

國立臺北科技大學 101 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

第一節 普通熱力學 試題

第一頁 共二頁

注意事項：

1. 本試題共 13 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. Which of the following gives rise to temperature? (5%)
 - (1) Change of internal energy with respect to volume at constant entropy.
 - (2) Change of Helmholtz free energy with respect to entropy at constant volume.
 - (3) Change of Gibbs free energy with respect to entropy at constant pressure.
 - (4) Change of enthalpy with respect to entropy at constant pressure.
2. For a metastable phase to transform into a mixture of stable phases at constant pressure and temperature, what would you expect? (5%)
 - (1) Universe entropy increases.
 - (2) Universe entropy must keep at constant.
 - (3) System Gibbs free energy increases.
 - (4) System Gibbs free energy keeps at constant.
3. For a solid M with saturated vapor pressure, p_M° , which of the following might be wrong? (5%)
 - (1) p_M° is a constant no matter how total P changes at a constant temperature.
 - (2) p_M° decreases with increasing volume at constant temperature.
 - (3) p_M° increases with increasing pressure at constant volume.
 - (4) p_M° increases with increasing temperature.
4. For regular solutions, what properties do they not have? (5%)
 - (1) Constant volume.
 - (2) Constant atomic interaction.
 - (3) Ideal entropy of mixture.
 - (4) Nonzero activity coefficients.
5. In spinodal decomposition, which of the following is incorrect? (5%)
 - (1) Gibbs-Duhem Equation is met.
 - (2) There are inflection points in the change of Gibbs free energy curves with composition.
 - (3) Activity coefficient is either larger or smaller than unity.
 - (4) One single phase transforms to immiscible phases below a critical temperature.
6. For an ideal gas undergoing reversible process at the following conditions, which of the following paths might possibly keep the system entropy at constant, given that the initial $T=373\text{K}$ and $P=1\text{ atm}$? (5%)
 - (1) T decreases 273K at constant P.
 - (2) T decreases 273K and P decreases to 0.46 atm.
 - (3) T decreases 273K at constant V.
 - (4) T decreases 273K and P increases to 1.36 atm..
 - (5) T keeps at constant while P increases to 1.36atm.
7. For Fe-Mn alloy that demonstrates regular solution behavior, the enthalpy of mixture can be expressed as $4400 X_{\text{Fe}} X_{\text{Mn}}$ J, please estimate the activity of Mn in Fe containing 2 at.% of Mn at 1300K. (5%)
 - (1) 0.98
 - (2) 0.020003
 - (3) 0.02957
 - (4) 0.0135
 - (5) 0.663
8. The constant pressure specific heat of FeO is $45.91+0.013T$ (J/K/mole, T is temperature) and its constant volume specific heat is 50 J/K/mole, which is correct in the following to heat a mole of FeO from 25°C to 1000°C in atmosphere? (5%)
 - (1) FeO absorbs 48750J.
 - (2) The environment absorbs 48750 J.
 - (3) The environment gains entropy of 79.34 J/K.
 - (4) The environment absorbs 54718 J.
 - (5) FeO absorbs 54718 J.

注意：背面尚有試題

9. For an ideal gas mixture containing equal amount of H₂, CO₂, CO and H₂O with total pressure of 1 atm, considering the reaction of H₂+CO₂ = CO + H₂O, at what condition would it proceed to the right? (5%)

$$\Delta G_{CO}^{\circ} = -111,700 - 87.65T(J/mole) \quad , \quad \Delta G_{CO_2}^{\circ} = -394,100 - 0.84T(J/mole)$$

$$\Delta G_{H_2O}^{\circ} = -247,500 + 55.85T(J/mole) \quad ,$$

- (1) Increase pressure.
 - (2) Decrease pressure.
 - (3) Increase temperature over 1127K.
 - (4) Decrease temperature below 1127K.
 - (5) Cannot be judged depending on total pressure.
10. For a mole of super-cooled water frozen at -5°C, 1 atm to become ice of the same temperature, which of the following descriptions about the water/ice system is correct? (heat of melting for H₂O=6008 J/mole at 0°C, specific heat of ice c_{p,ice}=38.1 J/mole/K, c_{p,water}=75.3 J/mole/K) (5%)
- (1) Change of enthalpy is 6194 J.
 - (2) Change of enthalpy is -6194 J.
 - (3) Change of entropy is 21.32 J/K.
 - (4) Change of entropy is -21.32 J/K.

11. Bi and Cd are insoluble in solid state and form a eutectic phase diagram. Assume their liquid solution being ideal, please estimate their eutectic temperature and composition. Gibbs free energy of melting for Bi and Cd are given as follows. (20%)

$$\Delta G_{m,Bi}^{\circ} = 10900 \left[\frac{554 - T}{554} \right] \quad , \quad \Delta G_{m,Cd}^{\circ} = 6400 \left[\frac{594 - T}{594} \right]$$

12. For a gas mixture of 95 vol.% Air-5 vol.% H₂, please list and calculate the equilibrium partial pressures of all gases after H₂ reacting with O₂ at 700°C and 1 atm pressure. (Air is composed of 79 vol.% N₂ and 21 vol.% O₂. The Gibbs free energy of formation for H₂O is listed in Prob.#9) (20%)
13. Calculate the temperature requirements for Ag₂O to reduce to Ag in air at 1 atm. (10%)

$$\Delta G_{Ag_2O}^{\circ} = -30,540 + 66.11T(J/mole)$$