NATIONAL OPEN UNIVERSITY OF NIGERIA
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE
EXPRESS WAY, JABI - ABUJA.
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2024 1 EXAMINATION

COURSE CODE: CHM 301
COURSE TITLE: PHYSICAL CHEMISTRY III
COURSE UNIT: 2
TIME: 2 HOURS
INSTRUCTION: *Answer question one and any other two questions.*

Question 1

(a) When 0.25g compound of an unknown substance is dissolved in 25g of a solvent while K_b is 2.9 Kmolal^{-1} and boils at 0.14°C higher than the pure solvent. What is the formula mass of the solute?

(b) Explain how the mixing of reactants and products affects the position of chemical equilibrium.

(c) Explain the colligative Properties of solutions of Electrolyte

(d) State the third law of thermodynamics and hence explain the concept of zero entropy of solid

(e)Calculate the free energy change which occurs when 1.00 mole of an ideal gas expands reversibly and isothermally at 3.10×10^2 K from an initial volume of 5.00×10^{-2} m^3 to 1.00 m^3.

(f) State second law of thermodynamics

Question 2

(a) What is the total volume of the solution, when 3.80 mol of water is mixed with 0.500 mol of ethanol? The partial molar volumes of water and ethanol at this composition are 1.80×10^5 m^3 mol^{-1} and 5.34×10^{-5} m^3 mol^{-1}, respectively.

(b) Define the term heat of solution

(c) What are state functions

(d) Write equations to show the net heat absorbed in one cycle based on carnot's assumption

(e) Define efficiency of a machine and hence write an equation to show the efficiency of Carnot engine

Question 3
(a) Discuss the physical interpretation of anyone Maxwell relation.

(b) Calculate ΔS (for the system) when the state of 2.00 mol diatomic perfect gas molecules, for which $C_{p,m} = 7/2R$, is changed from 25°C and 1.50 atm to 135°C and 7.00 atm.

(c) Write and equation to represent mechanical work and explain what is mechanical work in thermodynamics

QUESTION 4
(a) Given a sample of nitrogen of mass 3.12 g at 23.0°C is allowed to expand reversibly and adiabatically from 400 cm³ to 2.00 dm³. What is the work done by the gas? Take $\gamma = 1.4$

(b) Mention six (6) thermodynamic functions

(c) **Write equations in terms of temperature and volume to show adiabatic expansion and compression**
(d) Explain internal energy of a system :

Question 5
(a) Given a gas which expands from 10 m³ to 12 m³ against a constant pressure of 1 bar at 298K. What is the work done on the gas?
(b)Derive an equation to show the change in entropy accompanying isothermal expansion process of a perfect gas

(c) Explain the term equation of state and write mathematical expression to show equation of state