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OFFICE OF THE DEPUTY VICE CHANCELLOR
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER REGULAR

EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHE 317

COURSE TITLE: ELECTROCHEMISTRY

DATE: 21/12/2022 **TIME:** 9-12 NOON

INSTRUCTION TO CANDIDATES

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REGULAR – MAIN EXAM

CHE 317: ELECTROCHEMISTRY

STREAM: BED (Science) **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

i. *Answer **ALL** questions.*

ii. *Diagrams may be used whenever they serve to illustrate the answer.*

iii. *Useful physical data: $F = 96{,}500\ C\ mol^{-1}$; $R = 0.08205\ L\ atm\ K^{-1}\ mol^{-1} = 8.314\ J\ K^{-1}mol^{-1}$ at 25 °C, $\frac{2.303RT}{F} = 0.0592V$.*

Question One (11 Marks)

a) Define the following terms:

i. Electrolysis (1 Mark)

ii. Transport Number (1 Mark)

iii. Equivalence Conductance (Λ) (1 Mark)

iv. Ionic Mobility (1 Mark)

b) Explain why the equivalent conductance for a strong electrolyte is higher upon dilution but decreases at higher concentrations. (2 Marks)

c)

i. What is an electrolyte? (1 Mark)

ii. Differentiate between a strong and weak electrolyte (2 Marks)

d) Determine Λ_m^0 for HAC at 25^{0}C for 0.1 M given Λ_m^0 $(NaAC)$ =0.00728

e) Define the Kohlransch Law and give its expression defining all terms (2 Marks)

Question Two (15 Marks)

a) Briefly explain the principle behind the Hittorf Method (2 Marks)

b) The velocity of a boundary of HCl with LiCl is followed in aqueous solution. It moves 15 cm in a tube 1 cm diameter in 22 minutes when the current is 11.54 mA. If the concentration of the HCl is 0.01065 mol dm^{-3}, what is the transport number of the hydroxonium ion? (4 Marks)

c) Discuss Debye – Huckel Theory (5 Marks)

d) For a 0.1 molar solution of MX_2 at 25°C, $\gamma_\pm$ was found to be 0.265. Determine:

i. The mean activity (2 Marks)

ii. The activity (2 Marks)

Question Three (16 Marks)

a) Define conductometric titration (1 Mark)

b) Describe the principle behind operation of conductometric titrations. (3 Marks)

c) List two conditions under which conductometric titrations are most applicable (2 Marks)

d) For a cell to be reversible, it must satisfy three conditions when connected to an external source of emf. List these conditions. (3 Marks)

e) What is a reference electrode? (1 Mark)

f) For the cell $Pt/Hg_{(l)}/Hg_2Cl_{2(s)}/KCl_{(reaction)}$, give the electrode reactions and overall reaction. (3 Marks)

g) Write the cell reaction for the following cells and determine the emf. (3 Marks)

$Cd^{2+}/Cd//KCl/Hg_2Cl_2/Hg$

$E°_L = -0.403$ V $E°_R = 0.267$ V

Question Four (14 Marks)

a) What is a battery? Give two examples of types of batteries. (2 Marks)

b) Discuss the lead acid battery in terms of the following:

i. Reactions during discharge (2 Marks)

ii. Electrolyte and current collectors (2 Marks)

iii. Applications/uses (1 Mark)

c) Define cycle life and differentiate between primary and secondary batteries (3 Marks)

d) Write the chemical equations for all the steps involved in the rusting of iron. Give any one method to prevent rusting of iron. (4 Marks)

Question Five (14 Marks)

a) Calculate the e.m.f of the cell $Zn/Zn^{2+}(0.001M)//Ag+(ag)/Ag(s)$. Given that the standard potential of $Ag^+/Ag(s)$ is +0.80 V and Zn/Zn^{2+} is 0.76 V (3 Marks)

b) Give one advantage of using a standard hydrogen electrode (1 Mark)

c) Name three secondary standard electrodes (3 Marks)

d) Sketch conductometric titration curve showing the variation of conductance and volume of base on addition of ammonia solution to mixture of HCl and C_6H_5OH. Explain the shape. (3 Marks)

e) Describe the glass electrode with respect to: principle, working and limitations. (4 Marks)

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