

## Solubility Rules

There are many versions of the so-called solubility rules. They can be quite explicit and lengthy. These contain a little more information and are presented a little differently than those on [xaktly.com](http://xaktly.com). You should determine the solubility of enough compounds using these rules to become familiar with them, but they need not be memorized in full.

Solubilities, solubility product constants ( $K_{sp}$ ) and other solubility information can also be found in the *CRC Handbook*, the *Merck Index* or other handbooks, and in on-line resources. *Wikipedia* has become a good modern resource for much chemical information.

### Soluble Salts

1. The  $\text{Na}^+$ ,  $\text{K}^+$ , and ammonium ( $\text{NH}_4^+$ ) ions form soluble salts. Thus,  $\text{NaCl}$ ,  $\text{KNO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Na}_2\text{S}$ , and  $(\text{NH}_4)_2\text{CO}_3$  are soluble.
2. The nitrate ( $\text{NO}_3^-$ ) ion forms soluble salts. Thus,  $\text{Cu}(\text{NO}_3)_2$  and  $\text{Fe}(\text{NO}_3)_3$  are soluble.
3. The chloride ( $\text{Cl}^-$ ), bromide ( $\text{Br}^-$ ), and iodide ( $\text{I}^-$ ) ions generally form soluble salts. Exceptions to this rule include salts of the  $\text{Pb}_2^+$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Ag}^+$ , and  $\text{Cu}^+$  ions.  $\text{ZnCl}_2$  is soluble, but  $\text{CuBr}$  is not.
4. The sulfate ( $\text{SO}_4^{2-}$ ) ion generally forms soluble salts. Exceptions include  $\text{BaSO}_4$ ,  $\text{SrSO}_4$ , and  $\text{PbSO}_4$ , which are insoluble, and  $\text{Ag}_2\text{SO}_4$ ,  $\text{CaSO}_4$ , and  $\text{Hg}_2\text{SO}_4$ , which are slightly soluble.
5. The acetate ( $\text{CH}_3\text{COO}^-$ ) salts are all soluble.

### Insoluble Salts

6. Sulfides ( $\text{S}^{2-}$ ) are usually insoluble. Exceptions include  $\text{Na}_2\text{S}$ ,  $\text{K}_2\text{S}$ ,  $(\text{NH}_4)_2\text{S}$ ,  $\text{MgS}$ ,  $\text{CaS}$ ,  $\text{SrS}$ , and  $\text{BaS}$ .
7. Oxides ( $\text{O}^{2-}$ ) are usually insoluble. Exceptions include  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$ ,  $\text{SrO}$ , and  $\text{BaO}$ , which are soluble, and  $\text{CaO}$ , which is slightly soluble.
8. Hydroxides ( $\text{OH}^-$ ) are usually insoluble. Exceptions include  $\text{NaOH}$ ,  $\text{KOH}$ ,  $\text{Sr}(\text{OH})_2$ , and  $\text{Ba}(\text{OH})_2$ , which are soluble, and  $\text{Ca}(\text{OH})_2$ , which is slightly soluble.
9. Chromates ( $\text{CrO}_4^{2-}$ ) are usually insoluble. Exceptions include  $\text{Na}_2\text{CrO}_4$ ,  $\text{K}_2\text{CrO}_4$ ,  $(\text{NH}_4)_2\text{CrO}_4$ , and  $\text{MgCrO}_4$ .
10. Phosphates ( $\text{PO}_4^{3-}$ ) and carbonates ( $\text{CO}_3^{2-}$ ) are usually insoluble. Exceptions include salts of the  $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{NH}_4^+$  ions, which are soluble by rule 1.