

國立清華大學命題紙

99 學年度 核子工程與科學研究所甲組(工程組) 碩士班入學考試

科目 材料熱力學 科目代碼 2805 共 1 頁, 第 1 頁 *請在【答案卷卡】作答

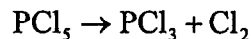
1. A nuclear power plant generates 5×10^5 kW, the reactor temperature is 600 K, and a local river with water temperature about 300 K acts as sink. (1) Find the maximum possible thermal efficiency of the plant and the minimum quantity of heat which is discharged into the river. (10%)(2) If the actual thermal efficiency of the plant is 70% of the maximum value how much heat is discarded into the river?(10%)

2. In a liquid Pb-Bi alloy, the activity coefficient of Pb depends on its molar fraction in the following way:

$$\log_{10}(\gamma_{\text{Pb}}) = -0.32(1 - X_{\text{Pb}})^2.$$

What is the activity coefficient of Bi at $X_{\text{Bi}} = 0.4$. (20%)

3. The equilibrium constant $K_p = 1.78$ at $T = 525$ K for the reaction



The reaction proceeds at constant volume. Find the total pressure p_o of an initial equi-molar mixture PCl_5 and Cl_2 (a mixture where the numbers of molecules of PCl_5 and Cl_2 are the same), if the partial pressure of PCl_5 in equilibrium is $p_{\text{PCl}_5} = 0.89$ atm. (20%)

4. Two identical bodies of constant heat capacity C_p have the same initial temperature T_i . If a refrigerator working between the two bodies cools down one of them to temperature T_2 , show that the minimum work required to do this is

$$W_{\min} = C_p \left(\frac{T_i^2}{T_2} + T_2 - 2T_i \right). \quad (20\%)$$

5. For a first-order phase transition, $\Delta G = 0$, $\Delta T = 0$, show that during a first-order phase transition

$$\Delta U = \Delta H \left(1 - \frac{d \ln T}{d \ln P} \right). \quad (20\%)$$