

大同大學 九十四 學年度研究所碩士班入學考試試題

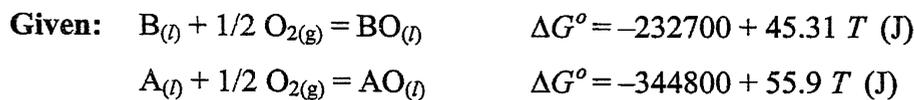
考試科目：冶金熱力

所別：材料工程研究所

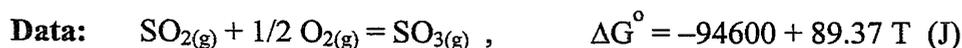
第 1/1 頁

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) One mole of N_2 gas is contained at 273 K and a pressure of 1 atm. The addition of heat q_p to the gas at constant pressure causes 800 J of work to be done during the expansion. Calculate (a) the final state of the gas, P_2 , V_2 , and T_2 , (b) the values of ΔU and ΔH for the change of state. Assume that nitrogen behaves as an ideal gas, and that the above change of state is conducted reversibly. The constant pressure molar heat capacity of the gas, c_p , has the value $3.5 R$. (16%)
- (2) Calculate the change in the enthalpy and the change in entropy when 1 mole of CaO is heated from 300 K to 1000 K. The constant pressure molar heat capacity of CaO varies with temperature as $c_p = 49.62 + 4.51 \times 10^{-3}T - 6.95 \times 10^{-5}T^2$ J/mole·K. (14%)
- (3) The isotopic composition of lead in atomic percent is 1.5, 23.6, 22.6, and 52.3 for atomic weight 204, 206, 207, and 208 respectively. Calculate the molar configurational entropy of lead. The configurational entropy is obtained from Boltzmann's equation $S = k \ln \Omega$, where $k = 1.38054 \times 10^{-23}$ J/K. (10%)
- (4) The vapor pressures of solid and liquid NaF have been written as $\ln p(\text{atm}) = -\frac{34450}{T} - 2.01 \ln T + 33.74$ and $\ln p(\text{atm}) = -\frac{31090}{T} - 2.52 \ln T + 34.66$ respectively. Calculate the molar heat of evaporation at the boiling point $T_b = 2006$ K. (10%)
- (5) A liquid A-B alloy and a liquid AO-BO solution can be in equilibrium with an oxygen-containing atmosphere.
 - (a) How many degrees of freedom does the system have? (6%)
(For full credit, point out the chemical species, the phases and the independent reactions of the system. No credit will be given for a simple numerical answer.)
 - (b) If a liquid A-B alloy with a composition of $X_B = 0.5$ is in equilibrium with an AO-BO liquid solution in an atmosphere containing oxygen at 1800°C , what is the composition of the AO-BO solution? What is the equilibrium oxygen pressure? Assuming that the liquid A-B alloy is ideal and the liquid AO-BO solution is regular with a Ω value of 100 J. (10%) (Just tell me **how** to solve the problem **in details**. It is not necessary to calculate the answer numerically.) **Note:** For a binary regular solution, $RT \ln \gamma_i = \Omega(1 - X_i)^2$.



- (6) A graduate student is asked to mix two flows of SO_3 and SO_2 in a ratio x such that the resulting partial pressure of oxygen is equal to 0.05 atm in a reactor at 1100 K and under a total atmosphere of 1.2 atm (assuming equilibrium). Calculate the ratio x . (12%)



- (7) The Ag-Cu eutectic phase diagram is shown in the following figure.

- (a) Determine the activity coefficient of Cu in the β phase, γ_{Cu}^β , at 500°C assuming that Cu behaves ideally in α phase and Henrian in β phase and that the standard state for Cu is pure solid copper. From the phase diagram, the solubility of Ag in α phase is 2 wt%, and the solubility of Cu in β phase is 1.9 wt% at 500°C . The atomic weight of Ag is 107.868, and the atomic weight of Cu is 63.546. (10%)
- (b) Draw the free energy (ΔG^M) vs. composition curves at temperatures 800°C and 700°C . (6%)
- (c) Draw the activity vs. composition curves at temperatures 800°C and 700°C . (6%)

