SCHOOL OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES **UNIVERSITY**

EXAMINATION FOR:

DIPLOMA IN ANALYTICAL CHEMISTRY

ACH 2102: FUNDAMENTALS OF PHYSICAL CHEMISTRY

END OF SEMESTER EXAMINATION

SERIES: MARCH 2025

TIME: 2 HOURS

DATE: Pick Date MAR 2023

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt **Question one** and any other **TWO questions**.

Do not write on the question paper.

Question ONE

a) i) Write the equilibrium constant expression for the dissociation of water. **(1mark)**

ii) From your equation derive the equation pKw = pH + pOH **(3 marks)**

(iii) Find the pH of

A. 0.02 M HCl **(3 marks)**

B. 0.024M H_2SO_4 **(4 marks)**

C. 0.02M NaOH **(Kw=1x10^{-14} at 25 ^{o}C) (5 marks)**

b) State five characteristics of acids. **(5 marks)**

c) State five characteristics of chemical equilibrium. **(5 marks)**

d) Define the following terms and give one example for each

i) Arrhenius acid **(1mark)**

ii) Bronsted Lowry base **(1mark)**

iii) Conjugate acid **(1mark)**

iv) Amphoteric substance **(1mark)**

Question TWO

Given a solid sample of slightly soluble ionic compound $Zn(OH)_2$

a) Write the equation for the equilibrium established when solid $Zn(OH)_2$ is placed in water. **(2 marks)**

b) Give the K_{sp} expression for $Zn(OH)_2$ **(2 marks)**

c) If the K_{sp} for $Zn(OH)_2$ = 1.8 x 10^{-14} find the molar solubility of $Zn(OH)_2$ in

i) Pure water **(5 marks)**
ii) 0.01M NaOH **(5 marks)**

d) Explain the results obtained in c above. **(1 mark)**

Question THREE

a. A solution is made by dissolving a non-volatile solute B in a volatile Solvent A. Using a clearly labelled sketch graph(in the same set of axes) indicate the following

i) Freezing point of pure solvent T_1

ii) Freezing point of solution T_2**.**

iii) Boiling point of pure solvent T_3.

iv) Boiling point of solution T_4.

(10 marks)

b. The equation $(P_o - P)/P_o = X_i$ is applicable to binary solutions where the solute is involatile while the solvent is volatile.

i) State what is represented by X_i , P_o and $(P_o - P)/P_o$ **(3marks)**

ii) Give the name of the law represented by the equation **(1mark)**

iii) State two conditions under which the equation is valid **(1mark)**

Question FOUR

a) 3.69g of propyl bromide $CH_3CH_2CH_2Br$ was dissolved in 360 cm3 of ethanol CH_3CH_2OH. Find the mole fraction of propyl bromide in the solution. **(**C=12, Br = 80, O=16, H=1 Density of C_2H_5OH = 0.8g/cm^3)
(7marks)

b) 35.5 g of Sulphur in 100g of carbon disulphide CS_2 produces a solution of boiling point49.48 ^oC. Determine the molecular formula of Sulphur in a solution of CS_2 given that the boiling point of pure carbon disulphide is 46.23 ^oC. S=32. **(8marks)**

Question FIVE

a) State five factors that affect equilibrium systems. **(5 marks)**

b) Give that in pure water the solubility of AgCl is 1.34 X 10^{-5} mol/lit

i) Find Ksp for AgCl **(5 marks)**

ii) Find solubility of AgCl in water in g/lit Ag = 108, Cl = 35.5 **(3 marks)**

c) Distinguish heterogeneous equilibrium from homogeneous equilibrium and give one example for each.
(2 mark)