GARISSA UNIVERSITY

UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE FIRST SEMESTER EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: CHE 112

COURSE TITLE: INTRODUCTION TO ANALYTICAL CHEMISTRY

EXAMINATION DURATION: 3 HOURS

DATE: 01/12/17 **TIME: 09.00-12.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of FOUR (4) printed pages ***please turn over***

QUESTION ONE (COMPULSORY)

(a) Define the following Analytical Chemistry terms **[8 marks]**

i. Precision

ii. Accuracy

iii. Determinate and indeterminate errors

iv. Back titration

(b) What is the primary ionization technique in the following Analytical techniques **[6 marks]**

i. GC-MS

ii. LC-MS

iii. ICP-MS

(c) State any three (3) electro- analytical techniques **[3 marks]**

(d) How many milliliters of 0.100M KI are needed to react with 40.00 ml of 0.0400 M $Hg_2(NO_3)$ if the reaction is: $Hg_2^{2+} + 2I^- \rightarrow Hg_2I_2(s)$ **[6 marks]**

(e) Differentiate between systematic and random errors in analytical analysis **[2 marks]**

QUESTION TWO

(a) Describe the following terms and state their acceptable values in a set of analytical analysis data **[3 marks]**

i. LOD

ii. LOQ

(b) Describe the basic steps to be followed in a chemical analysis in Analytical Chemistry **[3 marks]**

(c) Which technique can be used to separate a soluble solid from the liquid it is dissolved in **[1 mark]**

(d) State four desirable properties of standard solutions for Chemical Analysis **[2 marks]**

(f) Define the following terms as used in analytical chemistry **[2 marks]**

i. Precision

ii. Accuracy

(g) State the three types of chromatography and give their main features. **[4 marks]**

QUESTION THREE

(a) Name two extraction techniques of liquid- liquid mixtures **[1 mark]**

(b) Differentiate between **[4 marks]**

i. Qualitative analysis
ii. Quantitative analysis

(c) What is the most commonly used stationary phase in reversed phase (RP) HPLC? Give the specific name **[2 marks]**

(d) What is the most commonly used stationary phase in gas-liquid chromatography GLC? Specify name **[2 marks]**

(e) Which technique can be used to separate an insoluble solid from a liquid **[2 marks]**

(f) Name 4 Important requirements for primary standards to have **[4 marks]**

QUESTION FOUR

An ore containing magnetite, Fe_3O_4, was analyzed by dissolving a 1.5419-g sample in concentrated HCl, giving a mixture of Fe^{2+} and Fe^{3+}. After adding HNO_3 to oxidize any Fe^{2+} to $Fe^{3+,}$ the resulting solution was diluted with water and the Fe^{3+} precipitated as $Fe(OH)_3$ by adding NH_3. After filtering and rinsing, the residue was ignited, giving 0.8525 g of pure Fe_2O_3. Calculate the %w/w Fe_3O_4 in the sample. **[5 marks]**

QUESTION FIVE

(a) Two students titrated a 100.00 mL sample of HCl with an unknown concentration with a standardized 0.1339 M NaOH sample.

$$HCl + NaOH \rightleftharpoons NaCl + H_2O$$

The students obtained the following results:

Student A: 23.17 mL, 22.69 mL, 23.25 mL, 22.97 mL

Student B: 25.25 mL, 25.19 mL, 25.23 mL, 25.23 mL

i. Determine the average (mean) and standard deviation for each student's data set **[5 marks]**

ii. Which student was more precise? Explain **[2 marks]**

iii. If the unknown HCl sample has a concentration of 0.0030 M, which student is more accurate **[2 marks]**

iv. Are the results (titration volumes) obtained by the two students significantly different at the 95% confidence level (Given: $S_{pooled} = 0.18$**)** **[3 marks]**

v. Using the Q test, decide if the second measurement (22.69 mL) for student A should be discarded **[3 marks]**

QUESTION SIX

In the lab a student got the following 4 numbers for the concentration of chloride in a

Sample: 0.1015, 0.0991, 0.1016, and 0.1017. Calculate the following using the above data;

i. The mean **[3 marks]**

ii. The standard deviation **[3 marks]**

iii. Check whether any point should be excluded at the 95% confidence level. Tabulated Q 95% = 0.829 for 4 observations [**9 marks]**