



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER

**SCHOOL OF PURE, APPLIED AND HEALTH
SCIENCES**

MASTER OF SCIENCE IN CHEMISTRY

COURSE CODE: CHE 8106

COURSE TITLE: ADVANCED ELECTROCHEMISTRY

DATE: 1/2/2024

TIME: 0830-1130 HRS

INSTRUCTIONS TO CANDIDATES

1. Answer any **THREE** questions.

*This paper consists of **four** printed pages. Please turn over.*

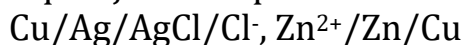
QUESTION ONE

a) Define the following terms as used in electrochemistry

- i) Cell voltage
- ii) Electromotive force
- iii) Potential
- iv) Standard cell potential

(4 marks)

b) The Nernst equation is the consequence of the electrochemical equilibrium which can easily be obtained from the electrochemical potentials. Consider the cell below without a liquid junction potential.



- i) Write down the reactions taking place at each of the electrodes.
- ii) Deduce the overall redox reaction. **(2 marks)**
- iii) Hence or otherwise derive the Nernst equation. **(6 marks)**

c) Thermodynamically, the cell potential is related to the Gibbs energy and thus spontaneity of the reaction can be predicted. Discuss any TWO conditions for spontaneity. **(4 marks)**

QUESTION TWO

a) Polarization is a collective term for certain mechanical side effects of an electrochemical process by which isolating barriers develop at the interface between electrode and electrolyte. There are two limiting cases of the electrode polarization.

- i) Name and discuss the TWO types of polarized electrodes. **(8 marks)**
- ii) Draw a schematic representation of the TWO sets of electrode polarization. **(6 marks)**
- iii) Sketch the polarization curves of the identified polarized electrodes. **(6 marks)**

QUESTION THREE

a) In electrochemistry, electrodes are of essence and their type defines their operation. There are few principal types of electrodes. Discuss the following types of electrodes as used in electrochemistry:

- i) Electrodes of the first kind **(3 marks)**

- ii) Electrodes of the second kind **(3 marks)**
- iii) Electrodes of the third kind **(3 marks)**
- iv) Redox electrodes **(3 marks)**
- b) Concentration cells are composed of two electrodes of the same type but containing different concentrations. Discuss the following types of concentration cells.
 - i) One with liquid junction **(4 marks)**
 - ii) One without liquid junction **(4 marks)**

QUESTION FOUR

- a) A battery is an electrochemical cell or series of cells that produces an electric current.
 - i) Differentiate between primary batteries, secondary batteries and fuel cells. **(3 marks)**
 - ii) List THREE examples of each of the batteries. **(6 marks)**
- b) Adsorption isotherms describe dependence of the surface versus bulk concentrations. In equilibrium, the electrochemical potentials of the species in the bulk and at the surface should be equal. Basing on the above, explain the following isotherms:
 - i) Langmuir Isotherm **(2 marks)**
 - ii) Frumkin Isotherm **(2 marks)**
 - iii) Temkin Isotherm **(2 marks)**
 - iv) Freundlich Isotherm **(2 marks)**
- c) The Langmuir adsorption isotherm is based on several assumptions. List any THREE of these assumptions. **(3 marks)**

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