(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

(MMUST)

UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

FOURTH YEAR MAIN EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE (CHEMISTRY)/BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: SCH 440

COURSE TITLE: ELECTROCHEMISTRY

DATE: Monday 28th January 2019 **TIME: 12.00 - 2.00 pm**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer ALL questions

1. (a) Define the following electrochemical terms: **(6 marks)**

I. Molar Conductivity:

II. Kohlrausch Law of Independent migration

III. Reference electrode

IV. Electrode of the first kind

V. Working electrode

VI. Liquid junction potential

(b)

I. Using appropriate diagrams, describe the electrical double layer characteristics of an electrode in solution **(6 Marks)**

II. Explain how the following factors affect the transport of dissolved species to and from the electrode surface **(6 marks)**

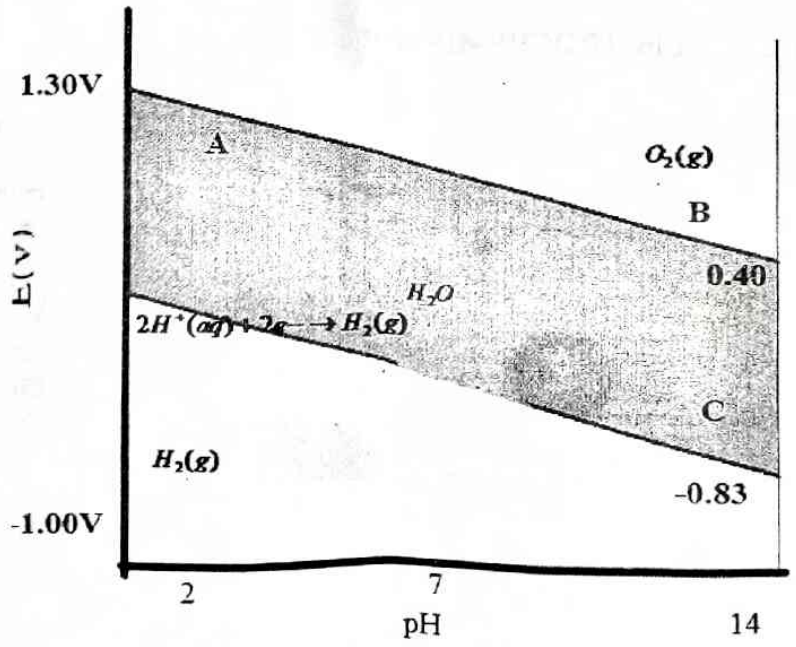
(i) Mass transfer Migration

(ii) Electron transfer

(iii) Chemical reactions

(iv) Other surface reactions

2. (a)



The graph above shows the electrochemical behaviour of water at various pH values

(i) Write the possible chemical equations occurring at points A, B and C.

(6 marks)

(ii) Draw the cyclic voltamograms for electrochemical processes responsible for

1. Evolution of oxygen
2. Evolution of hydrogen **(6 marks)**

(b). Describe how oxygen is removed from electrolyte solutions during normal electrochemical processes? **(2 mark)**

(c) Using appropriate diagrams, discuss the effects of:

1. stirring the electrolytic solution ~~during~~
2. Increasing the scan rate ~~during~~ **(4 marks)**

Question Three

(a) The voltammogram for 20.00 mL of solution that was 3.65×10^{-3} M in Cd^{2+} gave a wave for that ion with a limiting current of 31.3μA.

Calculate the percentage change in concentration of the solution if the current in the limiting current region were allowed to continue for

I. 5 min.
II. 10 min.
III. 30 min. **(6 marks)**

(b) (i) Diferentiate between an Electroltic Cell and a Danieli Cell **(4 marks)**

(ii) An electrochemical cell has the following reaction taking place:

$Mg(s) + 2Ag^{+}(0.0002M) \rightarrow Mg^{2+}(0.260M) + 2Ag(s)$

Calculate its $E^{(cell)}$ if $E^{\ominus}_{(cell)} = 3.17$ V. **(2 marks)**

(iii) Determine the number of moles of electrons transferred **(2 marks)**

(iv) Calculate the non-standard cell potential, E_{cell}, using the Nernst equation **(4 marks)**

Question Four

(a) Describe the theory behind the ion selective electrode **(4 marks)**

(b) What are the limitations of a glass electrode in pH measurements **(4 marks)**

(c) A lithium ion-selective electrode prepared from snake skin gave the potentials shown below for four standard solutions of LiCl and 2 samples of unknown concentrations.

$F = 96500$
$R = 8.134$
$T = 25^{\circ}C$

Solution (a_{Li})	Potential vs SCE, mV
0.100M	+1.0
0.050M	- 30.0
0.010M	-60
0.001M	- 138.0
Unknown 1	-48.5
Unknown 2	-75.3

I. Draw a calibration curve of the electrode potentials vs log a_{Li} (5 **marks**)

II. Determine the concentration of the unknowns **(2 marks)**

III. Determine if the electrode follows the Nerstian equation **(2 marks)**