

國立臺北科技大學 103 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

第二節 普通熱力學 試題

第一頁 共一頁

注意事項：

1. 本試題共七題，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 a regular liquid solution with $\Omega=20$ kJ, please judge right or wrong for each of the following statements. (15%)
 - (1) Volume does not change by mixing the pure components.
 - (2) Temperature drops when mixing isobarically.
 - (3) Activity of the components becomes larger than their molar fractions.
 - (4) Vapor pressures of the components are higher than the saturated vapor pressures.
 - (5) The liquid solution could form a miscibility gap at 1500 K.
2. Judge right or wrong for the following statements. (15%)
 - (1) The condition for reaction equilibrium is $\Delta U=0$, if the reactions proceed in an isometric and adiabatic container.
 - (2) Pressure decreases with increasing entropy at constant temperature.
 - (3) There is no change in enthalpy with pressure for all substances if carried out isothermally.
 - (4) The reaction proceeds toward exothermic side when temperature increases.
 - (5) For a closed clockwise loop in P-V space, the ideal gas system always gain heat.
3. Show that the internal energy of ideal gases does not vary with pressure when temperature is kept constant. (10%)
4. For a solid A to sink in its own liquid phase, do you expect by increasing the pressure, the melting temperature increase or decrease and explain why? (10%)

5. Compare the entropy change for oxidation reactions of Ca, Ti, and Al for one mole of their oxides. Which is the largest and which is the smallest? (10%)

6. The vapor pressure of liquid tin is $\log_{10} P_{\text{Sn(l)}} (\text{atm}) = -\frac{15332}{T} + 5.262$,

and the vapor pressure of liquid lead is $\log_{10} P_{\text{Pb(l)}} (\text{atm}) = -\frac{9701}{T} + 4.911$.

Please estimate: ($MW_{\text{Pb}} = 207$, $MW_{\text{Sn}} = 119$)

(1) the boiling temperature at 1 atm for Sn- 38 wt.% Pb solder assuming the solution is ideal. (10%)

(2) The change of Gibbs free energy of mixture at 350 °C in mixing pure Sn liquid and pure Pb liquid to form ideal liquid solution. (10%)

7. For 100 mole of Mg to burn with 1 mole air in an adiabatic container which is filled with air (79% N₂ and 21% O₂) at 298K. Please estimate:

(1) amount of final products: Mg, MgO, O₂, and N₂ at equilibrium. (10%)

(2) final temperature of the adiabatic container. (10%)

$$\Delta G^{\circ}_{\text{MgO}} = -729600 + 204T \text{ J/mole}$$

$$\Delta H^{\circ}_{\text{MgO}, 298\text{K}} = -601490 \text{ J/mole}$$

$$c_{p, \text{Mg}} = 25 \text{ J/mole} \cdot \text{K}$$

$$c_{p, \text{MgO}} = 37.22 \text{ J/mole} \cdot \text{K}$$

$$c_{p, \text{O}_2} = 29.33 \text{ J/mole} \cdot \text{K}$$

$$c_{p, \text{N}_2} = 29.14 \text{ J/mole} \cdot \text{K}$$