6 units (corrected for a blank). When exactly 0.5 ml of 0.0287M  $\text{Cu}(\text{NO}_3)_2$  was added to the solution, the signal increased to 37.9 units. Calculate the molar concentration of  $\text{Cu}^{2+}$  assuming that the signal was directly proportional to the analyte. (5 marks)
- iii. For an analog domain, the variation in the signal amplitude can be plotted against time as is shown in the figure below.



State any five important analytical information that can be obtained from a correlation of amplitudes measured at different times in such a plot. (5 marks)

**QUESTION FOUR (20 marks)**

- i. State the principles on which Potentiometric methods of analysis are based. (4 marks)
- ii. An equipment used for Potentiometric method of analysis includes a reference electrode, an indicator electrode and a potential measuring device. (4 marks)
- I. Give four properties of an ideal reference electrode. (4 marks)



- II. Name the device used to measure potential. (1 mark)
- III. Electrodes of the first kind are not widely used as indicator electrodes in Potentiometric methods of analysis. Give four reasons why they are not widely used. (8 marks)
- iii. State three general advantages of electro-analytical methods of analysis over other methods of analysis. (3 marks)