



UNIVERSITY OF JORDAN
CHEMICAL ENGINEERING DEPARTMENT

0905323 – CHEMICAL ENGINEERING THERMODYNAMICS 2

Name	
University ID	

Course	ChE Thermodynamics II (905323)
Exam	Midterm
Date	Saturday, 24/11/2007
Time	* 10 minutes completely closed book part * 60 minutes closed book part with A4 sheet allowed
Instructor	Dr. Ali Al-matar

Problem	Full Mark	Mark
1	20	
2	20	
3	20	
4	40	
Total	100	

وقع على القسم التالي المتعلق بالغش الأكاديمي:

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

التوقيع:

Name:

Registration number:

1. (20 marks)

Select the most correct answer and circle it in the provided answers sheet. More than one answer may be correct, make your choices carefully and wisely.

1. At equilibrium, in a closed isothermal system with a fixed boundary, one of these properties is a minimum

- a) S b) G c) H d) A

2. The mechanical stability criteria dictates that

- a) $\kappa_T = 0$ b) $\kappa_T \geq 0$ c) $\kappa_T < 0$ d) $\kappa_T \leq 0$

3. The Poynting factor is important at

- a) Extremely low P b) High P c) At low T d) b and c

4. The partial molar Gibbs free energy is defined as

- a) $\bar{g}_i = \frac{\partial(Ng)}{\partial N_i} \Big|_{T, V, N_{j \neq i}}$ b) $\bar{g}_i = \frac{\partial(Ng)}{\partial N_i} \Big|_{P, V, N_{j \neq i}}$ c) $\bar{g}_i = \frac{\partial(Ng)}{\partial N_i} \Big|_{T, P, N_{j \neq i}}$ d) $\bar{g}_i = \frac{\partial(NG)}{\partial N_i} \Big|_{T, P, N_{j \neq i}}$

5. $\lim_{x_i \rightarrow 0} (\bar{\theta}_i - \theta_i) \rightarrow ?$

- a) maximum b) minimum c) 0 d) ∞

6. The relative volatility for a certain binary mixture is found to be $\alpha_{1,2}=10$. Therefore, component 1 will most likely concentrate in the vapor phase.

- a) True b) False

7. Positive deviations from Raoult's law are manifested on a Pxy plot as

- a) Bubble curve below Raoult's line b) Bubble curve above Raoult's line c) Dew curve below Raoult's line d) Dew curve above Raoult's line

8. A system will flash if the system pressure is lower than the dew point pressure and lower than the bubble point pressure

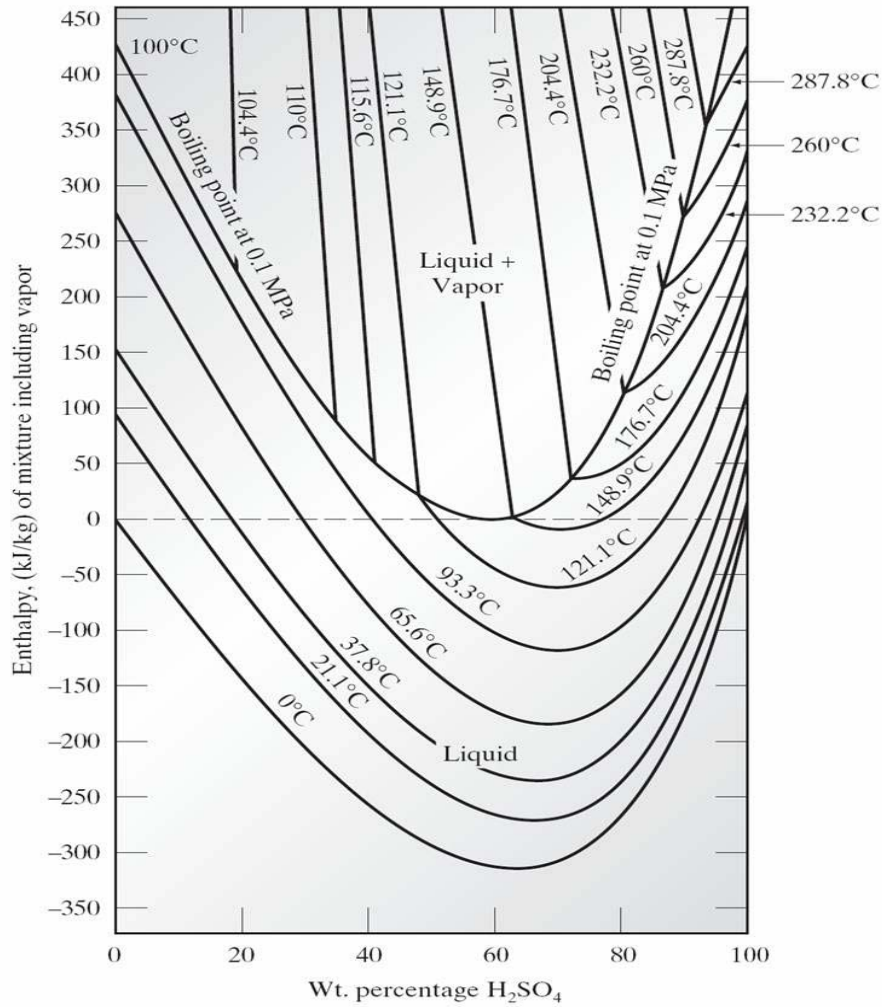
- a) True b) False

	(A)	(B)	(C)	(D)
0 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0 8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. (20 marks) Derive the necessary conditions to describe the equilibrium between a supercritical solvent whose fugacity can be calculated using an expression similar to that of vapor fugacity and a pure solid. You may assume that the solid is soluble in the supercritical phase while the supercritical solvent is not soluble in the solid.

3. (20 marks) Use the attached sulfuric acid-water enthalpy chart to solve the following:

- What is the boiling point for a 80-wt-% aqueous solution of H_2SO_4 at 0.1 MPa?
- What is the heat of mixing for a 80-wt-% aqueous solution of H_2SO_4 at 93.3°C?



4. (40 marks) The reputation of Mr. Okla Zaki as a smart chemineer (chemical engineer) is unsurpassed at the chemical engineering department of the University of Jordan. Mr. Zaki suggested that a mixture of xylene isomers fed to a flash separator at 300 K and 0.012 bars will flash and provide some separation of these isomers. The feed composition and the Antoine equation constants are given in the table below.

	x_i	A	B	C
m-Xylene	0.4	9.5188	3366.99	-58.04
o-Xylene	0.2	9.4954	3395.57	-59.46
p-Xylene	0.4	9.4761	3346.65	-57.84

The Antoine equation is given in the units of bar when temperature is in Kelvin

$$\ln P^{\text{vap}} (\text{bar}) = A - \frac{B}{T(K) + C}$$

- If the system can be flashed, what are the equilibrium compositions in the vapor phase? Comment on the answers you have calculated.
- Determine the relative volatilities for each binary system i.e., m-xylene/o-xylene, m-xylene/p-xylene, o-xylene/p-xylene.
- In your opinion, will chemineer Zaki be justified in recommending to use distillation as a separation technique for such a system?
- Discuss if Raoult's law can be considered as a good model for such system.