

國立清華大學 107 學年度碩士班考試入學試題

系所班組別：工程與系統科學系碩士班 甲組(0528)

考試科目（代碼）：材料熱力學 (2802)

共__2__頁，第__1__頁 *請在【答案卷】作答

INSTRUCTIONS: Complete answers to all of the problems below. You need not restate the problem as part of the solution, but you must explain your methodology carefully and in detail, including the specific assumptions you use.. No credit will be given unless the reasoning which led to your answer is clear. Reasoning is more important than a numerically correct answer. Schematics should be used and considered as part of your solutions. Be careful to define all of the symbols you use in your solutions and the units of each term in numerical problems, including the final answer.

1. A metatectic binary phase diagram displays the following invariant transformation on cooling: $\beta \rightarrow \alpha + L$

- (a) Sketch such a phase diagram. (5%)
- (b) Draw free energy curves of mixing just below the invariant temperature. (5%)
- (c) Draw free energy curves of mixing at the invariant temperature. (5%)
- (d) Draw free energy curves of mixing just above the invariant temperature. (5%)

2. The change in enthalpy when one mole of solid water (ice) is melted at 273 K is 6008 J. Take the heat capacity of liquid water to be 75.44 J/K and that of solid water to be 38 J/k over the range in temperatures of the problem. The enthalpy of liquid water at 298 K may be set equal to zero.

- (a) Calculate the change in enthalpy when ice is melted at 298 K. Is this process possible at 1 atm? (8%)
- (b) Calculate the change in enthalpy when supercooled water solidifies at 260 K. (8%)
- (c) Calculate the change in entropy for the freezing of water at 260 K. (9%)

3. It is known that at 300 K the value of K_p for a certain reaction is 10^{12} . For the reaction ΔH° is 100 kJ/mole.

- (a) Determine if this reaction is favorable at 800 K and estimate K_p (800K). Explain your answer. (6%)
- (b) The actual value of K_p (800) is 35. Explain any discrepancy from your estimate. (4%)

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共 2 頁，第 2 頁

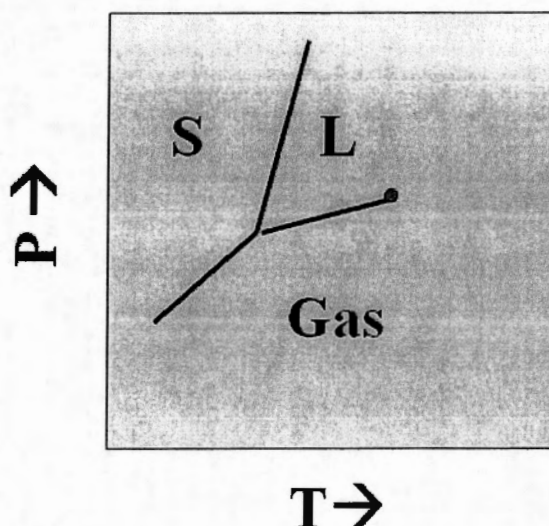
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4. All regular solutions with positive heats of mixing have the same value of the activity of its components (A or B) at the critical point of the miscibility gap.

(a) Calculate this activity (represent as a). (6%)

(b) Plot a_B vs. X_B for a regular solution at TC for a miscibility gap. (6%)

5. The Pressure Temperature phase diagram of a certain material is shown below. Construct the Volume Temperature diagram for this substance and label all phase fields. (15%)



6. A weak magnetic field is applied to a system of up and down spins. The up spins have a slightly lower energy state than those with down spins. This is because the up spins are favored by the weak magnetic field. Thus

$$\epsilon_{\uparrow} < \epsilon_{\downarrow}$$

(a) Determine the partition function for this system under the influence of the weak magnetic field. (6%)

(b) Determine the ratio of: $\frac{n_{\uparrow}}{n_{\downarrow}}$ for very high temperatures and very low temperatures. (6%)

(c) Determine the ratio of: $\frac{n_{\uparrow}}{n_{\downarrow}}$ for very high temperatures and very low temperatures. (6%)