

國立清華大學 命題紙

八十七學年度 工科系 系(所) _____ 組碩士班研究生入學考試

科目 冶金熱力學 科號 4013 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. (10%)

The initial state of a quantity of monatomic ideal gas is $P = 1$ atm, $V = 1$ liter and $T = 373$ K. The gas is isothermally expanded to a volume of 2 liters and is then cooled at constant pressure to the volume V . This volume is such that a reversible adiabatic compression to a pressure of 1 atm returns the system to its initial state. All of the changes of state are conducted reversibly. Calculate the value of V and the total work done on or by the gas.

2. (10%)

10 moles of ideal gas, in the initial state $P_1 = 10$ atm, $T_1 = 300$ K are taken round the following cycle.

- a a reversible change of state along a straight line path on the P - V diagram to the state $P = 1$ atm, $T = 300$ K,
- b a reversible isobaric compression to $V = 24.6$ liters, and
- c a reversible constant volume process to $P = 10$ atm.

How much work is done on or by the system during the cycle? Is this work done on the system or by the system?

3. (15%)

Calculate the change in the enthalpy and the change in entropy when one mole of SiC is heated from 25°C to 1000°C . The constant pressure molar heat capacity of SiC varies with temperature as

$$c_p = 50.79 + 1.97 \times 10^{-3}T - 4.92 \times 10^{-6}T^2 + 8.20 \times 10^{-9}T^3 \text{ J/mole.K}$$

國 立 清 華 大 學 命 題 紙

八十七學年度 工科系 系(所) _____ 組碩士班研究生入學考試

科目 冶金熱力學 科號 4013 共 3 頁第 2 頁 *請在試卷【答案卷】內作答

4. (15%)

On the assumption that copper and nickel form ideal solutions, calculate the mass of copper which, when mixed with 100 g of nickel, causes an increase in entropy of 15 J/K. The gram atomic weights of Cu and Ni are, respectively, 63.55 and 58.69.

5. (10%)

At the normal boiling temperature of iron, $T_b = 3330\text{K}$, the rate of change of the vapor pressure of liquid iron with temperature is $3.72 \times 10^{-3} \text{ atm/K}$. Calculate the molar latent heat of boiling of iron at 3330K.

6. (15%)

One mole of solid Cr_2O_3 at 2500 K is dissolved in a large volume of a liquid Raoultian solution of Al_2O_3 and Cr_2O_3 in which $X_{\text{Cr}_2\text{O}_3} = 0.2$ and which is also at 2500 K. Calculate the changes in enthalpy and entropy caused by the addition. The normal melting temperature of Cr_2O_3 is 2538 K, and it can be assumed that the $\Delta S_{m,\text{Al}_2\text{O}_3} = \Delta S_{m,\text{Cr}_2\text{O}_3}$.

八十七學年度 工科系 系(所) _____ 組碩士班研究生入學考試

科目 冶金熱力學 科號 6013 共 3 頁第 3 頁 *請在試卷【答案卷】內作答

7. (15%)

The molar excess Gibbs free energy of formation of solid solutions in the system Au-Ni can be represented by

$$G^{xs} = X_{Ni}X_{Au} (24140 X_{Au} + 38280 X_{Ni} - 14230 X_{Au}X_{Ni}) \left[1 - \frac{T}{2660} \right] \text{ J}$$

Calculate the activities of Au and Ni in the alloy of $X_{Au} = 0.5$ at 1100 K.

8. (10%)

Three equations for the oxidation of Mg according to $Mg + \frac{1}{2}O_{2(g)} = MgO_{(s)}$ are

$$\Delta G^\circ = -604000 - 5.36T \ln T + 142.0T \text{ J} \quad (I)$$

$$\Delta G^\circ = -759800 - 13.4T \ln T + 317T \text{ J} \quad (II)$$

and

$$\Delta G^\circ = -608100 - 0.44T \ln T + 112.8T \text{ J} \quad (III)$$

One of these expressions is for the oxidation of solid Mg, one is for the oxidation of liquid Mg and one is for the oxidation of gaseous Mg. Determine which equation is for which oxidation and calculate the melting and normal boiling temperature of Mg.