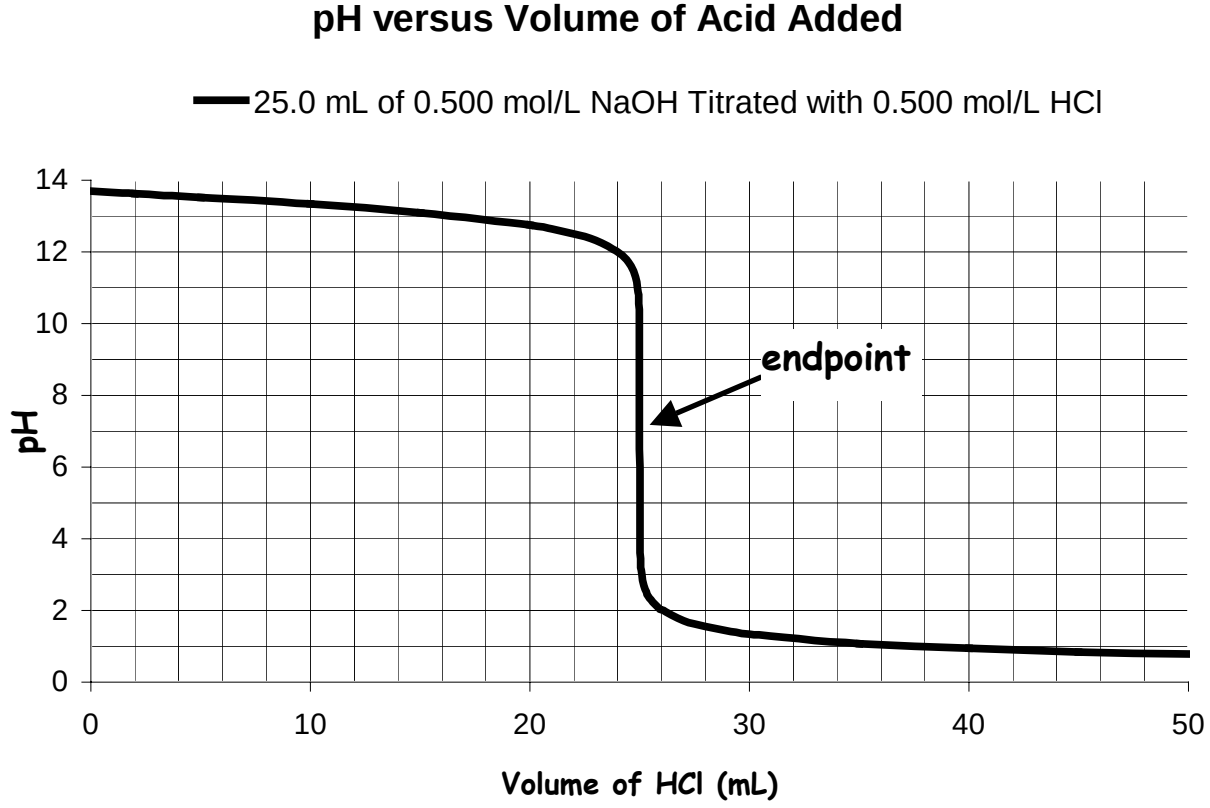
pH Changes in Acid-Base Reaction Systems

For many acid-base reactions the appearance of the products is not visibly different from the reactants, so you cannot directly observe the progress of the reaction. Also, an acidic solution cannot be easily distinguished from a basic solution except by measuring pH. A graph showing the continuous change of pH during an acid-base reaction is called a **pH curve**.

Interpreting pH Curves

The pH curves for acid-base reactions have characteristic shapes.



The initial pH is high because the sample is a strong base and no acid has yet been added. The final pH is low because an excess of strong acid has been added. The initial addition of the titrant (from the buret) to either an acid or base sample does not produce large changes in the pH of the solution. This relatively flat region of a pH curve is where a ***buffering*** action occurs.

Following this buffering region there is a very rapid change in pH for a small additional volume of the titrant. The midpoint of this vertical region is the **endpoint** of a titration. If a suitable indicator is chosen, it would change colour at this point. An indicator is chosen for a titration so that it completes its colour change within the vertical section of the graph. Theoretically, the **equivalence point** represents the stoichiometric quantity of titrant required by the balanced chemical equation. If the titration is performed efficiently, the endpoint should be the same as the equivalence point.

Polyprotic Substances.

The pH curve for the titration of sodium hydroxide with hydrochloric acid has only on observable endpoint. According the Brønsted-Lowry concept, only one reaction has occurred. But the pH curve for the addition of HCl(aq) to Na_2CO_3(aq) displays two endpoints – two rapid changes in pH. pH curves such as this can be interpreted as indicating the number of quantitative reactions for polyprotic acids or bases.

sodium carbonate titrated with hydrochloric acid