109 學年度第二學期　材料熱力學二　第一次期中考試

1. Derive following equations:

   1.1 (10%)　$\mathrm{dU} = C_V dT + [T\left(\frac{\delta P}{\delta T}\right)_V - P]dV$

   1.2 (10%)　$\mathrm{dH} = C_P dT + [V - T\left(\frac{\delta V}{\delta T}\right)_P]dP$

   1.3 (10%)　$(\frac{dP}{dT})_{eq} = \frac{\Delta H_{S\to L}}{T\Delta V_{S\to L}}$

2. (10%) Prove that the gas's solubility in water is consistently decreased when the temperature increases if the enthalpy change of dissolution is negative.
3. The vapor pressure of the substance is followed by the formula of:

$$\mathrm{lnP(atm)} = \frac{A}{T} + B$$

   The vapor pressure of this liquid substance is:

$$\mathrm{lnP(atm)} = -\frac{831.6}{T} + 2.079$$

   The vapor pressure of this solid substance is:

$$\mathrm{lnP(atm)} = -\frac{137.4}{T} - 0.235$$

   Calculate:

   3.1 (5%) The normal boiling temperature

   3.2 (5%) The temperature and pressure at triple point

   3.3 (5%) The molar heat of evaporation at normal boiling temperature

   3.3 (5%) The molar heat of melting at the triple point (Ignore the answer's rationality)

4. (10%) At the normal boiling temperature of iron, $T_b = 3330K$, the rate of change of the vapor pressure of liquid iron with temperature is $3.72 \times 10^{-3}\ atm\ K^{-1}$. Calculate the molar latent heat of boiling of iron at 3330K.
5. One molar of the ideal gas and two molar of the ideal gas, each of them at 1 atm pressure and 298K, are isothermally mixed. Calculate the change of Gibbs' free energy ΔG^{Mix}, the change of enthalpy ΔH^{Mix}, and the change of entropy ΔS^{Mix} under following conditions:

   5.1 (10%) The final pressure is at 1 atm

   5.2 (10%) The final pressure is at 2 atm

6. (10%) A real gas obeys the equation at constant temperature:

$$\mathrm{V} = \frac{RT}{P} - \alpha$$

   Derive the relationship of fugacity {f} and pressure {P} is:

$$\frac{f}{P} = e^{-\frac{\alpha P}{RT}}$$