

Math Tutor

WRITING EQUATIONS FOR IONIC REACTIONS

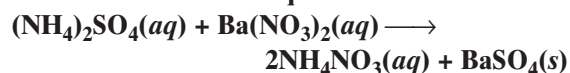
Many chemical reactions that occur in water solutions are reactions involving ions. Soluble ionic compounds dissociate into ions when they dissolve, and some molecular compounds, including acids, ionize when they dissolve. An ionic equation represents the species actually present more accurately than an equation that uses full formulas.

Problem-Solving TIPS

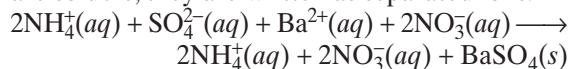
- All dissolved substances in ionic reactions are dissociated into ions. Therefore, soluble ionic compounds are shown as the separated ions in the full ionic equation. Strong acids and bases are also shown as the separated ions in the full ionic equation because they are 100% ionized.
- Ions that do not take part in the reaction are called *spectator ions*. In other words, spectator ions stay in solution and will be labeled “(aq)” on both sides of the equation. Eliminating spectator ions reduces the “clutter” of the full ionic equation and produces a net ionic equation that shows only the species that actually react.

SAMPLE 1

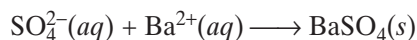
Write the net ionic equation for the reaction of aqueous ammonium sulfate and aqueous barium nitrate to produce a precipitate of barium sulfate. The balanced formula equation is



Rewrite the equation in full ionic form; because ammonium sulfate and barium nitrate are soluble, they are written as separated ions:



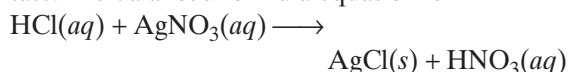
Eliminating spectator ions, NH_4^+ and NO_3^- , yields the net ionic equation:



SAMPLE 2

Write full and net ionic equations for the reaction that occurs when hydrochloric acid solution is combined with silver nitrate solution.

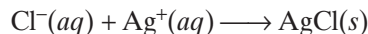
Hydrochloric acid is a strong acid, so it is completely ionized in solution. Silver nitrate is a soluble ionic compound, so its ions are separated in solution. Although most chlorides are soluble, silver chloride is not, so silver chloride will precipitate. The balanced formula equation is



The full ionic equation is

$$\text{H}_3\text{O}^+(\text{aq}) + \text{Cl}^-(\text{aq}) + \text{Ag}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \longrightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{AgCl}(\text{s})$$

Eliminate spectator ions to obtain the net ionic equation:



PRACTICE PROBLEMS

1. Aqueous copper(II) sulfate reacts with aqueous sodium sulfide to produce a black precipitate of copper(II) sulfide. Write the formula equation, the full ionic equation, and the net ionic equation for this reaction.
2. Write full and net ionic equations for the reaction that occurs when a solution of cadmium chloride, CdCl_2 , is mixed with a solution of sodium carbonate, Na_2CO_3 . Cadmium carbonate is insoluble.