10.

(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

MASTER OF SCIENCE (CHEMISTRY)

COURSE CODE: SCH 842

COURSE TITLE: ADVANCED CHEMICALTHERMODYNAMICS

DATE: 11-04-2023 **TIME: 8.00-11.00 AM**

INSTRUCTIONS TO CANDIDATES

- Answer all the Questions

TIME: 3 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (15 MARKS)

a. Given that $\bar{G}_{real} = \bar{G} + RTln\frac{f}{P}$, Show that $lnf = lnP + \int_0^P \left(\frac{\bar{V}_{real}}{RT} - \frac{1}{P}\right) dP$

(10 marks)

b. A satisfactory equation of state for ammonia is the modified Van der Waals equation $(P(\bar{V} - b) = RT$, where b is 0.0379 L mol-1. Calculate the fugacity of the gas when pressure is 50 atm at 298K. Comment on the answer obtained (5 marks)

QUESTION TWO (15 MARKS)

a. Use the Gibbs-Duhem equation to show that the partial molar volume of a component B can be obtained if the partial molar volume of A is known for all compositions of interest. Do this by proving that $V_B = V_B^* - \int_{V_A^*}^{V_A} \frac{X_A}{1-X_A} dV_A$

Use the following data at 298K to evaluate the integral graphically to find the partial molar volume of acetone at x = 0.500

x($CHCl_3$)	0	0.194	0.385	0.559	0.788	0.889	1.000
V_m/cm^3mol^{-1}	73.99	75.29	76.50	77.55	79.08	79.82	80.67

(15 marks)

QUESTION THREE (20 MARKS)

a. What is the ionic strength I of a 1:1 electrolyte and 1: 2 electrolyte at a concentration c?

(5 marks)

b. What is the activity coefficient of copper in a solution containing 10^{-4} mol dm^{-3} $CuSO_4$?

(5 marks)

c. Liquids A and B form an ideal solution at a certain temperature. Suggest a method for measuring the partial pressures of A and B at equilibrium (5 marks)

QUESTION FOUR (15 MARKS)

a. A certain dilute solution has an osmotic pressure of 12.2 atm at 20°C. Calculate the difference between chemical potential of the solvent in the solution and that of pure water. Assume that the density is the same as that of water (5 marks)

b. Explain why jams can be stored under atmospheric conditions for long periods of time without spoilage (5 marks)

c. From the relationships among the van der Waals constants and the critical constants, show that

$Z_C = \frac{P_c V_c}{RT_c} = 0.375$ where Z_C is the compressibility factor at the critical point.

(5 marks)