

國立臺北科技大學九十五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. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，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.)* 【45%】，每題 3 分

- A1. Thermodynamics is based on empirical laws.
- A2. The enthalpy is a variable whose change is equal to the amount of heat transferred in a constant-pressure process.
- A3. For an ideal gas, the internal energy and the enthalpy depend only on the temperature and not on the pressure or volume.
- A4. The work done by the system in a reversible expansion from A to B represents the maximum work that the system can perform in changing from A to B.
- A5. Reversible processes do not occur in the real world.
- A6. Thermodynamics is a general microscopic theory of the behavior of matter.
- A7. According to the IUPAC convention, a positive amount of work corresponds to work being done on the surroundings by the system.
- A8. It is impossible for an engine to perform work by cooling a portion of matter to a temperature below that of the coldest part of the surroundings.
- A9. The entropy of any system must increase when an irreversible process occurs.
- A10. There is always an entropy increase on melting process.
- A11. Entropy changes become zero at the temperature of absolute zero.
- A12. The entropies of all perfectly crystalline substances must be the same at the temperature of absolute zero.

- A13. The temperature of absolute zero can be reached by the method of adiabatic demagnetization process.
- A14. In an ideal solution, the mole fraction and the activity coefficient of every component are equal.
- A15. The ratio of the fugacity of a substance in any state to the fugacity in the standard state is known as the activity.

Section B. Choose "one" correct answer for each of the followings. 【30%】，每題3分

B1. For any cyclic process, which of the followings is the requirement of the First Law of Thermodynamics?

- (a) $\sum q_i = 0$ (b) $\sum w_i = 0$ (c) $(\sum q_i + \sum w_i) = 0$ (d) $(\sum q_i + \sum w_i) > 0$
(e) $(\sum q_i + \sum w_i) < 0$

B2. Which of the following processes has no heat exchange between the system and the surroundings?

- (a) adiabatic
(b) isothermal
(c) isobaric
(d) isomeric

B3. Heat capacity of an ideal gas is independent of

- (a) molar number
(b) number of vibrational degree of freedom
(c) pressure
(d) temperature

B4. Which one is true for the reaction " $\text{H}_2\text{O}(\text{liquid}) = \text{H}_2\text{O}(\text{gas})$ " 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) $\Delta S < 0$

B5. Under adiabatic condition, a gas expands against a constant external pressure of 5.0 atm to increase its volume by 4.5 liter . Due to this fact, which of the following statements is correct?

- (a) the internal energy of the gas is not changed
(b) the temperature of the gas will be raised
(c) the heat was adsorbed by the gas
(d) the work was done by the gas

注意：背面尚有試題

B6. Which of the following statements for ENTROPY is not true?

- (a) Entropy is a thermodynamic property.
- (b) Entropy of a universe tends always towards a maximum.
- (c) Because $dS = dQ_{rev}/T$, entropy is a path-dependent property.
- (d) Mixing process usually results in an increase in entropy unless the mixture shows a negative deviation from Raoult's Law.

B7. For an ideal gas expanded at constant temperature, which statement 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 $\Delta S > 0$
- (e) $\Delta U < 0$ and $\Delta S = 0$

B8. Which of the followings is not true as a Maxwell relation?

- (a) $\left(\frac{\partial H}{\partial S}\right)_p = V$
- (b) $\left(\frac{\partial U}{\partial V}\right)_s = -P$
- (c) $\left(\frac{\partial G}{\partial P}\right)_T = V$
- (d) $\left(\frac{\partial A}{\partial V}\right)_T = -P$

B9. In order to make the statement of " $\Delta H = 0$ for an isothermal 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

B10. 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

Section C. Choose "one" correct answer for each of the followings. 【25%】· 每題 5 分

C1. Initially 2 mol of an ideal gas, with $C_{v,m} = 12.5 \text{ J K}^{-1} \text{ mol}^{-1}$, 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}

C2. 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

C3. 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

C4. 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 $37.7 \text{ J K}^{-1} \text{ mol}^{-1}$, respectively, and the latent heat of fusion of ice as 6020 J mol^{-1})

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

C5. By previous question C3, the entropy change in the surroundings is

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