I. Characteristic Properties of Acids and Bases

Properties	Taste	Electrolyte (conduct?)	Reactivity	Litmus Paper	Common Examples
Acids	Sour	Yes	Corrosive to metals (make H2 gas)	Blue paper turns red Red paper stays red	Table K
Bases	Bitter	Yes	Caustic (dissolve skin/slippery)	Blue paper stays blue Red paper turns blue	Table L

II. Definitions

A. Arrhenius Acid - a substance that releases H+ in solution (compound starts with H).

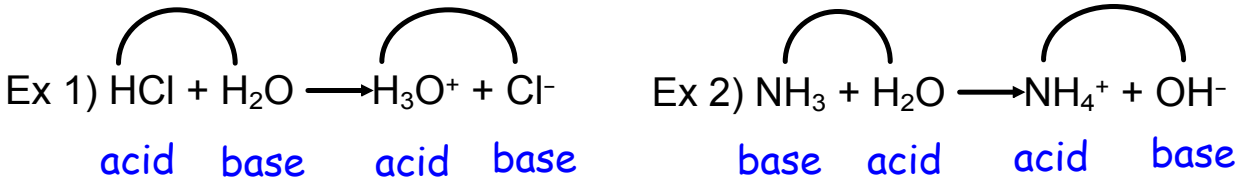
- H+ ions are hydrogen ions
- H+ can bond to water to make H3O+ (hydronium) ions (polyatomic - Table E)
- Ex: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$

B. Arrhenius Base - a substance that releases OH- in solution (ionic and end in OH).

- OH- ions are hydroxide ions (polyatomic - Table E)
- Ex: $NaOH + H_2O \rightarrow Na^+(aq) + OH^-(aq)$
- NON-example:

CH_3OH (ends in OH but not ionic)

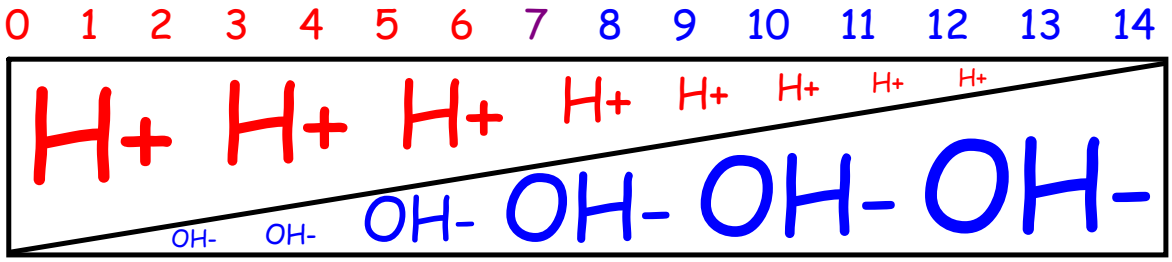
C. Bronsted-Lowry → Acid - proton donor (gives away H+)
Base - proton acceptor (gains H+)



III. pH Scale to Measure Strength

A. pH - power of hydrogen (measures concentration of H+ ions in solution)

B. pH Scale



In an acidic solution, [H+] is high and [OH-] is low.

In an basic solution, [H+] is low and [OH-] is high.

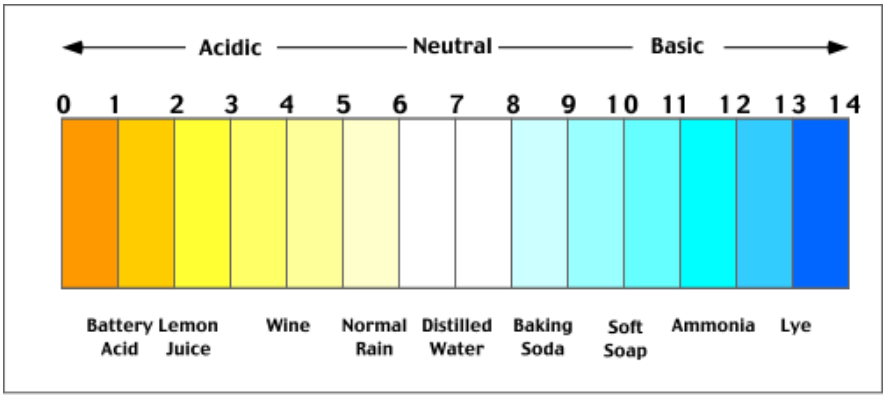
Neutral means [H+] = [OH-]

C. Rule - Each change of one pH unit represents a 10-fold change in [H+].

Ex 1) pH 0 = 1M acid = 1 x 10^{0} H+ in solution
pH 1 = 0.1M acid = 1 x 10^{-1} H+ in solution
pH 2 = 0.01M acid = 1 x 10^{-2} H+ in solution

} Relationship?

As [H+] decreases, molarity decreases, pH increases



Ex 2) An acid with a pH of 1 is 10x stronger than an acid with a pH of 2

An acid with a pH of 5 is 100x weaker than an acid with a pH of 3

An acid with a pH of 1 has 1000x more H+ than an acid with a pH of 4

IV. pH Indicators

A. Indicator - a chemical that changes color to represent the approximate pH of a substance.

B. How to interpret Table M:

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.1–4.4	red to yellow
bromthymol blue	6.0–7.6	yellow to blue
phenolphthalein	8–9	colorless to pink
litmus	4.5–8.3	red to blue
bromcresol green	3.8–5.4	yellow to blue
thymol blue	8.0–9.6	yellow to blue

Source: *The Merck Index*, 14th ed., 2006, Merck Publishing Group

Ex) Methyl Orange

If the pH is from 0-3.1, the color we will see is red.

If the pH is from 4.4-14, the color we will see is yellow.

What would methyl orange look like if the pH is in between 3.1 and 4.4? Orange

How can this indicator be useful?
When will it be useless?

If it turns red or orange it is useful because the pH range is small. If it turns yellow, all we know is that the pH is somewhere between 4.4 and 14 which could mean acidic, basic or neutral.

V. Acid and Base Neutralization

A. Neutralization Reaction (a *specific* type of double replacement rxn)

Acid + Base ⟶ Salt + Water OR

HCl + NaOH ⟶ NaCl + HOH

B. Titration - a technique that uses a neutralization reaction to determine an unknown concentration of an acid or a base. In order for neutralization to occur, moles of H+ = moles of OH-, so...

$$M_A V_A = M_B V_B$$ *(See Table T)*

Problems:

1) In a titration, 20.0 ml of KOH(aq) solution exactly neutralized 10.00 ml of a 4.0 M HCl(aq) solution. What is the molarity of KOH?

Vb Va Ma

(4.0M)(10.00ml) = (Mb)(20.0ml)

2.0 M = (Mb)

2) What is the concentration of a 600.0 ml solution of H_2SO_4 that is neutralized by 50.0 ml of a 6.0 M NaOH solution?

Va Vb Mb

2(Ma)(600.0ml) = (6.0M)(50.0ml)

Ma = 0.25 M