National Open University of Nigeria
Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi - Abuja
Faculty of Science
APRIL, 2019 EXAMINATION

COURSE CODE: CHM409
COURSE TITLE: ELECTROCHEMISTRY
CREDIT: 2 Units
TIME ALLOWED: 2 Hours
INSTRUCTION: Answer Question ONE (1) and any other THREE (3) Questions
In all calculations R = 8.314 J/mol/K

1. (a) Write an equation that relates flux to Fick's law and define all terms used **(3 marks)**

(b) An electrochemical reaction represented according to the equation given below,

$$M^{n+} = M + ne^-$$

(i) At which electrode, do you expect the above reaction. Given reason for your answer

(2 marks)

(ii) Sketch a graph and explain the expected changes in electrode potential if current is pumped or withdrawn from the electrode system? **(8 marks)**

(c) Use suitable equations or notations explain what exchange current density is (**2 marks**)

(d) Outline the three major components to mass transport **(3 marks)**

(e) What accounts for differences in ionic concentration and what is the effect of such differences ?

(2 marks)

(f) Differentiate between Galvanic and electrochemical cell **(2 marks)**

(g) Calculate over voltage of a cell whose pH is 11 at 300 K **(3 marks)**

2. (a) What is polarography and polarogram ? **(2 marks)**

(b) Draw a typical diagram to show polarogram and indicate the position of diffusion current, wall

of the wave, half wave potential and residual current on the diagram **(4 marks)**

(c) Define the following terms with respect to polarography

    i.   Residual current   **(1 mark)**

    ii.   Half wave potential   **(1.5 mark)**

    iii.   Diffusion current   **(1.5 mark)**

(c)   Given the following values for a dropping mercury electrode, calculate the diffusion current using the Ilkovic equation $n = 2$, $D = 4.0$, $t = 64s$, $m = 8$ and $C = 2.3$ M (all in S.I unit)   **(5 marks)**

3. (a)   Differentiate between polarizable and non- polarizable interface   **(3 marks)**

(b)   State two major types of polarization and explain how they arise   **(3 marks**)

(c)   Write an equation to show the relationship between the two types of polarization and total polarization   **(2 marks)**

(d)   Write an expression for cathodic polarization and anodic polarization. Hence calculate the cathodic and anodic polarization when the electrode potential at equilibrium is 12 V and the shifts in potentials are 6 and 32 V respectively.   **(7 marks)**

4. (a) State the Tafel rule for most electrode reactions and write expressions for the rule. Also write expression for the cathodic and anodic polarization. Define all terms use in the equation (8 marks)

(b) Highlight the significant of Tafel plots in obtaining Tafel constants   **(2.5 marks)**

(c)   What are the charge factors that can leads to difference in electrode potentials

                            (4.5 marks)

5(a)   Draw a labeled diagram of a potentiostat circuit indicates the basic component of the circuit

                            (5 marks)

(b)   What is emf?   (1 mark)

(c)   Draw a labeled circuit diagram for measuring emf of a cell. Hence explain how the emf can be measured.   (6 marks)

(d)   Calculate the force between two charges of magnitude, 1.2 and 1.6 C separated by a distant of 0.8 m in a medium whose relative permittivity is 78.54 at 298 K   **(3 marks)**