



**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**FACULTY OF APPLIED SCIENCES**

**DEPARTMENT OF APPLIED CHEMISTRY**

**ANALYTICAL CHEMISTRY I**

**SCH 1206**

**Second Semester Examination Paper**

**May 2016**

This examination paper consists of 4 pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Examiner's Name: Dr. A. Maringa**

**INSTRUCTIONS**

1. Answer ALL questions in section A and any three (3) questions in section B
2. Each question in section A carries 10 marks and each question in section B carries 20 marks

**MARK ALLOCATION**

<b>QUESTION</b>	<b>MARKS</b>
SECTION A: 1.	<b>10</b>
2.	<b>10</b>
3.	<b>10</b>
4.	<b>10</b>
SECTION B: 5	<b>20</b>
6	<b>20</b>
7	<b>20</b>
8	<b>20</b>
<b>TOTAL POSSIBLE MARKS</b>	<b>100</b>

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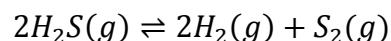
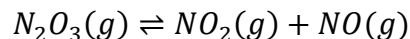
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**SCH 1206**

## **SECTION A**

1. a) Distinguish between qualitative analysis and quantitative analysis. Give examples. [4 marks]

b) Write equilibrium-constant expressions  $K_c$  for each of the following reactions.



2. a) State the Le-Chatelier's principle. [2 marks]

b) Predict the direction of reaction when  $H_2$  is removed from a mixture in which the following equilibrium has been established:



c) Calculate the standard deviation and the relative standard deviation for the following data:

Measurement No.	Value (g)
1	16.7724
2	16.7735
3	16.7722
4	16.7756
5	16.7729
6	16.7716
7	16.7720
8	16.7733

[5 marks]

3. a) Explain briefly the salt effect. [3 marks]

b) State the properties of activity coefficient. [5 marks]

c) Explain why the solubility of an ionic compound increases as the ionic strength of a solution increases. [2 marks]

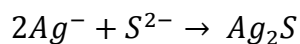
4. a) Distinguish between determinate and indeterminate errors. [4 marks]
- b) Calculate the ionic strength of a solution that is:
- (i) 0.030 M in  $\text{FeSO}_4$ .
  - (ii) 0.30 M in  $\text{FeCl}_3$  and 0.20 M in  $\text{FeCl}_2$ .
  - (iii) 0.05 M in  $\text{KNO}_3$  and 0.1 M in  $\text{Na}_2\text{SO}_4$ . [6 marks]

### **SECTION B**

5. a) Describe 5 factors which affect the rate of a chemical reaction. [10 marks]
- b) An analyst determines that the analytical balance he used in a given analytical test is wrongly calibrated. Is this a determinate or an indeterminate error? Explain. [4 marks]
- c) A mixture of 1.20 mol of X, 2.10 mol of Y, and 0.950 mol of Z is found at equilibrium in a 1.00 L vessel. (a) Calculate  $K$ . (b) If the same mixture had been found in a 2.00 L reaction mixture, would the value of  $K$  have been the same? Explain. [6 marks]
6. a) Calculate the pH of 0.100 M  $\text{NH}_3$ .  $K_b = 1.8 \times 10^{-5}$  [5 marks]
- b) Calculate the value of the equilibrium constant at a certain temperature for the following reaction if there are present at equilibrium 0.10 mol of  $\text{N}_2$ , 0.070 mol of  $\text{O}_2$ , and  $1.4 \times 10^{-3}$  mol of  $\text{NO}_2$  in 2.0 L. [5 marks]
- c) Is  $\text{NH}_4\text{Cl}$  solution in water acidic or basic? Explain. [4 marks]
- d) Calculate the hydronium ion concentration of a 0.250 M acetic acid solution also containing 0.190 M sodium acetate.  $K_a = 1.81 \times 10^{-5}$ . [6 marks]

7. a) Describe the factors that are ideal for a standard solution. [8 marks]

b) A 100 mL sample of brackish water was ammoniacal and the sulfide it contained was titrated with 16.47 mL of 0.0231 M  $\text{AgNO}_3$ . The analytical reaction is



Calculate the concentration of  $\text{H}_2\text{S}$  in water in parts per million. [12 marks]

8. a) Make a distinction between thermodynamic and concentration equilibrium. [4 marks]

b) Calculate the solubilities of the following compounds in a 0.0167 M solution of  $\text{Ba}(\text{NO}_3)_2$  using (1) activities and (2) molar concentrations:

(i)  $\text{AgIO}_3$ . [4 marks]

(ii)  $\text{Mg}(\text{OH})_2$ . [4 marks]

(iii)  $\text{BaSO}_4$ . [4 marks]

(iv)  $\text{La}(\text{IO}_3)_3$ . [4 marks]