CHEM 101: CHAPTER 14: SOLUTIONS pgs. 316-346

SOLUTIONS

* Recall that another name for a solution is a "homogenous mixture."
* Solutions consist of a solute (what is dissolved) and a solvent (what does the dissolving).
* There are several ways of expressing the concentration of a solution.

Mass Percent (Percent By Mass)

* **Formula:**
* $\% \; by \; Mass = \frac{Mass \; of \; Solute}{Total \; Mass \; of \; Solution} \times 100$
* Usually units of mass are in grams.
* **Example:**
* How many grams of a 1.5% NaCl solution are needed to provide 5 grams of NaCl?

$$1.5\% = \frac{5 \; grams \; NaCl}{Mass \; of \; Solution} \times 100$$

$$1.5x = 500$$

Mass of Solution = 333.33 g NaCl

MOLARITY

* These solutions are usually prepared in volumetric flasks.
* Rearranging,
* M × L of solution = moles of solute
* OR
* **M × L of solution × molar mass of solute = g of solute**

* See handout for example problems.

MOLALITY

* Molality (m) = $\frac{moles\ of\ solute}{kg\ of\ solvent}$
* The solvent is usually water.
* **Example:**
* What is the molality of a solution of 250 g of sucrose ($C_{12}H_{22}O_{11}$) in 600 g of water?
* Moles of solute = 250 g ÷ 342.23 g/mole = 0.73 moles
* Molarity (M) = $\frac{0.73\ moles}{0.600\ kg\ of\ solvent}$ = 1.22 m

MOLAL FREEZING POINT DEPRESSION

* **One can predict how much a given amount of solid solute will depress (decrease) the freezing point (t_f) of a liquid by knowing the molal freezing point depression constant (K_f) and the molality of the solution.**
* See Table 14.5 pg. 333 for values.

* $\Delta t_f = K_f \times m$

* **Example:**
* Suppose a solution of 2.35 moles of glucose ($C_6H_{12}O_6$) and 1,250 g of acetic acid is prepared. What would the expected freezing point of this solution be?
* T_f for acetic acid = 16.6 ^oC and K_f = 3.90 $^oC/m$ (from Table 14.5)

* The molality of the solution would be:

* m = $\frac{moles\ of\ solute}{kg\ of\ solvent} = \frac{2.35\ moles}{1.25\ kg\ of\ solvent}$
* = 1.88 m
* $\Delta t_f = K_f \times$ m
* = 3.90 °C/m × 1.88 m
* = 7.33 °C
* Note: This is the freezing point change, NOT the freezing point. We must subtract 7.33 °C from the original freezing point of 16.6 °C.
* **The final answer would then be: 16.6 °C – 7.33 °C = 9.27 °C**

MOLAL BOILING POINT ELEVATION

* **Similarly, one can predict how much a given amount of solid solute will elevate (increase) the boiling point (t_b) of a liquid by knowing the molal boiling point elevation constant (K_b) and the molality (m) of the solution.**
* $\Delta t_b = K_b \times$ m
* See Table 14.5 pg. 333 for values.