

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2015/2016**

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR THE**

**DEGREE OF BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY**

 **SCH 2456: ELECTRO ANALYTICAL CHEMISTRY**

**DATE: DECEMBER 2015 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE**

1. Distinguish between Faradaic and Non- Faradaic currents. [4 marks]
2. i) Describe cyclic voltammetry technique and plot the triangular

 wareform and label the wareform clearly [4 marks]

ii) The following cyclic volammogram was recorded for a reversible

 couple. Calculate the number of electrons transferred and the

 formal potential for the couple. [3 marks]

1. i) Define redox reactions. [1 mark]

ii) Given the following half cells

Cu2+ | Cu  = +0.34V

Zn2+ |Zn  = -0.76V

Fe3+, Fe2+| Pt  = +0.77V

 Write the reactions and potentials of cells that have the following

 properties.

 a) A cell in which Copper dissolves [1 ½ marks]

 b) The cell with the largest  [1 ½ marks]

1. i) Write down the Ilkovi equation for the limiting diffusion

 current and state what each parameter stands for? [2 marks]

ii) Calculate the limiting current that would be expected from the

 reduction of 2 x 10-4 M Pb2+, using the DME characteristics

 M= 2.0 mgs-1 and t = 4S. The diffusion coefficient of

 Pb2+ is 1.01 x 10-5 Cm2 S-1. [3 marks]

1. i) What is a biosensor? [1 ½ marks]

ii) Plot a schematic diagram of a Biosensor and name each

 component. [1 ½ marks]

iii) Name and systematically describe the five different levels

 which a biosensor functions. Give four examples of the

 1st three levels. [7 marks]

**QUESTION TWO**

1. Name and describe three distinct parts of the electrical double layer. [6 marks]
2. Draw clearly the structure of the electrical double layer showing

the three distinct parts named above. [2 marks]

1. Mass transport controlled reactions occurs by three different modes.

Name and describe the three different modes. [3 marks]

1. i) Using a sketch plot, distinguish between irreversible and

 Quasi-Reversible systems. [4 marks]

ii) Write the equation for the ip current for the above stated

 systems in d(i). [2 marks]

1. Describe the chronoamperometric technique and plot the potential

 sweep wave form. [3 marks]

**QUESTION THREE**

1. What is polarography? [2 marks]
2. Explain the terms:
3. Half wave potential [1 mark]
4. Diffusion limited current [1 mark]
5. Current data from a polarography experiment at 250C are given below.

|  |  |
| --- | --- |
| Voltage against SCE/V | Current /A |
| -0.2 | 0.00 |
| -0.3 | 0.01 |
| -0.33 | 0.07 |
| -0.36 | 0.61 |
| -0.39 | 2.38 |
| -0.41 | 3.13 |
| -0.42 | 3.27 |
| -0.43 | 3.34 |
| -0.45 | 3.39 |
| -0.5 | 3.40 |
| -0.6 | 3.40 |

Determine the half-wave potential and the diffusion limited current. [7 marks]

1. i) Describe and draw clearly the waveform employed in square voltammetry.

 Explain how the current is measured. [7 marks]

ii) Why is square voltammetry method considered more sensitive

 than the cyclic voltammetric method? [2 marks]

**QUESTION FOUR**

1. i) Define chronocoulometry? [2 marks]

ii) Draw clearly the waveform employed in double step

 chronocoulometry. Explain how current is measured during

 single step and double step chronocoulometry. [6 marks]

1. Calculate the emf of the following well:
2. Zns|  || , Agcl (aq)

Given  = 0.76V and  = + 0.222 V [3 marks]

1. Distinguish between an electrolytic cell and a galvanic cell. [2 marks]
2. The current readings shown below were taken in a coulometric

experiment to determine the amount of copper in a solution of

copper (II) sulphate. Plot a suitable graph and determine the

charge passed at infinite time (). [7 marks]

|  |  |
| --- | --- |
| Time | Current/A |
| 1 | 3.1 |
| 4 | 2.6 |
| 7 | 1.25 |
| 10 | 0.31 |
| 13 | 0.08 |
| 15 | 0.03 |