國立屏東科技大學 九十三 學年度 碩士班暨碩士在職專班 招生考試
材料工程研究所碩士班
專業科目（一）冶金熱力學 試題

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1. One mole of an ideal gas is subjected to the following sequence of steps:
   (a) Starting at 25 °C and 1 atm, the gas expands freely into a vacuum to double its volume.
   (b) The gas is next heated to 125 °C at constant volume.
   (c) The gas is reversibly expanded at constant temperature until its volume is again doubled.
   (d) The gas is finally reversibly cooled to 25 °C at constant pressure.
   Calculate ΔU, ΔH, q, w, and ΔS. (Assume the gas is monatomic) (20%)

2. Why is C_P greater for white tin (metal) than for gray tin (nonmetal)? (10%)

3. One mole of gold is taken from state 1 (P = 1 atm, T = 293 K) to state 2 (P = 1atm, T = 273 K). What pressure must be applied to the gold at 273 K in order to raise its enthalpy back to that of state 1? Calculate the entropy difference between states 1 and 3. (15%)

Given: The density of Au at 20 °C is 19.30 g/cm^3; the coefficient of (volumetric) thermal expansion is $\alpha = 4.32 \times 10^{-5}$ K^{-1}; $C_P = 23.7 + 5.19 \times 10^{-3} T$ J/mol·K; Au_{MW} = 196.9665 g/mole. Assume that $P_3 - P_2$ is small enough that V and α are not changed significantly. Also, assume that the 20 °C values for ρ and α can be used at 0°C.

4. Refer to phase diagram Figure 1. Sketch a free energy-composition diagram at 800 °C, and indicate the composition ranges where various phases are stable. (Show free energy curves for stable phases only.) (10%)

5. Read carefully and determine whether the following statements are true or false and indicate your thermodynamic reasoning. If you claim that a statement is false, you may state which law or laws of thermodynamics that it violates.
   (a) The internal energy of an isolated system is constant. (4%)
   (b) If an ideal gas increases its volume by 1 cubic meter at a constant pressure of 1 newton/(square meter), then its internal energy will decrease by 1 joule. (4%)
   (c) The internal energy of a system and its surroundings is not conserved during an irreversible process. (4%)
   (d) The increase of internal energy of an adiabatic system consisting of an incompressible diamagnetic material is the work performed on the system. (3%)

6. At a pressure of 1 atm the equilibrium melting temperature of lead 600 K, and, at this temperature, the latent heat of melting of lead is 4810 J/mole. Calculate the entropy produced when 1 mole of supercooled liquid lead spontaneously freezes at 590 K and 1 atm pressure. $C_{p(l)} = 32.4 - 3.1 \times 10^{-3} T$ J/K, $C_{p(s)} = 23.6 - 9.75 \times 10^{-3} T$ J/K. (15%)

7. Draw a graph showing the variation in the molar Gibbs free energy as a function of temperature for a unary system at the pressure which gives a triple point. Repeat the drawing for pressures just above and just below the triple point. (15%)

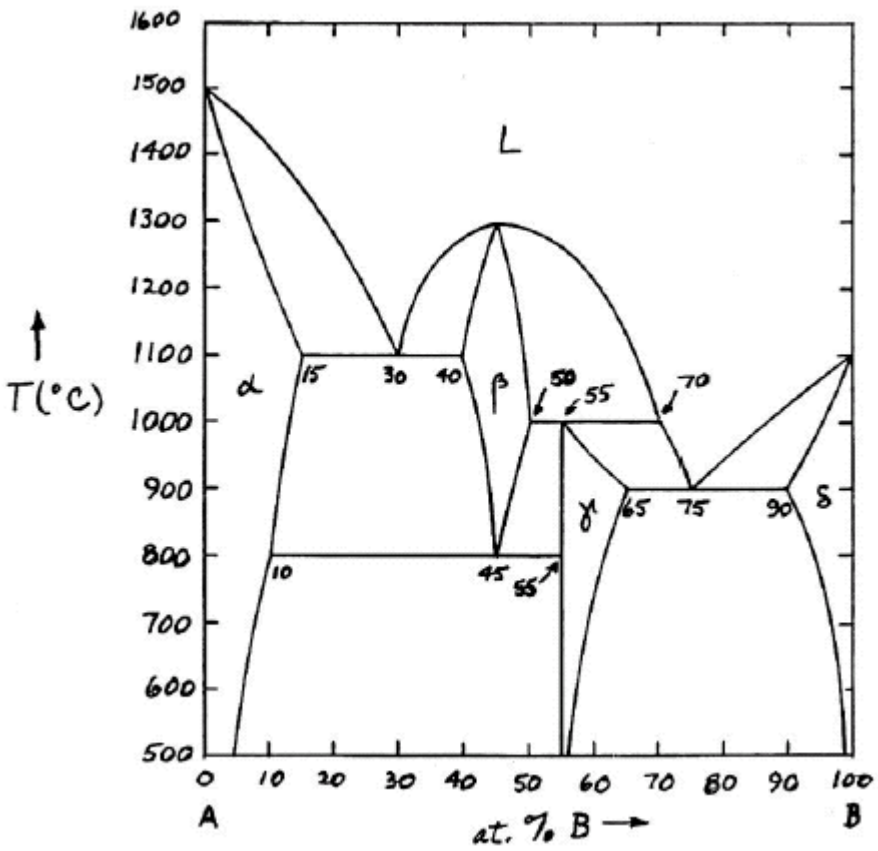
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Figure 1