MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR
FIRST YEAR FIRST SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES
MASTER OF SCIENCE IN CHEMISTRY

COURSE CODE: CHE 8104
COURSE TITLE: ADVANCED ELECTROCHEMISTRY

DATE: 24/4/ 2023   **TIME: 1100-1400 HRS**

INSTRUCTIONS TO CANDIDATES
1. Answer any **THREE** questions.

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

QUESTION ONE (20 marks)

a) Define the following terms as used in electrochemistry
   i)   Electrical double layer
   ii)   Ideally polarized electrode
   iii) Internal potential
   iv)   Potential difference
   v)   Electromotive force

(5 marks)

b) 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. **(6 marks)**
   ii)   List THREE examples of each of the batteries. **(9 marks)**

QUESTION TWO (20 marks)

a) In practice, certain reference electrodes are used, depending on the solutions studied. To avoid contamination of the working solution by the ions from the reference electrode special junctions are normally used and a special cases double junction reference electrode p r e f e r r e d .
   i)   List and draw any three types of junctions for reference electrodes
(6 marks)
   ii)   Hence or otherwise draw the double junction for the reference electrode **(4 marks)**

   b) Discuss the TWO types of polarized electrodes as used in electrochemistry
(10 marks)

QUESTION THREE (20 marks)
   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. There are two types of such cells. By deriving relevant equations, discuss the two types of cells.

(8 marks)

QUESTION FOUR (20 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.

$$Cu/Ag/AgCl/Cl^-, Zn^{2+}/Zn/Cu$$

   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)**

a) 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   **(3 marks)**
   ii)   Frumkin Isotherm   **(3 marks)**
   iii)   Temkim Isotherm   **(3 marks)**
   iv)   Freundlich Isotherm   **(3 marks)**

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