

所別： 材料工程研究所 組別： \_\_\_\_\_ 科目： 材料熱力學

注意：  准  不准 使用計算器，考試時間總計：100 分鐘。 試題共 1 頁，第 1 頁

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

$$G^{xs} = X_{Ni}X_{Au}(24140X_{Au} + 38280X_{Ni} - 14230 X_{Ni}X_{Au})(1 - T/2660) \text{ J}$$

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

2. Copper and gold form a complete range of solid solution at temperatures between 410°C and 889°C, and, at 600°C, the excess molar Gibbs free energy of formation of the solid solution is given by

$$G^{xs} = -28280 X_{Au}X_{Cu} \text{ J}$$

Calculate the partial pressures of Au and Cu exerted by the solid solution of  $X_{Cu} = 0.6$  at 600°C.

Knowing that

$$\ln p_{Cu}^{\circ} (\text{atm}) = -40920/T - 0.86 \ln T + 21.67$$

$$\ln p_{Au}^{\circ} (\text{atm}) = -45650/T - 0.306 \ln T + 10.81.$$

3. Prove that

(1) for an ideal solution,  $\Delta H^M = 0$ ;

(2) for a positively deviated solution,  $\Delta H^M > 0$ ; and

(3) for a regular solution,  $\Delta H^M = \alpha' X_A X_B$ .

4. Calculate the pressure which, when applied to graphite at 298K, causes the transformation of graphite to diamond, given

$$H_{298 \text{ K, (graphite)}} - H_{298 \text{ K, (diamond)}} = -1900 \text{ J}$$

$$S_{298 \text{ K, (graphite)}} = 5.74 \text{ J/K}$$

$$S_{298 \text{ K, (diamond)}} = 2.37 \text{ J/K}$$

The density of graphite at 298 K is 2.22 g/cm<sup>3</sup>

The density of diamond at 298 K is 3.515 g/cm<sup>3</sup>.

5. Below the triple point (-56.2°C) the vapor pressure of solid CO<sub>2</sub> is given as

$$\ln P (\text{atm}) = -3116/T + 16.01$$

The molar latent heat of melting of CO<sub>2</sub> is 8330 J. Calculate the vapor pressure exerted by liquid CO<sub>2</sub> at 25°C and explain why solid CO<sub>2</sub> is referred to as “dry ice.”

(每題 20 分)