

國立臺北科技大學九十八學年度碩士班招生考試

系所組別：3301 3302 材料科學與工程研究所不分組

第一節 普通熱力學 試題

第一頁 共一頁

注意事項：

1. 本試題共八題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Calculate the entropy changes for 1 mole of ideal gas with initial pressure of 30atm and temperature of 300°K to final pressure of 10atm via: ($C_p=5/2 R$, $C_v=3/2 R$, $R=\text{gas constant}=8.31 \text{ J}^\circ\text{K}/\text{mole}$)
 - (a) Reversible isothermal process. (10%)
 - (b) Reversible adiabatic expansion. (10%)
 - (c) Reversible isometric process. (10%)
2. Given that $c_p-c_v = R$ for ideal gases, prove that for ideal gases undergoing reversible adiabatic process, $P_1V_1^\gamma=P_2V_2^\gamma=\text{const.}$, where $\gamma=c_p/c_v$. (10%)
3. According to Richards' rules that the heats of melting are related to the melting points of metallic elements as follows: (where "m" subscript means "melting")
 $\Delta H_m = 9.61 T_m \pm 0.01 \text{ J/K/mole}$ for fcc metallic elements
 $\Delta H_m = 8.25 T_m \pm 0.19 \text{ J/K/mole}$ for bcc metallic elements
Can you compare the entropy of fcc and bcc metallic elements by observing the above relations and explain why?. (10%)
4. Please outline the $\Delta G^{\text{mix}}-X_B$ diagram for the A-B binary eutectic phase diagram at temperature lower than the eutectic point where A and B are completely immiscible to each other. (10%)
(ΔG^{mix} : Gibbs free energy change of mixture; X_B : molar fraction of B)

5. Please calculate the lowest temperature at which FeO may be reduced to pure Fe by graphite under total pressure of 1 atm assuming no Fe_3C is formed? (10%)
Given: $\text{Fe(s)} + \frac{1}{2} \text{O}_2(\text{g}) = \text{FeO(s)}$, $\Delta G^\circ_{\text{FeO}} = -263700 + 64.35 T \text{ J/mole}$
 $\text{C(s)} + \frac{1}{2} \text{O}_2(\text{g}) = \text{CO(g)}$, $\Delta G^\circ_{\text{CO}} = -111700 - 87.65 T \text{ J/mole}$
6. (a) For a regular solution of A and B solid solution, it was determined that the enthalpy of mixture, $\Delta H^{\text{mix}} = 4060 X_A X_B \text{ J/mole}$. Please estimate the activities of A and B at $X_A=X_B=0.5$ and $T=700\text{K}$. (10%)
(b) What are the activities of A and B if they form ideal solution at $X_A=X_B=0.5$ and $T=700\text{K}$? (10%)
7. Please choose one that is correct: (5%)
 - (1) Supercritical CO_2 fluids have higher entropy than CO_2 gas at room temperature and 1 atm.
 - (2) Diamond has lower Gibbs free energy than graphite at ambient environment.
 - (3) The universe gains entropy when iced water melts into water at room temperature.
 - (4) The environment gains heat when ice melts into water at 0°C , 1atm.
8. Please choose one that is incorrect: (5%)
 - (1) Solution mixtures always have negative entropy changes.
 - (2) Positive enthalpy changes of mixtures indicate that the solute and solvent atoms dislike each other.
 - (3) Positive Gibbs free energy changes of reactions mean that the reverse reactions can proceed spontaneously.
 - (4) Gibbs free energy of matters decrease with increasing temperatures.

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