

國立臺北科技大學

九十四學年度材料及資源工程系碩士班入學考試

普通熱力學試題

填准考證號碼

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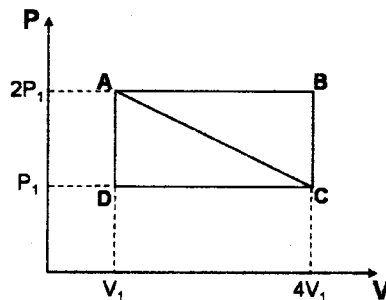
<p>注意事項：</p> <ol style="list-style-type: none"> 1. 本試題共七題，配分共 100 分。 2. 請按順序標明題號作答，不必抄題。 3. 全部答案均須答在答案卷之答案欄內，否則不予計分。
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1. Identify the following statements as either true or false. Use "O" for true and "X" for false. (If a statement requires some special condition to make it true, label it as false.)
 - (a) For any adiabatic process, the entropy of the system cannot decrease.
 - (b) The ΔG for the liquid water vaporized at 1 atm and 100°C is positive.
 - (c) At constant-pressure processes, both the heat "q" and work "w" are path-independent.
 - (d) The (q + w) is a state function.
 - (e) In an ideally dilute solution, the activity and the mole fraction of a solute are equal.

(15%)
2. Choose "one" correct answer for each of the followings. (15%)
 - A. Isothermal reversible expansion of an ideal gas. (a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta S=0$; (d) None of the above.
 - B. Adiabatic reversible expansion of a nonideal gas. (a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta S=0$; (d) None of the above.
 - C. Adiabatic expansion of a nonideal gas through a throttling valve. (a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta U=0$; (d) None of the above.
 - D. Reaction between H_2 and O_2 in a thermally insulated bomb. (a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta U=0$; (d) None of the above.
 - E. Reaction between H_2SO_4 and NaOH in dilute aqueous solution at constant temperature and pressure. (a) $\Delta G=0$; (b) $\Delta H=0$; (c) $\Delta U=0$; (d) None of the above.

3. Prove that $q = -w = nRT \ln \left(\frac{V_2}{V_1} \right)$ for an isothermal change of state of a closed ideal gas system where V_2 is the final volume and V_1 is the initial volume. (10%)

4. As shown in the following figure, calculate the works done by the system from A to C by path A-B-C, path A-C and path A-D-C, respectively. (15%)



5. Liquid water at 373.15 K is in equilibrium with water vapor at 1 atm pressure. If the enthalpy change associated with the vaporization of liquid water at 373.15 K is 40.60 kJ/mol, what is the entropy change? (10%)
6. 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 and Al_2O_3 at 298.15 and 898.15 K. (20%)
7. 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).
 (a) 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.
 (b) Calculate ΔG° if the standard state is 1 mol/L. (15%)

【1 atm = 101325 Pa ; 1 Pa = 1 J/m³ ; R = 8.314 J mol⁻¹ K⁻¹】