

# Solubility Rules

The following ionic compounds are soluble, which we define here as meaning that we can prepare a solution that is 0.1 M at room temperature:

- those containing nitrate ( $\text{NO}_3^-$ ) and acetate ( $\text{CH}_3\text{COO}^-$ )
- those containing chloride ( $\text{Cl}^-$ ), bromide ( $\text{Br}^-$ ), and iodide ( $\text{I}^-$ ), **except** those of  $\text{Ag}^+$ ,  $\text{Cu}^+$ ,  $\text{Hg}_2^{2+}$ , and of  $\text{Pb}^{2+}$
- those containing sulfate ( $\text{SO}_4^{2-}$ ), **except** for  $\text{CaSO}_4(ss)$ ,  $\text{SrSO}_4$ ,  $\text{BaSO}_4$ ,  $\text{Hg}_2\text{SO}_4(ss)$ ,  $\text{Ag}_2\text{SO}_4(ss)$ , and  $\text{PbSO}_4$

The following ionic compounds are insoluble, which we define here as meaning that a saturated solution has a soluble concentration that is less than 0.001 M at room temperature:

- those containing sulfide ( $\text{S}^{2-}$ ), **except**  $(\text{NH}_4)_2\text{S}$ , and the alkali metal and alkaline earth sulfides, such as  $\text{Na}_2\text{S}$  and  $\text{CaS}$
- those containing carbonate ( $\text{CO}_3^{2-}$ ) **except** for  $(\text{NH}_4)_2\text{CO}_3$  and the alkali metal carbonates, such as  $\text{Na}_2\text{CO}_3$
- those containing phosphate ( $\text{PO}_4^{3-}$ ) **except** for  $(\text{NH}_4)_3\text{PO}_4$  and the alkali metal phosphates, such as  $\text{Na}_3\text{PO}_4$
- those containing hydroxide ( $\text{OH}^-$ ) **except** for  $\text{Ca}(\text{OH})_2(ss)$ ,  $\text{Sr}(\text{OH})_2$ ,  $\text{Ba}(\text{OH})_2$ , and the alkali metal hydroxides, such as  $\text{NaOH}$
- those containing oxide ( $\text{O}^{2-}$ ) **except** for  $\text{CaO}(ss)$ ,  $\text{SrO}$ ,  $\text{BaO}$ , and the alkali metal oxides, such as  $\text{Na}_2\text{O}$

Some compounds fall between the extremes of soluble (0.1 M) and insoluble (0.001 M); these compounds are considered slightly soluble and indicated above using the symbol (*ss*). As most references report compounds as soluble or insoluble, you will find some ambiguity in how these compounds are listed in different references.