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University Examinations 2022/2023

FOURTH YEAR, FIRST SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

FOURTH YEAR, FIRST SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN EDUCATION SCIENCE

SCH 3401: ELECTROCHEMISTRY

DATE: AUGUST 2023

TIME: 2 HOURS

INSTRUCTIONS: *answer question one and any other two questions*

QUESTION ONE (30 MARKS)

- a) (i) Define Kohlraush's law (1 mark)
- (ii) Suggest a way to determine the Λ_m^α for CH_3COOH (3 marks)
- (iii) The Λ_m^α for sodium acetate, HCl, NaCl are 91.6, 425.9 and 126.4 $\text{S cm}^{-1}\text{mol}^{-1}$, respectively at 298K. calculate the Λ_m^α for CH_3COOH (3 marks)
- b) (i) Explain the drawbacks of the following batteries electrochemical batteries, fuel cells, solar cell (3 marks)
- (ii) State the advantages of paper battery over electrochemical batteries, fuel cells, solar cell (2 marks)
- c) Explain the following observations
- i) Conductivity of a solution decrease with dilution (2 marks)
- ii) Mercury cell gives a constant voltage throughout its life (2 marks)
- iii) It is not possible to measure single electrode potential (2 marks)
- iv) Alternating current used for measuring resistance of an electrolytic solution (2 marks)

- d) (i) Define conductivity and molar conductivity for a solution of an electrolyte (2 marks)
(ii) The conductivity of 0.02M solution of an electrolyte (2 marks)
- e) (i) Define transport number (1 mark)
(ii) A solution containing 0.00739g AgNO₃ per gram of water was electrolyzed between silver electrodes. During the experiment 0.0078g of silver was deposited in a silver coulometer placed in series. At the end of experiment, the anodic solution contains 23.14g of water and 0.236g of AgNO₃. What are the transport number of Ag⁺ and NO₃⁻ ions? (5 marks)

QUESTION TWO (20 MARKS)

- a) Define weak and strong electrolyte (2 marks)
- b) Explain how you can increase the reduction potential of an electrode for the reaction (2 marks)
 $Mn^{+}(aq) + n e^{-} \rightarrow M(s)$
- c) The E^o value corresponding to the following two reduction electrode processes are Cu⁺/Cu=0.52 V; Cu²⁺/Cu⁺ = -0.16V. formulate the galvanic cell for their combination. Calculate the cell potential and ΔG^o the cell reaction (4 marks)
- d) Conductivity of 0.00241M acetic acid is 7.896 x 10⁻⁴ S cm⁻¹. Calculate the
i) Molar conductivity (2 marks)
ii) If Λ_m^o is 390 S cm⁻¹, what is its dissociation constant? (2 marks)
- e) The resistance of a 0.1 M solution of an electrolyte is 60 Ω at 300 K the dimension of each of the electrode in the cell are (0.85cm x 1.4cm) and the distance between the two electrodes is 1cm. calculate
i) Cell constant (2 marks)
ii) Resistivity (2 marks)
- f) At 25°C, the molar conductance of propanoic acid at infinite dilution is 386.6 S cm²mol⁻¹. If its ionization constant is 1.4 x 10⁻⁵. Calculate molar conductance of 0.05 M propanoic acid solution at 25°C? (4 marks)

QUESTION THREE (20 MARKS)

- a) What is the use of platinum foil in the hydrogen electrode? (1 mark)
A glass tube of 2 cm internal diameter is fitted with platinum electrodes 50 cm apart. The tube is filled with a 0.1N solution of KCl at 25°C (specific conductance = 0.0129 S cm⁻¹). What

- will be the current passing through the solution if a potential difference of 1,234 V is applied across the electrodes) (4 marks)
- b) The limiting molar conductivities of KCl, KNO₃ and AgNO₃ are 14.99 mSm²mol⁻¹, 14.50 mSm²mol⁻¹ and 13.34 mSm²mol⁻¹ respectively at 25°C. calculate the limiting molar conductivity of AgCl at this temperature? (4 marks)
- c) At 25°C the molar ionic conductivities of Li⁺, Na⁺, and K⁺ are 3.87 mSm²mol⁻¹, 5.01 mSm²mol⁻¹ and 7.35 mSm²mol⁻¹ respectively. calculate their mobilities (4 marks)
- d) (i) Define coulometer (1 mark)
- (ii) Describe the following types of coulometers
- (i) Silver (3 marks)
- (ii) Iodine (3 marks)

QUESTION FOUR (20 MARKS)

- a) Distinguish between electrolytic and galvanic cell (2 marks)
- b) Discuss Debye-Huckel-Onsagar theory (6 marks)
- c) Describe the following electrochemical techniques
- i) Electrolysis (2 marks)
- ii) Polarography (2 marks)
- d) (i) Define conductometric titration (1 mark)
- (ii) Using a graph explain the conductance of
- i. Strong Acid with a Strong Base (2 marks)
- ii. Strong Acid with a Weak Base (2 marks)
- iii. Weak Acid with Weak Base (2 marks)