國立臺灣大學 103 學年度碩士班招生考試試題

1. (a) Compute the rise in the temperature of water that goes over a waterfall of 100 meters. Assume that all of the gravitational potential energy is converted into heat. Plot the kinetic energy (KE), potential energy (PE), internal energy (U) and total energy (TE) of the water as a function of height. What is the temperature rise of water in °C? (1 cal = 4.184 J) (10%)

   (b) Repeat the problem assuming that a hydroelectric generator at the bottom of the waterfall converts 90% of the potential energy into mechanical energy. What is the temperature rise of water in °C? (10%)

2. Consider the fundamental relation below where c is a positive constant. (30%)

$$U = (c/N)\,(S^2 - V^2)$$

   (U = internal energy, S = entropy, V = volume, N = number of mole)

   (a) Write the fundamental relation as H (S, P, N) (H = enthalpy, P = pressure)

   (b) Write the fundamental relation as G (T, P, N)
   (G = Gibbs free energy, T = temperature)

   (c) Determine C_P (heat capacity at constant pressure), C_v (heat capacity at constant volume) and α (isobaric thermal expansivity)

3. A CO_2-CO-H_2O-H_2 gas mixture at a total pressure of 1 atm exerts a partial pressure of oxygen of 10^{-6} atm at 1600 °C. In what ratio were CO_2 and H_2 mixed to produce the gas with this oxygen pressure? Use the Ellingham Diagram (Figure 1) for your data. (20%)

4. At 700 K, the activity of Ga in a liquid Ga-Cd solution of composition X_{Ga}=0.5 has the value of 0.79. On the assumption that liquid solutions of Ga and Cd exhibit regular solution behavior, estimate the energy of the Ga-Cd bond in the solution. It is known that ϵ_{GaGa}= -8.15×10^{-20} J and ϵ_{CdCd}= -4.15×10^{-20} J. (20%)

5. Prove that, in a binary solution if the Henry's law is obeyed for one component in some composition range, then the Raoult's law is obeyed for the other component in the same composition range. (10%)

見背面

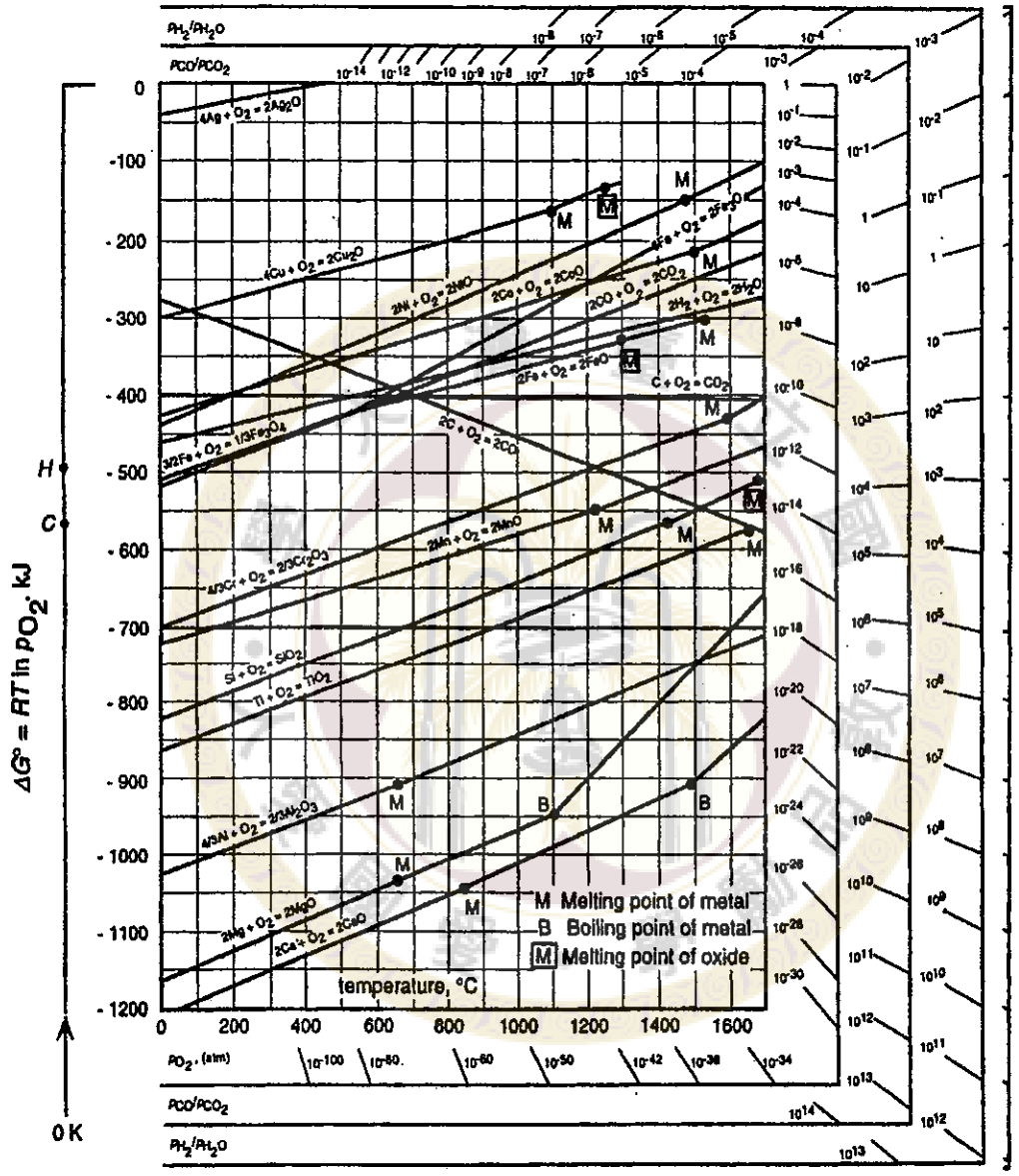

Figure 1　The Ellingham diagram for selected oxides.

試題隨卷繳回