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**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2018/2019 ACADEMIC YEAR THREE**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: CHE 317**

**COURSE TITLE: ELECTROCHEMISTRY**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 10/02/2020 TIME: 2.00-4.00 PM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of THREE (3) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Define the following terms as used in electrochemistry **[5 marks]**
2. Electrolysis
3. Resistance
4. Equivalent conductance
5. Electrochemical cell
6. Cell constant
7. Give explanation to the following statements:
8. The molar conductance of a weak electrolyte increases with dilution **[2 marks]**
9. Metallic conductivity decreases with increase in temperature while electrolytic conductance increases with temperature **[4 marks]**
10. (i) State Kohlrausch’s law of independent migration of ions [2 marks]
11. At 300K, the molar conductance at infinite dilution of KCl, KNO3 and AgNO3 are 149.9 Χ 10-4 Sm2mol-1 , 145.0 Χ 10-4 Sm2mol-1 and 133.4 Χ 10-4 Sm2mol-1 respectively. Calculate the molar conductance of AgCl at infinite dilution. **[6 marks]**
12. Differentiate between Voltaic cells and Electrolytic cells  **[2 marks]**
13. State one significance of Debye-Huckel limiting law **[1 mark]**
14. The specific conductance of a saturated solution of Barium sulphate at 298K is 1.84× 10-3 Sm-1.and that of water is 1.60 × 10--4Sm-1. The ionic conductivities at infinite dilution of Ba2+ and SO4- at 298K are 63.6 × 10-4 Sm2Mole-1 and 79.8× 10-4 Sm2Mole-1.respectively. Calculate solubility and the solubility product of Barium sulphate at this temperature **[6 marks]**
15. State any two advantages of Potentiometric titrations over ordinary titrations using indicators **[2 marks]**

**QUESTION TWO**

1. Explain the effect of temperature on conductance of a weak electrolyte **[4 marks]**
2. Other than temperature, state and explain any other four (4) factors that affects conductance **[8 marks]**
3. A conductance cell was calibrated by filling it with 0.02M solution of potassium chloride (**k = 0.2768 Sm-**1) and measuring the resistance at 298K, which was found to be 457.3 ohm The cell was then filled with Calcium chloride solution containing 0.555g of CaCl2 per litre. The measured resistance was 1050 ohm. Calculate
4. the cell constant for the cell **[2 marks]**
5. the conductivity of CaCl2 solution **[3 marks]**
6. the molar conductance of CaCl2 at this concentration **[3 marks]**

**QUESTION THREE**

1. Define Electrochemical equivalence of a substance **[1 mark]**
2. State Faraday’s first law of electrolysis **[2 marks]**
3. Derive an expression of electrochemical equivalence in light of Faraday’s first law of electrolysis **[3 marks]**
4. When a current of 1.5 amperes was passed through a cell containing M3+ ions of metal M for 15 minutes. The mass of cathode increased by 0.26g.Calculate the relative atomic mass of metal M **[4 marks]**
5. Use the information below to answer the questions that follow

**Eϑ(volts)**

Zn2+ (aq) + 2e- ⇔ Zn(s) -0.76

Al3+ (aq) + 3e- ⇔ Al(s) -1.66

Fe3+ (aq) + 3e- ⇔ Fe (s) -0.44

(i) Calculate the **Eϑ** value for the electrochemical cell represented below

**Al (s) / Al3+ (aq) // Fe2+ (aq) / Fe (s) [3 marks]**

1. Give a reason why Aluminium metal would protect Iron from rusting better than Zinc metal [2 marks]
2. Draw a well labeled diagram of the electrochemical cell that would be obtained when the half-cells

Zn2+ (aq) + 2e- ⇔ Zn(s) and

Fe3+ (aq) + 3e- ⇔ Fe (s) are combined **[4 marks]**

1. On the diagram above show the direction of electron flow **[1 mark]**

**QUESTION FOUR**

1. Define transport number  **[2 marks]**
2. A solution of hydrochloric acid is electrolyzed in a transport cell using platinum electrodes. 20.175g of the cathode solution contained 0.175g of Cl- ion before electrolysis and 18.466g of the cathode solution contained 0.146g of Cl- ion after electrolysis. A silver coulometer connected in series had a deposit of 0.2508g of Ag. Calculate the transport number of Cl- and H+ ions **[9 marks]**
3. The specific conductance of a saturated solution of silver chloride at 18oC was found to be 1.22Χ 10-4 Sm-1 . The molar conductance of the silver and the chloride ions are 0.0054 Sm2mol-1and 0.00652 Sm2mol-1 respectively. Calculate the solubility product of the salt at the same temperature **[9 marks]**

**QUESTION FIVE**

1. Calculate the potential for the following cell at 298 K

**Zn / Zn 2+ (a = 0.1) // Cu 2+ (a = 0.01) / Cu**

Given that- Zn2+ / Zn = -0.762 V and Cu2+/ Cu =+0.337V **[6 marks]**

1. Compare the free energy change for this cell with the free energy change of the cell in the standard state **[5 marks]**
2. (i) The standard emf of the Daniel cell is 1.1V. Calculate the equilibrium constant for the reaction at 298K. **[6 marks]**

**(ii)** What does the large value of equilibrium constant in (i) above shows on the reaction **Zn + Cu 2+ ⇔ Zn 2+ + Cu [3 marks]**