

八十六學年度材料科學工程研究所(系) 第一 組碩士班研究生入學考試

科目 冶金熱力學 科號 1803 共 2 頁第 1 頁 \*請在試卷【答案卷】內作答

1. Five moles of an ideal gas are contained adiabatically at 50 atm pressure and 300K. The pressure is suddenly released to 8 atm, and the gas undergoes an irreversible expansion during which it performs 4000 joules of work. Show that the final temperature of the gas after the irreversible expansion is greater than that of the final state if the process was conducted reversibly. Calculate the entropy produced as a result of the irreversible expansion. (10%)

2. The isotopic composition of lead in atomic percent is

<u>atomic weight</u>	<u>atomic percent</u>
204	1.5
206	23.6
207	22.6
208	52.3

Calculate the molar configurational entropy of lead. (10%)

3. Please derive, from the thermodynamic first and second laws, the relationship between the reversibility of a reaction and the change of Gibbs free energy of the system involved. (10%)

4. Please show that

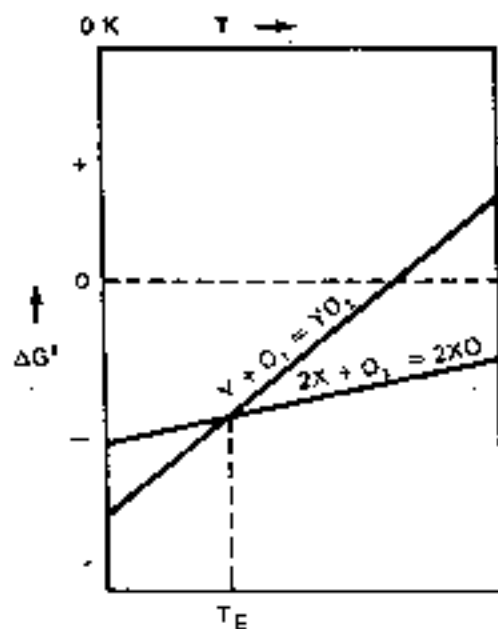
$$C_p - C_v = (dV/dT)_P [P + (dU/dV)_T]$$

where P, T, V, U are respectively the pressure, temperature, volume and internal energy of a specified system. (10%)

5. Please explain the third law of thermodynamics. Can you provide an experimental verification? You may use graphs to illustrate your points. (10%)

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6.  $n$  moles of an ideal gas A and  $(1-n)$  moles of an ideal gas B, each at 1 atm pressure, are mixed at constant total pressure. What ratio of A and B in the mixture maximizes the free energy decrease of the system? If this free energy decrease is  $\Delta G$ , to what value must the pressure be increased in order to increase the total free energy of the gas mixture by  $0.5\Delta G$ ? (10%)
7. Suppose the Ellingham lines for two hypothetical oxidation reactions:  $Y + O_2 = YO_2$  and  $2X + O_2 = 2XO$  are those shown in the following figure. How could you identify which reaction has a more negative standard enthalpy change  $\Delta H^\circ$  and more negative standard entropy change  $\Delta S^\circ$ ? Does the element X might reduce the oxide  $YO_2$  below the temperature  $T_E$ ? Please explain your answer. (20%)



8. Please state the Raoult's law and Henry's law, respectively. Moreover, plot the activity versus composition curve of a binary solution exhibiting positive deviation behavior and indicate the composition range for each law to become true? (10%)
9. What is the Gibbs phase rule? Please prove this rule based on the equilibrium conditions of a system. (10%)