

Acids & Bases

What are Acids?



Vinegar



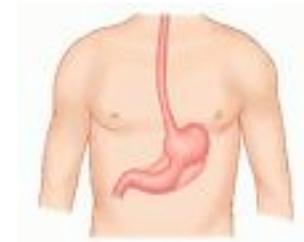
Battery Acid



Lemon Juice



Soft Drinks



Stomach Acid
(Hydrochloric Acid)

Properties of Acids

- Molecular substances that ionize in water
- Solutions will conduct electricity
- React with active metals to produce $H_{2(g)}$
- Sour taste
- Effect the colors of acid-base indicators
(Example: Acids turn litmus paper red)
- Neutralize bases

Bases



Drain Cleaner



Baking Soda



Oven Cleaner



Grapes



Sweet Potato



Almonds



Ammonia



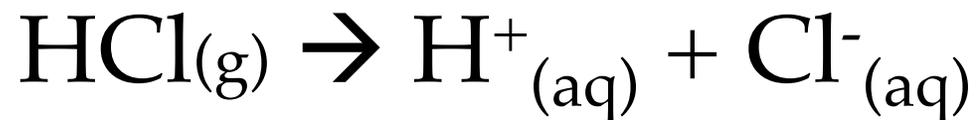
Stomach Relief Medicines

Properties of Bases

- Solutions conduct electricity
- Solutions feel slippery
- Taste bitter
- Emulsify fats & oils
- Effect the colors of acid-base indicators
(Example: Bases turn litmus paper **blue**)
- Neutralize acids

Arrhenius Acid

A substance that yields hydrogen ions (H^+) as the only positive ion in an aqueous solution.



Arrhenius Base

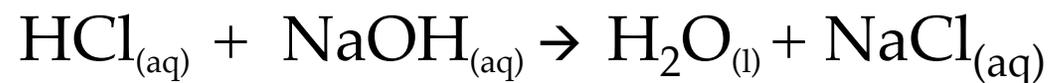
A substance that yields hydroxide ions (OH⁻) as the only negative ion in an aqueous solution



Neutralization

The mutual destruction of a base and acid when solutions of the two are mixed.

Acid + Base = Water + Salt



H⁺ and OH⁻ Concentration

When the hydrogen ion and hydroxide ion concentrations are *equal* the solution is *pure water*. The equilibrium constant for pure water has been experimentally determined to be 1.0×10^{-14} .

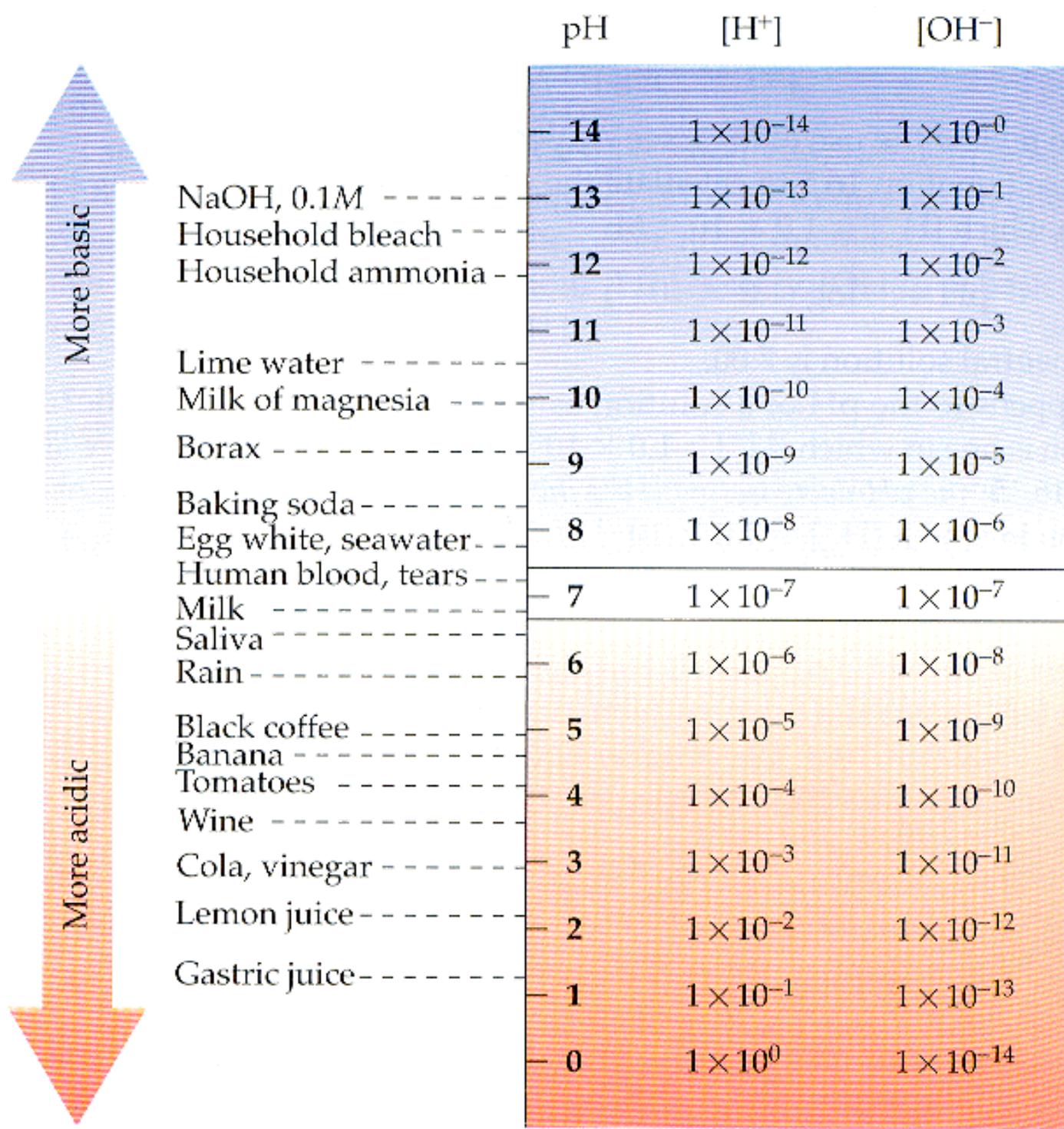
$$[\text{H}^+] \times [\text{OH}^-] = 1.0 \times 10^{-14}$$

Hydrogen Ion
Concentration (M)

Hydroxide Ion
Concentration (M)

The pH of a Solution

Because it is difficult to conceptually compare very small and large numbers, the concentrations of H^+ ions (acids) and the concentration of OH^- ion (bases) are compared using a logarithmic scale known as the *pH scale*.



Calculating pH and Concentration

$$[\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

$$\text{pH} = -\log[\text{H}^+]$$

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

Concentration of an acid = $[\text{H}^+]$

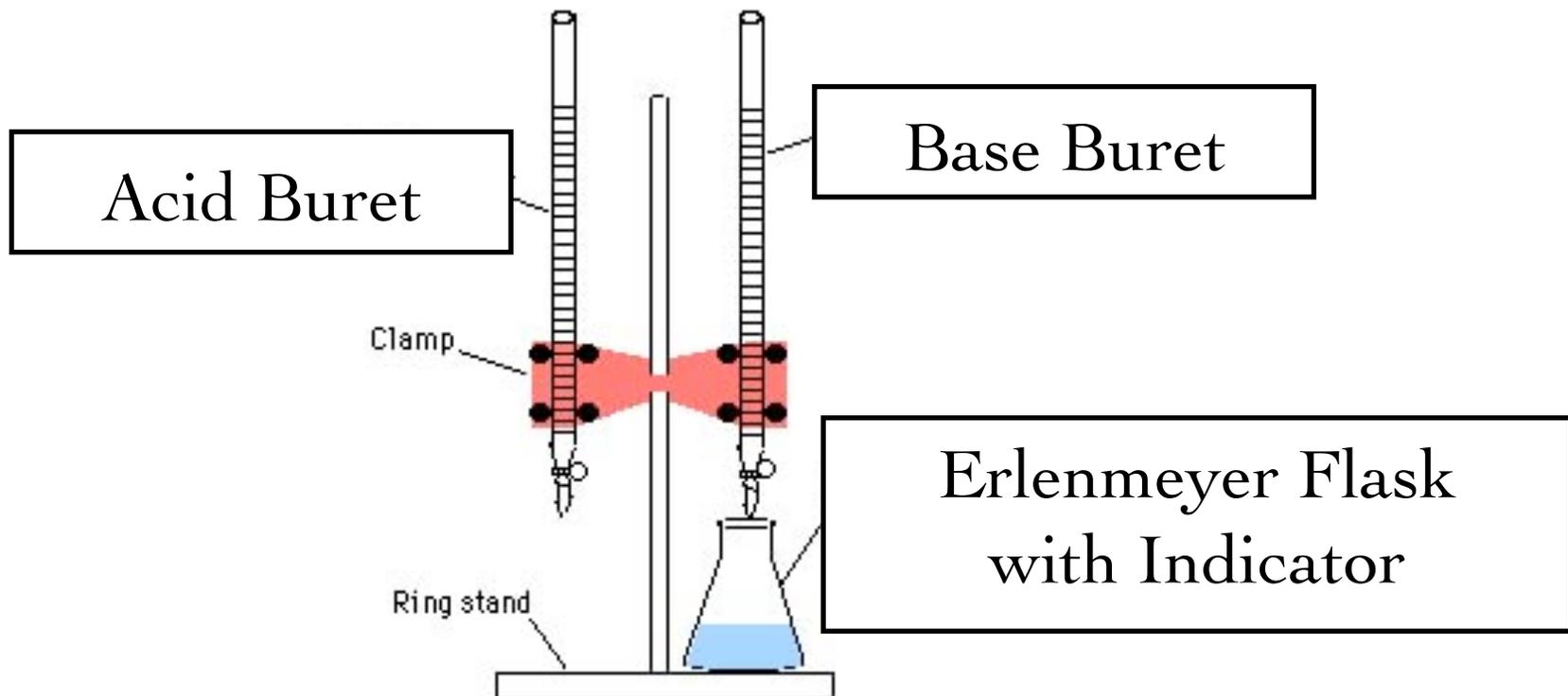
Concentration of a base = $[\text{OH}^-]$

Examples

1. What is the pH of a 1.0×10^{-4} M solution of HCl?
2. What is the pH of a 4.0×10^{-3} M solution of NaOH?
3. What is the H^+ concentration for a solution with a pH of 9.32?

Acid - Base Titration

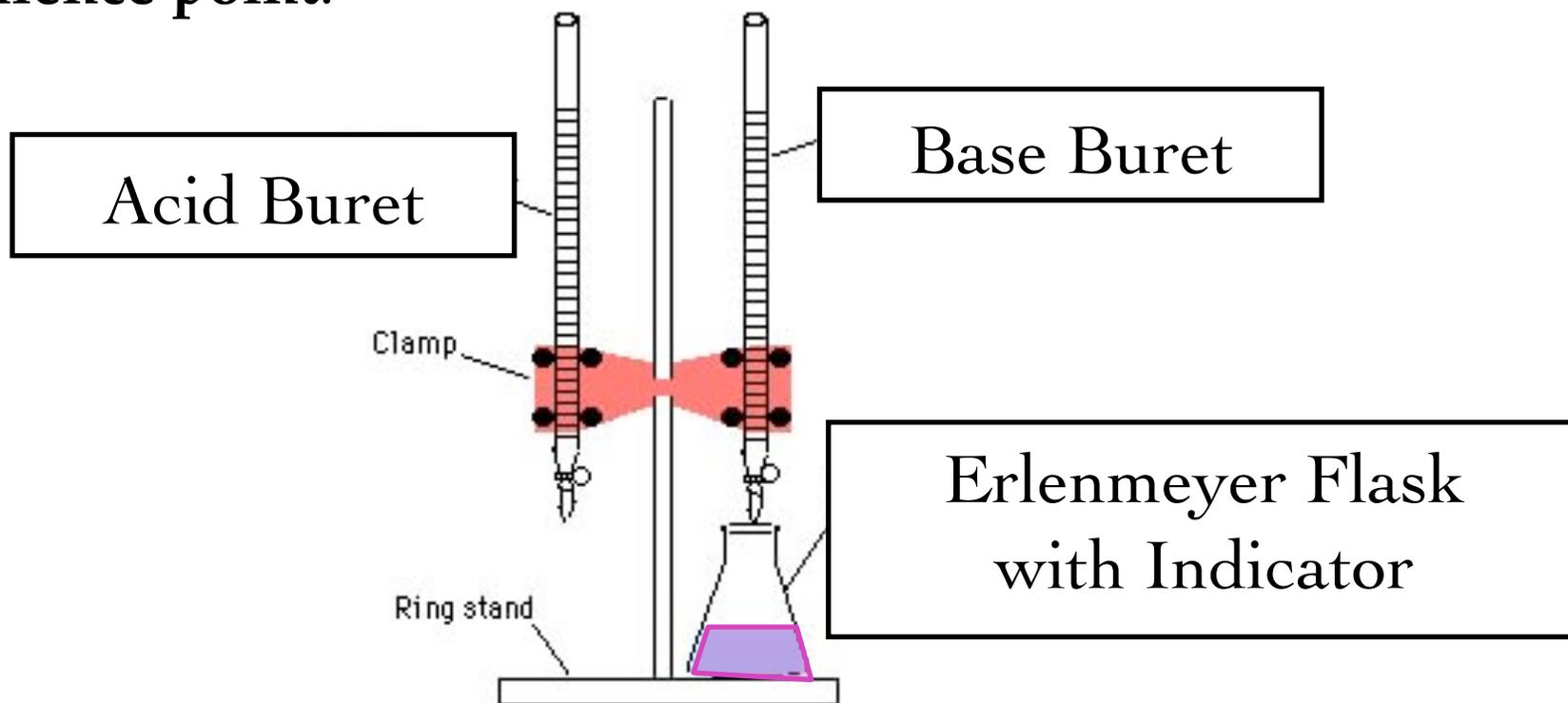
A lab procedure used to determine the unknown concentration of an acid or base.



Neutralization and Titration

One buret contains a solution of unknown concentration and the other contains a solution of known concentration and is referred to as the **standard solution**.

An indicator signals when enough of the standard solution has been added to neutralize the unknown. This is known as the **end point** or **equivalence point**.



Solving Acid - Base Titrations

This process compares moles of the acid to the moles of base.

Step 1: Write a balanced chemical equation.

Step 2: Identify the coefficients of the acid and base.

Step 3:

Moles Acid = Moles Base

$$\text{(Coefficient of Base)} V_a M_a = \text{(Coefficient of Acid)} V_b M_b$$

V_a = volume of acid (L or dm³)

V_b = volume of base (L or dm³)

M_a = molar concentration of acid solution

M_b = molar concentration of basic solution

Example:

By titration, 20.0 cm³ of strontium hydroxide is neutralized by 25.0 cm³ of 0.0500 M hydrochloric acid. Find the original concentration of the strontium hydroxide.