Z.1 Electrolytes

To conduct electricity must need mobile ions
(anything in an ion form absorbed in H₂O is an electrolyte)
Concentration (of an ion) dependent on conductivity; need ion present to conduct electricity

\[ \text{H}_2\text{O} \]

Salts  - NaCl (s) → Na⁺ (aq) + Cl⁻ (aq)

a solid Ionic Compound, is made up of positively and negatively charged ions that are
held in fixed positions. These ions become free to move when they are dissolved in
water. It is the movement of ions that makes up an electrical current in a solution.

Ex: HX → H⁺ (aq) + X⁻ (aq)

Weak acid does not ionize completely; weak electrolyte

Strong acid ionizes completely; strong electrolyte, HCl → H⁺ (aq) + Cl⁻ (aq)

\[ \% \quad 100\% \]

\[ \text{HC}_2\text{H}_3\text{O}_2 \Leftrightarrow \text{H}^+ + \text{C}_2\text{H}_3\text{O}_2^- \quad \text{(weak)} \]

98%  2%

Z.1 Electrolytes

Strong electrolyte: a substance that when dissolved, yields a solution that is a good
conductor of electricity because of nearly complete ionization or
dissociation

Nonelectrolyte: a substance that when dissolved yields a solution that is a nonconductor
of electricity; a solution or other fluid that does not conduct electricity by
ionic movement

Weak electrolyte: a substance that when dissolved yields a solution that is a poor conductor
of electricity because of limited ionization or dissociation

Z.3 Strong and weak Acids

An acid is a hydrogen-bearing compound that releases ions in water solution

<table>
<thead>
<tr>
<th>Seven Common Strong Acids</th>
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</thead>
<tbody>
<tr>
<td>TWO WELL-KNOWN ACIDS</td>
</tr>
<tr>
<td>Nitric acid, HNO₃</td>
</tr>
</tbody>
</table>
Sulfuric, $H_2SO_4$  
hydrobromic, HBr  
perchloric, $HClO_4$  
Hydroiodic, HI

**Solubility - (H$_2$O)** (see table Z.2)

1. if ionic; soluble if it dissociates into ions, if they dissociate – strong electrolyte 
   non-soluble – no ions (see table) - nonelectrolyte
2. -covalent – polarity – polar covalent = soluble; non-polar = non-soluble 
   if no charge, not an electrolyte
3. weak electrolyte – weak bases & weak acids, weak acids & weak bases are water 
   covalent bonds – soluble

**Z.4 Net Ionic Equations**

An equation from which all spectators have been removed

<table>
<thead>
<tr>
<th>Three steps in writing a Net Ionic Equation:</th>
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<tbody>
<tr>
<td>1. Write the conventional equation, including state symbols – (g), (l), (s), and (aq). Balance the [\text{Pb(NO}_3\text{)}_2 \text{(aq)} + 2 \text{NaCl (aq)} \rightarrow \text{PbCl}_2 (s) + 2 \text{NaNO}_3 \text{(aq)}]</td>
</tr>
<tr>
<td>2. Write the total ionic equation by replacing each aqueous (aq) substance that is a strong acid or an ionic compound with its major species. Do not separate a weak acid into ions, even though it state is aqueous (aq). Also, never change solids (s), liquids (l), or gases (g) into ions. Be sure the equation is balanced in both atoms and charge. [\text{Pb}^{2+} \text{(aq)} + 2 \text{NO}_3^- \text{(aq)} + 2 \text{Na}^+ \text{(aq)} + 2 \text{Cl}^- \text{(aq)} \rightarrow \text{PbCl}_2 (s) + 2 \text{Na}^+ \text{(aq)} + 2 \text{NO}_3^- \text{(aq)}]</td>
</tr>
<tr>
<td>3. Write the net ionic equation by removing the spectators from the total ionic equation. Reduce coefficients to lowest terms, if necessary. Be sure the equation is balanced in both atoms and charge. [\text{AgNO}_3 \text{(aq)} + \text{CaCl}_2 \text{(aq)} \rightarrow \text{Ag}^+ \text{(aq)} + \text{NO}_3^- \text{(aq)} + \text{Ca}^{2+} \text{(aq)} + 2 \text{Cl}^- \text{(aq)} \rightarrow \text{Ag}^+ \text{(aq)} + \text{Cl}^- \text{(aq)} \rightarrow \text{AgCl (s)}] (equation) [\text{balanced equation}) \rightarrow \text{net ionic equation)]</td>
</tr>
</tbody>
</table>

Ex: \[\text{AgNO}_3 \text{(aq)} + \text{CaCl}_2 \text{(aq)} \rightarrow \text{Ag}^+ \text{(aq)} + \text{NO}_3^- \text{(aq)} + \text{Ca}^{2+} \text{(aq)} + 2 \text{Cl}^- \text{(aq)} \rightarrow \text{Ag}^+ \text{(aq)} + \text{Cl}^- \text{(aq)} \rightarrow \text{AgCl (s)}\]

Copper(II) Nitrate + ammonium sulfate

Cu(NO$_3$)$_2$ + (NH$_4$)$_2$S

Cu$^{2+}$ (aq) + 2NO$_3^-$ (aq) + 2NH$_4$(aq) + S$^{2-}$ (aq) $\rightarrow$ CuS (s) + NH$_4$(aq) + NO$_3^-$ (aq) $\rightarrow$ Cu$^{2+}$ (aq) + S$^{2-}$ (aq) $\rightarrow$ CuS (s)
Lead(II)nitrate + potassium iodide

\[ \text{Pb(NO}_3\text{)}_2 + \text{KI} \]

\[ \text{Pb}^{2+} + 2\text{NO}_3^- + \text{K}^+ + \text{I}^- \quad \rightarrow \quad \text{PbI}_2(s) + \text{K}^+ + 2\text{NO}_3^- \quad \rightarrow \quad \text{Pb}^{2+} + 2\text{I}^- \quad \rightarrow \quad \text{PbI}_2(s) \]

These are all precipitation reaction = solids (Refer to Table Z.3 for Solubilities of Ionic Compounds)

**Z.7 Ions that form Neutralization Reaction**

Neutralization reactions are the most common molecular product reactions

\[ \text{HX} + \text{YOH} \quad \rightarrow \quad \text{H}^+ + \text{X}^- + \text{Y}^+ + \text{OH}^- \]

\[ \text{acid} \quad \text{(base)} \quad \vert \quad \rightarrow \quad \text{H}_2\text{O} + \text{XY}^{(aq)} \]

Net ionic \( \text{H^+}^{(aq)} + \text{OH^-}^{(aq)} \rightarrow \text{H}_2\text{O} \) (net ionic equation for any strong acid/strong base)

ex: \( \text{HNO}_3 + \text{NaOH} \)

\[ \text{H}^+^{(aq)} + \text{NO}_3^-^{(aq)} + \text{Na}^+^{(aq)} + \text{OH}^-^{(aq)} \rightarrow \text{H}_2\text{O}^{(aq)} + \text{Na}^+^{(aq)} + \text{NO}_3^-^{(aq)} \rightarrow \text{H}^+^{(aq)} + \text{OH}^-^{(aq)} \rightarrow \text{H}_2\text{O} \]