

## Solubility Rules

- 1.) All compounds containing alkali metal cations and the ammonium ion are soluble.
- 2.) All compounds containing  $\text{NO}_3^-$ ,  $\text{ClO}_4^-$ ,  $\text{ClO}_3^-$ , and  $\text{C}_2\text{H}_3\text{O}_2^-$  anions are soluble.
- 3.) All chlorides, bromides, and iodides are soluble except those containing  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ , or  $\text{Hg}^{2+}$ .
- 4.) All sulphates are soluble except those containing  $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ , or  $\text{Ba}^{2+}$ .
- 5.) All hydroxides are insoluble except compounds of the alkali metals,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ , and  $\text{Ba}^{2+}$ .
- 6.) All compounds containing  $\text{PO}_4^{3-}$ ,  $\text{S}^{2-}$ ,  $\text{CO}_3^{2-}$ , and  $\text{SO}_3^{2-}$  ions are insoluble except those that also contain alkali metals or  $\text{NH}_4^+$ .

### *Solubility Chart for Selected Ionic Compounds*

|                                  | Acetate, $\text{C}_2\text{H}_3\text{O}_2^-$ | Bromide, $\text{Br}^-$ | Carbonate, $\text{CO}_3^{2-}$ | Chlorate, $\text{ClO}_3^-$ | Chloride, $\text{Cl}^-$ | Chromate, $\text{CrO}_4^{2-}$ | Hydroxide, $\text{OH}^-$ | Iodide, $\text{I}^-$ | Nitrate, $\text{NO}_3^-$ | Oxide, $\text{O}^{2-}$ | Phosphate, $\text{PO}_4^{3-}$ | Silicate, $\text{SiO}_3^{2-}$ | Sulfate, $\text{SO}_4^{2-}$ | Sulfide, $\text{S}^{2-}$ |
|----------------------------------|---|------------------------|-------------------------------|----------------------------|-------------------------|-------------------------------|--------------------------|----------------------|--------------------------|------------------------|-------------------------------|-------------------------------|-----------------------------|--------------------------|
| Aluminum, $\text{Al}^{+3}$       | aq  | aq                     | ---                           | aq                         | aq                      | ---                           | s                        | aq                   | aq                       | s                      | s                             | s                             | aq                          | (d)                      |
| Ammonium, $\text{NH}_4^{+1}$     | aq  | aq                     | aq                            | aq                         | aq                      | aq                            | aq                       | aq                   | aq                       | ---                    | aq                            | ---                           | aq                          | aq                       |
| Barium, $\text{Ba}^{+2}$         | aq  | aq                     | (s)                           | aq                         | aq                      | s                             | (s)                      | aq                   | aq                       | aq                     | s                             | aq                            | s                           | (d)                      |
| Calcium, $\text{Ca}^{+2}$        | aq  | aq                     | (s)                           | aq                         | aq                      | aq                            | s                        | aq                   | aq                       | (s)                    | (s)                           | (s)                           | s                           | aq                       |
| Copper (II), $\text{Cu}^{+2}$    | aq  | aq                     | ---                           | aq                         | aq                      | ---                           | s                        | aq                   | aq                       | s                      | s                             | s                             | aq                          | s                        |
| Hydrogen, $\text{H}^{+1}$        | aq  | aq                     | aq                            | aq                         | aq                      | aq                            | liquid                   | aq                   | aq                       | liquid                 | aq                            | s                             | aq                          | aq                       |
| Iron (II), $\text{Fe}^{+2}$      | aq  | aq                     | (s)                           | aq                         | aq                      | ---                           | s                        | aq                   | aq                       | s                      | s                             | ---                           | aq                          | s                        |
| Iron (III), $\text{Fe}^{+3}$     | aq  | aq                     | ---                           | aq                         | aq                      | s                             | s                        | aq                   | aq                       | s                      | (s)                           | ---                           | aq                          | (d)                      |
| Lead (II), $\text{Pb}^{+2}$      | aq  | s                      | s                             | aq                         | s                       | s                             | (s)                      | s                    | aq                       | (s)                    | s                             | s                             | (s)                         | s                        |
| Lithium, $\text{Li}^{+1}$        | aq  | aq                     | aq                            | aq                         | aq                      | aq                            | aq                       | aq                   | aq                       | aq                     | aq                            | aq                            | aq                          | aq                       |
| Magnesium, $\text{Mg}^{+2}$      | aq  | aq                     | (s)                           | aq                         | aq                      | aq                            | s                        | aq                   | aq                       | s                      | (s)                           | s                             | aq                          | (d)                      |
| Manganese (II), $\text{Mn}^{+2}$ | aq  | aq                     | (s)                           | aq                         | aq                      | ---                           | s                        | aq                   | aq                       | s                      | (s)                           | s                             | aq                          | s                        |
| Mercury (I), $\text{Hg}^{+1}$    | aq  | s                      | s                             | aq                         | s                       | (s)                           | ---                      | s                    | aq                       | s                      | s                             | ---                           | aq                          | s                        |
| Mercury (II), $\text{Hg}^{+2}$   | aq  | aq                     | ---                           | aq                         | aq                      | (s)                           | s                        | (s)                  | aq                       | (s)                    | s                             | ---                           | (d)                         | s                        |
| Potassium, $\text{K}^{+1}$       | aq  | aq                     | aq                            | aq                         | aq                      | aq                            | aq                       | aq                   | aq                       | aq                     | aq                            | aq                            | aq                          | aq                       |
| Silver, $\text{Ag}^{+1}$         | s   | s                      | s                             | aq                         | s                       | (s)                           | ---                      | s                    | aq                       | (s)                    | s                             | ---                           | s                           | s                        |
| Sodium, $\text{Na}^{+1}$         | aq  | aq                     | aq                            | aq                         | aq                      | aq                            | aq                       | aq                   | aq                       | (d)                    | aq                            | aq                            | aq                          | aq                       |
| Tin (II), $\text{Sn}^{+2}$       | (d)   | aq                     | ---                           | aq                         | aq                      | s                             | s                        | aq                   | (d)                      | s                      | s                             | ---                           | aq                          | s                        |
| Tin (IV), $\text{Sn}^{+4}$       | aq  | aq                     | ---                           | ---                        | aq                      | aq                            | (s)                      | (d)                  | aq                       | s                      | ---                           | ---                           | aq                          | s                        |
| Strontium, $\text{Sr}^{+2}$      | aq  | aq                     | (s)                           | aq                         | aq                      | (s)                           | (s)                      | aq                   | aq                       | aq                     | s                             | s                             | s                           | aq                       |
| Zinc, $\text{Zn}^{+2}$           | aq  | aq                     | (s)                           | aq                         | aq                      | (s)                           | s                        | aq                   | aq                       | (s)                    | s                             | s                             | aq                          | s                        |