AR Chemistry: Water Solutions Short Hand Notes

Definitions:

Solution 2 or more materials mixed at the molecular level (all phases, s, l, g)

Solute the material being dissolved (eg. salt in saltwater)

Solvent the material doing the dissolving (eg. water in saltwater)

Concentration the ratio of solute to water or total solution

% Mass grams solute / total mass of solution

eg. 3% NaCl solution: 3 g NaCl, 97 g H_2O, 100 g Total

Molarity moles solute / Liters of solution "add **enough** water"

Normality moles solute **particles** / Liters of solution

Solubility measures **maximum concentration at a given temperature**

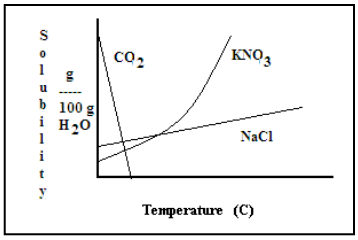
Measurement grams solute / 100 grams water

Unsaturated Solution can dissolve more material, not at maximum concentration

Saturated Solution cannot dissolve more, at maximum concentration

Supersaturated Solution holding a greater concentration **than it should**

Tests for State of Solution



drop 1 crystal into the solution

dissolves = was unsaturated

sinks = is saturated

more precipitates out = was supersaturated

Solids: solubility generally increases with temperature

Gases: solubility generally decreases with temperature

Characteristics for Solubility

Ionic Compounds Most are **HIGHLY** Soluble

Exceptions: $CaCO_3$, $MgCO_3$

Process **<u>Solvation</u>**: Water is a polar molecule (+ and – ends)

+ and – ends surround the ions

ions break free of crystal when the water's partial charges offset the ionic charges.

Dissolved particles are **aqueous (aq)**

Prediction of # Particles Dissolved

To "break apart" the compound starts with: **Metal, NH_4 or H**

The "naming break" is the "break apart break"

The neutral compound dissolves into ions forming a neutral solution

$NaCl \xrightarrow{H_2O} Na^{+1} + Cl^{-1}$ 2 particles

$CaCl_2 \xrightarrow{H_2O} Ca^{+2} + 2\ Cl^{-1}$ 3 particles

$AlCl_3 \xrightarrow{H_2O} Al^{+3} + 3\ Cl^{-1}$ 4 particles

Covalent Molecular Compounds

Most are **insoluble** or very slightly soluble (water cannot grab non +/- molecules)

Exceptions: **Acids** (start with H) HCl, HNO_3, H_2SO_4

Sugars (eg. $C_{12}H_{22}O_{11}$) and **Alcohols** (CH_3OH) (have polar OH ends)

Concentration Problems

Molarity

How many grams of $CaCl_2$ are in 50. mL of a 2.0 M solution?

1) M = 2.0 M
mol = ?
L = 50 mL = 0.050 L

M = mol / L, 2.0 M = mol / 0.050 L
mol = 0.10 mol $CaCl_2$

2) 0.10 mol $CaCl_2$ x 1 mol $CaCl_2$ / 110.98 g $CaCl_2$ = **11 g $CaCl_2$**

Normality

What is the normality of the 2.0 M $CaCl_2$ solution above?

N = (M)("# swimmers) = (2.0 M)(3 swimmers [Ca^{+2}, Cl^{-1}, Cl^{-1}]) = **6.0 N**

% Mass

How many grams of NaCl are in 237 g of a 5 % NaCl solution?

5 g NaCl = 95 g H_2O = 100 g total

237 g total x (5 g NaCl / 100 g total) = **11.9 g NaCl**

g dissolved / 100 g water

The solubility of chemical 'x' is 35 g 'x' in 100 g H_2O at 20 C. What is the minimum number of grams of water required to dissolve 71.5 grams of chemical 'x' at 20 C?

71.5 g 'x' x (100 g H_2O / 35 g 'x') = **204 grams of water**

Colligative Properties

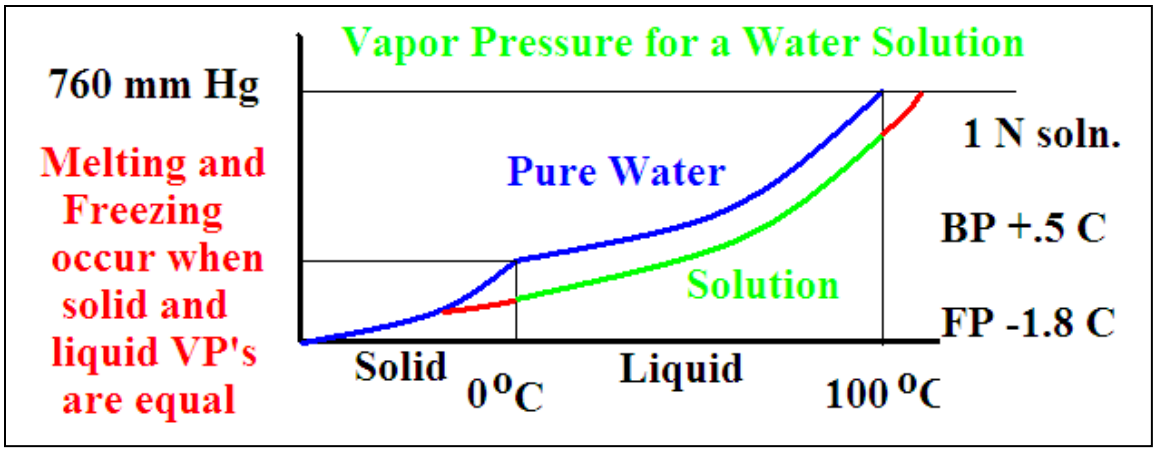
Definition: Properties that depend on the concentration of dissolved particles, regardless of their mass or volume.

Example: Vapor Pressure Lowering

Dissolved particles block some water molecules from evaporating

The vapor pressure of the water is lowered

Causes: **Boiling Point to be RAISED**
Freezing Point to be LOWERED



What are the boiling and freezing points for a 1.50 M $Ca(OH)_2$ solution?

M = 1.50 M
# = 3 (Ca^{+2}, OH^{-1}, OH^{-1})
N = 1.50 M x 3 = **4.50 N**

BP: 4.50 N x +0.5 C / 1 N = +2.25 C
FP: 4.50 N x –1.8 C / 1 N = -8.1 C

100 C + 2.25 C = **102.25 C**
0 – 8.1 C = **-8.1 C**