JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS & ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE,

BIOLOGICAL SCIENCE

2ND YEAR 1ST SEMESTER 2022/2023 ACADEMIC YEAR

MAIN CAMPUS

COURSE CODE: SPB 9202

COURSE TITLE: Analytical Chemistry

DATE: **TIME:**

TIME: 2   HOURS

Instructions:

Answer ALL questions in Section A and B and ANY other TWO questions in Section C

Section A - Compulsory

QUESTION ONE (30 marks)

    a. Explain the meaning of the following terms

    i.   Qualitative analysis (1 Marks)

    ii.   Quantitative analysis (1 Marks)

    b. List the various steps in a typical quantitative analysis (4 Marks)

b. Describe the classification of quantitative analysis methods into various categories based on the nature of the measurement (4 Marks).

c. Describe the preparation of 2.000 L OF 0.050 M $AgNO_3$ (169.87 g/mol) from the primary standard grade solid (4 Marks)

e. A standard 0.0100 M solution of Na ion is required to calibrate an ion selective electrode method to determine sodium. Describe how 500 mL of this solution can be prepared from primary standard Na_2CO_3 (105.99 g/mL) (3 Marks)

f. Describe the mechanism of precipitate formation (3 Marks)

g. Describe what is sampling (1 Marks)

h. What are the goals of an analytical separation? (3 marks)

i. Explain the following with respect to Liquid chromatography

    i)   Partition chromatography (1 marks)

    ii)   Adsorption chromatography (1 marks)

    iii)   Ion-exchange chromatography (1 marks)

    iv)   Size-exclusion chromatography (1 marks)

j. What does the work of an analytical chemist entail (2 mark)

Section B

QUESTION TWO (20 marks)

    a. Describe three categories of separation methods alongside the principle behind each separation method (10 marks)

    b. Describe a case study illustrating the use of analytical chemistry to solve a problem in toxicology (10 Marks)

QUESTION THREE (20 marks)

    a. What are systematic errors (1 Marks)

    b. The calcium in a 200.00 mL sample of a natural water was determined by precipitating the cation as CaC_2O_4. The precipitate was filtered, washed, and ignited in a crucible with an empty mass of 26.60 g. The mass of the crucible plus CaO (56.08 g/mol) was 26.71 g. Calculate the concentration of Ca (40.08 g/mol) in water in units of grams per 100 mL of the water (3 marks)

    c. List several properties of ideal precipitates (2 Marks)

    d. Describe the mechanism of precipitate formation (3 Marks)

    e. Abottle of metal hydrate $BaCl_2.2H_2O$ is mixed with an unknown amount of KCl. In order to find the purity of the $BaCl_2.2H_2O$, we heat 9.51g of the metal hydrate mixture to remove water from the sample. After heating, the sample has a reduced mass of 9.14g.

    i) Calculate change in sample mass (1 mark)

    ii) Calculate the moles of evaporated water (1 mark)

    iii) Calculate moles of $BaCl_2.2H_2O$ (1 mark)

iv) Calculate mass of $BaCl_2.2H_2O$ in grams (1 mark)

v) Calculate the mass percent of $BaCl_2.2H_2O$ in the original sample (1 mark)

f. Describe the various methods that are based on mass measurements (6 Marks).

QUESTION FOUR (20 marks)

a. Discuss three types of systematic errors (6 marks)
b. How can systematic errors be detected and eliminated (6 marks)
c. Describe how you can go about sampling soils at a dumping site (5 Marks)
d. Describe the preparation of 2.000 L of 0.0500 M $AgNO_3$ (169.87 g/mol) from the primary standard grade solid (3 Marks)

QUESTION FIVE (20 marks)

a. The following results were obtained in the replicate determination of the lead content of a blood sample: 0.752, 0.756, 0.752, 0.751, and 0.760 ppm Pb. Find the mean and the standard deviation of this set of data. (4 marks)

b. What is gravimetric analysis (2 marks)

c. Explain what is meant by a gravimetric precipitation method and a gravimetric volatilization method (2 marks).
d. What is the difference between a lab sample and a gross sample (2 marks)

e. Explain the following terms; (10 marks)

      i)   Precision and accuracy

      ii)   Random and systematic error

      iii)   Avarage and median

      iv)   Standard deviation and variance

      v)   Detection limit

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