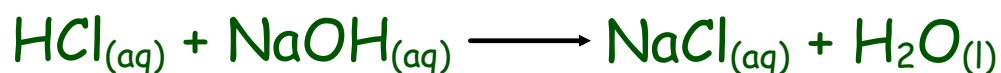# Neutralization Reactions

Acid-Base Reactions

What do you think would happen if you mix a solution of a strong acid with a solution of a strong base containing an equal number of hydrogen and hydroxide ions?

Example

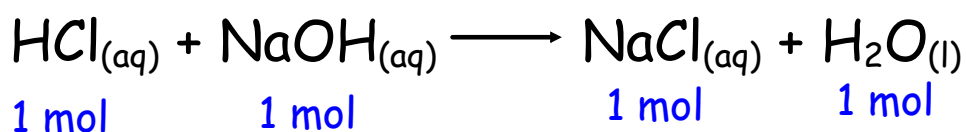$$HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Similar reactions of weak acids and weak bases do not usually produce neutral solutions.
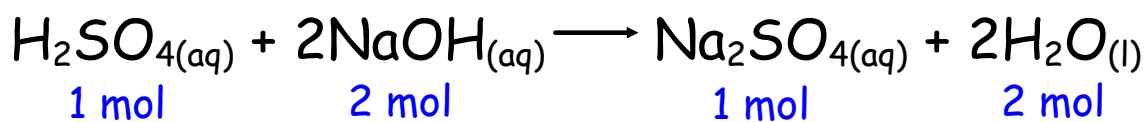
In general, the reaction of an acid with a base produces water and a class of compounds called salts. The process is called a neutralization reaction.
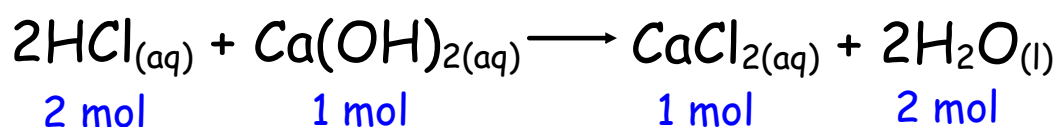
Titration

Acids and bases sometime react in a 1:1 mole ratio

$$HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

1 mol   1 mol   1 mol   1 mol

However, this is not always the case...

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$$

1 mol   2 mol   1 mol   2 mol

1:2 mole ratio

$$2HCl_{(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaCl_{2(aq)} + 2H_2O_{(l)}$$

2 mol   1 mol   1 mol   2 mol

2:1 mole ratio

Notice that in all of the above examples, the number of moles of the hydrogen and hydroxide ions are the same. This is called the **equivalence point**.

Example

How many moles of sulfuric acid ($H_2SO_{4(aq)}$) are required to neutralize 0.50 mole of sodium hydroxide ($NaOH_{(aq)}$)?

We can determine the concentration of an acid (or base) in a solution by performing a neutralization reaction.

1. A measured volume of an acid solution of unknown concentration is added to a flask.
2. Several drops of an indicator are added to the solution while the flask is gently swirled.
3. Measured volumes of a base of known concentration are mixed into the acid until the indicator just barely changes color.

The process of adding a known amount of solution of known concentration to determine the concentration of another solution is called **titration**.

Example

A 25 mL solution of H_2SO_4 is completely neutralized by 18 mL of 1.0M NaOH. What is the concentration of the H_2SO_4 solution?

Try questions #30-37 on pages 614-616