DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SECOND SEMESTER EXAMINATION 2018/2019 SESSION

COURSE CODE: CHM 324

UNITS: 3

COURSE TITLE: ANALYTICAL CHEMISTRY TIME ALLOWED: 2 HOURS

INSTRUCTION: ANSWER *ONE* QUESTION ONLY FROM EACH SECTION

SECTION A

1. (a) (i) Define the term *t-test.*

(ii) State three applications of t-test .

[5 Marks]

(b) In a repeated analysis, the concentrations (mg/kg) of arsenic obtained from a sample of an industrial wastewater were; 2.24, 2.14, 2.18, 2.21 and 2.22.

(i) Find the mean and the standard deviation of the values.

(ii) Using student t-test, compare your mean in b (i) with expected value of 2.15, stating if there exists any significant difference. (t-tab = 1.11, at 95% Confidence Interval) **[8 Marks]**

(c) When is a method of chemical analysis said to be rugged? **[2 Marks]**

2. (a) The following data refer to the cyanide concentrations (µ/g) in a sample of foreign soft drink in replicate determinations: 14.17, 14.15, 14.24, 14.27, 14.01. Determine whether the value 14.27 should be accepted or not. (Q_{tab} = 0.54, at 95 % confidence interval). **[3 Marks]**

(b) (i) Define the term *accuracy*.

(ii) When is a result said to be highly accurate? **[4 Marks]**

(c) (i) Differentiate between systematic and random error. **[4 Marks]**

(ii) State two examples of systematic error. **[2 Marks]**

(iii) What are the ways in which systematic error could be eliminated? **[2 Marks]**

SECTION B

3. (a) Highlight any four (4) operational steps in gravimetric analysis. **[4 Marks]**

(b) Give the chemical structures and two ions the following organic compound precipitate.

i. 1- Nitroso-2- naphthol

ii. Dimethylglyoxime **[8 Marks]**

(c) In the analysis of nickel content of steel us DMG as precipitating agent, what is the percentage of Nickel if 0.6472g of steel gives 0.1188g of $Ni(DMG)_2$ precipitate. [Molar masses: Ni = 58.69, $Ni(DMG)_2$ =288.91] **[3 Marks]**

4. (a) Describe any four (4) methods in gravimetric analysis.
[6 Marks]

(b) Distinguish between inclusion and occlusion adsorbed impurities with examples.

[3 Marks]

(c) Explain three ways to minimize precipitate impurities in gravimetric analysis.

[3 Marks]

(d) A limestone sample weighing 1.5g was dissolved and the calcium content was precipitated with ethanedioic acid. The precipitate was ignited and weighed as CaO. Determine the percentage of $CaCO_3$ in the sample if the CaO weighed 0.8g. [Molar masses: $CaCO_3$ =100.09, CaO = 56.08]

[3 Marks]

SECTION C

5. (a) Explaining all the terms used, show that the percentage extraction of a solute in a solvent extraction technique is given by the expression:

$$\%\ \text{Etraction (E)} = \frac{100\text{D}}{\text{D} + \text{V}_{aq}/\text{V}_{org}}$$

(b) Discuss how a mixture of two solutes in an aqueous medium can be analysed using solvent extraction technique.
[7 Marks]

6. (a) Using appropriate mathematical expressions, show that the affinity of a compound for stationary phase in ion exchange chromatography can have values from 0 to 1.

[4 Marks]

(b) Briefly explain the following terms as used in ion exchange chromatography.

(i) Retention factor (ii) The basic principles

[4 Marks]

SECTION D

7. a) Define the term "Titrimetric analysis". **[2 marks]**

b) Outline the quality of specific requirements a primary standard substance must meet.

[3 marks]

c) For the titration of 25.00cm^3 of 0.050 00 $moldm^{-3}$ NaOH with 0.250 00 $moldm^{-3}$HCl, calculate the pH when the titre value is (i) 0.30Ve (ii) 1.10Ve **[10 marks]**

8. a) What is the;

i) mass of CsOH required to prepare 250cm^3 of 0.020 00 $moldm^{-3}$ CsOH solution?

[Cs = 132.9; O = 16.0; H = 1.0] **[3 marks]**

ii) pH of 0.020 00$moldm^{-3}$ CsOH solution? **[3 marks]**

b) Derive an expression for acid dissociation constant. **[3 marks]**

c) Briefly describe the four groups of titrimetric methods based on the type of reactions involved. **[6 marks]**