NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY II

SCH 2106

First Semester Examination Paper

December 2015

This examination paper consists of 4 pages of examination questions and 3 pages of reduction potential tables.

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: **Reduction Tables (attached to the paper)**

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

INSTRUCTIONS

1. Answer any four (4) questions.
2. Each question carries 25 marks.
3. Use of calculators is permissible.
4. Electrode potential tables will be provided.

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
TOTAL POSSIBLE MARKS	**100**

1. (a). Define the following terms

i. Reducing agent

ii. Nernst equation

iii. Oxidation

iv. Salt bridge

v. Electrode potential [10 marks]

(b). Calculate the potential of copper electrode immersed in

i. 0.0380 M $Cu(NO_3)_2$. [5 marks]

ii. 0.0560 M in NaCl and saturated with CuCl. [5 marks]

iii. 0.0350 M in NaOH and saturated with $Cu(OH)_2$. [5 marks]

Given that: $Cu^{2+} + 2e^- \rightleftharpoons Cu(s)\ E^o = 0.337$ V

$Cu^+ + e^- \rightleftharpoons Cu(s)\quad E^o = 0.521$ V

$K_{CuCl} = 1.9\ x\ 10^{-7}$, $K_{Cu(OH)_2} = 4.8\ x\ 10^{-20}$

2. (a). Describe the basic differences between atomic emission and atomic absorption spectroscopy. [4 marks]

(b). Explain what is meant by spectral, chemical, ionization, and isobaric interference. [12 marks]

(c). Why is an internal standard most appropriate for quantitative analysis when unavoidable sample losses are expected during sample preparation? [4 marks]

(d). What processes occur to produce light emission from the flame when a solution containing sodium ions is introduced into the instrument? [5 marks]

3. (a). What is the relationship between:

i. Absorbance and transmittance [3 marks]

ii. Absorptivity and molar absorptivity [3 marks]

(b). Identify factors that cause the Beer's law relationship to be nonlinear. [6 marks]

(c). At 580 nm, the wavelength of its maximum absorption, the complex $Fe(SCN)^{2+}$ has a molar absorptivity of 7.00×10^3 L cm^{-1} mol^{-1}. Calculate:

i. The absorbance of a 3.40×10^{-5} M solution of the complex at 580 nm in a 1.00-cm cell. [3 marks]

ii. The absorbance of a solution in which the concentration of the complex is twice that in (i). [3 marks]

iii. The transmittance of the solutions described in (i) and (ii). [4 marks]

iv. The absorbance of a solution that has half the transmittance of that described in (i). [3 marks]

4. (a). Draw different wave forms encountered in voltammetry. [8 marks]

(b). List the advantages and disadvantages of the dropping mercury electrode compared with platinum or carbon microelectrodes. [8 marks]

(c). Distinguish between a limiting current and a diffusion current. [4 marks]

(d). The polarogram for 20.0 ml of solution that was 3.65×10^{-3} M in Cd^{2+} gave a wave for that ion with a diffusion current of 31.3 μA. Calculate the percentage change in concentration of the solution if the current in the limiting current region were allowed to continue for 5 mins. [5 marks]

5. (a). Distinguish between

i. Voltammetry and amperometry. [4 marks]

ii. Differential-pulse voltammetry and square-wave voltammetry. [4 marks]

iii. A limiting current and a diffusion current. [3 marks]

iv. The standard electrode potential and the half wave potential for a reversible reaction at a working electrode. [4 marks]

(b). Two types of interferences are encountered in atomic absorption methods. Give a detailed description of each. What steps can be taken to eliminate or minimize such interferences? [10 marks]

End of question paper!!!