

Solubility can be defined as the amount of solute that can dissolve in a certain amount of solvent at a given temperature.

The solubility guide below is a result of multiple experiments on solubility of substances since there are no hard and fast rules for predicting the solubility.

Soluble ionic compounds	Exceptions
Compounds containing	
Nitrate (NO_3^-)	None
Acetate (CH_3COO^-)	None
Alkali metals (Li^+ , Na^+ , K^+ , Rb^+ , Cs^+)	None
Ammonium (NH_4^+)	None
Chlorate (ClO_3^-)	None
Perchlorate (ClO_4^-)	None
Halides (Cl^- , Br^- , I^-)	Compounds of Ag^+ , Hg^{2+} , Pb^{2+}
Sulfate (SO_4^{2-})	Compounds of Ag^+ , Ca^{2+} , Sr^{2+} , Ba^{2+} , Hg^{2+} , Pb^{2+}
Insoluble ionic compounds	Exceptions
Carbonate (CO_3^{2-})	Compounds with alkali metals and ammonium
Phosphate (PO_4^{3-})	Compounds with alkali metals and ammonium
Chromate (CrO_4^{2-})	Compounds with alkali metals and ammonium
Sulfide (S^{2-})	Compounds with alkali metals and ammonium, Ca^{2+} , Sr^{2+} , Ba^{2+}
Hydroxide (OH^-)	Compounds with alkali metals and ammonium, Ca^{2+} , Sr^{2+} , Ba^{2+}

Which of the following substances is soluble in water?

1. Ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$
2. Lead iodide PbI_2
3. Strontium nitrate $\text{Sr}(\text{NO}_3)_2$
4. Barium hydroxide $\text{Ba}(\text{OH})_2$
5. Sodium carbonate Na_2CO_3

Answers

1. **Ammonium sulfate is soluble.** All compounds containing the ammonium ion is soluble. There are no exceptions.
2. **Lead iodide is insoluble.** Compounds with iodide are soluble except when the cation is Ag^+ , Hg^{2+} , or Pb^{2+} .
3. **Strontium Nitrate is soluble.** All compounds containing nitrates are soluble. There are no exceptions.
4. **Barium hydroxide is soluble.** Compounds with the hydroxide ions are insoluble except when the cation is ammonium, an alkali metal, Ca^{2+} , Sr^{2+} , or Ba^{2+} .
5. **Sodium carbonate is soluble.** All compounds with alkali metal cations are soluble.

Predicting the formation of Precipitates

To predict whether or not a precipitate will form in a reaction,

1. Write the balanced molecular equation for the reaction. We do this to determine if one of the products to the reaction is insoluble in water.
2. Write the ionic equation to more accurately show what happens in the reaction and identify the spectator ions.