

大同大學 100 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1/2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) Calculate the change in the enthalpy and the change in entropy when one mole of solid A is heated from T_1 to T_2 . The constant-pressure molar heat capacity of solid A varies with temperature as (10%)

$$c_p = a + bT - c/T^2 \quad (\text{J/mole K})$$

- (2) (a) Show that $\left(\frac{\partial H}{\partial P}\right)_T = V(1 - \alpha T)$, where $\alpha =$ isobaric thermal expansivity $= \frac{1}{V} \left(\frac{\partial V}{\partial T}\right)_P$. (7%)

- (b) Copper exists in the state $T = 298 \text{ K}$, $P = 1 \text{ atm}$. Calculate the temperature to which the copper must be raised at 1 atm pressure to cause the same increase in molar enthalpy as is caused by increasing its pressure to 1000 atm at 298 K. The molar volume of Cu at 298 K is 7.09 cm^3 , and the thermal expansivity is $0.493 \times 10^{-3} \text{ K}^{-1}$. These values can be taken as being independent of pressure in the range 1-1000 atm. The constant-pressure molar heat capacity of Cu is (8%)

$$c_p = 22.64 + 6.28 \times 10^{-3} T \quad (\text{J/mole K})$$

- (3) Explain the following terms:

- (a) Ideal gas (5%)
- (b) Ideal solution and regular solution. (5%)
- (c) Gibbs-Helmholtz equation. (5%)
- (d) Clapeyron equation. (5%)
- (e) Fugacity. (5%)

- (4) One mole of a monatomic ideal gas, in the initial state $T = 273 \text{ K}$, $P = 1 \text{ atm}$, is subjected to the following three processes, each of which is conducted reversibly: (*hint: $1 \text{ atm} = 101325 \text{ Nt/m}^2$*)

- (a) A doubling of its volume at constant pressure,
- (b) Then a doubling of its pressure at constant volume
- (c) Then a return to the initial state along a straight line path on the P-V diagram (where P in atm, V in liter)

Calculate the heat and work effects which occur during each of the three processes. (18%)

- (5) A rigid container is divided into three compartments of equal volume by two partitions. There are two kinds of ideal gas, A and B. One compartment contained 4 molecules of A and 2 molecules of B, another contained 1 molecule of A and 5 molecules of A, the other contained 4 molecules of A and 2 molecules of A. Please calculate the entropy change between the initial state and most probable state after all the partitions were removed. (16%)

<背面繼續>

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第2/2頁

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(6) True or false (After writing down the question number, ○ denotes that you agree the description, otherwise × denotes you disagree the description)

(是非題，作答請標示題號後，以 ○代表您認為該描述為正確，×代表您認為該描述有錯誤)

(a) Density is an intensive property. (2%)

(b) The entropy of any material at 0 K is equal to zero (the third law of the thermodynamics). (2%)

(c) For the chemical potential (μ_i),
$$\mu_i = \left(\frac{\partial G}{\partial n_i} \right)_{T,P,n_j \neq i} = \left(\frac{\partial A}{\partial n_i} \right)_{T,P,n_j \neq i}$$
 (2%)

(d) Regular solution exhibits ideal mixing behavior. (2%)

(e) In the effect of melting of the metal on the Ellingham line for oxidation of the metal, the Ellingham line for the oxidation of liquid A to form solid AO_2 has a greater slope than the corresponding line for the oxidation of solid. (The line contains an “elbow upwards” at T_{mA} .) (2%)

(f) Pressure is a state function. (2%)

(g) Increasing the temperature of a nonideal solution will causes a decrease in the extent to which its components deviate from ideal behavior. (2%)

(h) The relationship, $dG = VdP$, holds when the system is an closed system with only PV work. (2%)