NATIONAL OPEN UNVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
JANUARY/FEBRUARY 2018 EXAMINATION QUESTIONS

CHM409:   ELECTROCHEMISTRY
TIME: 2 HOURS
INSTRUCTION: ANSWER QUESTION ONE & ANY OTHER THREE QUESTIONS.

1(a) i) Write the Tafel's statement with respect to polarization. (3 Marks)

ii)   Write the Tafel equations for anodic, cathodic and overall polarizations. (9 Marks)

iii)   Explain briefly how the Tafel constants can be obtained from a polarization plot. (3 Marks)

(b)   Define the term, exchange current density and explain its significance in electrochemistry.

(3 Marks)

(c)   What is the mathematical implication of the Tafel equations if suitable plots are developed for anodic and cathodic polarization? (7 Marks)

2.   **I**n a an electrochemical cell, given that the concentration of the cations vary from C_s, near the surface to C_B, (i.e in the bulk concentration) across the cathode over a distance (δ). Answer the following questions,

(a)   Write an expression for the concentration gradient. (1 Mark)

(b)   State Fick's first law and relate the law to the concentration gradient. (3 Marks)

iii)   Derive expressions for cathodic current, limiting cathodic current and hence derive an equation

for concentration over potential of the cell (i.e $\eta_{C,Con} = \frac{2.3RT}{nFD_{ion}} log \left[1 - \frac{i_C}{i_L}\right]$).   (11 Marks)

3.   (a)   What do you understand by polarography and polarogram? (5 Marks)

(b)   Sketch a graph to show a typical pattern expected from the results of polarography study.
(3 Marks)

In your sketch, indicate and define the following:

(i)   Residual current   (1 Mark)

(ii)   Half wave potential   (2 Marks)

(iii)   Diffusion current (1 Mark)

(c)   Write the Ilkovic equation and explain all the terms in the equation   (2 Marks)

4.   (a)   Define the term, ion transport   (1 Mark)

(b) (i) Write the mathematical expression that relates conductance to length and cross sectional area. Define all the terms in the equation.   (2 Marks)

(ii) Calculate the conductivity of a cell whose length is 10 cm, cross sectional area is 20 cm^2 and the conductance is 50 S/cm. (3 Marks)

(c) (i)   List the three major factors that affects the conductivity of ions. (3 Marks)

(ii) Hence show that the mobility of ion can be expressed as $k = F\Sigma z_i C_i u_i$ (6 Marks)

5.   (a) (i) Define the term, flux as it relate to mass transport in electrochemistry. (2 Marks)

(ii)   How does the flux relates to Fick's first law of diffusion?   (3 Marks)

(b)(i)   What are the three major aspect of mass transport in electrochemistry?. (3 Marks)

(ii) Write a general equation to show how these three aspect are related to mass transport. (5 Marks)

(c)   What is the significance of Stokes' law in mass transport?. Use suitable mathematical equation to support your answer. (2 Marks)