



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY II

SCH 2106

Supplementary Examination Paper

July 2016

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

Time Allowed: 3 hours

Total Marks: 100

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

Examiner's Name: Dr A. Maringa

INSTRUCTIONS

1. Answer any **FOUR** questions. Each question carries 25 marks. Illustrate your answer, where appropriate, with large clearly labelled diagrams.
2. Use of calculators is permissible.
3. Electrode potential tables will be provided.

MARK ALLOCATION

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

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1. (a). Briefly describe or define
- i. Electrode potential.
 - ii. Formal potential.
 - iii. Standard electrode potential.
 - iv. Liquid-junction potential.
 - v. Oxidation potential [10 marks]
- (b). Calculate the potential of a platinum electrode immersed in a solution that is
- i. 0.0160 M in K_2PtCl_4 and 0.2450 M in KCl. [5 marks]
 - ii. 0.0650 M in $\text{Sn}(\text{SO}_4)_2$ and 3.5×10^{-3} M in SnSO_4 . [5 marks]
 - iii. Buffered to a pH of 6.50 and saturated with $\text{H}_2(g)$ at 1.00 atm. [5 marks]
2. (a). With the aid of labeled diagrams explain the difference between single-beam and double beam spectrophotometers. [7 marks]
- (b). Discuss the limitations of Beer's Law. [13 marks]
- (c). Why is it necessary for the glass in the membrane of pH-sensitive electrode to be appreciably hygroscopic? [5 marks]
3. (a). Define the following:
- i. Absorbance [2 marks]
 - ii. Transmittance [2 marks]
 - iii. Beer Lambert's Law [2 marks]
- (b). What are the advantages and disadvantages of decreasing monochromator slit width? [6 marks]

3. (c). A solution containing a complex formed between Bi(III) and thiourea has a molar absorptivity of $9.32 \times 10^3 \text{ L}\cdot\text{cm}^{-1}\cdot\text{mol}^{-1}$ at 470 nm.
- What is the absorbance of a $5.67 \times 10^{-5} \text{ M}$ solution of the complex in a 1.00 cm cell? [4 marks]
 - What is the percentage transmittance of the solution described in (i)? [4 marks]
 - What is the molar concentration of the complex in a solution that has the absorbance described in (i) when measured at 470 nm in a 2.50 cm cell. [5 marks]
4. (a). Why is atomic emission more sensitive to flame instability than atomic absorption? [7 marks]
- (b). Draw a diagram illustrating the main parts of an atomic absorption spectrophotometer. [8 marks]
- (c). What processes occur to produce light emission from the flame when a solution containing sodium ions is presented to the instrument? [10 marks]
5. Consider the following oxidation/reduction reactions:
- $$\text{AgBr}(s) + \text{V}^{2+} \rightarrow \text{Ag}(s) + \text{V}^{3+} + \text{Br}^{-}$$
- $$\text{Tl}^{3+} + 2\text{Fe}(\text{CN})_6^{4-} \rightarrow \text{Tl}^{+} + 2\text{Fe}(\text{CN})_6^{3-}$$
- $$2\text{V}^{3+} + \text{Zn}(s) \rightarrow 2\text{V}^{2+} + \text{Zn}^{2+}$$
- $$\text{Fe}(\text{CN})_6^{3-} + \text{Ag}(s) + \text{Br}^{-} \rightarrow \text{Fe}(\text{CN})_6^{4-} + \text{AgBr}(s)$$
- $$\text{S}_2\text{O}_8^{2-}(s) + \text{Tl}^{+} \rightarrow 2\text{SO}_4^{2-} + \text{Tl}^{3+}$$
- Write each net process in terms of two balanced half-reactions. [10 marks]
 - Express each half-reaction as a reduction. [10 marks]
 - Arrange the half-reactions in (b) in order of decreasing effectiveness as electron acceptors. [5 marks]

End of question paper!!!

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