# SOUTH EASTERN KENYA UNIVERSITY

## UNIVERSITY EXAMINATIONS 2016/2017

### SECOND SEMESTER EXAMINATION FOR THE DEGREES OF BACHELOR OF SCIENCE (CHEMISTRY)

### SCA 201: QUANTITATIVE ANALYSIS

**DATE: APRIL, 2017**                                   **TIME:**

### INSTRUCTIONS TO CANDIDATES

(a) Answer <u>question One</u> and any other <u>Two questions</u>

(b) Question 1 <u>carries 30 marks</u> while the other questions <u>carry 20 marks</u> each

(c) Illustrate your answers with well label diagrams where applicable

---

**Question 1**                                                                    **[30 marks]**

a) Define the following terms

   i) Population

   ii) Sample

   iii) Laboratory sample

                                                                                    [3 marks]

b) State five conditions that should be fulfilled during sample preparation.

                                                                                    [5 marks]

---

c) Identify **THREE** sources of systematic errors and give **TWO** examples for each.

[6 marks]

d) The sodium ion level in urine specimen was measured using an ion-selective electrode. The following values were obtained: 102, 97, 99, 98, 101,106 mM. Calculate the confidence limits and confidence interval at 99 % confidence level for the sodium ion concentration. [10 marks]

e) Explain the difference between:

i) Colloid and crystalline precipitate
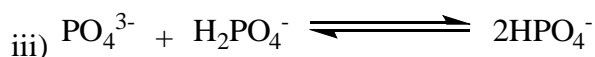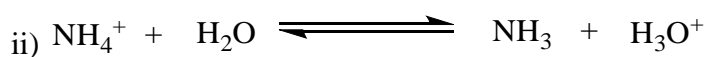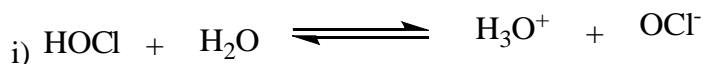
ii) Precipitation and co-precipitation

iii) Occlusion and mixed crystal formation
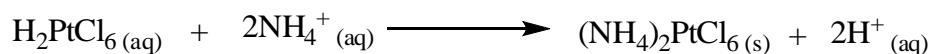
[6 marks]

## Question 2 [20 marks]

a) Identify the acid on the left and its conjugate base on the right in the following equations

i) $HOCl + H_2O \rightleftharpoons H_3O^+ + OCl^-$

ii) $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

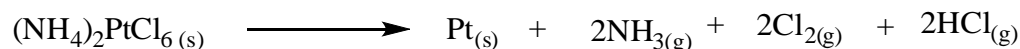iii) $PO_4^{3-} + H_2PO_4^- \rightleftharpoons 2HPO_4^-$

[6 marks]

b) Ammoniacal nitrogen can be determined by treatment of the sample with chloroplatinic acid; the product is a slightly soluble ammonium chloroplatinate

$$H_2PtCl_{6\,(aq)} + 2NH_4^+{}_{(aq)} \longrightarrow (NH_4)_2PtCl_{6\,(s)} + 2H^+{}_{(aq)}$$

The precipitate decomposes on ignition, yielding metallic platinum and gaseous products

$$(NH_4)_2PtCl_{6\,(s)} \longrightarrow Pt_{(s)} + 2NH_{3(g)} + 2Cl_{2(g)} + 2HCl_{(g)}$$

Calculate the percentage of ammonia in a sample if 0.2115 g gave rise to 0.4693 g of platinum. (RAM N = 1, H = 1, Pt = 195.08) [8 marks]

c) Calculate the pH during the titration of 50.00 mL of 0.0500 M NaOH with 24.50 mL of 0.1000 M HCl at 25 °C. ($Kw = 1.0 \times 10^{-14}$) [6 marks]

---

a) The atomic absorption method for the determination of the amount of iron present in jet engine oil was found by pooling 30 triplicate analyses to have a standard deviation s = 3.6 µg Fe/mL. If s is a good estimate of σ, calculate the 95 and 99 % confidence interval for the result 18.5 µg Fe/mL if it was based on:

i) A single analysis

ii) The mean of four analyses

[10 marks]

b) The data in the table below were obtained during a colorimetric determination of glucose in blood serum

| Glucose concentration, mM | Absorbance, A |
|---|---|
| 0.0 | 0.002 |
| 2.0 | 0.150 |
| 4.0 | 0.294 |
| 6.0 | 0.434 |
| 8.0 | 0.570 |
| 10.0 | 0.704 |

i) Assuming a linear relationship between the variables, find the least-squares estimates of the slope and intercept and hence the least-squares equation for the relationship between the variables.

ii) Calculate the standard deviation of slope and intercept.

[10 marks]

## Question 4 [20 marks]

a)

    i.    Calculate the weight of silver nitrate needed to convert 2.33 g of sodium carbonate to silver carbonate (relative atomic mass Na = 23, C = 12, O = 16, Ag = 108).

    ii.    Calculate the weight of silver carbonate formed.

[10 marks]

b) A 100.00 mL sample of spring water was treated to convert any iron present to $Fe^{2+}$. Addition of 25.00 mL of 0.002517 M $K_2Cr_2O_7$ resulted in the reaction

$$6Fe^{2+} + Cr_2O_7^{2-} \longrightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$$
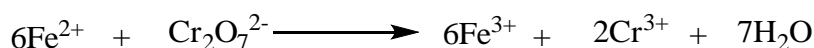
The excess $K_2Cr_2O_7$ was back titrated with 8.53 mL of 0.00949 M $Fe^{2+}$ solution. Calculate the concentration of iron in the sample in parts per million. [10 marks]

## Question 5 [20 marks]

a)

i) Define a primary standard     [1 mark]

ii) State FIVE requirements of a primary standard     [5 marks]

b) A 0.8040 g sample of an iron ore is dissolved in an acid. The iron is then reduced to $Fe^{2+}$ and titrated with 47.22 mL of 0.02242 M $KMnO_4$ solution. The reaction of the analyte with the reagent is described by the equation

$$MnO^{4-} + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$
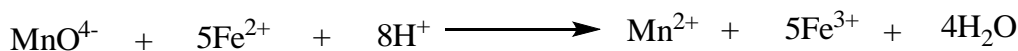
Calculate the results of this analysis in:

i) % Fe (RAM Fe = 55.847g/ mol)     [5marks]

ii)% $Fe_3O_4$ (RMM $Fe_3O_4$ = 231.54 g/ mol)     [5 marks]

c) Explain Four advantages of gravimetric titrations over volumetric titrations

[4 marks]