CYL501 2011-2012

Minor 2

9 October 2011

Time: 1 hour Narayanan Kurur

1. This question refers to the paper F. L. Lambert, J. Chem. Ed. 79, 187 (2002).

   (a) Explain the following two sentences found in example number 3.

   > In the preceding example, if the instructor used a diagram involving molecular-dot arrangements, an implication any student could draw was that entropy change was like a chemical concentration change; entropy was therefore an intensive property. However in this example, the disorder description of entropy must be changed to the opposite, to be extensive!

   (b) Boltzmann introduced "disorder" as a device for visualizing entropy change in the late 19th century. Argue whether this was justified or not.

2. (a) The vapor pressures of liquid and solid chlorine are given by

$$\ln(P^{\mathrm{s}}/\mathrm{torr}) = 24.320 - \frac{3777\ \mathrm{K}}{T}$$

$$\ln(P^{\mathrm{l}}/\mathrm{torr}) = 17.892 - \frac{2669\ \mathrm{K}}{T}$$

   where T is the absolute temperature. Calculate the temperature and pressure at the triple point.

   (b) The following table gives the vapor pressure data for liquid palladium as a function of temperature:

T/K	P/bar
1587	1.002×10^{-9}
1624	2.152×10^{-9}
1841	7.499×10^{-8}

   Estimate the molar enthalpy of vaporization of palladium.

3. Determine the entropy change accompanying the Joule-Thomson expansion of an ideal gas from (T, P_1) to (T, P_2). What would be the entropy change if a van der Waals gas underwent a similar expansion from (T_1, P_1) to (T_2, P_2)?

4. (a) A removable partition divides a vessel into two portions with volumes V_A and V_B. In the V_A portion is n_A moles of an ideal gas A while n_B moles of another ideal gas B occupies V_B. Both gases are at the same temperature T. What is the Gibbs energy change accompanying the removal of the partition which mixes the gases?

   (b) Consider the same situation as in 4a except that $n_A = n_B$ and $V_A = V_B$. Express the Gibbs energy change of mixing in terms of the mole fractions. Plot the variation of ΔG as a function of x.