1. CaF_2 and MgF_2 are mutually insoluble in the solid state and form a simple binary eutectic system. Calculate the composition and temperature of the eutectic melt assuming that the liquid solutions are Raoultian. Knowing that,

   $\Delta H_{m,\,CaF2}^{\circ} = 31200$ J/mol at $T_{m,\,CaF2} = 1691$ K

   $\Delta H_{m,\,MgF2}^{\circ} = 58160$ J/mol at $T_{m,\,MgF2} = 1536$ K.

2. A quantity of supercooled liquid tin is adiabatically contained at 495 K. Calculate the fraction of the tin which spontaneously freezes. Given

   $\Delta H_m = 7070$ J at $T_m = 505$ K

   $C_{p(l)} = 34.7 - 9.2\times10^{-3}\,T$ J/K

   $C_{p(s)} = 18.5 + 26\times10^{-3}\,T$ J/K.

3. A rigid container is divided into two compartments of equal volume by a partition. One compartment contains 3 mole of ideal gas A, and the other contains 2 mole of ideal gas B. Calculate the increase in entropy which occurs when the partition is removed. If the initial temperatures of the ideal gases A and B were 300 and 400 K respectively, what would have been the increase in entropy when the partition was removed?

4. Joule and Thomson showed experimentally that when a steady stream of non-ideal gas is passed through a thermally insulated tube, in which is inserted a throttle valve, the state of the gas is changed from P_1, T_1 to P_2, T_2. Show that this process is isenthalpic (in a corresponding P-V diagram too). The change in T is described in terms of the Joule-Thomson coefficient, $\mu_{J\text{-}T}$, as

   $\mu_{J\text{-}T} = \left(\dfrac{\partial T}{\partial P}\right)_H$. Show that

   $\mu_{J\text{-}T} = -\dfrac{V}{C_P}(1-\alpha T)$, and show that $\mu_{J\text{-}T} = 0$ for an ideal gas.

(每題 25 分)