明志科技大學 106 學年度研究所碩士班一般考試暨在職專班招生命題用紙

所別：材料工程研究所　組別：＿＿＿＿＿＿＿＿　科目：材料熱力學

注意：□不准□一般計算器■工程用計算器，考試時間總計：100 分鐘。試題共 1 頁，第 1 頁

1. One mole of a monoatomic ideal gas is subjected to the following sequence of steps:
   (a) Starting at 300 K and 10 atm, the gas expands freely into a vacuum to triple its volume.
   (b) The gas is next heated reversibly to 400 K at constant volume.
   (c) The gas is reversibly expanded at constant temperature until its volume is again triples.
   (d) The gas finally reversibly cooled to 300 K at constant pressure.
   Calculate the values of Δq and Δw and the changes in U, H, and S. (20%)

2. A rigid and adiabatic container is divided into two compartments of equal volume by a partition.
   (a) One compartment contains 1 mole of ideal gas A at 1 atm, and the other contains 1 mole of ideal gas B at 1 atm.
   (b) One compartment contains 2 mole of ideal gas A at 3 atm, and the other contains 1 mole of ideal gas B at 2 atm.
   Calculate the increase in entropy which occurs when the partition between the two compartments is removed. (20%)

3. Two hundred moles of hydrogen gas at 298 K are reversibly and isothermally compressed from 30 to 15 liters. The van der Waals constants for hydrogen are a = 0.2461 liter^2·atm/mole^2 and b = 0.02668 liter/mole. The virial equation for hydrogen is $PV = nRT\left(1+6.4\times10^{-4}P\right)$. Calculate the work that must be done on the system if hydrogen behaves as (a) van der Waals gas, (b) the virial equation and (c) ideal gas. Please also calculate the change in the internal energy for three models. (30%)

4. (a) Consider a binary system A-B at a temperature T which is below $T_{m(B)}$, the melting temperature of B, and above $T_{m(A)}$, the melting temperature of A. Consider, further, that this system forms Raoultian ideal liquid solutions and Raoultian ideal solid solutions. Please derive $X_{A(l)}$ and $X_{A(s)}$ as a function of R, T, $\Delta G^o_{m(A)}$ and $\Delta G^o_{m(B)}$.
   (b) A binary system Ge-Si contains complete solid and liquid solutions. The melting temperature are $T_{m,Si}$ = 1685 K and $T_{m,Ge}$ = 1210 K, and $\Delta H^o_{m,Si}$ = 50200 J. At 1500 K, the liquidus and solidus compositions are, respectively, X_{Si} = 0.32 and X_{Si} = 0.665. Calculate the value of $\Delta H^o_{m,Ge}$, assuming
   (i) that the liquid solutions are ideal.
   (ii) that the solid solutions are ideal. (30%)