國　立　清　華　大　學　命　題　紙

98 學年度 工程與系統科學系甲組碩士班入學考試

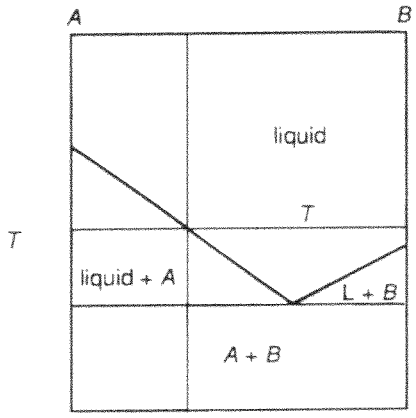
科目 材料熱力學 科目代碼 2602 共 1 頁第 1 頁 *請在【答案卷卡】內作答

1. A cylindrical container is initially separated by a clamped piston into two compartments of equal volume. The left compartment is filled with one mole of neon gas at a pressure of 4 atm and the right with argon gas at one atm. The gases may be considered as ideal. The whole system is initially a temperature $T = 300$ K, and is thermally insulated from the outside world. The heat capacity of the cylinder-piston system is C (a constant). The piston is now unclamped and released to move freely without friction. Eventually, due to slight dissipation, it comes to rest in an equilibrium position. Calculate:
   (1) The new temperature of the system (the piston is thermally conductive).(5%)
   (2) The ratio of final neon to argon volumes.(5%)
   (3) The total entropy change of the system.(5%)
   (4) The additional entropy change which would be produced if the piston were removed.(5%)
   (5) If in the initial state, the gas in the left compartment were a mole of argon instead of a mole of neon, which , if any, of the answers to (1), (2), (3) and (4) would be different?(5%)

2. Determine the ratio (pV/RT) at the critical point for a gas which obeys the equation of state (Dieterici equation)
$$p(V-b) = RT\exp(-1/RTV)$$
Give the numerical answer accurately to two significant figures. (20%)

3. The transition temperature of grey and white tin at a pressure of one atm is 291 K, grey tin being the stable modification below this temperature. The change in enthalpy for this transition is 2238 J/mol. The densities of grey and white tin are 5.75 and 7.30 g/cm^3 respectively, and the atomic weight of tin is 118.7. What is the change in the transition temperature if the system is at a pressure of 100 atm? (15%)

4. (1) Draw the diagrams of ΔG^M vs. X_B, a_A vs. X_B and a_B vs. X_B in a binary eutectic system that exhibits complete liquid miscibility and virtually complete solid immiscibility, as shown in the following figure. You should specify the standard states. (12%)
   (2) Prove that complete insolubility is not possible. State any assumptions you make in the proof. (8%)



5. The molar excess Gibbs free energy of formation of solid solution in a binary A-B solution can be represented by $G^{XS} = (a + bX_B)X_A X_B$
   (1)Calculate the partial molar free energy $\overline{G}_A^{XS}$ and $\overline{G}_B^{XS}$ (10%) (2) Prove that as $a = 0$, G^{XS} has a minimum at $X_B = \frac{2}{3}$ (10%).