

**CH353 – Physical Chemistry I**  
Spring 2012, Unique 52135

**Homework, Week 7**

1. Sketch the phase diagram for oxygen using the following data: triple point, 54.3 K and  $1.129 \times 10^{-3}$  bar; critical point, 154.6 K and 42.86 bar; standard melting point,  $-218.4$  °C; and standard boiling point,  $-182.9$  °C. Does oxygen melt as pressure increases?
2. The molar enthalpy of vaporization of water is  $40.65 \text{ kJ mol}^{-1}$  at its normal boiling point. Determine the vapor pressure of water at  $110$  °C. How does this compare with the experimental value (1075 Torr)?
3. The vapor pressure of dichloromethane ( $\text{CH}_2\text{Cl}_2$ ) is  $24.1$  °C at 53.3 kPa, and its enthalpy of vaporization is  $28.7 \text{ kJ mol}^{-1}$ . Estimate the temperature at which its vapor pressure is 70.0 kPa.
4. Calculate the melting point of ice under a pressure of 50 atm. Assume that the density of ice under these conditions is approximately  $0.92 \text{ g cm}^{-3}$  and that the density of liquid water is  $1.0 \text{ g mL}^{-1}$ .
5. Before the discovery that freon-12 ( $\text{CF}_2\text{Cl}_2$ ) was harmful to the Earth's ozone layer, it was frequently used as the dispersing agent in spray cans for hair spray and other dispersed aerosols. Its enthalpy of vaporization at its normal boiling point of  $-29.2$  °C is  $20.25 \text{ kJ mol}^{-1}$ . Estimate the pressure that a can of hair spray using freon-12 had to withstand at  $40$  °C, a temperature it would experience sitting in sunlight. Assume that over the temperature range involved,  $\Delta H_{\text{vap}}$  is a constant equal to its value at  $-29.2$  °C.
6. The enthalpy of fusion of Hg is  $2.292 \text{ kJ mol}^{-1}$  at its normal freezing temperature of 234.3 K. The molar volume of Hg changes  $0.517 \text{ cm}^3 \text{ mol}^{-1}$  on melting. At what temperature will the bottom of a column of a 10.0 m column of liquid mercury (density of  $13.6 \text{ g cm}^{-3}$ ) be expected to freeze.