Acids	Bases
Operational Definitions: If you recall, operational definitions are based on what you can actually observe in the lab. • Acids taste sour. • They conduct electricity. • They destroy the properties of bases. • They turn blue litmus red. • Red litmus remains red. • Phenolphthalein indicator remains clear when added to acids. • They release H_2 gas when added to some metals.	**Operational Definitions**: If you recall, operational definitions are based on what you can actually observe in the lab. • Bases taste bitter. • They conduct electricity. • They destroy the properties of acids. • They turn red litmus blue. • Blue litmus remains blue • Phenolphthalein indicator turns deep pink when added to bases. • They feel slippery. • They turn fats into soaps.
Conceptual Definitions: The Arrhenius definition of an acid: a substance that releases H^{+1}. Example: $HCl_{(aq)} \rightarrow H^{+1}_{(aq)} + Cl^{-1}_{(aq)}$ Very important: Always remember that when considering acids and bases, the H^{+1} ion is aqueous, in other words, it is dissolved in *water*.	**Conceptual Definitions**: The Arrhenius definition of an acid: a substance that releases OH^{-1}. Example: $NaOH_{(aq)} \rightarrow Na^{+1}_{(aq)} + OH^{-1}_{(aq)}$. Very important: Always remember that when considering acids and bases, the OH^{-1} ion is aqueous, in other words, it is dissolved in *water*.
Everyday substances that are acidic (pH <7) include fruits (contain citric and/or malic and/or tartaric acids) soda drinks(carbonic acid and/or phosphoric acid), toilet bowl cleaner (HCl), muriatic acid brick cleaner (HCl).	**Everyday substances that are alkaline (basic) (pH >7) include baking soda ($NaHCO_3$), soap, milk of magnesia ($Mg(OH)_2$),ashes (contain KOH) and household ammonia (NH_4OH).**

The pH Scale

The pH scale is used to classify aqueous substances. If you leave out very concentrated acids or bases, it runs from 0 to 14. Distilled water is in the middle of the scale at 7. Distilled water is neutral. It only has a very small amount of acidic ions (H^{+1}) but an equally small amount of basic ions (OH^{-1}). For each unit above 7, a substance ends up with 10 times more OH^{-1} and so becomes increasingly alkaline or basic. For each unit below 7, a solution ends up with 10 times more H^{+1} and so becomes increasingly acidic. The small amount of OH^{-1} from water also becomes even smaller by that same factor.

(430 only)

$pH = -\log[H^{+1}]$, where $[H^{+1}]$ = molarity(moles/L) of the H^{+1} solution .

The "log" of a number is simply the exponent needed to turn 10 into the number being logged. So log(100) = 2 because $10^2 = 100$.

Example 1: If there are 0.01 moles of H^{+1} per litre (or 0.01 g/L since the molar mass of H^{+1} is 1g/mol), what is its pH ?

Solution: $pH = -\log[H^{+1}]$

$pH = -\log(0.01)$

$pH = -(-2) = 2$

Example 2: At a pH of 3, how much $[H^{+1}]$ is there?

Solution: Since pH is simply a negative exponent, we can rewrite the pH formula as

$[H^{+1}] = 10^{-pH}$

$[H^{+1}] = 10^{-3} = 0.001$ moles/L

Example					
pH	3	5	7	9	11
amount of H^{+1}	$10^{(7-3)}=10^4$ X more than water	$10^{(7-5)}=100$ X more than water	10^{-7} moles/L	100 X less than water	10^4 X less than water
amount of OH^{-1}	10^4 X less than water	100 X less than water	10^{-7} moles/L	100 X more than water	10^4 X more than water

To calculate the exact amount of either $[OH^{-1}]$ or $[H^{+1}]$, use the following formula:

$[OH^{-1}]\ [H^{+1}] = 10^{-14}$

Example 3: At a pH= 11, how much $[OH^{-1}]$ is in solution?

Solution **$[OH^{-1}]\ [H^{+1}] = 10^{-14}$.**

$[OH^{-1}](10^{-11}) = 10^{-14}$; don't forget $[H^{+1}] = 10^{-pH}$, so $[H^{+1}] = 10^{-11}$,

$[OH^{-1}] = 10^{-3}$ moles/L.

Indicators

Chemical Indicators are substances that change colour as pH changes. Since indicators are most often used in neutralizations, to be useful, they need more than two colours over the pH range.There should be an in between colour that can help determine when neutralization has been achieved. The pH range covered by the in-between colour is known as the **turning point**.

Example

Phenolphthalein indicator is clear below pH 6. Approximately between 6 and 8, it turns light pink. Beyond 8 it turns deep pink or fuschia. In neutralizing acid with base, we look for a light pink colour, not a fuschia.

Neutralization

This is a reaction in which a base and an acid destroy each other, leaving behind an ionic compound(salt) and water:

Examples

$NaOH + HCl \rightarrow NaCl + H_2O$.

$2\ KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\ H_2O$