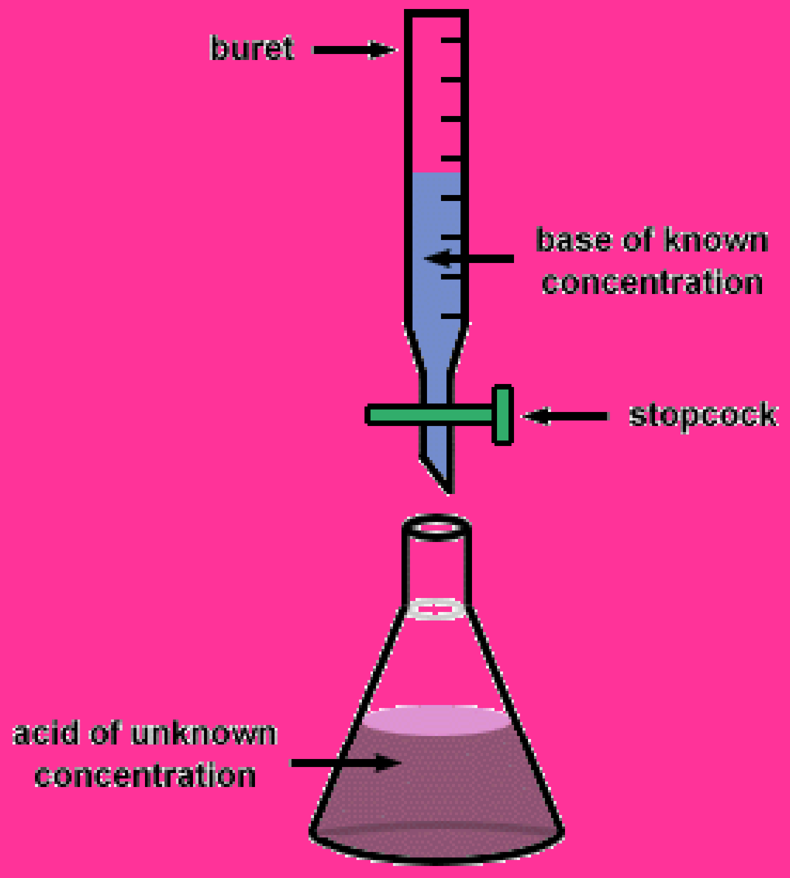
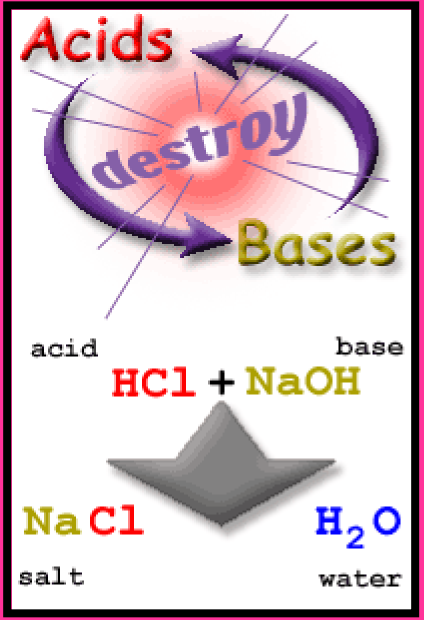
III. Titration

Acids & Bases



A. Neutralization

- Chemical reaction between an acid and a base.
- Products are a salt (ionic compound) and water.



A. Neutralization

ACID + BASE → SALT + WATER

$HCl + NaOH \rightarrow NaCl + H_2O$

strong strong neutral

$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

weak strong basic

- Salts can be neutral, acidic, or basic.
- Neutralization does not mean pH = 7.

B. Titration

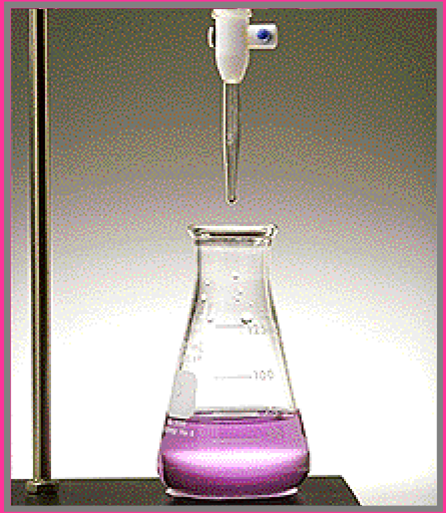
- **Titration**
  - Analytical method in which a standard solution is used to determine the concentration of an unknown solution.

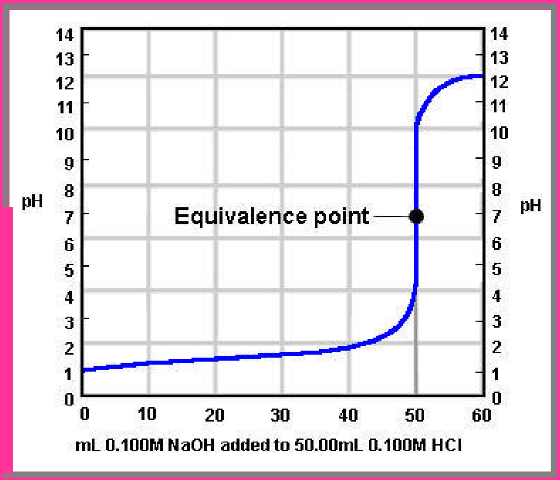
standard solution

unknown solution

B. Titration

- **Equivalence point** (endpoint)
  - Point at which equal amounts of H_3O^+ and OH^- have been added.
  - Determined by…
    - indicator color change
    - dramatic change in pH





B. Titration

$$\text{moles } H_3O^+ = \text{moles } OH^-$$

$$M_a \cdot V_a \cdot n_{H+} = M_b \cdot V_b \cdot n_{OH-}$$

M: Molarity

V: volume

n: # of H^+ ions in the acid or OH^- ions in the base

B. Titration

- 42.5 mL of 1.3 *M* KOH are required to neutralize 50.0 mL of H_2SO_4. Find the molarity of H_2SO_4.

H_3O^+	OH^-	MV# = MV#
M = ? V = 50.0 mL n = 2	M = 1.3M V = 42.5 mL n = 1	M(50.0mL)(2) =(1.3M)(42.5mL)(1) **M = 0.55M H_2SO_4**

Titration Animations

- http://www.chem.fsu.edu/chemlab/chm3120l/acid/intro.html

Type of Titration	Initial pH	Immediate Change in pH	pH at Equivalence Point
Strong Acid added to Strong Base	Given by the initial [strong base], since the strong base is 100% ionized. pH = 14 - pOH (in the base)	Virtually no change in pH at beginning of titration. The added acid is completely consumed. Note the almost level curve.	Since both are strong, $[H_3O^+] = [OH^-]$ pH = 7
Strong Base added to Strong Acid	Given by the initial [strong acid], since the strong acid is 100% ionized.	Virtually no change at beginning of titration. The added base is completely consumed.	Again, since both are strong. $[H_3O^+] = [OH^-]$ pH = 7
Strong Base added to Weak Acid	The weak acid is only partially ionized so the $[H_3O^+]$ is less than the [acid]. Therefore, pH is greater than that for a strong acid.	An immediate increase in pH occurs, which then levels off.	At the equivalence point, the conjugate base of the weak acid is present, therefore, the solution is basic. pH > 7
Strong Acid added to Weak Base	The weak base is only partially ionized, so the pH is less than that for a strong base.	An immediate decrease in pH occurs, which then quickly levels off.	At the equivalence point, the conjugate acid of the weak base is present, therefore, the solution is acidic. pH < 7