



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

MASTER SCIENCE (CHEMISTRY)

SCH 841: ADVANCED ELECTROCHEMISTRY

DATE: 16/4/2019

TIME: 8.30-11.30 AM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

SECTION A - COMPULSORY.

QUESTION ONE (30 MARKS)

- a) Define the following terms as used in electrochemistry
- i) Homogeneous chemical reactions (1 mark)
 - ii) Heterogeneous chemical reactions (1 mark)
 - iii) Rate determining step (1 mark)
- b) Explain the working principles of a three – electrode electrochemical cell system (5 marks)
- c) The study of electrode kinetics is very fundamental in understanding electrochemical processes. Explain the application of the following concepts and equations in the study of electrode kinetics:
- i. Over potential (3 marks)
 - ii. Butler – Volmer equation (4 marks)
 - iii. Tafel equation (4 marks)
- d) Cyclic voltammetry is a useful electroanalytical technique for quantitative and qualitative analysis of analytes. Discuss the technique with respect to:
- i. It's working principles (7 marks)
 - ii. Analyte quantification (4 marks)

SECTION B

Answer any two questions

QUESTION TWO (20 MARKS)

- a) Polarographic techniques are useful for electroanalytical work on samples which are electrolytes. Discuss this aspect with reference to:
- i. Working principles polarography (6 marks)
 - ii. Analyte quantification methods (4 marks)
- b)
- i Derive the Heyrovsky-Ikovic equation (5 marks)
 - ii Explain the applications of the Heyrovsky-Ikovic equation in polarography (5 marks)

QUESTION THREE (20 MARKS)

- a) The ability to predict how a system will behave under certain conditions is very important for practicing electrochemists. Explain the application of the following fundamental equations/constants/laws in electrochemistry:
- i. Nernst equation (4 marks)
 - ii. Cottrell equation (4 marks)
 - iii. Faraday's law (4 marks)
 - iv. Equilibrium constant (4 marks)
- b) Using relevant equations, explain the concept of chemical reversibility (4 marks)

QUESTION FOUR (20 MARKS)

- a) Mass transfer of analytes to the electrochemical electrode systems occur in different modes/ways;
- i. Explain the different modes/ways of mass transfer (6 marks)
 - ii. Explain how the following equations describe the different modes of mass transfer;
 - i) Nernst – Planck equation (3 marks)
 - ii) Fick's laws of diffusion (3 marks)
- b) Discuss the working principles of the following electroanalytical techniques
- i. Square Wave Voltammetry (4 marks)
 - ii. Electrochemical Impedance Spectroscopy (4 marks)

QUESTION FIVE (20 MARKS)

- a) State and explain the different types of ion selective electrodes (12 marks)
- b) Explain the various techniques used in corrosion monitoring (8 marks)