

逢甲大學104學年度碩士班考試入學試題

編號：030 科目代碼：311

科目	熱力學	適用 系所	材料科學與工程學系	時間	100 分鐘
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※請務必在答案卷作答區內作答。

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1. (10%) Use the first law and the second law of thermodynamics to prove that $dU = TdS - PdV$
2. (20%) The virial equation of state for n-butane at 460 K is $Z = 1 + A/V + B/V^2$ in which $A = -265 \text{ cm}^3/\text{g} \cdot \text{mole}$ and $B = 30250 \text{ cm}^6/\text{g} \cdot \text{mole}^2$. Calculate the change in the Gibbs free energy (J) when one mole of n-butane is decreased from 400 to 200 cm^3 at 460 K.

3. (20%) The isotopic composition of lead in atomic percent is

atomic weight	atomic percent
204	1.5
206	23.6
207	22.6
208	52.3

Calculate the molar configurational entropy of lead.

4. (20%) Sn obeys the Henry's law in dilute solutions of Sn and Cd and the Henrian activity coefficient of Sn, γ_{Sn}^0 , varies with temperature as

$$\ln \gamma_{\text{Sn}}^0 = -840/T + 1.58$$

Calculate the change in temperature when 1 mole of liquid Sn and 99 moles of liquid Cd are mixed in an adiabatic enclosure. The molar constant pressure heat capacity of the alloy formed is 29.5 J/K.

5. (10%) Melts in the system Pb-Sn exhibit regular solution behavior. At 473°C $a_{\text{Pb}} = 0.055$ in a liquid solution of X_{Pb} (molar fraction of Pb) = 0.1. Calculate the activity of Sn in the liquid solution of $X_{\text{Sn}} = 0.5$ at 500°C.

6. (20%) The molar excess Gibbs free energy of formation of solid solutions in the system Au-Ni can be represented by

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

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