Titration

As you know, neutralization reactions occur between acids and bases. The OH^- ion acquires a proton from the H_3O^+ ion, forming two molecules of water. The following equation summarizes this reaction.

$$H_3O^+(aq) + OH^-(aq) \longrightarrow 2H_2O(l)$$

This equation shows that one mol of hydronium ions and one mol of hydroxide ions are chemically equivalent amounts. They combine in a one-to-one mole ratio. Neutralization occurs when hydronium ions and hydroxide ions are supplied in equal numbers by reactants, as shown in **Figure 7.**

One liter of a 0.10 M HCl solution contains 0.10 mol of hydronium ions. Now suppose that 0.10 mol of solid NaOH is added to 1 L of 0.10 M HCl solution. The NaOH dissolves and supplies 0.10 mol of hydroxide ions to the solution. HCl and NaOH are present in chemically equivalent amounts. Hydronium and hydroxide ions, which are present in equal numbers, combine until the product $[H_3O^+]\,[OH^-]$ returns to the value of 1×10^{-14}. NaCl, the salt produced in the reaction, is the product of this neutralization of a strong acid and a strong base. The resulting solution is neutral.

Because acids and bases react, the progressive addition of an acid to a base (or a base to an acid) can be used to compare the concentrations of the acid and the base. **Titration** *is the controlled addition and measurement of the amount of a solution of known concentration required to react completely with a measured amount of a solution of unknown concentration.* Titration provides a sensitive means of determining the chemically equivalent volumes of acidic and basic solutions.

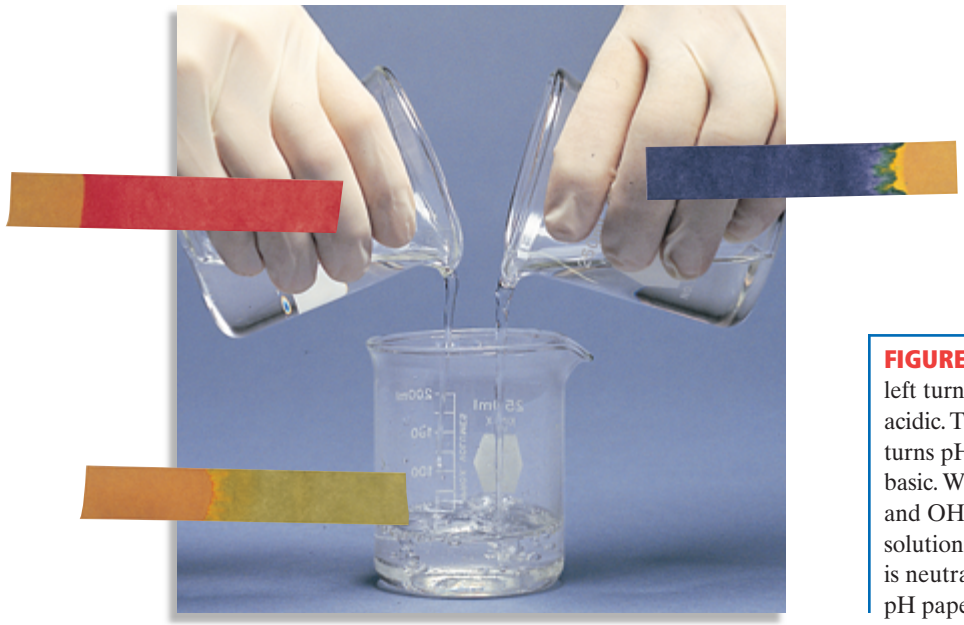

FIGURE 7 The solution on the left turns pH paper red because it is acidic. The solution on the right turns pH paper blue because it is basic. When equal numbers of H_3O^+ and OH^- from the acidic and basic solutions react, the resulting solution is neutral. The neutral solution turns pH paper green.