

國立臺北科技大學 102 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 12 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. For an ideal gas to complete a reversible cycle in the P-V space by starting at one point and finish at the same point via a clockwise path, what would you expect? (6%)
 - (1) The ideal gas gains internal energy in the cycle..
 - (2) The area of the cycle represents the work done on the gas.
 - (3) The gas has a gain of heat by completing the cycle.
 - (4) There is a positive change of entropy.
2. For the reduction reaction of metal oxides, what would you expect? (6%)
 - (1) The change of standard free energy of reaction increases with temperature.
 - (2) The change of entropy for the reaction is positive.
 - (3) The change of enthalpy is negative.
 - (4) The change of standard free energy for the reaction is negative.
3. For an endothermic reaction by mixing copper and iron, which is incorrect? (6%)
 - (1) The configurational entropy of mixture is positive.
 - (2) Change of free energy of mixture must be negative.
 - (3) Heat is needed to mix copper and iron.
 - (4) Both copper and iron have activity coefficients larger than unity.
4. By applying a pressure upon metals at a constant temperature, what will occur? (6%)
 - (1) The enthalpy will increase.
 - (2) The enthalpy does not change.
 - (3) The entropy will increase.
 - (4) None of the above.

5. In the $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g})$ reaction, $\Delta G^\circ = -247,500 + 55.85T(\text{J})$. This means: (6%)
 - (1) The reaction always proceeds toward H_2O formation.
 - (2) At room temperature, the reaction will be endothermic.
 - (3) The entropy will increase in the reaction toward forming H_2O .
 - (4) The volume shrinks during the reaction forming H_2O .

6. For the thermit reaction $8 \text{Al} + 3 \text{Fe}_3\text{O}_4 = 4 \text{Al}_2\text{O}_3 + 9 \text{Fe}$ and

$$\Delta G_{\text{Al}_2\text{O}_3}^\circ = -1687200 + 326.8T(\text{J}), \quad \Delta G_{\text{Fe}_3\text{O}_4}^\circ = -1102200 + 307.4T(\text{J})$$

$$\Delta H_{\text{Al}_2\text{O}_3, 298\text{K}}^\circ = -1675700(\text{J}), \quad \Delta H_{\text{Fe}_3\text{O}_4, 298\text{K}}^\circ = -1115726(\text{J})$$

Which of the following is correct? (6%)

- (1) The thermit reaction at 298K will generate $\sim 3,334,200$ J of heat.
- (2) The thermit reaction at 298K will absorb $\sim 3,355,622$ J of heat.
- (3) The change of entropy for the reaction is about 385 J/K.
- (4) The reaction must always proceed toward right, because it is a spontaneous reaction.

7. For aluminum to melt by heating from 25°C to 700°C at 1 atm, and

$$c_{p, \text{Al}(s)} = 20.67 \text{ J/K/mole}, \quad c_{p, \text{Al}(l)} = 31.76 \text{ J/K/mole}$$

$$T_m = \text{melting point} = 661^\circ\text{C}, \quad \Delta H_{m, \text{Al}} = 10700 \text{ J/mole}$$

Which of the following is incorrect? (6%)

- (1) 25085 J of heat is needed.
- (2) The entropy increases by 36.37 J/mole/K.
- (3) At 700°C , the Gibbs free energy for melting is negative
- (4) At 661°C , the entropy of liquid Al is 11 J/mole/K higher than that of solid Al.

8. For $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) = \text{CO}_2(\text{g})$ reaction, $\Delta G^\circ = -282,400 + 86.81T(\text{J})$. If the reaction achieves equilibrium at 25°C , what is right? (6%)
 - (1) When temperature rises, the reaction proceeds toward right.
 - (2) The ratio of partial pressures of CO_2 and CO is 9.24×10^{44} .
 - (3) When pressure is increased, the reaction proceeds toward right.
 - (4) In air, p_{O_2} is kept at 0.21 atm, so the ratio of partial pressure of CO_2 and CO is 9.24×10^{44} .

注意：背面尚有試題

9. For a regular solution of A-B alloy demonstrating miscibility gap with $\Delta H_{\text{mix}}=4400 X_A X_B$ J at 1000 K, what is incorrect? (6%)

- (1) The activity coefficient is higher than 1.
- (2) The activity coefficient of A is 1.68 at $X_B=0.01$.
- (3) The activity coefficient of B is nearly 1 at $X_A=0.01$.
- (4) The activity of B is 0.168 at $X_A=0.99$.

10. For alloy systems with miscibility gap, what of the following would you expect? (6%)

- (1) The critical point occurs at the temperature where both the second and the first derivatives of free energy of mixture to composition are zero.
- (2) The activity is lower than molar fraction of each element in the alloys.
- (3) The entropy of mixture is negative.
- (4) The enthalpy of mixture is negative.

11. In a rigid tube closure, CO and O₂ are mixed at a ratio of 1:1 with an initial pressure of 1 atm and are allowed to react at 500 K. Assume only CO₂ exists in the atmosphere besides the original reactant gases, what are final total pressure and the partial pressures of all gases? (20%)

$$\Delta G_{\text{CO}_2}^{\circ} = -394,100 - 0.84T(J)$$

$$\Delta G_{\text{CO}}^{\circ} = -111,700 + 87.65T(J)$$

12. For a regular solution showing miscibility gap with $\Delta H_{\text{mix}}=20000 X_A X_B$, please calculate the temperature at which such solution is separated into two phase, one at $X_A=0.3$ and the other at $X_B=0.3$. (20%)