



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

MASTER OF SCIENCE (CHEMISTRY)

COURSE CODE: SCH 843E

COURSE TITLE: ADVANCED ELECTROCHEMISTRY

DATE: 13-4-2023

TIME: 9-12 P.M.

INSTRUCTIONS TO CANDIDATES

- Answer all the Questions

TIME: 3 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over. ►

QUESTION ONE (15 MARKS)

- a. What is the significance of the gradient of Heyrovsky -Ilkovic graph? (5 marks)
- b. Consider the reduction at a DME of Fe^{2+} to form Fe. What is the accurate value of $E_{1/2}$ from the data shown below? Take $I_d = 3.24 \mu\text{A}$ and assume a temperature of 20°C . (10 marks)

E/V vs SCE	-0.395	-0.406	-0.415	-0.422	-0.431	-0.445
$I/\mu\text{A}$	0.48	0.97	1.46	1.94	2.43	2.92

QUESTION TWO (15 MARKS)

- a. The one-electron reduction of the heptyl viologen dication (HV^{2+}) occurs at a platinum electrode with an area of 1.50 cm^2 . Calculate the value of k_{et} , given that the intercept on a Tafel plot is -2.2 . Comment on the answer obtained (5 marks)
- b. One way to prevent iron pipe from rusting is to connect it with a piece of wire to a magnesium rod. What is the electrochemical principle of this action (3 marks)
- c. A solution containing potassium ions is known to also contain NaCl at a concentration of $0.001 \text{ mol dm}^{-3}$. When $0.02 \text{ mol dm}^{-3} \text{ KNO}_3$ is dissolved in the same chloride solution, the emf is 1.403 V . What is the concentration of K^+ in a new sample if the emf is 1.390 V (7 marks)

QUESTION THREE (15 MARKS)

- Is non faradaic current a problem in polarography? Discuss this statement with possible solutions and explanations. Use well illustrated diagrams. (15 marks)

QUESTION FOUR (15 MARKS)

- a. Compare and Contrast the Tafel and Butler Volmer approach to electrode kinetics, outlining clearly the advantages and disadvantages of each approach (10 marks)
- b. Apply the Butler-Volmer equation to determine the net current at an overpotential η of 0.120 V (Take $\alpha=0.5$, $T=298\text{K}$, $n=1$ and $I_0=0.034\text{ A}$). (5 marks)