"Like dissolves like"

Non-polar substances (such as hydrocarbons) don't dissolve well in water.

They aren't able to disrupt the extensive hydrogen bonding in water.

Polar covalent molecules (such as sugars and short-chain alcohols) dissolve in water without dissociating.
basic anhydride

\[ \text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 \]

calcium oxide
(lime)

calium hydroxide
(lime water)

Saturated

2 g \text{CaO} \text{ in 1 L water}
Ionic crystals separate into independent-floating ions in water.

\[
\text{NaCl}(s) \overset{\text{H}_2\text{O}}{\longrightarrow} \text{Na}^+(aq) + \text{Cl}^-(aq)
\]

Indeed: Complete independence

Not all ionic compounds are soluble in water. Most silver salts are not soluble in water.

\[
\text{AgNO}_3
\]

Most metal hydroxides are not soluble in water. Most metal oxides are not soluble in water.

PbSO\(_4\), BaSO\(_4\), and SrSO\(_4\) are not soluble in water. (CaSO\(_4\) is somewhat soluble in water).

All common salts of Group I metals are soluble in water.

All common ammonium salts are soluble in water.

All nitrates are soluble in water.
Metathesis (double displacement) reactions

Swap partners

Overall equation

\[ 2 \text{AgNO}_3 (aq) + \text{CaCl}_2 (aq) \rightarrow 2 \text{AgCl} (s) + \text{Ca(NO}_3)_2 (aq) \]

Ionic equation

\[
\begin{align*}
2\text{Ag}^+ &+ 2\text{NO}_3^- + \text{Ca}^{2+} + 2\text{Cl}^- \\
\rightarrow & \quad 2 \text{AgCl} + \text{Ca}^{2+} + 2\text{NO}_3^- \\
\end{align*}
\]

Net ionic equation

eliminate spectator ions

\[
\begin{align*}
2\text{Ag}^+ &+ 2\text{Cl}^- \rightarrow 2 \text{AgCl} \\
\text{Ag}^+ + \text{Cl}^- &\rightarrow \text{AgCl} \\
\end{align*}
\]
Overall equation

\[ \text{BaCl}_2 (aq) + \text{Na}_2\text{SO}_4 (aq) \rightarrow \text{BaSO}_4 (s) + 2 \text{NaCl} (aq) \]

Ionic equation

\[ \text{Ba}^2+ + 2\text{Cl}^- + 2\text{Na}^+ + 5\text{O}_4^{2-} \rightarrow \text{BaSO}_4 \downarrow + 2\text{Na}^+ + 2\text{Cl}^- \]

Net ionic equation

\[ \text{Ba}^2+ + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4 \downarrow \]

Separated ions in solution

Ions together in crystal lattice
Overall equation

KNO₃ (aq) + NaCl (aq) → NaNO₃ (aq) + KCl (aq)

Ionic equation

\[ \text{K}^+ + \text{NO}_3^- + \text{Na}^+ + \text{Cl}^- \rightarrow \text{Na}^+ + \text{NO}_3^- + \text{K}^+ + \text{Cl}^- \]

Net ionic equation

\[ \text{KNO}_3 + \text{NaCl} \rightarrow \text{NR} \]

no reaction

\[ \text{H}_2\text{SO}_4 + \text{CuCl}_2 \rightarrow \text{CuSO}_4 + \text{2HCl} \]

NR
Overall equation

H₂SO₄ (aq) + 2NaOH (aq) → Na₂SO₄ + 2H₂O

Ionic equation

2H⁺ + SO₄²⁻ + 2Na⁺ + 2OH⁻ → 2H₂O + Na₂SO₄

Net ionic equation
\[ 2H^+ + 2OH^- \rightarrow 2H_2O \]

\[ H^+ + OH^- \rightarrow H_2O \]

\( H_2O \) is a non-electrolyte.

\( H_2SO_4 \) strong acid
\( HCl \)
\( HNO_3 \) strong electrolyte
\( HClO_4 \)

\( NaOH \) strong base
\( K OH \) strong electrolyte
\( Na^+ \), \( OH^- \)
\( K^+ \), \( OH^- \)