逢甲大學101學年度碩士班招生考試試題 編號：048 科目代碼：

科目	熱力學	適用系所	材料科學與工程學系	時間	100 分鐘

※請務必在答案卷作答區內作答。

1. (15%) The virial equation of state for n-butane at 460 K is $Z = 1 + A/V + B/V^2$ in which A = –265 cm^3/mole and B = 30,250 $cm^6/mole^2$. Calculate ΔG when the volume of one mole of n-butane is decreased from 400 to 200 cm^3 at 460 K.

2. (15%) For an ideal gas, show that $dS = (nC_v/T)dT + (nR/V)dV$.

3. The initial state of one mole of a monotomic ideal gas (γ=5/3) is P = 12 atm and T = 300K. Calculate ΔS, ΔU, ΔH of the gas for
   (a) (10%) an isothermal decrease in the pressure to 1 atm;
   (b) (10%) a reversible adiabatic expansion to a pressure of 1 atm.

4. (25%) The variation, with composition, of G^{XS} (excess molar Gibbs free energy) for a regular solution system, liquid Fe-Mn alloys, at 1927°C is listed below.

X_{Mn}	0.1	0.2	0.3	0.4	0.5
G^{XS} joules	360	640	840	960	1000

   Calculate the following answers assuming that the solution still exhibits regularly at a temperature of 2127 °C.
   (a) The respective $\overline{G}_{Fe}^{XS}$ and $\overline{G}_{Mn}^{XS}$ (partial excess molar Gibbs free energy of component Fe and Mn) at X_{Mn} =0.6 at 2127°C.
   (b) The ΔG^M (molar Gibbs free energy of mixing) at X_{Mn} = 0.6 at 2127°C.
   (c) The respective activities of Mn and Fe in the alloy of X_{Mn} = 0.4 at 2127°C.
   (d) The respective partial pressures of Mn and Fe exerted by the alloy of X_{Mn} = 0.4 (as the same case in (c)) at 2127°C. The saturated vapor pressures of liquid Mn and liquid Fe are given by

$$\ln P_{Mn}^{\circ}(atm) = -\frac{33{,}440}{T} - 3.02\ln T + 37.68$$

$$\ln P_{Fe}^{\circ}(atm) = -\frac{45{,}390}{T} - 1.27\ln T + 23.93$$

5. (10%) A CH_4-H_2 gas mixture at 1 atm total pressure, in which p_{H2} = 0.9425 atm, is equilibrated with an Fe-C alloy at 1000 K. Calculate the activity of carbon with respect to graphite in the alloy. What would the value of p_{H2} in the gas mixture (at P_{total} = 1 atm) have to be in order to saturate the Fe with graphite at 1000 K. Given:
   $2H_{2(g)} + C_{(gr)} = CH_{4(g)}$ $\Delta G^{\circ} = -91040 + 110.7T$ J

6. (15%) For the reaction $M_{(s)} + O_{2(g)} = MO_{2(s)}$ in ΔG–T diagram, if $M_{(s)}$ and $MO_{2(s)}$ are present in solution with respective activities of a_M and a_{MO2}, show a plot of the differences in ΔG between the reactions $M_{(s)} + O_{2(g)} = MO_{2(s)}$ and $M_{(in\ solution)} + O_{2(g)} = MO_{2(in\ solution)}$ at a temperature of T in the case of $a_{MO2}/a_M = 1$, $a_{MO2}/a_M > 1$, and $a_{MO2}/a_M < 1$, respectively. And, the corresponding lines for the equilibrium partial pressures of oxygen should be also plotted.