Chapter 5
Reactions in Aqueous Solution

Many reactions involve ionic compounds, especially reactions in water — *aqueous solutions*.

KMnO₄ added to water

\[ \text{K}^+(\text{aq}) + \text{MnO}_4^-(\text{aq}) \]

Screen 5.2 on the CD-ROM

Aqueous Solutions

How do we know ions are present in aqueous solutions?

The solutions conduct electricity.

Ionic compounds that dissolve in water are called *electrolytes*. HCl, KMnO₄, MgCl₂, and NaCl are strong electrolytes. They dissociate completely (or nearly so) into ions.

\[ \text{KMnO}_4(\text{aq}) \rightarrow \text{K}^+(\text{aq}) + \text{MnO}_4^-(\text{aq}) \]

Aqueous Solutions

Acetic acid ionizes only to a small extent, so it is a weak electrolyte.

\[ \text{CH}_3\text{CO}_2\text{H}(\text{aq}) \rightarrow \text{CH}_3\text{CO}_2^-\text{(aq)} + \text{H}^+(\text{aq}) \]
Acetic acid — Weak Electrolyte

Ionized acetic acid (acetate)

Nonionized acetic acid

H^+

Some compounds dissolve in water but do not conduct electricity. They are called nonelectrolytes.

Examples include:
- sugar
- ethanol
- ethylene glycol (in antifreeze)

All of these have POLAR bonds that do not separate into ions.

Aqueous Solutions

Water Solubility of Ionic Compounds

Not all ionic compounds dissolve in water. Some are INSOLUBLE.

See screen 5.4 on the CD-ROM and Example 5.1

WATER SOLUBILITY OF IONIC COMPOUNDS

Common minerals are often formed with anions that lead to insolubility:
- sulfide
- fluoride
- carbonate
- oxide

Azurite, a copper carbonate
Iron pyrite, a sulfide
Orpiment, arsenic sulfide
WATER SOLUBILITY OF IONIC COMPOUNDS

The insolubility of some ionic compounds can be used to determine what is in solution.

Precipitation reactions produce an insoluble precipitate.

For example, add AgNO₃ to NaCl

Start with Ag⁺, NO₃⁻, Na⁺ and Cl⁻:

\[ \text{Ag}^+(aq) + \text{Cl}^-(aq) \rightarrow \text{AgCl(s)} \]

This reaction is diagnostic for the presence of Ag⁺.