20.110/5.60/2.772 Fall 2005

Homework # 6

Due Friday October 28

1.) (Castellan) The standard entropy of lead at 25°C is $\overline{S}^{\circ}_{298}$=64.80 J/K mol. The heat capacity of solid lead is $\overline{C}^{\circ}_{p}(s)$/(J /K mol) =22.13 + 0.01172T + 0.96 $\times 10^5$ T^{-2} The melting point is 327.4°C and the heat of fusion is 4770 J/mol. The heat capacity of liquid lead is $\overline{C}_{P}(l)$/(J /K mol)=32.51-0.00301T.

a) Calculate the standard entropy of liquid lead at 500°C.

b) Calculate the ΔH in changing solid lead from 25°C to liquid lead at 500°C.

2.) (Castellan) a) What is the entropy change if one mole of water is warmed from 0°C to 100°C under constant pressure, $\overline{C}_{P}$=75.291 J/K mol.

b) the melting point is 0°C and the heat of fusion is 6.0095 kJ/mol. The boiling point is 100°C and the heat of vaporization is 40.6563 kJ/mol. Calculate ΔS for the transformation

ice (0°C, 1atm)→steam (100°C, 1atm)

3.) (Castellan) Dry ice has found its way into movies and spooky Halloween houses via fog machines. It has a vapor pressure of 1 atm at -72.2°C and 2 atm at -69.1°C. Calculate the ΔH of sublimation for dry ice.

4.) (Castellan) Napthalene, $C_{10}H_8$, melts at 80°C. If the vapor pressure of the liquid is 10 Torr at 85.8°C and 40 Torr at 119.3°, and that of the solid is 1 Torr at 52.6°C, calculate

a) the ΔH_{vap} of the liquid, the boiling point T_b, and ΔS_{vap} at T_b

b) the vapor pressure at the melting point.

c) Assuming that the melting-point and triple-point temperatures are the same, calculate ΔH_{sub} of the solid and ΔH_{fus}.

d) What must be the temperature if the vapor pressure of the solid is to be less than 10^{-5} Torr?

5.) (SAB 6.11) The sublimation pressures of solid Cl_2 are 352 Pa at –112°C and 35 Pa at –126.5°C. The vapor pressures of liquid Cl_2 are 1590 Pa at –100°C and 7830 Pa at –80°C. Calculate (a) $\Delta_{sub}H$, (b) $\Delta_{vap}H$, (c) $\Delta_{fus}H$, and (d) the triple point.

6.) (SAB 6.19) A binary liquid mixture of A and B is in equilibrium with its vapor at constant temperature and pressure. Prove that $\mu_A(g) = \mu_A(l)$ and $\mu_B(g) = \mu_B(l)$ by starting with $G = G$(g)

+ G(l) and the fact that dG = 0 when infinitesimal amounts of A and B are simultaneously transferred from the liquid to the vapor.

7.) (SAB 6.10) The heats of vaporization and of fusion of water are 2490 J g^{-1} and 33.5 J g^{-1} at 0°C. The vapor pressure of water at 0°C is 611 Pa. Calculate the sublimation pressure of ice at –15°C, assuming that the enthalpy changes are independent of temperature.

8.) (SAB 6.12) The vapor pressure of solid benzene, C_6H_6 is 299 Pa at –30°C and 3270 Pa at 0°C, and the vapor pressure of liquid C_6H_6 is 6170 Pa at 10°C and 15,800 Pa at 30°C. From these data, calculate (a) the triple point of C_6H_6, and (b) the enthalpy of fusion of C_6H_6