



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY II

SCH 2106

Supplementary Examination Paper

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: DR H. Chiririwa

INSTRUCTIONS

1. Answer ***FOUR*** questions, ***TWO*** from Section A and ***TWO*** from Section B. Each question carries 25 marks. Illustrate your answer, where appropriate, with large clearly labelled diagrams
2. Use of calculators is permissible

MARK ALLOCATION

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

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SECTION A

1. (a) Explain the difference between electric charge, electric current and electric potential. [6 marks]
- (b) Define the following terms:
- (i) Junction potential. [2 marks]
 - (ii) Salt bridge. [2 marks]
- (c) (i) How much work is required to move 2.36 mmol of electrons through a potential difference of 1.05V? [3 marks]
- (iii) State the relationship between free energy and electric potential. [2 marks]

- (d) From the overall formation constant of $\text{Ni}(\text{glycine})_2^{2+}$ plus the value of E° for the $\text{Ni}^{2+} | \text{Ni}(s)$ couple,



Deduce the value for E° from the following reactions:

- (i) $\text{Ni}^{2+} + 2 \text{glycine} \leftrightarrow \text{Ni}(\text{glycine})_2^{2+}$ [5 marks]
 - (ii) $\text{Ni}(\text{glycine})_2^{2+} + 2e^- \leftrightarrow \text{Ni}(s) + 2\text{glycine}$ [5 marks]
2. (a) The most widely employed ion-selective electrode for measuring pH is the glass electrode.
- (i) State five (5) limitations of a glass electrode on pH measurement. [5 marks]
 - (ii) State four (4) advantages of ion selective electrodes. [4 marks]
- (b) Define the following terms as applied in electrogravimetry:
- (i) Overpotential [2 marks]
 - (ii) Concentration polarization [2 marks]
 - (iii) Ohmic potential [2 marks]

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- (c) A perchlorate ion-selective immersed in 50.0 mL of unknown perchlorate solution gave a potential of 358.7 mV versus S.C.E. When 1.00 mL of 0.050 M NaClO_4 was added, the potential changed to 346.1 mV. Assuming that the electrode has a Nernstian response ($\beta = 1.00$), find the concentration of ClO_4^- in the unknown. [10 marks]
3. (a) A solution containing 0.402 49 g of $\text{CoCl}_2 \cdot x \text{H}_2\text{O}$ was exhaustively electrolysed to deposit 0.099 37 g of metallic cobalt on a platinum cathode.
- $$\text{Co}^{2+} + 2\text{e}^- \rightarrow \text{Co(s)}$$
- Calculate the number of moles of water per mole of cobalt in the reagent. [8 marks]
- (b) Giving examples, if possible, explain the role of mediators in coulometric analysis. [5 marks]
- (c) Draw a fully labelled diagram of a liquid based ion selective electrode and explain how it works. [12 marks]

SECTION B

4. (a) Distinguish between the following terms used in spectrophotometry:
- (i) Chromophore and auxochrome. [2 marks]
 - (ii) Natural band width and spectral band width. [2 marks]
 - (iii) Bathochromic shift and hypsochromic shift. [2 marks]
 - (iv) Extinction and transmittance. [2 marks]
 - (v) Resolution and dispersion. [2 marks]
- (b) Describe how light energy is changed into electrical energy in a photomultiplier tube. [7 marks]
- (c) A sample contains two metallic ions, CO^{2+} and Cr^{3+} whose absorption spectra overlap. Explain how you could determine the concentration of both species using absorption spectrophotometry. (λ_{max} is 510 nm and 575 nm for CO^{2+} and Cr^{3+} respectively). [8 marks]
5. (a) Draw a diagram illustrating the main parts of an atomic absorption spectrophotometer. [5 marks]
- (b) Write notes on the functions of the following:
- (i) Nebulizer. [2 marks]
 - (ii) Premix chamber. [2 marks]
 - (iii) Flame. [3 marks]
 - (iv) Hollow cathode lamp. [2 marks]
- (c) (i) Describe how you would digest a sample by dry ashing. (Volumes and weights not required). [6 marks]
- (ii) State the positive and negative attributes of the method. [5 marks]
6. (a) Describe and give example of the three sample preparation techniques used in Infrared Spectroscopy. [10 marks]
- (b) Infrared Spectroscopy can be used for both quantitative and qualitative analysis. Explain why it is mainly used in qualitative analysis. [15 marks]

End of Question Paper!!!

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