109MM01

國立臺北科技大學 109 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. 本試題共二大題，總分 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。

一、選擇題 (單選題，每題 4 分，共 15 題，合計 60 分)

1. Which one of the following descriptions is true?
(a) ΔS can never be negative in a closed system.
(b) $\Delta H = \Delta U + P\Delta V$ for every process in a closed system.
(c) For an isothermal process in a perfect gas, q must be zero.
(d) For an isothermal process in a perfect gas, ΔU must be zero.

2. Which one of the following descriptions is correct when a perfect gas expands adiabatically into vacuum?
(a) $\Delta S > 0$
(b) $\Delta U < 0$
(c) $q < 0$
(d) $w > 0$

3. Which one of the following descriptions is correct when an ice melts to liquid water at 0°C and 1 atm?
(a) $\Delta S > 0$
(b) $\Delta U < 0$
(c) $q < 0$
(d) $w = 0$

4. Which one of the following descriptions is correct when water is cooled from 50°C to 20°C at a constant pressure of 1 atm?
(a) $\Delta S > 0$
(b) $\Delta U > 0$
(c) $q > 0$
(d) $w > 0$

5. Which one of the following descriptions is true?
(a) $\Delta S_{univ} \geq 0$ for every reversible process.
(b) Every adiabatic process in a closed system must be an isothermal process.
(c) The quantities U, H, A, and G all have the same dimensions.
(d) The relation $\Delta G = \Delta H - T\Delta S$ is valid for all processes.

6. Which one of the following descriptions is true?
(a) $G = U + PV$
(b) For every closed system in thermal and mechanical equilibrium and capable of only P-V work, the state function G is minimized when material equilibrium is reached.
(c) The Gibbs energy of 12 g of ice at 0°C and 1 atm is less than the Gibbs energy of 12g of liquid water at 0°C and 1 atm.
(d) The quantities SdT, TdS, VdP, and $\int$VdP all have dimensions of energy.

7. Which one of the following descriptions is true?
(a) $C_{p,m} - C_{V,m} = R$ for all gases
(b) $C_P - C_V = TV\alpha^2/\kappa$ for every substance.
(c) ΔG is always 0 for a reversible process in a closed system capable of P-V work only.
(d) The Gibbs energy of a closed system with P-V work only is always minimized at equilibrium.

8. Which one of the following descriptions is true?
(a) The work done by a closed system can exceed the decrease in the system's internal energy.
(b) For an irreversible, isothermal, isobaric process in a closed system with P-V work only, ΔG must be positive.
(c) $G_{syst} + G_{surr}$ is constant for any process.
(d) ΔS is positive for every irreversible process.

9. Which one of the following descriptions is true?
(a) $\Delta S_{syst} + \Delta S_{surr}$ is zero for every irreversible process.
(b) $\Delta(TS) = S\Delta T + T\Delta S$
(c) $\Delta(U - TS) = \Delta U - \Delta(TS)$
(d) If a system remains in thermal and mechanical equilibrium during a process, then its T and P are constant during the process.

注意：背面尚有試題

10. Which one of the following descriptions is true?
(a) The term "standard state" implies that the temperature is 0°C.
(b) The standard state of a pure gas is the pure gas at a pressure of 1 bar and temperature T.
(c) The SI units of ΔH° for a reaction are J.
(d) Doubling the coefficients of a reaction doubles its ΔH°.

11. Which one of the following descriptions is true?
(a) The term "standard state" implies that the temperature is 25°C.
(b) The rate of change of ΔH° with respect to temperature is equal to ΔC°_P.
(c) For a reaction involving only ideal gases, ΔC°_P is idependent of temperature.
(d) $\int_{T_1}^{T_2} T dT = \frac{1}{2}(T_2 - T_1)^2$.

12. Without consulting tables, state which one of the following must be equal to zero?
(a) $\Delta_f H^\circ_{298}(N_2O_5, g)$
(b) $\Delta_f H^\circ_{298}(Cl, g)$
(c) $\Delta_f H^\circ_{298}(Cl_2, g)$
(d) $S^\circ_{m,298}(Cl_2, g)$

13. Which one of the following descriptions is true for ideal-gas reactions?
(a) K°_P is always dimensionless.
(b) K_P is always dimensionless.
(c) K_P is never dimensionless.
(d) K°_P for the reverse reaction is the negative of K°_P for the forward reaction.

14. Which one of the following descriptions is NOT true for ideal-gas reactions?
(a) K°_P for the reverse reaction is the reciprocal of K°_P for the forward reaction.
(b) Doubling the coefficients doubles K°_P.
(c) Doubling the coefficients squares K°_P.
(d) K°_P for a particular reaction is a function of temperature but is independent of pressure and of the initial composition of the reaction mixture.

15. Which one of the following descriptions is true?
(a) If $\Delta G^\circ > 0$, then no amount of products can be formed when the reaction is run at constant T and P in a closed system capable of P-V work only.
(b) In any closed system with P-V work only, G is always minimized at equilibrium.
(c) If the partial pressure P_i increases in an ideal gas mixture held at constant T, then μ_i increases in the mixture.
(d) Addition of a reactant gas to an ideal-gas reaction mixture always shifts the equilibrium to use up some of the added gas.

二、(計算類)選擇題 (單選題，每題 8 分，共 5 題，合計 40 分)

1. Calculate the change in enthalpy when 124 g of liquid methanol initially at 1.00 bar and 298 K undergoes a change of state to 2.50 bar and 425 K. The density of liquid methanol under this conditions is 0.791 g cm^{-3}, and $C_{p,m}$ for liquid methanol is 81.1 J K^{-1} mol^{-1}. (molecular weight of methanol is 32 g mol^{-1})
(a) 29911 J　(b) 39935 J　(c) 40146 J　(d) 1277398 J

2. Find ΔS for the melting of 5.0 g of ice (heat of fusion = 79.7 cal g^{-1}) at 0°C and 1 atm.
(a) 1.46 cal K^{-1}　(b) -1.46 J K^{-1}　(c) -6.10 J K^{-1}　(d) 0.24 J K^{-1}

3. One mole of an ideal gas underwent a reversible isothermal expansion until its volume was doubled. If the gas performed 2 kJ of work, what was its temperature?
(a) 0.347 K　(b) 347 K　(c) 0.120 K　(d) 120 K

4. Exactly one liter of a 0.100 M solution of a substance A is added to 3.00 liters of a 0.050 M solution of a substance B. Assume ideal behavior and calculate the entropy of mixing.
(a) 2.28 J K^{-1}　(b) 1.51 J K^{-1}　(c) 1.15 J K^{-1}　(d) 0.36 J K^{-1}

5. Liquid water at 100°C is in equilibrium with water vapor at 1 atm pressure. If the enthalpy change associated with the vaporization of liquid water at 100°C is 40.60 kJ mol^{-1}, which one of the following is correct for ΔG and ΔS?
(a) $\Delta G > 0$ and $\Delta S > 0$
(b) $\Delta G = 0$ and $\Delta S = 0$
(c) $\Delta G > 0$ and $\Delta S = 0$
(d) $\Delta G = 0$ and $\Delta S > 0$