

# Solubility Rules

Whether or not a reaction forms a precipitate is dictated by the solubility rules. These rules provide guidelines that tell which ions form solids and which remain in their ionic form in aqueous solution. The rules are to be followed from the top down, meaning that if something is insoluble (or soluble) due to rule 1, it has precedence over a higher-numbered rule.

1. Salts formed with group 1 cations and  $\text{NH}_4^+$  cations are **soluble**. There are some exceptions for certain  $\text{Li}^+$  salts.
2. Acetates ( $\text{C}_2\text{H}_3\text{O}_2^-$ ), nitrates ( $\text{NO}_3^-$ ), and perchlorates ( $\text{ClO}_4^-$ ) are **soluble**.
3. Bromides, chlorides, and iodides are **soluble**.
4. Sulfates ( $\text{SO}_4^{2-}$ ) are **soluble** with the exception of sulfates formed with  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ , and  $\text{Ba}^{2+}$ .
5. Salts containing silver, lead, and mercury (I) are **insoluble**.
6. Carbonates ( $\text{CO}_3^{2-}$ ), phosphates ( $\text{PO}_4^{3-}$ ), sulfides, oxides, and hydroxides ( $\text{OH}^-$ ) are **insoluble**. Sulfides formed with group 2 cations and hydroxides formed with calcium, strontium, and barium are exceptions.

If the rules state that an ion is soluble, then it remains in its aqueous ion form. If an ion is insoluble based on the solubility rules, then it forms a solid with an ion from the other reactant. If all the ions in a reaction are shown to be soluble, then no precipitation reaction occurs.