



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
INSTITUTIONAL BASED PROGRAMME (AUGUST SESSION)
EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE
SCH 541: ADVANCED ELECTROCHEMISTRY

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DATE: Tuesday, 3rd January, 2012

TIME: 9.00 a.m. – 12.00 p.m.

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INSTRUCTIONS

Answer **ALL** questions.

1. Define the following terms. Give appropriate examples
 - a) Corrosion
 - b) Cathodic current
 - c) Polarization (6 marks)

2. Differentiate between the following concepts with regard to electrochemistry.
Illustrative diagrams will be awarded marks
 - a) Reversible and irreversible reactions
 - b) Limiting diffusion current and exchange current density
 - c) Activation and concentration overpotentials (9 marks)

3. Using Evans diagrams, or otherwise explain the following concepts
 - a) Despite zinc occurring at a higher active position in the electrochemical series than iron, the later has a higher dissolution rate in water in presence of air. (10 marks)
 - b) Pt and Pd show extremely high i_0 (H_2) yet their corresponding corrosion rates are very low as compared to Fe of Zn. (10 marks)

4. Electron transfer process is a very important aspect to an electrochemist.
- a) Give a plausible mechanism, with relevant explanations, for the electron transfer at an electrode. Illustrative diagrams will be awarded marks.
(10 marks)
 - b) Sketch an appropriate symmetrical diagram, with clear explanations, of a model for electron transfer relating energy profile (ΔG) to reaction path or coordinates.
(10 marks)
5. Pourbaix diagram, attached, is a good tool to understanding the concept of various stable states of a metal in a given medium of solution.
- a) Give an expression of the Nernst equation relating corrosion of iron metal in water at 25°C
(3 marks)
 - b) Give anodic and cathodic reaction of corroding iron in water at 25°C
(8 marks)
 - c) Identify the passivation, corrosion and immune regions of iron in the diagram
(12 marks)
 - d) Give chemical reactions related to lines a, b, 1 and 4.
(8 marks)
 - e) Derive relevant equations for lines 1 and 4
(10 marks)