MM01

國立臺北科技大學 108 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

注意事項：

1. 本試題共 A、B、C 三大題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
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.)*** **【60%】**

A1. According to thermodynamics, a closed system is defined to have a boundary through which energy cannot be transferred.

A2. Heat is the transfer of energy as a result of a temperature difference between the system and the surroundings.

A3. For isothermal reversible expansion of an ideal gas, the internal energy of system does not change.

A4. Maximum work can be achieved in a reversible change.

A5. The standard state is the pure substance at 1 bar.

A6. Trouton's rule states that different liquids perform in very different standard entropy of vaporization.

A7. Engine can perform work by cooling a portion of matter to a temperature below that of the coldest part of the surroundings.

A8. The Gibbs and Helmholtz energies provide criteria for spontaneity at constant pressure and constant temperature, respectively.

A9. The change in the Helmholtz energy is equal to the maximum work accompanying a process at constant temperature.

A10. The Third law of thermodynamics states that the entropy of all perfect crystalline substances is zero at $T = 0$.

A11. The Gibbs energy of a pure substance decreases when the temperature is raised but increases when the pressure is raised.

A12. If a closed system undergoes a reversible process for which $\Delta V = 0$, then the P-V work done on the system in this process must be zero.

A13. ΔS when 1 mol of $N_2(g)$ goes irreversibly from 25 °C and 10 L to 25 °C and 20 L must be the same as ΔS when 1 mol of $N_2(g)$ goes reversibly from 25 °C and 10 L to 25 °C and 20 L.

A14. $C_p - C_v = TV\alpha^2/\kappa$ for every substance.

A15. The work done by a closed system cannot exceed the decrease in the system's internal energy.

A16. For an irreversible, isothermal, isobaric process in a closed system with P-V work only, ΔG must be negative.

A17. $(\Delta S_{syst} + \Delta S_{surr})$ is positive for every irreversible process.

A18. The relation $\Delta G = \Delta H - T\Delta S$ is valid for all processes.

A19. $(\partial V/\partial T)_p = \Delta V/\Delta T$ is valid for a constant-pressure process.

A20. If a system remains in thermal and mechanical equilibrium during a process, then its T and P are constant during the process.

Section B. ***Choose "one" correct answer.*** **【20%】**

B1. Which statement in the following is correct?

(a) $\Delta T = 0$ for every isothermal process

(b) ΔH is a state function

(c) $\Delta U \geq 0$ for every cyclic process

(d) $q = 0$ for every cyclic process

B2. Under adiabatic condition, a gas expands against a constant external pressure of 2 atm to increase its volume from 2 L to 6 L. Due to this fact, which of the following statements is correct?

(a) the internal energy of the gas is decreased

(b) the work was done on the gas

(c) the heat is absorbed by the gas

(d) the heat is released by the gas

(e) the temperature of the gas is increased

注意：背面尚有試題

B3. Which statement is incorrect?

(a) For a reversible process in a closed system, ΔS_{univ} must be zero

(b) For an adiabatic process in a closed system, ΔS cannot be negative

(c) For a process in an isolated system, ΔS cannot be negative

(d) For an adiabatic process in a closed system, ΔS must be zero

B4. Which of the following equations is NOT true for a reversible process?

(a) $dU = PdV+TdS$

(b) $dH= VdP+TdS$

(c) $dG= VdP-SdT$

(d) $dA= -SdT-PdV$

B5. One mole of a perfect gas expands isothermally and reversibly against a pressure that is gradually reduced. Which one of following statements is correct for this case?

(a) $\Delta U = 0; \Delta H = 0; \Delta A = 0$

(b) $\Delta U = 0; \Delta A = 0; \Delta S = 0$

(c) $\Delta H = 0; \Delta A < 0; \Delta S = 0$

(d) $\Delta U = 0; \Delta A < 0; \Delta S > 0$

(e) $\Delta H = 0; \Delta A > 0; \Delta S > 0$

Section C. *Calculation and Explanation.* 【20%】

C1. A chemical reaction occurs at 500 K in a gas mixture that behaves ideally, and the total amount of gas increases by 0.2 mol. If $\Delta U = 1$ kJ, what will be the ΔH?

C2. Consider an ideal gas that is carried through a Carnot cycle as shown in the following diagram. Re-plot the diagram using other coordinates of (a) T vs. P and (b) T vs. H (Note that P: pressure; V: volume; T: temperature; H: enthalpy)