PS#5 CHEM 113 -Colligative Properties - (Rev. 1/2001)

Text:Zumdahl-Chapter 11 (11.2-11.8)

Problems: 35*,37*,39,41,43,47,49,51,55,59,61,63,65,67,69,71,73,75*,87,93*

Additional Problems:

1. State Raoult's Law and explain it on a molecular basis.

The vapor pressure of a solvent decreases upon the increase of solute in a solution. At the molecular level, this is due to a reduction in the number of solvent molecules at the surface which are available to evaporate

2. List the following solutions in order of decreasing freezing point:

(A) 0.080 m glucose $m_T = 0.080m$ (B) 0.020 m KBr $0.040\,m$ (2 ions) (C) 0.030 m $Zn(NO_3)_2$ $0.090\,m$ (3 ions)

$\Delta T_f = m_T K_f$ ⟶ smallest m_T will have the highest F.P.

F.P. B > A > C

3. An aqueous solution freezes at -8.95°C. What is the boiling point of this solution?

H_2O { $K_f = 1.86\,°C/m$; $K_b = 0.52\,°C/m$ }

Step 1: $T_f' = -8.95 \Rightarrow \Delta T_f = 8.95\,°C$ ∴ $m = \frac{\Delta T}{K_f} = \frac{8.95}{1.86}$

$m = 4.81$

Step 2: $\Delta T_b = (4.81\,m)(0.52\,°C/m) = 2.50\,°C$

$T_b = 100 + 2.50 = \boxed{102.5\,°C}$

4. Explain the phrase "likes dissolve likes" in terms of intermolecular forces.

Substances with similar intermolecular forces are capable of mixing because solvent and solute molecules have equivalent attraction for each other.

5. For carbon tetrachloride (CCl_4):

Normal Boiling Point : 76.8°C
K_b : 5.02 °C/m

Normal Freezing Point : -22.3°C
K_f : 29.8°C/m

Calculate the freezing point and the boiling point for a solution prepared by dissolving 20.0 grams of $C_{12}H_{26}$ in 350 grams of CCl_4.

$20.0\,g\ C_{12}H_{26}\left(\frac{1\,mole}{170\,g}\right) = 0.1176\,moles$ $\quad m = \frac{0.1176\,mole}{0.350\,kg} = 0.336\,m$

$\Delta T_f = (0.336m)(29.8°C/m) = 10.0°C$ $\quad T_f = -22.3 - 10 = \boxed{-32.3°C}$

$\Delta T_b = (0.336m)(5.02°C/m) = 1.69°C$ $\quad T_b = 76.8 + 1.69 = \boxed{78.5°C}$