大同大學 99 學年度研究所碩士班入學考試試題

考試科目:冶金熱力　　所別:材料工程研究所　　

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

(1) At one atmosphere pressure pure germanium melts at 1232 K and boils at 2980 K. The pressure at the triple point (S, L, G) is 8.4×10^{-8} atm. Estimate the heat of vaporization of germanium? State your assumptions. (10%)

(2) Assuming that an A-B alloy is a random mixture of A and B atoms, calculate the increase in entropy when 10 g of A are mixed with 20 g of B to form an ideal homogeneous alloy. The gram atomic weight of A and B are, respectively, 200 and 100. (10%)

(3) One mole of a monatomic ideal gas undergoes a reversible adiabatic expansion and the state was changed from (T_1, P_1, V_1) to (T_2, P_2, V_2).

(a) What is the change in internal energy? (5%)

(b) What is the work done by the gas in terms of T and R? (5%)

(c) What is the work done by the gas in terms of P, V and γ ($= c_p / c_v$) ? (5%)

Hint : PV^{γ} = constant for the reversible adiabatic process.

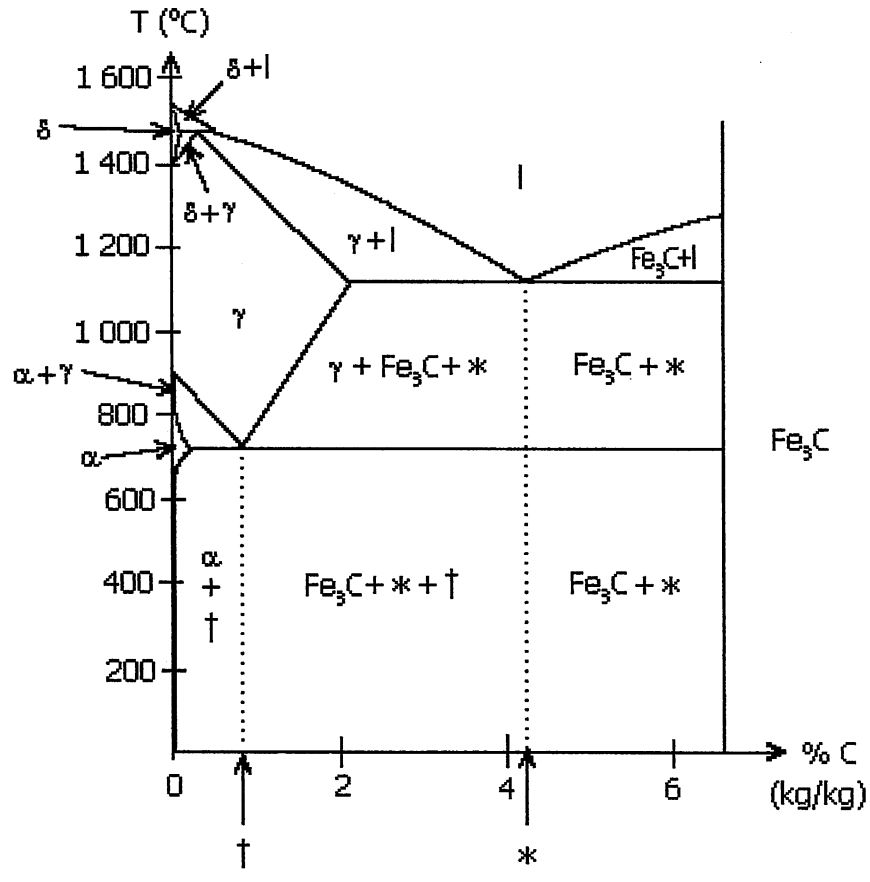
(4) (a) Show that $\left(\frac{\partial P}{\partial T}\right)_V = \frac{\alpha}{\beta}$, where

α = isobaric thermal expansivity = $\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$,

β = isothermal compressibility = $-\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$.

(5%)

(b) One mole of a metal, m, at 1 atm pressure is heated at constant volume from 300 to 500 K. Calculate the pressure that results from such a process. What is the work done ? Assume c_p is constant over the temperature interval. $\alpha_m = 5 \times 10^{-5}\ K^{-1}$, and $\beta_m = 8 \times 10^{-6}\ atm^{-1}$. (5%)



(c) Calculate the entropy change for the above process. $c_p = 20.9$ J/(mol•K), $V_m = 6$ cm^3/ mol. (5%)
Hint : $dS = (\partial S/\partial T)_P\, dT + (\partial S/\partial P)_T\, dP$.

(5) There are five phases in the iron-iron carbide phase diagram (right above).(10%)

(a) Draw schematic plots of the molar Gibbs energy as a function of composition at 800°C.

(b) Draw schematic plots of the activity of iron as a function of composition at 800°C.

(6) You are responsible for the purchase of 600 moles of oxygen gas which, before use, will be stored at 300K in a cylindrical vessel of diameter of 0.2 meters and height 2 meters. Would you prefer that the gas behaved ideally or as a van der Waals gas in terms of safety? The van der Waals constants for oxygen are a = 1.36 l^2•atm•mole^{-2} and b = 0.0318 l/mol. (**Hint:** Please calculate the pressure of the gases in the cylindrical vessel first. The smaller pressure of the gas is preferred. $(P + \frac{an^2}{V^2})(V' - nb) = nRT$) (15%)

(7) For the regular solution with $\Omega < 0$, which of the following statement is false?(10%)

(a) The average bond strength of E_{AA} and E_{BB} is greater than the bond strength of E_{AB}.

(b) The mixing is endothermic.

(c) The volume is shrinked (decreased) after mixing.

(d) The mixing is negatively deviated from ideal mixing.

(選擇答案後，必須要說明原因，才會計分)

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(8) Please read the equilibrium oxygen pressure and the PCO/PCO_2 ratio of the Ti-TiO_2 at 1300°C from Ellingham diagrm. Please verify that the above values (the equilibrium oxygen pressure and the PCO/PCO_2 ratio) can also be related from the reaction, $2CO_{(g)}+O_{2(g)} = 2CO_{2(g)}$, G^o=-564800+173.62T (joule) (**Hint:** The equilibrium constant caculated from Gibbs free energy should be equal or near to the the equilibrium constant caculated from the reading values.)(15%)