



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
2023 2 EXAMINATIONS

COURSE CODE: CIIM 301

CREDIT: 3 Units

COURSE TITLE: PHYSICAL CHEMISTRY III

TIME ALLOWED: 3 Hours

INSTRUCTION: Answer Question ONE (1) and any other Four (4) Questions

- Q1a) Derive Kirchhoff's equation. (6Marks)
- b) Explain bond enthalpy and state its application (3Marks)
- c) State the three applications of Clausius-Clapeyron equation (6Marks)
- d) Explain phase diagram of water system (7Marks)

2a) 1.00 Mol. of a monoatomic gas initially at 3.00×10^2 K and occupying $2.00 \times 10^{-3} \text{ m}^3$ is heated to 3.25×10^2 K and the final volume is $4.00 \times 10^{-3} \text{ m}^3$. Assuming ideal behaviour, calculate the entropy change for the process. (4Marks)

b) Derive an equation for entropy of mixing for mole fraction of gases (8Marks)

3a) 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 $1.80 \times 105 \text{ M}^3 \text{ mol}^{-1}$ and $5.34 \times 10^{-5} \text{ M}^3 \text{ Mol}^{-1}$, respectively. (5Marks)

b) Derive an expression for determining the fugacity of a gas at any pressure. (4Marks)

c) The γ factor in the above derivation is known as what. Give the general ideal gas equation. (3Marks)

4a) The equilibrium constant for the reaction



is 18.5 at 925 K and 925 at 1000 K, respectively. Calculate the standard enthalpy of the reaction. Also calculate $\Delta_r G^\circ$ and $\Delta_r S^\circ$ at 925 K. (4Marks)

b) Discuss osmotic pressure as one of the colligative properties (6Marks)