CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 448: ENVIRONMENTAL CHEMISTRY II

STREAMS: BSC (Y4S1) **TIME: 2 HOURS**

DAY/DATE: THURSDAY 23/09/2021 **8.30 A.M – 10.30 A.M.**

INSTRUCTIONS:

- Answer Question **ONE** and Any other T**WO Questions**

QUESTION ONE [30 marks]

(a) (i). What is environmental chemistry? **[2marks]**

(ii). Mention and explain briefly three major areas of applications associated

with the study of environmental chemistry
[4marks]

(iii) What factors have contributed to rapid growth in environmental

analysis**?** **[3marks]**

(b). Environmental analysis involves the application of a range of analytical ***techniques*** and ***methods*** to obtain and assess **qualitative,**

quantitative and **structural** information on the nature of matter in a ***matrix***.

Explain the underlined terms **[4marks]**

(c).(i). Distinguish between selective and specific reactions **[2marks]**

(ii). What factors would one consider in the selection of most appropriate analytical method**?** **[3marks]**

d) i) Describe the term method validation and mention two aspects of the validation process. Why is it necessary to validate an analytical method?

[4marks]

ii) To test a glucometer, a spike recovery is carried out by measuring the amount of glucose in a sample of a patient's blood before and after spiking it with a standard solution of glucose. Before spiking the sample, the glucose level is 86.7 mg/100 mL and after spiking the sample it is 110.3 mg/100 mL. The spike is prepared by adding 10.0 µL of a 25000 mg/100mL standard to a 10.0-mL portion of the blood. What is the spike recovery for this sample? **[4marks]**

e) The following replicate weighings were obtained in an environmental sample 29.8, 30.2, 28.6, and 29.7 mg. Calculate

(i). The standard deviation (ii) The relative standard deviation (iii) The standard deviation of the mean and v) Variance**.**

[4marks]

QUESTION TWO [20marks]

a) Define the following:

i) Limit of detection (LOD) ii) Limit of quantitation (LOQ) **[3marks]**

b) A chemist set an experiment to determine aluminum in plants by a fluorometric procedure. Seven prepared blanks give fluorescence readings of 0.12, 0.18, 0.25, 0.11, 0.16, 0.26, and 0.16 units. A 1.0ppm aluminum standard solution gave a reading of 1.25 units

Determine

(i). Determine the detection limit? **[3marks]**

(ii) What would be the total reading at the detection limit level? **[2marks]**

(iii) Determine the limit of quantitation **[2marks]**

c) Distinguish between the following pairs

(i) Precision and Accuracy
[1.5marks]

(ii) Repeatability and Reproducibility of a method**.**
[1.5marks]

d) i) How is accuracy of a method expressed? Mention ways of assessing accuracy of a method and how it can be improved? **[3marks]**

(ii) A standard serum sample containing 102 meq/L chloride was analyzed by coulometric titration with silver ion. Duplicate results of 101 and 98 meq/L were obtained. Calculate (a) the mean value, (b) the absolute error of the mean, and (c) the relative error in percent
[3marks]

iii) By giving one example each distinguish between determinate and indeterminate errors. How can the common determinate errors be minimized**?**
[2marks]

QUESTION THREE [20marks]

.a).i) Define water pollution **[2marks]**

ii)Name and briefly discuss three main categories of water pollutants. **[4marks]**

b) Illustrating with example/s where possible distinguish between the following pairs

(i) Point and a nonpoint sources of water pollution **[2marks]**

(ii) Oligotrophic and eutrophic waters **[2marks]**

(c) i) Name two important inorganic nutrients that limits the growth of aquatic plants. What are the possible sources of these nutrients**?** **[3marks]**

(ii). Name two aquatic plants and discuss how their growth is affected by the nutrients named in (i) above **[3marks]**

d) Explain the term eutrophication and by means of a flow diagram show the sequential process of eutrophication **[4marks]**

QUESTION FOUR [20marks]

a) i) What is raw sewage? **[2marks]**

ii). List categories of pollutants present in raw waste sewage and state their sources? **[2marks]**

iii). Explain briefly the sequential methods of treating raw sewage. **[4marks]**

b) (i). Name and describe three methods of treating raw sludge and give the end products that may be produced from each step and its use**. [4marks]**

ii) Why is the secondary treatment of wastewater called biological treatment? Outline the principle involved. **[2marks]**

c) (i). What is disinfection? **[2marks]**

(ii). Discuss briefly three water disinfecting techniques.Give advantages and disadvantages of each technique**.** **[4marks]**

QUESTION FIVE [20marks]

a) (i). Distinguish between bioremediation and biodegradation **[2marks]**

(ii). Why is Bioremediation considered important and is it safe? When can this process be considered unsafe? **[2marks]**

(ii) Discuss briefly the factors that affect the efficiency of microorganisms in biodegradation process. **[2marks]**

b). Our very existence necessitates the production of wastes and our responsibility is to adapt the means of meeting our present needs so that the byproducts are managed in ways that cannot endanger present and future generations. Discuss briefly this assertion and mention the general strategy. you can employ to accomplish this **[4marks]**

b) Comment on the following observations

(i). Although many bacteria are able to metabolize organic pollutants, a single

bacterium does not
[2marks]

(ii). Heavy metals are not biodegradable, yet bacteria are efficient in heavy

metal **.** **[2marks]**

c).). i). Distinguish between BOD and COD and state how they are

measured**.** **[3marks]**

ii). A 50 mL of sample is pipetted directly into a 300 mL incubation bottle. The initial dissolved oxygen of the diluted sample is 20.0 mg/L and its final dissolved oxygen is 12.0 mg/L. The temperature of incubation is 20 ^{o}C. If the sample is incubated for 5 days, what is the BOD of the sample? **[3marks]**
