

國立清華大學 100 學年度碩士班入學考試試題

系所班組別：工程與系統科學系甲組

考試科目（代碼）：材料熱力學(2802)

共 2 頁，第 1 頁 *請在【答案卷、卡】作答

1. (15%) A gas follows the equation of state $PV=nRT$. For this gas, $C_p=21.086+8.4\times 10^{-3}T$ (J.K⁻¹.mole⁻¹) (a) given 1mole of this gas and $P_1=20\text{atm}$, $V=2\text{liter}$, calculate $C_v=$ _____ (b) if the temperature is raised up to 409.7°C , calculate $\Delta U=$ _____ and $\Delta H=$ _____, for the gas for the process given in (b).

2. (15%) Calculate $\Delta H^\circ_{500} =$ _____ and $\Delta H^\circ_{900} =$ _____ for the reaction



Given :

$$C_{p, \text{Pb}(s)} = 5.63 + 2.33 \times 10^{-3}T \text{ cal/K}(298-600\text{K})$$

$$C_{p, \text{Pb}(l)} = 7.75 - 0.74 \times 10^{-3}T \text{ cal/K}(600-1200\text{K})$$

$$C_{p, \text{O}_2(g)} = 7.16 + 1.0 \times 10^{-3}T - 0.4 \times 10^{-5}T^2 \text{ cal/K}(298-3000\text{K})$$

$$C_{p, \text{PbO}(s)} = 9.05 + 6.4 \times 10^{-3}T \text{ cal/K}(298-1159\text{K})$$

$$\Delta H^\circ_{298, \text{PbO}} = -52400 \text{ cal/mole}$$

$$\Delta H^\circ_{m, \text{Pb}} = 1150 \text{ cal/mole at } 600\text{K}$$

$$T_{m, \text{Pb}} = 600\text{K}$$

$$T_{m, \text{PbO}} = 1159\text{K}$$

3. (20%) Calculate $\Delta U=$ _____, $\Delta H=$ _____, $\Delta S=$ _____, $\Delta A=$ _____ and $\Delta G=$ _____ in expanding 1 mole of ideal gas at 25°C from 10 to 100cm^3 .

4. (16 %) Please estimate the entropy and the enthalpy involved for the melting of the metals Zn and Al. Given: $T_{m, \text{Zn}}=419^\circ\text{C}$ and $T_{m, \text{Al}}=660^\circ\text{C}$.

$$\Delta S_{M, \text{Zn}} = \text{_____}$$

$$\Delta S_{M, \text{Al}} = \text{_____}$$

$$\Delta H_{M, \text{Zn}} = \text{_____}$$

$$\Delta H_{M, \text{Al}} = \text{_____}$$

5. (20%) The vapor pressure of solid Zinc varies with temperature as

$$\ln P = -15780/T + 0.755 \ln T + 25.89$$

and the vapor pressure of liquid Zinc varies with temperature as

$$\ln P = -15250/T - 1.255 \ln T + 28.42$$

where P is measured in mm of Hg in each case. Calculate

- (a) $T_{b, \text{Zn}}$ (boiling temperature under 1atm)=_____

- (b) $T_{tr, \text{Zn}}$ (triple point of Zn)=_____

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- (i) $\Delta H_{(s \rightarrow v)}$ (Heat of vaporization at boiling temperature under 1atm) = _____
(d) $\Delta H_{(s \rightarrow l)}$ (Heat of fusion at triple point) = _____

6. (14%) Carbon has two allotropes, graphite and diamond. At 25°C and 1 atm pressure, graphite is the stable phase. The transformation of graphite to diamond occurs at 25°C and 14300 atm pressure. Please determine the density of graphite at 25°C

$$\rho_{\text{graphite}, 25^\circ\text{C}} = \underline{\hspace{2cm}}$$

through the data given below.

$$\begin{aligned} H_{298}(\text{graphite}) - H_{298}(\text{diamond}) &= -1900 \text{ joule/mole} \\ S_{298}(\text{graphite}) &= 5.73 \text{ joule/degree.mole} \\ S_{298}(\text{diamond}) &= 2.43 \text{ joule/degree.mole} \\ \text{The density of diamond at } 25^\circ\text{C} &\text{ is } 3.515 \text{ g/cm}^3 \end{aligned}$$