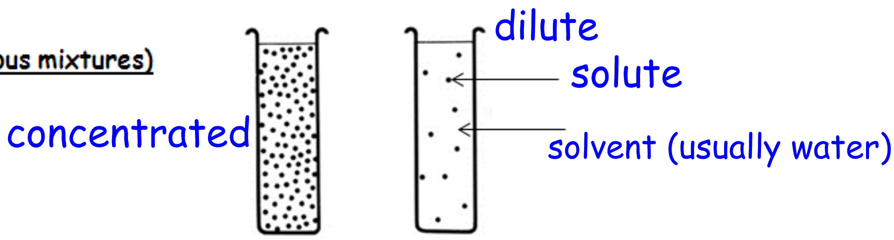
I. Types of Solutions (homogeneous mixtures)



A. Saturated- Contains ___maximum___ amount of dissolved solute. Additional solute will precipitate.

B. Unsaturated- More ___solute___ can be dissolved in solution.

C. Supersaturated- Contains ___more___ than the maximum amount of solute allowed. Very ___unstable___.

D. Solubility Curve (Table G)- line represents the maximum amount of solute that can be dissolved in 100 mL of water at a given temperature.

-any point sitting on the line is ___saturated___

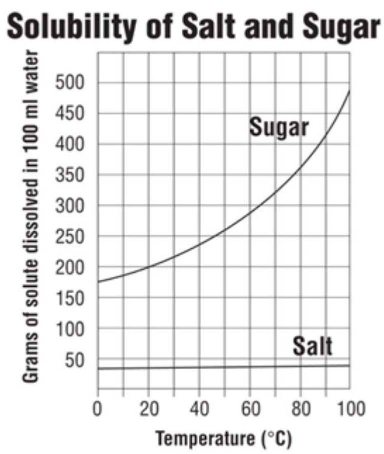
-any point under the line is ___unsaturated___

-any point **flies above** the line is ___supersaturated___

-200g sugar dissolved in 100ml water at 20°C ___saturated___

-100g salt dissolved in 100ml water at 50°C ___supersaturated___

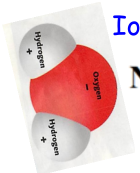
-250g sugar dissolved in 100ml water at 100°C ___unsaturated___

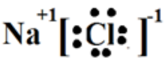


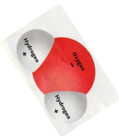
II. Factors Affecting Solubility

A. Nature of solvent and solute "Like dissolves like"

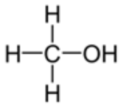
Ionic dissolves



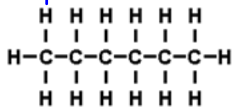




Polar dissolves



Nonpolar doesn't dissolve



To make sure ionic things will definitely dissolve, see Table F

1. $NaCl(aq) + AgNO_3(aq) \rightarrow$ $AgCl(s)$ + $NaNO_3(aq)$

2. $Li_2S(aq) + CaCl_2(aq) \rightarrow$ $LiCl(aq)$ + $CaS(s)$

3. $NaOH(aq) + ZnCl_2(aq) \rightarrow$ $NaCl(aq)$ + $Zn(OH)_2(s)$

B. Temperature (for solid and gas in a liquid)

**What does Table G tell you? For solids, as temp increases, more stuff can be dissolved, so solubility increases.

For gases, as temp goes up solubility decreases because less gas stays dissolved.

C. Pressure (only affects gases in liquid)

As pressure increases above a liquid, gas particles are pushed down, so solubility increases.

III. Calculating Concentration

A. % Concentration

-Formula: $\% = \frac{\text{mass or volume of solute}}{\text{mass or volume of sol'n}} \times 100$

-Ex) 6 grams of NaCl were dissolved in water to make a 50 gram solution. What is the concentration of this solution?

$\% = \frac{\text{6 grams}}{\text{50 grams}} \times 100$

12%

B. Parts per Million (ppm) – used for very dilute solutions.

-Formula (See Table T): $\text{ppm} = \frac{\text{mass of solute}}{\text{mass of sol'n}} \times 1{,}000{,}000$

-Ex) A certain gas has a concentration in water of 0.006 grams per 100 grams of solution. What is the concentration of the gas in parts per million?

$\text{ppm} = \frac{\text{0.006 grams}}{\text{100 grams}} \times 1{,}000{,}000$

60 ppm

C. Molarity (M)- The number of moles of solute per liter solution. Units = mol/L = M

-Formula (See Table T): Molarity (M) = $\frac{\text{moles of solute (mol)}}{\text{Liters of sol'n (L)}}$

-Ex 1) A student adds 4.0 moles of NaCl to 8.0 liters of solution. What is the molarity of the solution?

$X = \frac{4 \text{ moles}}{8 \text{ L}}$

X = 0.5 mol/L = 0.5 M

-Ex 2) A student has 300 ml (change to L) of a 6.0M sucrose solution. How many moles of sucrose are in the sample?

$6 \text{ M} = \frac{x}{3 \text{ L}}$

X = 18 moles

-Ex 3) A student puts 116.0 grams (change to mol) of NaCl into 4.0 liters and mixes until the salt is dissolved. What is the molarity of the solution?

$\# \text{ mol} = \frac{\text{given mass}}{\text{GFM}}$

$\# \text{ mol} = \frac{116 \text{ g}}{58\text{g/mol}}$

mol = 2

$X = \frac{2 \text{ moles}}{4 \text{ L}}$

X = 0.5 mol/L = 0.5 M

IV. Properties of Solutions

A. Colligative Properties- depend on # of dissolved particles. The more dissociation (breaking up into ions), the more the properties will change.

least effect on fp/bp — most effect on fp/bp

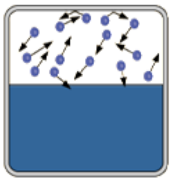
Examples) $C_6H_{12}O_6(s)$ doesn't dissociate   NaCl(s) Na^+ Cl^- $CaCl_2(s)$ Ca^{+2} Cl^{-1} Cl^{-1}

1) Boiling Point __increases__ because... dissolved particles attract water particles and make it harder (more energy) for them to separate

2) Freezing Point __decreases__ because... dissolved particles get between water molecules and make it harder for them to get closer together

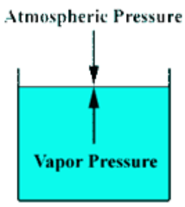
3) Conductivity- if it breaks up into ions, it's an __electrolyte__ (conducts electricity).
- if it doesn't dissociate, it's a __nonelectrolyte__ (doesn't conduct).

B. Vapor Pressure- When a liquid turns into a gas and exerts pressure on the container.



1) __weak__ IMFs → evaporate __faster__ → __high__ vapor pressure

2) __high__ temp → evaporates __faster__ → __high__ vapor pressure



3) __low__ air pressure → evaporates __faster__ → __lower__ boiling point
(vapor pressure = atmospheric pressure)

4) Table H: tells us the vapor pressure and BP's of water and other solutions