Many ionic compounds will dissolve in water so we say they are **soluble**. Sodium chloride (NaCl), and potassium nitrate (KNO₃) are two examples of soluble compounds. When these compounds are mixed with water they dissolve, and we describe them as aqueous (aq). There are many ionic compounds that do not dissolve in water, though. These are described as **insoluble**. An insoluble substance simply remains in the solid state (s) when added to water. The chart below can be used to predict whether the compounds are soluble or insoluble.

### Solubility Table

<table>
<thead>
<tr>
<th>Anions</th>
<th>Acetate C₂H₃O₂⁻</th>
<th>Carbonate CO₃²⁻</th>
<th>Chloride Cl⁻</th>
<th>Hydroxide OH⁻</th>
<th>Iodide I⁻</th>
<th>Nitrate NO₃⁻</th>
<th>Sulfate SO₄²⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum Al⁺⁺</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Ammonium NH₄⁺</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Barium Ba²⁺</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Copper (II) Cu²⁺</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>I</td>
<td>I</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Lead (II) Pb⁺⁺</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>I</td>
<td>I</td>
<td>S</td>
<td>I</td>
</tr>
<tr>
<td>Silver Ag⁺</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>S</td>
<td>I</td>
</tr>
<tr>
<td>Sodium Na⁺</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Zinc Zn⁺⁺</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>I</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

**S** - soluble  
**I** - insoluble

**Use the chart above to answer the following questions about solubility.**

1. Which of the following compounds are soluble? Which are insoluble?
   
   a. Sodium iodide  
   b. Silver nitrate  
   c. Lead (II) chloride  
   d. Ammonium chloride  
   e. Copper (II) hydroxide  
   f. Aluminum hydroxide

2. The following reactions take place in water. Rewrite each equation and specify whether each substance would be aqueous (aq) or solid (s).
   
   a. Pb(NO₃)₂( ) + BaI₂( ) → PbI₂( ) + Ba(NO₃)₂( )  
   b. Ba(C₂H₃O₂)₂( ) + CuSO₄( ) → Cu(C₂H₃O₂)₂( ) + BaSO₄( )  
   c. ZnSO₄( ) + 2AgNO₃( ) → Zn(NO₃)₂( ) + Ag₂SO₄( )  
   d. Cu(NO₃)₂( ) + 2NaOH ( ) → Cu(OH)₂( ) + 2NaNO₃( )  
   e. Silver nitrate and sodium carbonate react to form silver carbonate and sodium nitrate.

3. Which three anions form the most soluble compounds?

4. Which two cations form the most soluble compounds?

5. It is helpful to create a generate rule for solubility of compounds. Fill in the following blank to describe the solubility of some ionic compounds.
   
   a. Compounds containing the ion sodium (Na⁺) are always ____________.
   b. Compounds containing the anion nitrate (NO₃⁻) are always ____________.
   c. Compounds containing the ion carbonate are usually _______. Exceptions include ______ and ______. 

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WS15-ISolubilityRules