# Some Solubility Rules for Common Salts and Bases

## Soluble salts and bases

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Names</th>
<th>Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_3^-$</td>
<td>Nitrates</td>
<td>None</td>
</tr>
<tr>
<td>C$_2$H$_3$O$_2^-$ (CH$_3$COO$^-$)</td>
<td>Acetates</td>
<td>Silver acetate (AgCH$_3$COO) is only moderately soluble.</td>
</tr>
<tr>
<td>Cl$^-$, Br$^-$, and I$^-$</td>
<td>Chlorides, bromides, and iodides.</td>
<td>Silver halides (AgX), mercury(I) halides (Hg$_2$X$_2$), *lead(II) halides (PbX$_2$), and mercury(II) iodide (Hgl$_2$).</td>
</tr>
<tr>
<td>SO$_4^{2-}$</td>
<td>Sulfates</td>
<td>Barium sulfate (BaSO$_4$), and lead(II) sulfate (PbSO$_4$). Calcium sulfate (CaSO$_4$), Mercury(I) sulfate (Hg$_2$SO$_4$), and silver sulfate (Ag$_2$SO$_4$) are slightly soluble. The corresponding bisulfates are more soluble. They are: calcium bisulfate [Ca(HSO$_4$)$_2$], mercury(I) bisulfate [Hg$_2$(HSO$_4$)$_2$], and silver bisulfate [Ag(HSO$_4$)$_2$].</td>
</tr>
<tr>
<td>(HSO$_4^-$)</td>
<td>(Bisulfates)</td>
<td>Some uncommon ones*.</td>
</tr>
<tr>
<td>Na$^+$, K$^+$, NH$_4^+$</td>
<td>Cations of sodium, potassium, and ammonium</td>
<td>*Insoluble: Na$_2$Sb$_2$O$_7$, K$_2$NaCo(NO$_2$)$_6$, (NH$_4$)$_2$NaCo(NO$_2$)$_6$, K$_2$PtCl$_6$, and (NH$_4$)$_2$PtCl$_6$.</td>
</tr>
</tbody>
</table>

## Insoluble salts and bases

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Names</th>
<th>Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO$_3^{2-}$, PO$_4^{3-}$, SO$_3^{2-}$, and SiO$_2^{2-}$.</td>
<td>Carbonates, phosphates, sulfites, and silicates.</td>
<td>Carbonates, phosphates, sulfites, and silicates of alkali metals such as sodium (Na$^+$) and potassium (K$^+$), and of ammonium (NH$_4^+$). Many acid phosphates, such as Mg(H$_2$PO$_4$)$_2$ and Ca(H$_2$PO$_4$)$_2$.</td>
</tr>
<tr>
<td>CrO$_4^{2-}$</td>
<td>Chromates</td>
<td>Na$_2$CrO$_4$, K$_2$CrO$_4$, (NH$_4$)$_2$CrO$_4$, MgCrO$_4$, CaCrO$_4$, Al$_2$(CrO$_4$)$_3$, NiCrO$_4$.</td>
</tr>
<tr>
<td>O$^-$, &amp; OH$^-$</td>
<td>Oxides and hydroxides</td>
<td>NaOH, KOH, and Ba(OH)$_2$. Ca(OH)$_2$ is slightly soluble.</td>
</tr>
<tr>
<td>S$^2-$</td>
<td>Sulfides</td>
<td>Na$_2$S, K$_2$S, (NH$_4$)$_2$S; and those combined with alkaline earth metals such as MgS, CaS, SrS, and BaS. Note: Sulfides of aluminum (Al$_2$S$_3$) and chromium(III) (Cr$_2$S$_3$) hydrolyze to form hydroxides which are insoluble. This means a double displacement reaction occurs with water where aluminum or chromium combine with the hydroxide ion (OH$^-$) to form in insoluble precipitate: Aluminum: Al$_2$S$_3$(aq) + 6H$_2$O(l) → 2Al(OH)$_3$(s) + 3H$_2$S(aq) Chromium: Cr$_2$S$_3$(aq) + 6H$_2$O(l) → 2Cr(OH)$_3$(s) + 3H$_2$S(aq)</td>
</tr>
<tr>
<td>Ag$^+$</td>
<td>The cation of silver</td>
<td>Silver nitrate (AgNO$_3$) and silver chloride (AgClO$_4$). Silver acetate (AgCH$_3$COO) and silver sulfate (Ag$_2$SO$_4$) are only moderately soluble.</td>
</tr>
</tbody>
</table>