

# Net Ionic Equations

## Advanced Chem Worksheet 10-4

Name \_\_\_\_\_

When two solutions of ionic compounds are mixed, a solid may form. This type of reaction is called a **precipitation reaction**, and the solid produced in the reaction is known as the **precipitate**. You can predict whether a precipitate will form using a list of solubility rules such as those found in the table below. When a combination of ions is described as insoluble, a precipitate forms.

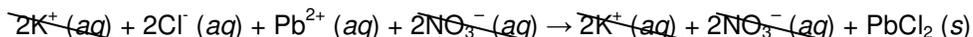
There are three types of equations that are commonly written to describe a precipitation reaction. The **molecular equation** shows each of the substances in the reaction as compounds with physical states written next to the chemical formulas. The **complete ionic equation** shows each of the compounds as separate ions if they are water soluble. Insoluble substances are not separated and these have the symbol (s) written next to them.

Notice that there are ions that are present on both sides of the reaction arrow – that is, they do not react. These ions are known as **spectator ions** and they are commonly eliminated from complete ionic equation by crossing them out. The remaining equation is known as the **net ionic equation**.

### Solubility Rules

**Rule 1 supercedes rule 2, rule 2 supercedes rule 3, etc.**

1. **Nitrate** ( $\text{NO}_3^-$ ) salts are soluble
2. Salts containing the **alkali metal** ions ( $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$ ) and the **ammonium** ion ( $\text{NH}_4^+$ ) are soluble
3. Most **chloride**, **bromide**, and **iodide** salts are soluble. Notable exceptions are salts containing the ions  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}_2^{2+}$
4. Most **sulfate** salts are soluble. Notable exceptions are  $\text{BaSO}_4$ ,  $\text{PbSO}_4$ ,  $\text{Hg}_2\text{SO}_4$  and  $\text{CaSO}_4$ .
5. Most **hydroxide** salts are slightly soluble (insoluble). Exceptions include  $\text{Ba}(\text{OH})_2$ ,  $\text{Sr}(\text{OH})_2$ , and  $\text{Ca}(\text{OH})_2$ .
6. Most **sulfide** ( $\text{S}^{2-}$ ), **carbonate** ( $\text{CO}_3^{2-}$ ), **chromate** ( $\text{CrO}_4^{2-}$ ), and **phosphate** ( $\text{PO}_4^{3-}$ ) salts are insoluble.



Write the **complete ionic equation** and cross out the spectator ions to give the **net ionic equation** for each of the reactions below. Include **physical states** for each species.

1.  $\text{LiCl} ( ) + \text{AgNO}_3 ( ) \rightarrow \text{AgCl} ( ) + \text{LiNO}_3 ( )$
2.  $\text{Na}_2\text{S} ( ) + \text{CaCl}_2 ( ) \rightarrow 2\text{NaCl} ( ) + \text{CaS} ( )$
3.  $\text{ZnCl}_2 ( ) + 2\text{KOH} ( ) \rightarrow \text{Zn}(\text{OH})_2 ( ) + 2\text{KCl} ( )$
4.  $\text{Na}_2\text{CO}_3 ( ) + \text{Co}(\text{NO}_3)_2 ( ) \rightarrow 2\text{NaNO}_3 ( ) + \text{CoCO}_3 ( )$
5.  $2\text{NaOH} ( ) + \text{MnBr}_2 ( ) \rightarrow 2\text{NaBr} ( ) + \text{Mn}(\text{OH})_2 ( )$
6.  $\text{FeCl}_3 ( ) + (\text{NH}_4)_3\text{PO}_4 ( ) \rightarrow 3\text{NH}_4\text{Cl} ( ) + \text{FePO}_4 ( )$

Write the **net ionic equation** for each of the following reactions. List all spectator ions.

7. A solution of aluminum bromide,  $\text{AlBr}_3$  reacts with a solution of sodium hydroxide,  $\text{NaOH}$  to form the precipitate aluminum hydroxide,  $\text{Al}(\text{OH})_3$ .
8. Aqueous copper (II) nitrate,  $\text{Cu}(\text{NO}_3)_2$  reacts with aqueous potassium carbonate,  $\text{K}_2\text{CO}_3$  forming solid copper (II) carbonate,  $\text{Cu}(\text{CO}_3)$ .
9. A solution of barium chloride,  $\text{BaCl}_2$  reacts with a solution of magnesium sulfate,  $\text{MgSO}_4$  to form the precipitate barium sulfate,  $\text{BaSO}_4$ .
10. Aqueous potassium sulfide,  $\text{K}_2\text{S}$  reacts with a solution of cadmium chloride,  $\text{CdCl}_2$  to form solid cadmium sulfide,  $\text{CdS}$ .