Balancing Net Ionic Equations

1. Balance the **molecular equation**. Find stoichiometric coefficients; do not change the subscripts or states of matter.

   Example: Balance the double displacement reaction between sodium hydroxide and aluminum chloride.

   $$NaOH_{(aq)} + AlCl_{3(aq)} \rightarrow NaCl_{(aq)} + Al(OH)_{3(s)}$$

   NaOH, $AlCl_3$ and NaCl are strong electrolytes; $Al(OH)_3$ is insoluble in water, so:

   $$\mathbf{3\ NaOH_{(aq)} + AlCl_{3(aq)} \rightarrow 3\ NaCl_{(aq)} + Al(OH)_{3(s)}}$$

2. Write the **total ionic equation** by rewriting the molecular equation with the strong electrolytes separated into ions. Do not "ionize" solids, liquids or gases; only aqueous species should be separated.

   Example:

   $$\mathbf{3\ Na^+_{(aq)} + 3\ OH^-_{(aq)} + Al^{3+}_{(aq)} + 3\ Cl^-_{(aq)} \rightarrow 3\ Na^+_{(aq)} + 3\ Cl^-_{(aq)} + Al(OH)_{3(s)}}$$

3. Write the **net ionic equation** by rewriting the total ionic equation and canceling the **spectator ions** (the species that appear on both the product and reactant sides of the total ionic equation.) Remember that atoms are *not* the same as ions (i.e. $Mg_{(s)}$ is not the same as $Mg^{2+}_{(aq)}$.)

   Example: Na^+ and Cl^- appear on both sides of the equation, so they are spectator ions

   $$\cancel{3\ Na^+_{(aq)}} + 3\ OH^-_{(aq)} + Al^{3+}_{(aq)} + \cancel{3\ Cl^-_{(aq)}} \rightarrow \cancel{3\ Na^+_{(aq)}} + \cancel{3\ Cl^-_{(aq)}} + Al(OH)_{3(s)}$$

   $$\mathbf{Al^{3+}_{(aq)} + 3\ OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}}$$

4. **Check** that the **total ionic charge** on the reactant side balances the total ionic charge on the product side. The equation will now be balanced for both mass and charge.

   Example: $\mathbf{Al^{3+}_{(aq)} + 3\ OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}}$ To check the total ionic charge:
   Reactant side: **+3** (from Al^{3+}) **+3(-1)** (from OH^-) = **0**
   Product side: **0** (no charge on molecular solids)

   Since the charge on the reactant side equals the charge on the product side, the total ionic charge for this reaction is balanced.