Solubility

pH, Acids and Bases

What is *Dissolving ?*

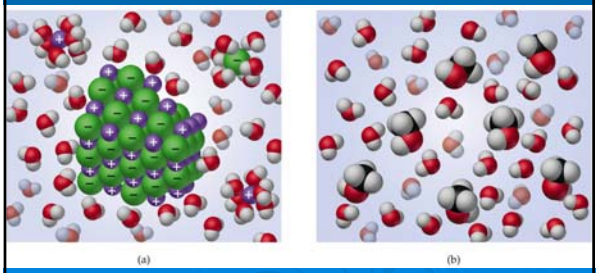
When an ionic compound (eg *salt*) dissolves in water, the compound disassociates. (breaks apart into cations and anions)

Ex: $Ca(NO_3)_2(s) \xrightarrow{H_2O(l)} Ca^{2+}(aq) + 2NO_3^-(aq)$

When a covalent compound (eg sugar) dissolves in water, it does *not disassociate*. Molecules of the covalent compounds simply disperse due to attraction with polar water molecules.

An Ionic Compound Dissolves:

A Covalent Compound Dissolves:

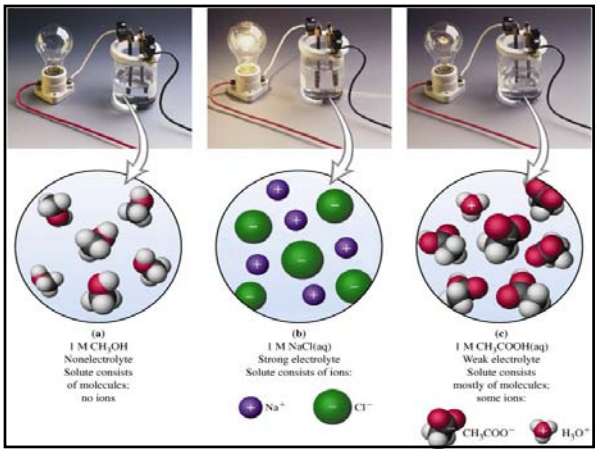


Dissolved Ionic Compounds are really ions in solution.

$NaCl_{(aq)}$

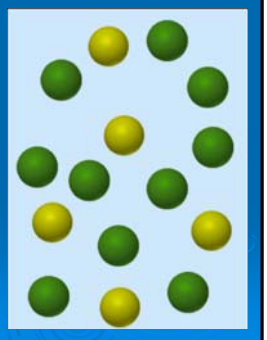
really means…

$Na^+_{(aq)} + Cl^-_{(aq)}$



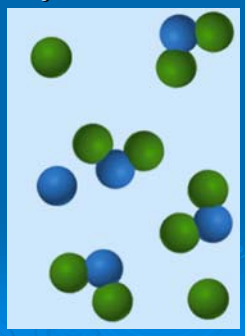
Strong electrolytes

- **all solute particles break apart into *ions***
- conducts electricity very efficiently
- includes:
  - strong acids
  - strong bases
  - soluble salts (ionic compounds)



Weak electrolytes

- **only a few solute particles create ions**
- conducts electricity only slightly
- includes:
  - weak acids
  - weak bases



Nonelectrolytes

- **no solute particles create ions**
- do not conduct electricity
- still must dissolve
- includes: soluble but nonionic compounds (ex. sugar, ethanol)

Water itself breaks into ions !

- Water ionizes on its own !
  - it falls apart into ions:

$H_2O \rightarrow H^+ + OH^-$

More accurately, it looks like this:

$2H_2O \rightarrow H_3O^+ + OH^-$

Hydronium ion — hydroxide ion

This is called the self ionization of water.

it only occurs to a small degree in pure water…

What does this have to do with pH?

$2\ H_2O \rightarrow H_3O^+ + OH^-$

Hydronium ion — hydroxide ion

Acids

increase the concentration of Hydronium Ions

They do this by donating H^+ ions (protons), which neutralize the OH^- :

$H^+ + OH^- \rightarrow H_2O$

$2\ H_2O \rightarrow H_3O^+ + OH^-$

Hydronium ion — hydroxide ion

Bases

increase the concentration of Hydroxide Ions

They do this by donating OH^- ions, which neutralize the H^+ :

$H^+ + OH^- \rightarrow H_2O$

ACIDS

- Proton Donors
- Formulae start with H
- Increase H_3O^+ conc.
- Taste Sour or Tart

Ex:

- Citric Acid
- Lactic Acid
- Vinegar (acetic acid)
- HCl
- H_2SO_4
- HNO_3

BASES

- Proton Acceptors
- Formulae end with OH
- Increase OH^- conc.
- Taste Bitter

Ex:

- Ammonia
- Baking Soda
- Dran-o
- NaOH
- $Ca(OH)_2$
- KOH

Naming Acids

- Acids always have hydrogen at the front of the formula
- Ex: **H**Cl, **H**Br, **H**ClO_4, $\mathbf{H_2}SO_4$
- To Name Binary Acids (H + element)
  - Hydro _____ ic Acid
- To Name Ternary Acids (H + polyatomic ion)
  - Name the polyatomic ion:
    - If the polyatomic ion ends in -ate, the acid will end in -ic acid
    - If the polyatomic ion ends in -ite, the acid will end in -ous acid
    - If the polyatomic ion ends in -ide, the acid will be named hydro _____ ic acid, (it is probably a binary acid, above)

Naming Acids, Con't

- To Name Ternary Acids (H + polyatomic ion)
  - Name the polyatomic ion:
    - If the polyatomic ion ends in -**ate**, the acid will end in -ic acid
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Examples

- HCl -- hydrochloric acid
- HBr -- hydrobromic acid
- HF -- hydrofluoric acid
- HNO_3 -- nitric acid (nitr*ate* --> nitr*ic*)
- HNO_2 -- nitrous acid (nitr*ite* -->nitr*ous*)
- HCN – hydrocyanic acid

Writing Formulas for Acids

- Hydrogen always has a +1 charge
- Just like always, use subscripts to make a neutral compound.
- Ex: Sulfuric Acid is H^{+1} and $(SO_4)^{-2}$

H_2SO_4

Acid-Base Reactions

Neutralization Reactions and Salts

- Neutralization occurs when a solution of an acid and a base are mixed:

$$HCl(aq) + NaOH(aq) \rightarrow H_2O(l) + NaCl(aq)$$

- Notice we form a salt (NaCl) and water.

Neutralization Reactions between acid and base produce water and a salt.

Assignment

Complete the following reactions

- HCl + NaOH → HOH + NaCl
- H_3PO_4 + 3NaOH → 3HOH + Na_3PO_4
- HNO_3 + KOH →
- HNO_3 + NH_4OH →

Complete the neutralization reactions:

$HC_2H_3O_2 + KOH \rightarrow$

$HNO_3 + NaOH \rightarrow$

$H_2SO_4 + NH_4OH \rightarrow$

$H_3PO_4 + Mg(OH)_2 \rightarrow$

Complete the neutralization reactions:

$HCl + NaOH \rightarrow H_2O + NaCl$

$\rightarrow 2H_2O + K_2SO_4$

$\rightarrow 2H_2O + Ca(NO_3)_2$

$\rightarrow 3H_2O + Li_3PO_4$