Solubility Rules for Ionic Compounds in Water

**Soluble Ionic Compounds:**

1. All common compounds of Group 1 ions (Li⁺, Na⁺, K⁺ etc…) and the ammonium ion (NH₄⁺) are soluble.

2. All common nitrates (NO₃⁻), acetates (C₂H₃O₂⁻ or CH₃COO⁻), chlorates (ClO₃⁻), and perchlorates (ClO₄⁻) are soluble.

3. All common chlorides (Cl⁻), bromides (Br⁻), and iodides (I⁻) are soluble, except those of Ag⁺, Pb²⁺ and Hg₂²⁺.

4. All common sulfates (SO₄²⁻) are soluble, except those of Ca²⁺, Ba²⁺, Sr²⁺, Ag⁺, Pb²⁺, and Hg₂²⁺.

**Insoluble Ionic Compounds:**

1. All common metal hydroxides are insoluble, except those of Group 1 and the larger members of Group 2 (starting with Ca²⁺).

2. All common carbonates (CO₃²⁻), phosphates (PO₄³⁻), and sulfides (S²⁻) are insoluble, except those of Group 1 and NH₄⁺ (because of Soluble rule #1).

Practice: predict the solubility of the following compounds.

a) Na₂CO₃  b) Ca(CH₃CO₂)₂  c) MgCO₃  d) BaCl₂  e) AgCl

**Tips for memorizing the solubility rule:**

As with anything you need to memorize, learn 1 or 2 a day and then 1 or 2 more the next day while reviewing the previous day. This is easier than trying to memorize all at once. It also helps to look at the exceptions on the Periodic Table.

1) Soluble rules #1 and #2 are important since salts of Na⁺, K⁺, and NO₃⁻ are very common and Soluble list #1 explains most of the exceptions for the Insoluble rules.

2) Mnemonics - To remember the exceptions for chlorides, bromides, iodides (Soluble rule #3)....HAP...H = Hg₂²⁺, A = Ag⁺, P = Pb²⁺

3) To remember the exceptions for sulfates (Soluble rule #4)...C-PBS (as in watch Public Television)... C = Ca²⁺, P = Pb²⁺, B = Ba²⁺, S = Sr²⁺ (plus others) The exceptions are the same as Soluble rule #3 plus the heavier Group 2 ions.