

國立臺灣科技大學

九十二學年度碩士班招生考試試題

系所組別：材料科技研究所碩士班

科目：熱力學

(CLOSED BOOK)

共四題，滿分 100 分

1. (25 %) Explain the following terms:

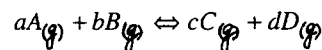
(a) chemical potential, (b) entropy, (c) critical point, (d) tie-line, (e) spinodal curve.

2. (20 %) A real gas is described by Van der Waals equation $\left(P + \frac{a}{v^2}\right)(v - b) = RT$,

where P is pressure, v is molar volume, T is temperature, R is the gas constant, and both a and b are positive constants.

Does the volume affect the internal free energy and the heat capacity at a fixed temperature? Please debate your answers in quantitative derivations.

3. (25 %) For a reaction



Please derive the equation which describes the relationship between the equilibrium constant K_P and the standard molar gibbs free energy difference Δg° , i.e., $\Delta g^\circ = -RT \ln K_P$.

4. (30 %) For a regular solution of binary A and B mixtures, the mixing Gibbs free energy per mole, ΔG_m , is given by

$$\Delta G_m = RT(x_A \ln x_A + x_B \ln x_B) + \Omega x_A x_B$$

where R is the gas constant, T is the temperature, x_i is the mole fraction of component i , $i=A, B$, and Ω is the net interaction parameter between A and B.

- (a) (8 %) Please derive the activity of component A, a_A .
 (b) (12 %) Please plot ΔG_m versus x_A for various Ω values. Please also plot the corresponding a_A versus x_A . For the curves you plot, please explain if there exists one-phase region and/or two-phase region. Why?
 (c) (6 %) Please determine the critical value of Ω , above which there exists two-phase region.
 (d) (4 %) Please draw the phase diagram in terms of Ω and x_A .

