Physical Science

Chapter 19
Acids & Bases

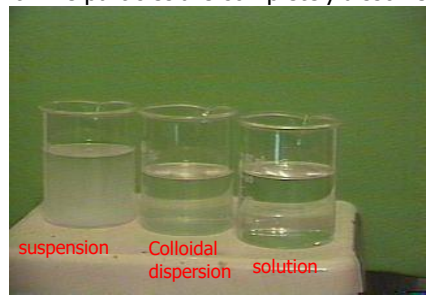
Solutions and Suspensions

Suspension - the particles are temporarily suspended in the liquid & are large enough to collectively make the material appear cloudy. They will settle out after a while.

Colloidal dispersion - very small particles spread throughout the liquid which are large enough to reflect light, but not large enough to be seen individually. It may look either clear or cloudy in ordinary room light. The particles in a colloidal dispersion remain dispersed in the liquid and will not settle out.

A **solution**, on the other hand, will appear clear even when a light is shown through it. The particles are completely dissolved & never settle out.

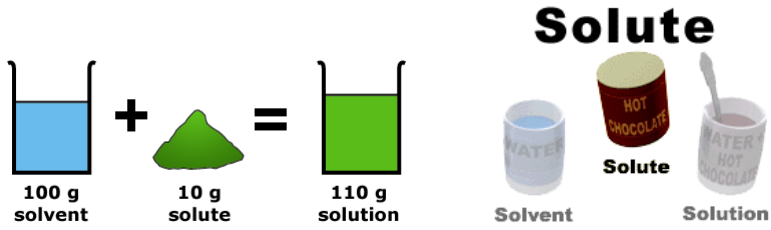
A mixture of flour & water



Colloidal dispersion spreads the light out

Solvents and Solutes

- Solvent – the part of the solution that is present in the largest amount
- Solute – the part of the solution present in the least amount



Parts of a Solution

Types of Solutions

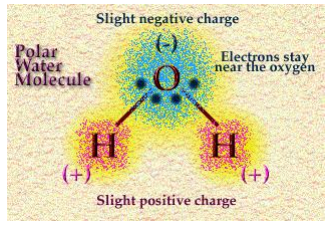
- Solutions can be made from different states of matter:

Solute	Solvent	Solution
Oxygen –gas	Nitrogen – gas	Air – gas
CO_2 – gas	Water – liquid	Soda Pop
Glycol – liquid	Water – Liquid	Antifreeze – liquid
Salt – solid	Water – liquid	Ocean water - liquid
Zinc – solid	Copper – Solid	Brass - Solid

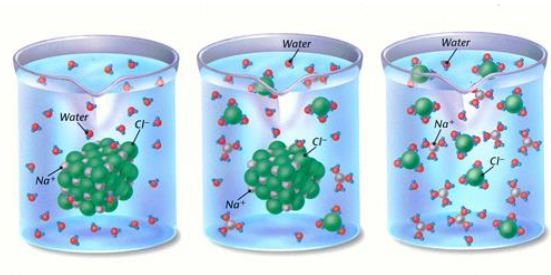
Ding-a-ling: I would know this if I were you

Particles in solution

- Solute particles are separated from each other and are surrounded by solvent particles.
  - a. Water is polar and easily dissolves ionic compounds i.e. NaCl
  - b. Water can also dissolve many "nonpolar" particles because these particles may have a slight polar side of the molecule which allows the polar water to be attracted to these surfaces.
  - c. Remember that most molecular bonds are a gradient between pure ionic and pure covalent types of bonds.

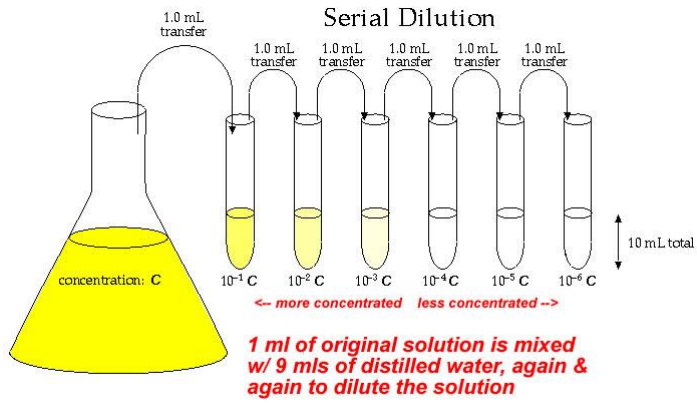


Because of its polarity, water is the "universal solvent"



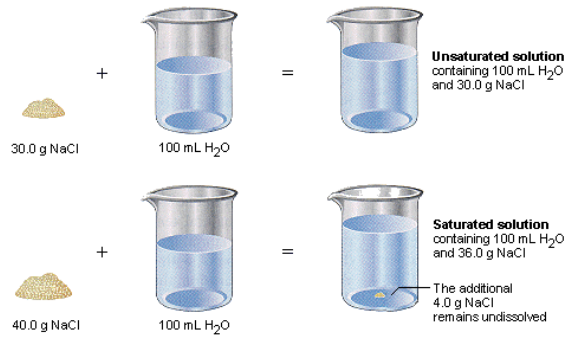
Concentration

- Concentrated – strong solution "more" solute present
- Dilute – weak solution "less" solute present



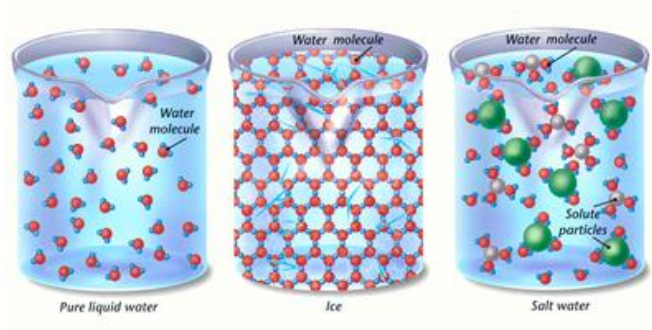
Solubility

- Solubility – the amount of solute that will dissolve in a solvent at a given temperature.
- Unsaturated Solutions - Generally speaking:
  - 1. Higher temperatures will allow more of a solid to dissolve into a liquid
  - 2. Higher temperatures will hold less gas in solution than colder temperatures
- Saturated – point when no more solute can dissolve into the solvent at the given temperature



Effects of Solutes on the Solvent:

- Increased concentrations of solute in a solution will lower the freezing point and increase the boiling point of the pure solvent



i. Salt spread over icy roads to melt the ice and turn it into water
ii. Salt placed into cooking water will increase the temperature of the water before it starts to boil, i.e. decreasing cooking time of pasta as it cooks in hotter water.

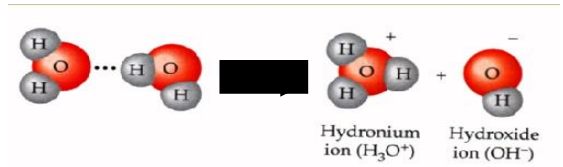
The Dissociation of Water

Water can actually "dissolve" itself by pulling a proton (Hydrogen atom w/out its electron) off of one water molecule

When proton can be transferred from one water molecule to another, resulting in the formation of one **hydroxide ion (OH^-)** and one **hydronium ion (H_3O^+).**

It also does the reverse, change a hydronium ion & an hydroxide ion back into water. The equation goes both ways until equilibrium is found.

Actual formula



However,

Shortcut formula

[redacted]

When equilibrium is reached and [Hydronium] = [Hydroxide]

the solution is **NEUTRAL**

Water & pH

$pH = -\log [H^+]$

At equilibrium, the concentration of H^+ (Hydronium) is 10^{-7}

so we can calculate the pH of pure water is neutral at equilibrium as:

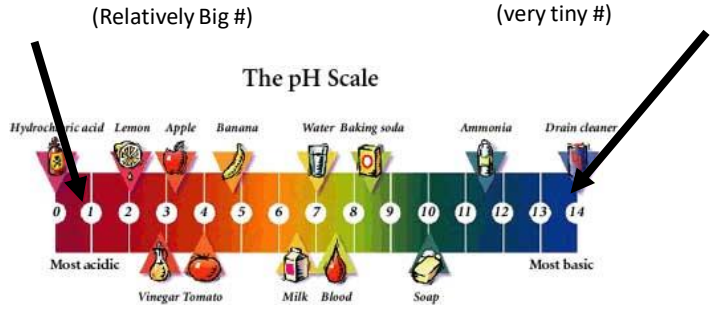
$pH=-(\log[H^+])= -(\log[10^{-7}])=pH=-(-7) =$ **pH 7**

pH scale goes from 0 to 14

7 is neutral, <7 is acid and >7 base

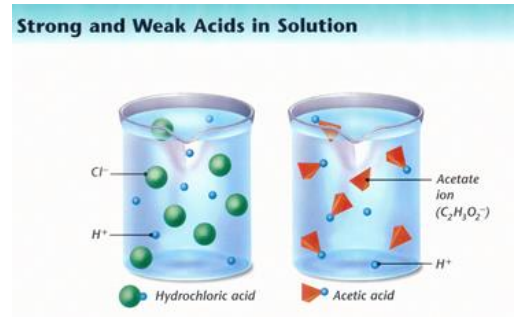
$pH[10^{-1}]$ $[10^{-14}]$

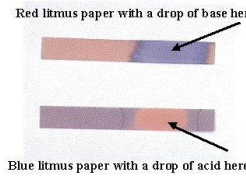
(Relatively Big #) (very tiny #)



Properties of Acids

- Properties of Acids – compounds that:
  - pH < 7.0
  - Release free Hydrogen ions into solution (H+)
  - Reacts with metals and carbonates
  - Turns blue litmus paper red
  - Tastes sour (never taste)
  - Are corrosive, eating away





"Need-to-Know "Acids":

Hydrochloric	HCl
Nitric Acid	HNO_3
Sulfuric Acid	H_2SO_4
Carbonic Acid	H_2CO_3

Properties of Bases

- Has a pH >7.0
- Bases are compounds that:
- Release hydroxide ions (OH-) into solution
- Has a bitter taste (never taste any solution unless told to do so)
- Feels slippery
- Reacts with indicators like litmus by turning red litmus blue

$HO^{\ominus}$

"Need-to-Know "Bases":

Sodium Hydroxide NaOH
Potassium Hydroxide KOH
Calcium Hydroxide $Ca(OH)_2$
Ammonia NH_3

Acids and Bases in Solution

- Remember in water $[H^+] = [OH^-]$
- Acids in Solution
  - Acids are made of an H^+ ion and an Anion (a $^-$ charged ion)
  - In water, acids release H^+ (hydronium) and anions
  - Therefore there are more H^+ in the water – definition of an acid
    - 1. HCl → $H^+ + Cl^-$
- Bases in solution
  - Bases are made of an OH^- ion and a Cation (a $^+$ charged ion)
  - In water, bases release OH- (hydroxide) into the water
  - Therefore there are more OH^- in the water – definition of a base
    - 1. NaOH → $Na^+ + OH^-$

Acid / Base Reactions

- When Acids and Bases are combined a Neutralization reaction produces water and a salt
  - 1. Hydrochloric Acid and Sodium Hydroxide yields water and Sodium Chloride
    - a. HCl + NaOH → H_2O + NaCl
    - b. $(H^+ + Cl^-) + (Na^+ + OH^-) \rightarrow H_2O$ + NaCl
  - 2. Salt is an ionic compound formed from an acid / base reaction (neutralization)

Acids & Bases

No mas…
no mas

We b done!!