Chapter 4 Homework Questions

Where necessary below, you may use the following relation between Molar Volume (V_m), Molar Mass (M), and density (ρ): $V_m = \frac{M}{\rho}$

4.1 For this question, assume that the molar entropy of iron is constant at 53 J/mol-K.

Calculate the change in Chemical Potential of iron (in J/mol) when the temperature is increased from 100 ^oC to 200 ^oC

4.2 The molar entropy of water is temperature dependent and over the liquid range, follows the equation: $S_m^o = a + bT$ J/mol-K, a = 1.5 J/mol-K, b = 0.23 J/mol-K^3 (T is temperature in Kelvins).

Calculate the change in Chemical Potential of water (in J/mol) when the temperature is increased from 25 ^oC to 90 ^oC

4.3 The density of liquid benzene (C_6H_6, M=78) is 0.88 g/cm^3 at 25 ^oC.

Calculae the change in Chemical Potential of benzene (in J/mol) when the pressure is increased from 1. bar to 1,000 bar at 25 ^oC.

4.4 Calculate the change in Chemical Potential of $CH_4(g)$ (in J/mol) when the pressure is increased from 1. bar to 20. bar at 25 ^oC.

4.5 When Benzene (C_6H_6, M=78) liquid freezes to the solid at 6.0 ^oC and 1 bar, the density changes from 0.88 g/cm^3 to 0.95 g/cm^3. The Enthalpy of Fusion of Benzene is 9.80 kJ/mol. Calculate the pressure (in bar) required to raise the freezing point to 15.0 ^oC.

4.6 Calculate the melting point of ice under a pressure of 1000 bar. Assume that the density of ice under these conditions is approximately 0.92 g/cm^3 and that of liquid water is 1.00 g/cm^3. The normal melting point (under 100 kPa pressure) is 0 ^oC and the Enthalpy of Fusion is 6.01 kJ/mol.

4.7 The molar volume of a certain **solid** is 161.0 cm^3/mol at 1.0 atm and 350.75 K, its normal melting point. The molar volume of the **liquid** is 163.3 cm^3/mol. At a pressure of 100.0 atm, the melting point changes to 351.26 K.

Calculate the Enthalpy and Entropy of Fusion of the solid.

4.8 The vapor pressure of dichloromethane at 24 ^oC is 53.3 kPa, and it's Enthalpy of Vaporization is 28.7 kJ/mol. Estimate the temperature (in ^oC) at which its vapor pressure is 70;0 kPa.

4.9 Napthalene ($C_{10}H_8$, M=128) melts at 80.2 ^oC. If the vapour pressure of the liquid is 1.3 kPa at 85.8 ^oC and 5.3 kPa at 119.3 ^oC, calculate the following:

(a) The Enthalpy of Vaporization
(b) The normal boiling point
(c) The Entropy of Vaporization at the normal boiling point.

4.10 The normal boiling point of liquid mercury, Hg(l), is 357 ^oC. The vapor pressure of liquid mercury at 250 ^oC is 75 torr. [1 bar = 750 torr]

Calculate the Enthalpy of Vaporization of mercury, in kJ/mol.