

八十五學年度 核子工程物理系(所) 組碩士班研究生入學考試

科目 普通熱力學 科號 3813 共 2 頁第 1 頁 \*請在試卷【答案卷】內作答

1. (10%)

If two closed systems are in contact to the reservoirs of two different temperatures respectively, and receiving the same amount of heat from the reservoirs, the entropy change is smaller for the system attaching to the higher temperature reservoir based on the definition of entropy. Please give your explanation based on the statistical thermodynamics argument.

2. (15%)

In two closed systems A and B, let the energy of A and B be  $U_A$  and  $U_B$ , and the number of complexions of A and B be  $\Omega_A$  and  $\Omega_B$ , respectively. After thermal contact is made between A and B, describe the phenomena regarding the heat flow, the change of  $U_A, U_B, \Omega_A, \Omega_B$ , and explain how the thermal equilibrium is achieved.

3. (15%)

Show that for ideal gas and  $C_p = C_v + R$ ,

- (1) the reversible adiabatic process obeys  $PV^\gamma = \text{constant}$ ,
- (2) the reversible isothermal process obeys  $PV = \text{constant}$ ,
- (3) and show that the work done in the isothermal process is greater than that in the adiabatic process.

4. (20%)

- (a) The van der Waals equation predicts the critical state of real gas. Please derive the critical volume, critical pressure, and critical temperature for the van der Waals gas.
- (b) Please demonstrate the law of corresponding states by writing the van der Waals equation derived in (a) in terms of the reduced variables.

5. (20%)

A gas mixture of 50% CO, 25% CO<sub>2</sub> and 25% H<sub>2</sub> (by volume) is fed into a furnace at 900°C. Find the composition of the equilibrium CO—CO<sub>2</sub>—H<sub>2</sub>O—H<sub>2</sub> gas if the total pressure in the furnace is 1 atm.

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6. (20%)

The variation, with composition, of  $G^{XS}$  for liquid Au-Cu alloys at 1550 K, shown in the following figure is

$x_{Cu}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
$G^{XS}$ joules/ mole	-2170	-3850	-5050	-5770	-6010	-5770	-5050	-3850	-2170

Please calculate:

- (a)  $\bar{G}_{Au}^{XS}$  and  $\bar{G}_{Cu}^{XS}$  at  $X_{Cu} = 0.3$
- (b)  $\Delta G^M$  at  $X_{Cu} = 0.3$
- (c) The partial pressure of Cu and Au exerted by the  $X_{Cu}=0.3$  alloy at 1550 K.

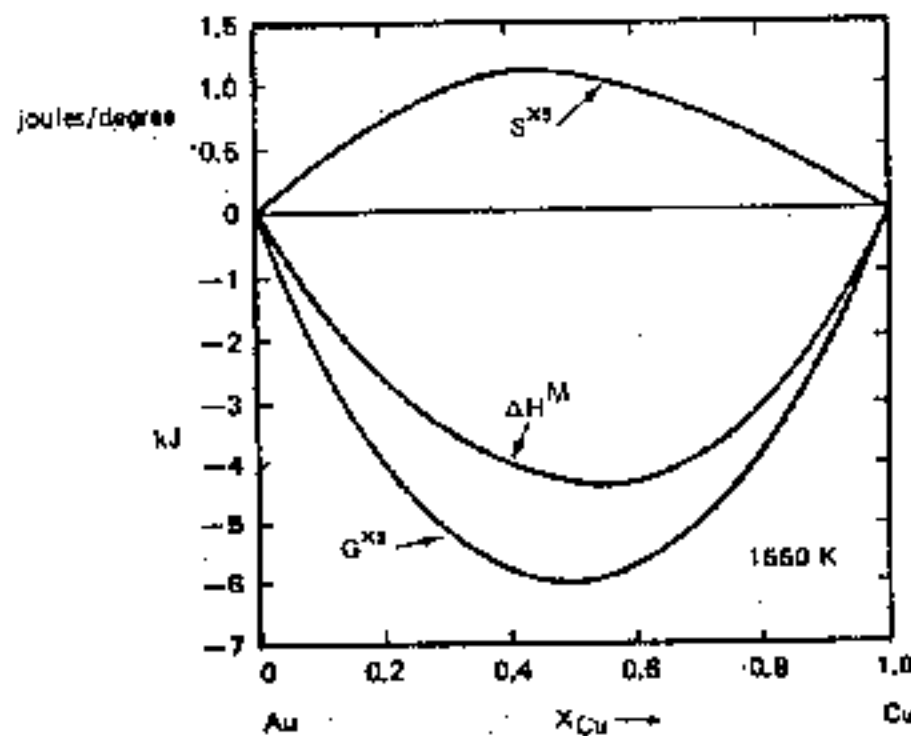


Fig. 1. The molar excess free energy, enthalpy, and excess entropy of mixing of gold and copper at 1550 K.