



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

INSTITUTIONAL BASED PROGRAMME (IBP) DECEMBER SESSION

EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE

SCH 503: ADVANCED CHEMICAL THERMODYNAMICS

DATE: THURSDAY 28TH APRIL 2011

TIME: 9.00 A.M -12.00 NOON

INSTRUCTIONS:

Attempt ALL questions.

1. Write short notes on the following gas equations. Use relevant equations and examples where necessary
 - a. The ideal gas equation
 - b. The Van der Waal's equation
 - c. Berthelot equations

20 mks
2. Given that $dG = VdP - SdT$
 - a. Show that $H_m - H_m^{ideal} = \left(B_m - \frac{TB_mP}{dT} \right) P + \left(C_m - \frac{TC_mP}{dT} \right) \frac{P^2}{2}$
 - b. Give an expression for C_p
 - c. Give an expression for S_m using the reference state as S_m^{ideal}
(All symbols used have their usual meaning)

20 mks
3. In the following questions, take component 1 as the solvent and component 2 as the solute
 - a. Give the general expression for the Gibb's Duhelm equation in terms of mole fractions and chemical potential for a solution with only two components
 - b. From question 3(a) above, derive expressions to show that Henry's Law is obeyed for solute standard state and Raoult's Law is obeyed for solvent standard state
 - c. From $nM = \sum dn_i \bar{M}_i$, for partial molar properties where $i = 1$ and 2 only, show that the Gibb's Duhelm equation holds

20 mks
4. Raoult's law is very important in calculating molar concentration of miscible liquid mixtures before and after distillation at specified temperatures.
 - a. Give a general mathematical expression of the corresponding vapour pressure of two miscible liquids
 - b. One mole of a 50 mole percent solution of propanol in ethanol is distilled until the boiling point of the solution rise to 90°C. The vapour pressure of the condensate (after cooling) is 1066 mmHg at 90 °C. The vapour pressure of pure ethanol at 90 °C is 1190 mmHg while that of pure propanol is 574 mmHg. Assuming the solutions and vapors behave ideally, calculate the mole fraction of ethanol at 90 °C in
 - i. Boiling liquid
 - ii. Distillate

20 mks