IONIC COMPOUNDS
Compounds in Aqueous Solution
Many reactions involve ionic compounds, especially reactions in water—aqueous solutions.
When a compound dissolves in water, it releases its ions (dissociates in water).
How do we know ions are present in aqueous solutions?
The solutions conduct electricity!
They are called ELECTROLYTES.

Solutions-Aqueous
• A SOLUTION is made up of 2 parts
• The SOLUTE is what is being dissolved
• The SOLVENT is what is doing the dissolving
• In an aqueous solution, water is always the solvent!
• The solubility of a compound determines if it dissociates (breaks up into ions) 100% or less.
• Knowing the SOLUBILITY RULES on p. 152 is MANDATORY!

Aqueous Solutions
HCl, MgCl₂, and NaCl are examples of strong electrolytes.
They dissociate completely (or nearly so) into ions.
Acetic acid ionizes only to a small extent, so it is a weak electrolyte.

CH₃CO₂H(aq) → CH₃CO₂⁻(aq) + H⁺(aq)
Aqueous Solutions

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

Examples include:
- sugar
- ethanol
- ethylene glycol

Water Solubility of Ionic Compounds

<table>
<thead>
<tr>
<th>SOLUBLE COMPOUNDS</th>
<th>EXCEPTIONS</th>
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<tbody>
<tr>
<td>Almost all salts of Na⁺, K⁺, NH₄⁺</td>
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<tr>
<td>Salts of nitrate, SO₄²⁻, CO₃²⁻, PO₄³⁻, H₂PO₄⁻</td>
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<td>Salts of silver, NO₃⁻</td>
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<table>
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<tr>
<th>INSOLUBLE COMPOUNDS</th>
<th>EXCEPTIONS</th>
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<tr>
<td>Almost all salts of Fe⁺, Cu⁺, Pb⁺</td>
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<tr>
<td>Complexes containing S⁻</td>
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<tr>
<td>Salts of chlorite, IO₃⁻</td>
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</tbody>
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Net Ionic Equations

\[ \text{Mg(s)} + 2 \text{HCl(aq)} \rightarrow \text{H}_2(g) + \text{MgCl}_2(aq) \]

We write the ionic equation...

\[ \text{Mg(s)} + 2 \text{H}^+(aq) + 2 \text{Cl}^-(aq) \rightarrow \text{H}_2(g) + \text{Mg}^{2+}(aq) + 2 \text{Cl}^-(aq) \]

And then what is really happening...

- Mg(s) + 2 H⁺(aq) \rightarrow H₂(g) + Mg²⁺(aq)

The two Cl⁻ ions are SPECTATOR IONS—they do not participate.

Writing NET IONIC equations are important to see what is REALLY happening!
Writing Net Ionic equations practice

• If a product is insoluble, it stays together - if it soluble, it breaks apart.
• Write the net ionic equation for the reaction between magnesium chloride with ammonium fluoride both are in water.

1. Write a balanced equation…
\[ \text{MgCl}_2(\text{aq}) + 2 \text{NH}_4\text{F}(\text{aq}) \rightarrow \text{MgF}_2 + 2 \text{NH}_4\text{Cl} \]

2. Determine if either product is insoluble…
\[ \text{MgF}_2 \text{ (insoluble)} + 2 \text{NH}_4\text{Cl} \text{ (soluble)} \]

\[ \text{MgCl}_2(\text{aq}) + 2 \text{NH}_4\text{F}(\text{aq}) \rightarrow \text{MgF}_2(\text{s}) + 2 \text{NH}_4\text{Cl} (\text{aq}) \]

• The reactants both change to ions
\[ \text{MgCl}_2(\text{aq}) + 2 \text{NH}_4\text{F(}\text{aq}) \rightarrow \text{Mg}^{2+} + 2 \text{Cl}^- + 2 \text{NH}_4^+ + 2 \text{F}^- \rightarrow \]

…And the product which is insoluble stays together
\[ \text{Mg}^{2+} + 2 \text{Cl}^- + 2 \text{NH}_4^+ + 2 \text{F}^- \rightarrow \text{MgF}_2 + \ldots \]

The soluble product breaks up…
\[ \text{Mg}^{2+} + 2 \text{Cl}^- + 2 \text{NH}_4^+ + 2 \text{F}^- \rightarrow \text{MgF}_2 + 2\text{NH}_4^+ + 2 \text{Cl}^- \]

IONIC & NET IONIC EQUATIONS

\[ \text{Mg}^{2+} + 2 \text{Cl}^- + 2 \text{NH}_4^+ + 2 \text{F}^- \rightarrow \text{MgF}_2 + 2\text{NH}_4^+ + 2 \text{Cl}^- \]

This is called the “ionic equation”
The “net ionic equation” contains no spectator ions
\[ \text{Mg}^{2+} + 2 \text{Cl}^- + 2 \text{NH}_4^+ + 2 \text{F}^- \rightarrow \text{MgF}_2 + 2\text{NH}_4^+ + 2 \text{Cl}^- \]

Which leaves…
\[ \text{Mg}^{2+} + 2 \text{F}^- \rightarrow \text{MgF}_2 \]

This is the net ionic equation!