**ELIZADE UNIVERSITY, ILARA – MOKIN, ONDO STATE, NIGERIA**
**DEPARTMENT: PHYSICAL AND CHEMICAL SCIENCES**
**FIRST SEMESTER EXAMINATIONS: 2020/2021 ACADEMIC SESSION**
**COURSE CODE: CHM 305 COURSE TITLE: PHYSICAL CHEMISTRY II**
**HOD's SIGNATURE**

***TABLE OF CONSTANTS:***

*Speed of light c, 2.997 x10$^{8}$m/s* *Elementary charge e, 1.602 x10$^{-19}$C*
*Faraday constant F, 96500C/mol* *Boltzmann constant k, 1.38 x10$^{-23}$J/K*
*Gas constant R, 8.314JK$^{-1}$mol$^{-1}$* *Gas constant R, 8.314 x 10$^{-2}$ L.bar K$^{-1}$mol$^{-1}$*
*Planck's constant h, 6.626 x 10$^{-34}$ Js* *Avogadro's constant $N_a$, 6.0228 x10$^{23}$mol$^{-1}$*

**DURATION: 2HOURS**
***INSTRUCTIONS:***

1. ***SECTION A: ATTEMPT QUESTION ONE AND ANY OTHER QUESTION***
2. ***SECTION B: ATTEMPT TWO QUESTIONS***

## SECTION A
## ATTEMPT QUESTION ONE AND ANY OTHER QUESTION

**1.**

**a.** State four applications of the Electric double layer (EDL) [4marks]

**b.** With the aid of **diagram only** define **flocculation** and **coagulation** [2marks]

**c.** Distinguish between the Electric double layer and the Nernst diffusion layer [2mark]

**d.** What is the difference between **voltammetry chrono ⇨ potentiometry**. State one application of both techniques. [3marks]

**e.** What is the difference between **polarizable** and **non – polarizable electrodes**[2marks]

**f.** Write an expression for the molar conductivity of a solution of known concentration. [1mark]

**g.** Classify the following pairs as ideal or non-ideal solutions. **Benzene and toluene, water + hydrochloric acid, benzene and chloroform, hexane and n – heptane, water and carbon tetrachloride and benzene, ethanol and water, ethyl bromide and ethyl iodide.** [5marks]

**h.** What is the magnitude of the enthalpy of mixing for a **non – ideal solution?** [1mark]

**2.**

**a.** Assume a solute decays exponentially along the length of a container, what is the thermodynamic force on the solute at 298K, given that the concentration falls to half its value in 10cm? [4marks]

**b.** An electrode is placed in an unstirred aqueous solution of 0.05M $Al^{+3}$. If the thickness of the diffusion layer is 0.25mm and the molar conductivity of the solution at 300K is 197Scm$^2$, what is the limiting current density? [2marks]

c. When 0.186g of a solute of unknown molar mass was dissolved in 22.1g of liquid camphor, its melting point changes from 179.9 °C to 176.8°C. Calculate the molar mass of the solute if the cryoscopic constant of camphor is 40.0°C/m [4marks]

3.

a. Define the terms in and limit the generality of the following expressions.

i. $j = j_0 f\eta$ [2marks]

ii. $j = e^{(1-\alpha)f\eta}$ [2marks]

iii. $j = j_0 e^{-\alpha/\eta}$ [2marks]

b. Predict the magnitude of the following thermodynamic parameters of mixing of an ideal solution at constant temperature and pressure.

i. enthalpy (ΔH) [1mark]

ii. entropy (ΔS) [1mark]

iii. free energy (ΔG) [1mark]

c. Write an expression relating $(\Delta H)_{mix}$ to $(\Delta S)_{mix}$ and $(\Delta G)_{mix}$. [1mark]

## SECTION B

## *ATTEMPT TWO QUESTIONS FROM THIS SECTION*

4.

a. Show that $TV^{\gamma-1}$ is a constant for the reversible adiabatic expansion of a mole of an ideal gas of constant heat capacity where $\gamma = C_p/C_v$ **[ 5 marks]**

b. 2 g of Hydrogen at 5 °C and 202650 $Nm^{-2}$ are subjected to reversible adiabatic expansion to a pressure of 76 cmHg. Calculate the work done. **[ 4 marks]**

c. 32 g of oxygen expands reversibly under isothermal conditions from a volume of 0.0045$m^3$ to 9000 $cm^3$ at 50°C. Evaluate: (i) q, (ii) ΔE and (iii) W. **[ 6 marks]**

5.

a. Distinguish between Gibbs free energy and Helmholts free energy **[ 2 marks]**

b. 5 moles of an ideal gas at 10°C is compressed adiabatically to $1/8^{th}$ of the original volume. What is the temperature of the gas after compression? **[ 5 marks]**

c. 3 moles of Argon at 380 mm Hg is compressed adiabatically and reversibly from 100 $dm^3$ to 5 x $10^7$ $mm^3$ at 10°C. The molar heat capacity, Cv at constant volume of Argon is 12.5 j/mol/k. Calculate the final pressure of Argon in atm. **[ 8 marks]**

6.

a. Define these terms: (i) Surrounding (ii) Thermal Equilibrium (iii) Intensive properties (iv) Closed system (v) Adiabatic wall **[5 marks]**

b. From the first principle, show that Cp = Cv + R **[ 4 marks]**

c. One mole of an ideal gas at 20°C is compressed adiabatically to $1/4^{th}$ of its initial volume. What is the temperature differential of the gas after compression (Cv = 12.v J/mol/k) **[6 marks]**