JARAMOGI OGINGA ODINGA UNIVERSITY

OF SCIENCE & TECHNOLOGY

UNIVERSITY EXAMINATIONS 2012/2013

3RD YEAR 1ST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

(MAIN)

COURSE CODE: SCH 310

COURSE TITLE: ANALYTICAL CHEMISTRY

DATE: 16/8/2013 **TIME: 2.00-4.00PM**

DURATION: 2 HOURS

INSTRUCTIONS

1. **This paper consists of two sections.**
2. **Answer all questions in section A (Compulsory) and any other 2 questions from section B.**
3. **Write your answers on the answer booklet provided.**

Section A: This section contains ONE COMPULSORY question

Question 1 (30 marks)

(a) Analytical chemistry comprises both qualitative and quantitative elemental analysis.

(i). What is elemental analysis? (1 mk)

(ii). Briefly state the meaning of each of the following terms:

I. Qualitative elemental analysis

II. Quantitative elemental analysis (2 mks)

(b) Gravimetric analysis is composed of four major types. List down these four major types and for each case state its basis. (6 mks)

(c) A 20.5 mL aqueous solution made using anhydrous Na_2SO_4 was treated with an excess aqueous solution of $Ba(NO_3)_2$ to form 0.56 g of $BaSO_4$ solid. Atomic masses of the elements Na, S, O, Ba and N are 22.98, 32.10, 15.99, 137.3 and 14.00 respectively.

(i) Specify the type of gravimetric analysis involved in this analysis. Briefly explain your answer. (1.5 mk)

(ii) By clearly showing your working, determine the molarity of the Na_2SO_4 in the solution? (3.5 mks)

(iii) Convert the concentration of Na_2SO_4 to:

I. ng/g

II. ppm (3 mks)

(d) Mention one significant limitation of gravimetric analysis in its applications. (1 mk)

(e) A stock solution of a standard is especially important in preparing calibration standards in chemical analysis. With an excess volume of a stock aqueous solution of 0.1 M $Na^+_{(aq)}$ show with the aid of calculations how you can prepare 40 mL portions of:

(i) 0.002 M $Na^+_{(aq)}$

(ii) 1.2 ppb $Na^+_{(aq)}$ (Atomic mass for Na is 22.98) (6 mks)

(f) A 50 mL sodium carbonate aqueous solution was titrated completely by 20 mL of 0.46 M sulphuric acid aqueous solution. By clearly showing your working, determine the concentration in ng/mL of sodium carbonate (anhydrous) in the 50 mL solution. (Atomic masses of elements Na, C, O, S and H are 22.98, 12.01, 15.99, 32.97 and 1.01 respectively). (4 mks)

(g) Mention two applications of Thin Layer Chromatography (TLC) in a reaction process in an industry. (2 mks)

Section B: This section contains FOUR questions. Answer ONLY TWO questions.

Question 2 (20 marks)

(a) What is colorimetry as applied to chemical analysis? (1.5 mks)

(b) Give the basis of colorimetric analysis. (1.5 mks)

(c) Light directed at a homogenous medium can behave in different ways.

(i) List the possible ways in which this light behaves? (3 mks)

(ii) What determines the color of the sample that interacts with light? (1 mk)

(d) Give two applications of colorimetry (2 mks)

(e) Gravimetric analysis is an essential tool in the gas and oil exploration industry. Explain. (3 mks)

(f) Briefly describe the factors that determine the success of titrimetric analysis. (6 mks)

(g) Mention two ways that can possibly be used to monitor the progress of a titration if there is no suitable indicator. (2 mks)

Question 3 (20 marks)

(a) (i) Mention three factors that influence the physical characteristics of an electrolyte deposition on electrodes. (3 mks)

(ii) Describe mechanisms responsible for the transport of dissolved species to and from an electrode surface. (3 mks)

(b) (i) What are the advantages of coulometric titration over conventional volumetric procedures? (4 mks)

(ii) A constant current of 0.800 A is used to deposit copper (63.55 g/mol) at the cathode and oxygen (32.0 g/mol) at the anode of an electrolytic cell. Calculate the number of grams of each product formed in 15.2 minutes, assuming no other redox reaction takes place (1 Faraday = 96485 C). (5 mks)

(c) Mention three uses of volumetric analysis. (3 mks)

(d) Colorimetric analysis has an edge over titrimetric and gravimetric analysis. Give two advantages of colorimetry over these two methods in analysis. (2 mks)

Question 4 (20 marks)

(a) Chromatography is one of the best utilized methods in chemical analysis.

(i) What is meant by the term chromatography? (1 mk)

(ii) Outline the basis of each of the following chromatographic techniques clearly pointing out the stationary phase and mobile phase?

I. Paper chromatography (3 mks)

II. TLC (3 mks)

III. GC (3 mks)

IV. HPLC (3 mks)

V. Column Chromatography (CC) (3 mks)

(iii) Explain the advantages of using TLC over paper chromatography. (4 mks)

Question 5 (20 marks)

(a) Give the meaning of the following terms as applied in titrimetric analysis?

(i) Standard solution (1 mk)

(ii) Titrant? (1 mk)

(iii) Titrand? (1 mk)

(iv) Titration process? (1 mk)

(v) Indicator? (1 mk)

(vi) Stoichiometric end point? (1 mk)

(vii) End point (1 mk)

(b) Column Chromatography (CC) is not used as an analytical tool just as TLC, HPLC or GLC are, however, it has proved to be a very important component especially in TLC analysis.

(i) Present a sketch of a column chromatogragh. (2 mks)

(ii) Briefly state the functions of the various components (layers) packed in the column. (4 mks)

(iii) Briefly state the aid of CC in TLC analysis. (2 mks)

(c) Present a block diagram of a GLC chromatograph and briefly state why the temperature of the column has to be controlled when a sample is run. (5 mks)