

國立臺北科技大學九十七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

填准考證號碼

第一頁 共二頁

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注意事項：

1. 本試題共 A、B、C 三大題，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。

Section A. Identify the following statements as either true or false. Use "O" for true and "X" for false. (If a statement requires some special condition to make it true, label it as false.) 【3% for each one; total 45%】

- A1. For adiabatic reversible expansion of a nonideal gas, the $\Delta S = 0$.
- A2. For isothermal reversible expansion of an ideal gas, the $\Delta H = 0$.
- A3. There is always an entropy decrease on melting process.
- A4. For any adiabatic process, the entropy of the system cannot decrease.
- A5. The ΔG for the liquid water vaporized at 1 atm and 100°C is positive.
- A6. $\Delta H = \Delta G$ is true for the reaction "H₂O (liquid) = H₂O (gas)" at 100 °C and 1 atm.
- A7. In an ideally dilute solution, the activity and the mole fraction of a solute are equal.
- A8. An isothermal process means the process having no heat exchange between the system and the surroundings.
- A9. Because $dS = dQ_{rev}/T$, entropy is a path-dependent property.
- A10. Entropy of a universe tends always towards a maximum.
- A11. For an ideal gas expanded at constant temperature, $\Delta U = 0$ and $\Delta S < 0$.
- A12. Mixing process usually results in an increase in entropy unless the mixture shows a negative deviation from Raoult's Law.
- A13. The ratio of the fugacity of a substance in any state to the fugacity in the standard state is known as the activity.
- A14. In an ideal solution, the mole fraction and the activity coefficient of every component are equal.

A15. Entropy changes become zero at the temperature of absolute zero.

Section B. Choose "one" correct answer for each of the followings.

【5% for each one; total 35%】

B1. In order to make the statement of " $\Delta G < 0$ for a spontaneous process" to be true, which of the following conditions must be applied?

- (a) An ideal gas; (b) A reversible process; (c) Isothermal process occurring at constant pressure; (d) Isothermal process occurring at constant volume.

B2. Which of the following quantities is zero for all substances when the temperature goes to absolute zero?

- (a) C_v ; (b) Electric resistance; (c) free energy; (d) sound velocity.

B3. By third law, the entropy of a solid at 1 atm pressure and temperature T is:

- (a) $\Delta H/T$; (b) $\int_0^T dq/T$; (c) $\int_0^T C_p dT$; (d) $\int_0^T C_p dT/T$.

B4. In a closed system, which of the following equations is NOT true?

- (a) $dw = -P_{int}dv$; (b) $dq_p = C_p dT$; (c) $C_v = (\partial U/\partial T)_v$; (d) $\Delta H = q_p$.

B5. A cooling system is designed to maintain a refrigerator at -5 °C in a room at 25 °C. If 10⁴ J of heat leaks into the refrigerator each minute, and the system works at 40 % of its maximum thermodynamic efficiency, what is the power requirement in watts? (1 watt = 1 J s⁻¹)

- (a) 7.5 W; (b) 47 W; (c) 448 W; (d) 1119 W; (e) 1798 W; (f) 2798 W.

B6. What is the efficiency of a Carnot heat engine that represents a steam engine with its boiler at 500 K and its exhaust at 273 K?

- (a) 0.746; (b) 0.573; (c) 0.254; (d) 0.797; (e) none of the above.

B7. The solubility of silver chloride in pure water at 25°C is 1.3 × 10⁻⁵ mol dm⁻³. Calculate the ΔG° for the process: $AgCl(s) = Ag^+(aq) + Cl^-(aq)$

- (a) 0 kJ mol⁻¹; (b) 4.2 × 10⁻⁷ kJ mol⁻¹; (c) 55.8 kJ mol⁻¹; (d) 0.55 kJ mol⁻¹.

注意：背面尚有試題

Section C. Calculations. 【10% for each one; total 20%】

C1. It is known that the C_p of Al (aluminum) is $(20.7 + 0.012T)$ and the C_p of Al_2O_3 (alumina) is $(106.6 + 0.018T - 2,850,000T^{-2})$ in the temperature range of 298.15 to 900.00 K at 1 atm, and the enthalpy of formation from elements of Al_2O_3 at 298.15 K is -1675.7 kJ/mol, calculate the enthalpy content of Al at 898.15 K.

C2. For the reaction of $N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$, the Gibbs energies of formation of $NO_{2(g)}$ and $N_2O_{4(g)}$ are 51.30 and 102.00 kJ/mol, respectively (standard state: 1 atm and 298.15 K). Calculate K_p (standard state: 1 atm and 298.15 K) and K_c (standard state: 1 mol/L and 298.15 K) for the reaction assume it obeys ideal behavior.