# 國立臺北科技大學產業研發碩士專班 96 年度秋季班招生考試

## 系所組別：150 金屬材料產業研發碩士專班

## 第一節 普通熱力學 試題



**注意事項：**

1.本試題共 A、B 兩大題，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.** *Choose "one" answer for each of the following questions.* 【40%，每小題 4%】

**A1. Which of the following equations is true for an ideal gas under the process of isothermal reversible expansion?**

(a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta S=0$; (d) None of the above.

**A2. Which of the following equations is true for a nonideal gas under the process of adiabatic reversible expansion?**

(a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta S=0$; (d) None of the above.

**A3. Which of the following statements is NOT true?**

(a) Thermodynamics is based on empirical laws.

(b) Reversible processes do not occur in the real world.

(c) Thermodynamics is a general microscopic theory of the behavior of matter.

(d) There is always an entropy increase on melting process.

**A4. Which of the following processes has no heat exchange between the system and the surroundings?**

(a) adiabatic; (b) isothermal; (c) isobaric; (d) isomeric.

**A5. Which one is true for the reaction "$H_2O$ (liquid) = $H_2O$ (gas)" at 100 °C and 1 atm?**



(a) $\Delta H = \Delta G$; (b) $\Delta H = 0$; (c) $\Delta S = 0$; (d) $\Delta H = T\Delta S$; (e) $\Delta S < 0$.

**A6. In a closed system, which of the following equations is NOT true?**

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

**A7. If an ideal gas is expanded at constant temperature, which of the followings is true?**

(a) $\Delta U = 0$ and $\Delta S = 0$; (b) $\Delta U > 0$ and $\Delta S = 0$; (c) $\Delta U = 0$ and $\Delta S > 0$; (d) $\Delta U > 0$ and $\Delta S > 0$.

**A8. 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.

**A9. 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.

**A10. 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) $\int_0^T C_p dT/T$.

**Section B.** *Choose "one" correct answer for each of the followings.* 【60%，每小題 6%】

**B1. Initially 2 mol of an ideal gas, with $C_{V,m} = 12.5\ J\ K^{-1}\ mol^{-1}$, are at a volume of 5 $dm^3$ and a temperature of 300 K. If the gas is heated to 600 K and the volume changed to 20 $dm^3$, what is the entropy change?**

(a) 11 $J\ K^{-1}$; (b) 17 $J\ K^{-1}$; (c) 23 $J\ K^{-1}$; (d) 34 $J\ K^{-1}$; (e) 40 $J\ K^{-1}$; (f) 45 $J\ K^{-1}$.

注意：背面尚有試題

**B2. What is the efficiency of a Carnot heat engine that represents a steam engine with its boiler at 500 K and its exhaust at 373 K?**

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

**B3. A cooling system is designed to maintain a refrigerator at -5 °C in a room at 25 °C. If $10^4$ 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.

**B4. One mole of supercooled water at -10 °C and 1 atm pressure turns into ice. What is the entropy change in the system? (Take the heat capacities ($C_{P,m}$) of water and ice to be constant at 75.3 and 37.7 J $K^{-1}$ $mol^{-1}$, respectively, and the latent heat of fusion of ice is 6020 J $mol^{-1}$)**

(a) -22.0 J $K^{-1}$ $mol^{-1}$; (b) -20.6 J $K^{-1}$ $mol^{-1}$; (c) -1.4 J $K^{-1}$ $mol^{-1}$; (d) 2.8 J $K^{-1}$ $mol^{-1}$; (e) 21.4 J $K^{-1}$ $mol^{-1}$.

**B5. According to the above question (B4), what is the entropy change in the surroundings?**

(a) -22.0 J $K^{-1}$ $mol^{-1}$; (b) -20.6 J $K^{-1}$ $mol^{-1}$; (c) -1.4 J $K^{-1}$ $mol^{-1}$; (d) 2.8 J $K^{-1}$ $mol^{-1}$; (e) 21.4 J $K^{-1}$ $mol^{-1}$.

**B6. The solubility of silver chloride in pure water at 25°C is $1.3 \times 10^{-5}$ mol $dm^{-3}$. Calculate the solubility product for the process:** $AgCl(s) = Ag^+(aq) + Cl^-(aq)$

(a) $1.3 \times 10^{-5}$ mol $dm^{-3}$; (b) $1.7 \times 10^{-5}$ mol $dm^{-3}$; (c) $1.7 \times 10^{-10}$ mol $dm^{-3}$; (d) None of the above.

**B7. According to the above question (B6), calculate the $\Delta G^\circ$ for the process.**

(a) 0 kJ $mol^{-1}$; (b) $4.2 \times 10^{-7}$ kJ $mol^{-1}$; (c) 55.8 kJ $mol^{-1}$; (d) 0.55 kJ $mol^{-1}$.

**B8. At 25°C the equilibrium constant for the reaction** $CO(g) + H_2O(g) = CO_2(g) + H_2(g)$ **is $1.0 \times 10^{-5}$, and $\Delta S^\circ$ is 42 J $K^{-1}$ $mol^{-1}$. Calculate $\Delta G^\circ$ at 25°C.**

(a) 0 J $mol^{-1}$; (b) -282 J $mol^{-1}$; (c) -28538 J $mol^{-1}$; (d) 282 J $mol^{-1}$; (e) 28538 J $mol^{-1}$.

**B9. According to the above question (B8), calculate the $\Delta H^\circ$ at 25°C.**

(a) 12522 J $mol^{-1}$; (b) -12240 J $mol^{-1}$; (c) -16016 J $mol^{-1}$; (d) 12804 J $mol^{-1}$; (e) 41061 J $mol^{-1}$.

**B10. Calculate the equilibrium constant at 400 K for the reaction** $3O_2(g) = 2O_3(g)$ **where $\Delta_f G^\circ(O_3, g) = 163.2$ kJ $mol^{-1}$.**

(a) 0; (b) 0.95; (c) $4.87 \times 10^{-22}$; (d) $2.37 \times 10^{-43}$; (e) None of the above.