UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

END OF SEMESTER FINAL ASSESMENT

SEMESTER 1, 2023/2024

COURSE:	BACHELOR OF SCIENCE WITH EDUCATION
YEAR:	TWO & THREE
EXAM:	*Electrochemistry*
SEMESTER:	I
DATE:	DECEMBER 14, 2023
TIME:	9:30am – 12:30pm
DURATION:	3 HOURS

INSTRUCTIONS

- This paper consists of ***FIVE*** questions.
- Attempt any four (4) Questions
- Begin each question on a fresh sheet of paper.
- All questions carry equal marks.

1. (a) Distinguish between the following:

(i) Dissociation and ionisation (2 marks)

(ii) Strong and weak electrolyte (2 marks)

(b) Describe the technique of applying conductance measurements in the determination of end-point in titrations. For each conductimetric titration, include a graph and the explanation for the shape of the graph. (10 marks)

(c) At 20°C the electrolytic conductivity of a saturated aqueous solution of silver bromide is 1.576×10^{-6} Ωcm^{-1} whereas that of water itself is 1.576×10^{-6}. If the molar conductivity of Ag^+ and Br^- at infinite dilution are 56.47 and 70.19 $\Omega cm^2 mol^{-1}$ respectively. Calculate the solubility of silver bromide in $moldm^{-3}$. (6 marks)

2. A copper electrode was placed in a 1M solution of $CuSO_4$ and in another beaker, containing a 1M solution of $AgNO_3$, was place a silver electrode. A salt bridge composed of Na_2SO_4 connected the two solutions. The voltage measured across the electrodes was found to be +0.42 volts.

(a) Draw a diagram to represent this cell. (4 marks)

(b) Describe what is happening at the cathode (3 marks)

(c) Describe what is happening at the anode. (3 marks)

(d) Write the balanced overall cell equation. (2 marks)

(e) Write the standard cell notation. (2 marks)

(f) A student added 4M ammonia to the copper sulphate solution, producing the complex ion $Cu(NH_3)_4^{2+}$ (aq). The student remeasured the cell potential and discovered the voltage to be 0.88 volts. What is the Cu^{2+} (aq) concentration in the cell after the ammonia has been added? (6 marks)

3. (a) Explain the meaning of the terms below and give an example in each case:

(i) Voltaic cells (4 marks)

(ii) Electrolytic cells (4 marks)

(b) Distinguish between **anode** and **cathode** in the two types of cells (6 marks)

(c) Explain the relationship between voltaic cells and electrolytic cells (6 marks)

4. (a) With relevant examples in each case, explain what is meant by the terms *oxidation* and *reduction*. (6 marks)

(b) Distinguish between a reducing and an oxidising agent. Use relevant examples

(4 marks)

(c) With the aid of the reaction below, explain what is meant by the term redox reaction

(6 marks)

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

(d) With the aid of half equations, explain the reaction between potassium dichromate and copper(II) iodide (4 marks)

5. (a) Define the following terms:

(i) Molar conductivity (1 mark)

(ii) Electrolytic conductivity (1 mark)

(b) The conductance of a 0.001M solution of potassium nitrate is 6.5×10^{-4} S. Calculate the electrolytic conductivity of a cell whose cell constant is $0.215 cm^{-1}$ and then use it to determine the molar conductivity of potassium nitrate. (5 marks)

(c) (i) Describe the deviation of electrolytes from ideality and its causes. (4 marks)

(ii) Explain why at infinite dilution, the deviation of electrolytes from ideal behavior reduces significantly. (3 marks)

(d) The activity coefficients of species are calculated using the Debye-Huckel equation

$$log\gamma = -Az^2 I^{\frac{1}{2}}$$

Where z is the charge on ion, I is the ionic strength and A is the constant ($=0.5 kg^{½} mol^{-1}$)

A solution contains 0.002M aluminium nitrate and 0.008M ammonium chloride. Calculate:

(i) The ionic strength (3 marks)

(ii) The activity coefficient and the activity of aluminium ions in the solution. (3 marks)

THE END