



Rules for Learning the Solubility of Ionic Compounds in Water

Negative Ions (Anions)	Positive Ions (Cations)	Solubility of compounds in water	Example
any anion	alkali ions (Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺)	soluble	Sodium fluoride, NaF, is soluble
any anion	hydrogen ion [H ⁺ _(aq)]	soluble	hydrogen chloride, HCl, is soluble
any anion	ammonium ion (NH ₄ ⁺)	soluble	ammonium chloride, NH ₄ Cl, soluble
chlorate, ClO ₃ ⁻ , nitrate, NO ₃ ⁻ , perchlorate, ClO ₄ ⁻	any cation	soluble	potassium nitrate, KNO ₃ , is soluble
acetate, C ₂ H ₃ O ₂ ⁻ (CH ₃ COO ⁻)	any cation	soluble	sodium acetate, CH ₃ COONa, soluble
Chloride (Cl ⁻), Bromide (Br ⁻), Iodide (I ⁻)	silver (Ag ⁺), lead (Pb ²⁺), mercury (Hg ₂ ²⁺), copper (Cu ⁺), thallium (Tl ⁺)	low solubility (insoluble)	silver chloride, AgCl, forms a white precipitate (a white solid)
	any other cation	soluble	potassium bromide, KBr, is soluble
Sulphate (SO ₄ ²⁻)	calcium (Ca ²⁺), strontium (Sr ²⁺), barium (Ba ²⁺), silver (Ag ⁺), lead (Pb ²⁺), radium (Ra ²⁺)	low solubility (insoluble)	Barium sulphate, BaSO ₄ , forms a white precipitate (a white solid)
	any other cation	soluble	copper sulphate, CuSO ₄ , is soluble
Sulfide S ²⁻	alkali ions (Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺), alkali earth metals (Be ²⁺ , Mg ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ , Ra ²⁺), and H ⁺ _(aq) , NH ₄ ⁺	soluble	magnesium sulfide, MgS, is soluble
	any other cation	low solubility (insoluble)	zinc sulfide, ZnS, is insoluble
Hydroxide OH ⁻	alkali ions (Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺), H ⁺ _(aq) , NH ₄ ⁺ , Sr ²⁺ , Ba ²⁺ , Ra ²⁺ , Tl ⁺ , Ca ²⁺	soluble	strontium hydroxide, Sr(OH) ₂ , is soluble
	any other cation	low solubility (insoluble)	silver hydroxide, AgOH, is insoluble (forms a precipitate)
phosphate, PO ₄ ³⁻ , Carbonate, CO ₃ ²⁻ , sulphite, SO ₃ ²⁻ , Chromates CrO ₄ ²⁻	alkali ions (Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ , Fr ⁺), H ⁺ _(aq) , NH ₄ ⁺	soluble	ammonium phosphate, (NH ₄) ₃ PO ₄ , is soluble
	any other cation	low solubility (insoluble)	magnesium carbonate, MgCO ₃ , insoluble

- All compounds of the ammonium ion (NH₄⁺), and of Alkali metal (Group IA) cations, are soluble.
- All nitrates and acetates (ethanoates) are soluble.
- All chlorides, bromides and iodides are soluble **EXCEPT** those of silver, lead and mercury(I).
- All sulphates 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 I) 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 (hydrolyse).

• Gases: H₂(g) ← when hydrogen is a product.

• Liquids: Br₂(l), H₂O(l), Hg(l) ← when these are the products.