

## Solubility Rules Chart

Negative Ions (Anions)	+	Positive Ions (Cations)	=	Solubility of Compounds in water	Example
any anion	+	Alkali Ions (Li <sup>+</sup> , Na <sup>+</sup> , K <sup>+</sup> , Rb <sup>+</sup> , Cs <sup>+</sup> , Fr <sup>+</sup> )	=	soluble	Sodium fluoride, NaF, is soluble
any anion	+	hydrogen ion [H <sup>+</sup> (aq)]	=	soluble	hydrogen chloride, HCl, is soluble
any anion	+	ammonium ion (NH <sub>4</sub> )	=	soluble	ammonium chloride, NH <sub>4</sub> Cl, is soluble
nitrate NO <sub>3</sub> <sup>-</sup>	+	any cation	=	soluble	potassium nitrate, KNO <sub>3</sub> , is soluble
acetate (CH <sub>3</sub> COO <sup>-</sup> )	+	any cation (except Ag)	=	soluble	sodium acetate, CH <sub>3</sub> COONa, is soluble
Chloride (Cl <sup>-</sup> ), Bromide (Br <sup>-</sup> ), Iodide (I <sup>-</sup> )	+	Ag <sup>+</sup> , Pb <sup>2+</sup> , Hg <sup>2+</sup> , Cu <sup>+</sup> , Tl <sup>+</sup>	=	low solubility (insoluble)	silver chloride, AgCl, forms a white precipitate
	+	any other cation	=	soluble	potassium bromide, KBr, is soluble
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	+	Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup> , Ag <sup>2+</sup> , Pb <sup>2+</sup> , Ra <sup>2+</sup> , Hg <sup>2+</sup>	=	low solubility (insoluble)	barium sulfate, BaSO <sub>4</sub> , forms a white precipitate
	+	any other cation	=	soluble	copper sulfate, CuSO <sub>4</sub> , is soluble
sulfide (S <sup>2-</sup> )	+	alkali ions (Li <sup>+</sup> , Na <sup>+</sup> , K <sup>+</sup> , Rb <sup>+</sup> , Cs <sup>+</sup> , Fr <sup>+</sup> ), alkali earth metals (Be <sup>2+</sup> , Mg <sup>2+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup> , Ra <sup>2+</sup> ), and H <sup>+</sup> (aq), and NH <sub>4</sub> <sup>+</sup>	=	soluble	magnesium sulfide, MgS, is soluble
	+	any other cation	=	low solubility (insoluble)	zinc sulfide, ZnS, is insoluble

hydroxide $\text{OH}^-$	+	alkali ions ( $\text{Li}^+$ , $\text{Na}^+$ , $\text{K}^+$ , $\text{Rb}^+$ , $\text{Cs}^+$ , $\text{Fr}^+$ ), $\text{Sr}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Ra}^{2+}$ , $\text{Tl}^+$ , and $\text{H}^+(\text{aq})$ , and $\text{NH}_4$	=	soluble	strontium hydroxide, $\text{Sr}(\text{OH})_2$ , is soluble
	+	any other cation	=	low solubility (insoluble)	silver hydroxide, $\text{AgOH}$ , is insoluble (forms a precipitate)
Phosphate ( $\text{PO}_4^{3-}$ ), Carbonate ( $\text{CO}_3^{2-}$ ), Sulfite ( $\text{SO}_3^{2-}$ )	+	alkali ions ( $\text{Li}^+$ , $\text{Na}^+$ , $\text{K}^+$ , $\text{Rb}^+$ , $\text{Cs}^+$ , $\text{Fr}^+$ ), and $\text{H}^+(\text{aq})$ , and $\text{NH}_4$	=	soluble	ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$ , is soluble
	+	any other cation	=	low solubility (insoluble)	magnesium carbonate, $\text{MgCO}_3$ , is insoluble
Chromate $\text{CrO}_4^{2-}$	+	alkali ions ( $\text{Li}^+$ , $\text{Na}^+$ , $\text{K}^+$ , $\text{Rb}^+$ , $\text{Cs}^+$ , $\text{Fr}^+$ ), $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , and $\text{NH}_4^+$ ,	=	soluble	sodium chromate, $\text{Na}_2\text{CrO}_4$ , is soluble
	+	any other cation	=	low solubility (insoluble)	

#### General Solubility Trends:

- All compounds of the ammonium ion ( $\text{NH}_4^+$ ), and of the Alkali metal (Group IA) cations, are soluble.
- All nitrates and acetates are soluble.
- All chlorides, bromides, and iodides are soluble EXCEPT those of silver, lead, and mercury(I).
- All sulfates are soluble EXCEPT those of silver, lead, mercury(I), barium, strontium, and calcium.
- All carbonates, sulfites, and phosphates are insoluble EXCEPT those of ammonium and Alkali metal (Group IA) cations.
- All hydroxides are insoluble EXCEPT those of ammonium, barium, and alkali metal (Group IA) cations.
- All sulfides are insoluble EXCEPT those of ammonium, Alkali metal (Group I) cations, and Alkali earth metal (Group II) cations.
- All oxides are insoluble EXCEPT those of calcium, barium, and Alkali metal (Group I) cations; these soluble ones actually react with the water to form hydroxides.