UNIVERSITY OF JORDAN
CHEMICAL ENGINEERING DEPARTMENT

0905322 – CHEMICAL ENGINEERING THERMODYNAMICS 1

Name	
University ID	

Course	ChE Thermodynamics II (905323)
Exam	Midterm
Date	Tuesday, 28/11/2006
Time	10 minutes closed book part 40 minutes open book part
Instructor	Dr. Ali Al-matar

Problem	Full Mark	Mark
1	24	
2	20	
3	20	
4	20	
5	36	
Total	**120**	

وقع على القسَم التالي المتعلق بالغش الأكاديمي:

اقسم بالله أنني لم اغش في هذا الامتحان ولم أساعد أي شخص على الغش سواءً لمنفعتي الشخصية أو لمنفعة الآخرين، وعلى هذا أوقع.

التوقيع:

Question 1 (24 points)

Indicate whether each of the following statements is true or false (2 point each) and provide suitable explanations and justifications for each of your answers (4 points each).

A) $\bar{\theta}_i = \left(\frac{\partial (N\theta)}{\partial N_i} \right)_{T,P,N_j}$ Can also be written as $\bar{\theta}_i = \left(\frac{\partial \theta}{\partial x_i} \right)_{T,P,x_j}$.

B) $\sum x_i d\phi_i = 0$ By the Gibbs-Duhem relationship.

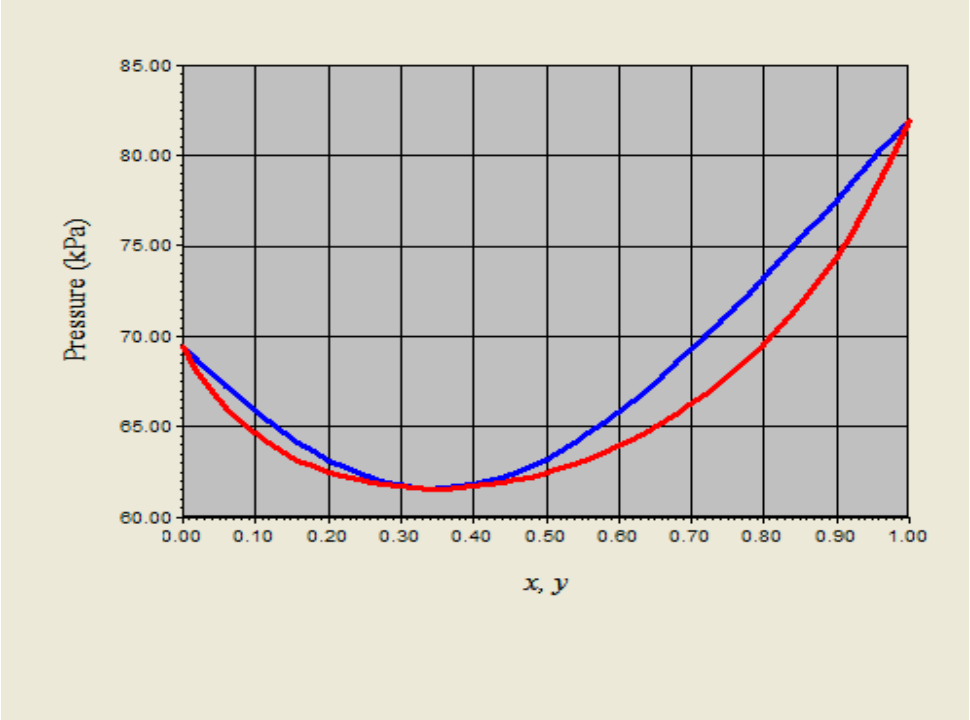
C) At equilibrium, a flavoring ingredient dissolved in salad dressing (a phase of oil on a phase of water) would have the same molar concentration.

D) The following demand is correct: "I want to set up VLE of a mixture of species A and species B at 100ºC and 250 atm, with liquid composition x_A=0.005".

Question 2 (20 points)

Mark clearly the appropriate number on the figure below for the following:

1. Bubble point curve.
2. Dew point curve.
3. Azeotrope.
4. What is the composition at the azeotrope? $x =$, $y =$.
5. What type of Azeotrope is featured in this diagram?
6. The composition in the vapor phase at equilibrium with $x = 0.56$.
7. The composition in the liquid phase at equilibrium with $y = 0.82$.
8. Which component is more volatile? Justify your answer.



1. **(20 points)** Ten moles (10 moles) of ethylene are to be compressed isothermally from their initial state (P = 21.7 bar, T = 25 ºC, and v = 1000 cm^3/mol) to 100 cm^3/mol. Under these conditions, the behavior of the gas is well described by the Peng-Robinson equation of state.
    a. Estimate the pressure at the final state.
    b. Estimate the fugacity of ethylene at the final state.
2. **(20 points)**A 10 mass % sulfuric acid in water is to be enriched to 50 mass % sulfuric acid solution by adding pure sulfuric acid. Both of the initial solutions are at 25°C.
    a. Compute the adiabatic mixing temperature (AMT) for this mixing process.
    b. How much heat have to be added / removed to produce the 50 mass % solution at 25°C?
3. **(36 points)** A feed stream of 20% benzene (1) – 80% Toluene (2) is to be flashed at 90°C and 0.65 atm. The vapor pressure of benzene and toluene, at the prescribed temperature, are 1.343 and 0.535 atm respectively.
    a. What is the vapor fraction?
    b. Determine the composition of the coexisting phases.