ANALYTICAL CHEMISTRY

Read the details of the information given below from Skoog and West's "Fundamentals of Analytical Chemistry" book, which is recommended as a reference.

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Principles of Neutralization Titrations

Solutions and Indicators for Acid/Base Titrations

Titration of Strong Acids and Bases

Titration Curves for Weak Acids

Titration Curves for Weak Bases

The Composition of Solutions During Acid/Base Titrations

14A Solutions and indicators for acid/base titrations

Neutralization titrations depend on a chemical reaction of the analyte with a standard reagent.

- The titration of a strong acid with a strong base
- The titration of a weak acid with a strong base
- The titration of a weak base with a strong acid

14A-1 Standard solutions

The standard reagents used in acid/base titrations are **always strong acids or strong bases**.

- react more completely with an analyte.
- produce sharper end points.

Weak acids and bases are never used as standard reagents because they react incompletely with analytes.

14A-2 Acid/base indicators

$$\underset{\text{acid color}}{\text{HIn}} + \text{H}_2\text{O} \rightleftharpoons \underset{\text{base color}}{\text{In}^-} + \text{H}_3\text{O}^+$$

$$\underset{\text{base color}}{\text{In}} + \text{H}_2\text{O} \rightleftharpoons \underset{\text{acid color}}{\text{InH}^+} + \text{OH}^-$$

$$\text{pH(acid color)} = -\log(10K_a) = \text{p}K_a + 1$$

$$\text{pH(basic color)} = -\log(0.1K_a) = \text{p}K_a - 1$$

$$\text{indicator pH range} = \text{p}K_a \pm 1$$

Titration errors with acid/base indicators

Two types of titration error:

- a determinate error that occurs when the pH at which the indicator changes color differs from the pH at the equivalence point.

To minimize: choose the indicator carefully or make a blank correction.

- an indeterminate error that originates from the limited ability of the human eye to distinguish reproducibly the intermediate color of the indicator.

Variables that influence the behavior of indicators

- Temperature
- Ionic strength of the medium
- The presence of organic solvents
- Colloidal particles

14B Titration of strong acids and bases

H_3O^+ in an aqueous solution of a strong acid have two sources:

- the reaction of the acid with water
- the dissociation of water itself

$$[H_3O^+] = c_{HCl} + [OH^-] \approx c_{HCl}$$

$$[OH^-] = c_{NaOH} + [H_3O^+] \approx c_{NaOH}$$

14B-1 Titrating a strong acid with a strong base

Three types of calculations must be done in order to construct the hypothetical curve for titrating a solution of a strong acid with a strong base:

- **Preequivalence**
- **Equivalence**
- **Postequivalence**

At the equivalence point, the solution is neutral, and pH = pOH.
pH and pOH = 7.00, at 25°C.