

## Problem Set 15

### Problems

1. The melting points of  $\text{CCl}_4$  at various pressures are given below, along with the Molar Volume change for Fusion. Calculate  $\Delta H_{\text{fus}}$  and  $\Delta S_{\text{fus}}$  at 1 atm and at 4000 atm.

P [atm]	t [ $^{\circ}\text{C}$ ]	$\Delta V$ [ $\text{cm}^3/\text{mol}$ ]
1	-22.6	3.97
1000	15.3	3.06
2000	48.9	2.51
5000	130.8	1.52
7000	176.2	1.08

2. Iodine boils at  $183.0^{\circ}\text{C}$ ; the vapor pressure of the liquid at  $116.5^{\circ}\text{C}$  is 100 Torr. If  $\Delta H_{\text{fus}}^{\circ} = 15.65$  kJ/mole and the vapor pressure of the solid is 1 Torr at  $38.7^{\circ}\text{C}$ , calculate:
- the Triple Point temperature and pressure.
  - $\Delta H_{\text{vap}}^{\circ}$  and  $\Delta S_{\text{vap}}^{\circ}$ .
  - $\Delta G_{\text{f}}^{\circ}$  for  $\text{I}_2$  gas at 298.15K.
3. The density of Diamond is  $3.52$  g/ $\text{cm}^3$  and that of Graphite is  $2.25$  g/ $\text{cm}^3$ . At  $25^{\circ}\text{C}$  the Gibbs Free Energy of Formation of Diamond from Graphite is 2.900 kJ/mole. At  $25^{\circ}\text{C}$  what pressure must be applied to bring Diamond and Graphite into equilibrium?
4. Benzene and Toluene form nearly Ideal Solutions. At 300K:

$$\begin{aligned}P_{\text{Tol}}^{\circ} &= 32.06 \text{ Torr} \\P_{\text{Ben}}^{\circ} &= 103.01 \text{ Torr}\end{aligned}$$

- A liquid mixture is composed of 3 mol Toluene and 2 mol Benzene. If the pressure over the mixture at 300K is reduced, at what pressure does the first vapor form?
- What is the composition of the first trace of vapor formed?
- If the pressure is further reduced, at what pressure does the last trace of liquid disappear?
- What is the composition of the last trace of liquid?

5. From the Melting Points of the mixtures of Al and Cu, sketch the Melting-Point curve.

<u>mass % Cu</u>	<u>t [°C]</u>
0	660
20	600
40	540
60	610
80	930
100	1083

Thermodynamic data for these two elements gives:

<u>Element</u>	<u>T<sub>m</sub> [K]</u>	<u>ΔH<sub>fus</sub><sup>o</sup> [kJ/mol]</u>
Cu	1356	13.05
Al	933	10.75

Sketch the Ideal Solubility curves and compare with the experimental curve above.