Solubility and Net Ionic Equations

Solubility

- Is a measurement of how a compound will break apart (dissociate) in a solution.
- Depends on many factors, compound size, bond length, polarity. Etc.
- We will use a chart to determine if an ionic compound is soluble in water.

SOLUBLE COMPOUNDS	**EXCEPTIONS**
1. Salts of Na^+, K^+ and NH_4^+	none
2. Chlorides (Cl^-), Bromides (Br^-), and Iodides (I^-) [so these are Halide Salts]	Ag^+, Hg_2^{+2}, Pb^{+2}
3. Compounds containing Fluoride (F^-)	Mg^{+2}, Ca^{+2}, Sr^{+2}, Ba^{+2}, Pb^{+2}
4. Nitrates (NO_3^-), Chlorates (ClO_3^-), Perchlorates, (ClO_4^-), Acetates ($C_2H_3O_2^-$)	$AgC_2H_3O_2$ and $Hg_2(C_2H_3O_2)_2$
5. Sulfates (SO_4^{-2})	Sr^{+2}, Ba^{+2}, Pb^{+2}, Ca^{+2} & Ag^{+1}
INSOLUBLE (OR POORLY SOLUBLE)	**EXCEPTIONS**
6. All carbonates (CO_3^{-2}), Phosphates (PO_4^{-3}), Chromates (CrO_4^{-2}), Oxalates ($C_2O_4^{-2}$)	Na^+, K^+, NH_4^+
7. All sulfides (S^{-2})	Group 1 and 2 cations and NH_4^+
8. All hydroxides (OH^-) and oxides (O^{-2})	Group 1 and NH_4^+

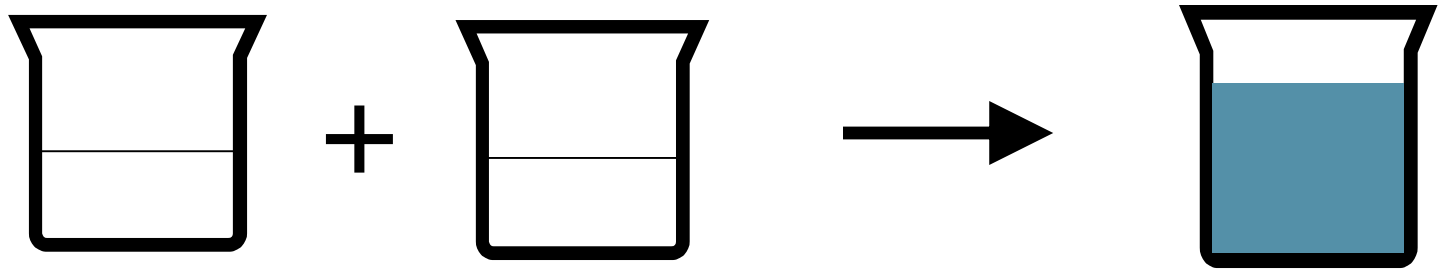
Practice Problems

- Determine if the following compounds are soluble:
- Aluminum Sulfide
- Barium Iodide
- Ammonium Carbonate
- Silver (I) Nitrate

Net Ionic Equations…

- Whenever chemicals are combined, they don't always react together.
- And even when they do react, not all elements are involved in creating new compounds.
- Net Ionic Equations help us predict if a reaction will occur, and how we identify what elements are involved in a reaction.

Net Ionic Equation



Clear
Na_2CO_3

Clear
$Ca(NO_3)_2$

Cloudy solution
But caused it?

We need to determine what made the solution cloudy. We need to look at what the reaction produced:

$Na_2CO_3 + Ca(NO_3)_2 \rightarrow$???

3 Parts of a Net Ionic Equation

- 1) Molecular Equation
  - Regular Balanced Equation
- 2) Total ionic equation
  - All Ions are written that can dissociate
- 3) Net ionic equation
  - Cancel out Spectator Ions: Compounds that do not change

Determining the Molecular Equation

$Na_2CO_3 + Ca(NO_3)_2 \rightarrow NaNO_3 + CaCO_3$

Make sure the Equation is Balanced!

$Na_2CO_3 + Ca(NO_3)_2 \rightarrow 2\ NaNO_3 + CaCO_3$

Determine which compounds will <u>dissociate</u>

$Na_2CO_3 + Ca(NO_3)_2 \rightarrow 2\ NaNO_3 + CaCO_3$

(Soluble) (Soluble) → (Soluble) (Insoluble)

Determining the Total Ionic Equation

- Any compound that is soluble will dissociate into its ions. Write each ion <u>including charges</u>. Pay attention to <u>coefficients</u> and <u>subscripts</u>.

$$Na_2CO_{3(aq)} + Ca(NO_3)_{2(aq)} \rightarrow 2\ NaNO_{3(aq)} + CaCO_{3(s)}$$

R: $2\ Na^{1+} + CO_3^{2-} + Ca^{2+} + 2\ NO_3^{1-} \rightarrow$

P: $2\ Na^{1+} + 2\ NO_3^{1-} + CaCO_3$

(insoluble solids can't dissociate)

Determining the Net Ionic Equation

- Cancel out any spectator ion. Spectator ions do not change in the course of the reaction. The same in the reactants as the products.

R: $2\,Na^{1+} + CO_3^{2-} + Ca^{2+} + 2\,NO_3^{1-} \rightarrow$

P: $2\,Na^{1+} + 2\,NO_3^{1-} + CaCO_3$

- Whatever is not a spectator ion represents the Net Ionic equation. They indicate what caused the observed change.

Determining the Net Ionic Equation

$$CO_3^{2-} + Ca^{2+} \rightarrow CaCO_3$$

- The Net Ionic Equation should balance both in number of atoms and in total charge.

Single Replacement Example

Fluorine gas is bubbled through a solution of sodium chloride.

Balanced Molecular Formula:

$F_2(g) + 2\ NaCl(aq) \rightarrow Cl_2(g) + 2\ NaF(aq)$

Only aqueous compounds are capable of dissociating. Gas, solid, pure liquids will not split apart.

Total Ionic Equation

Dissociate everything that can dissociate:

R: $F_2(g) + 2\ Na^+(aq) + 2\ Cl^-(aq) \rightarrow$

P: $Cl_2(g) + 2\ Na^+(aq) + 2\ F^-(aq)$

Net Ionic Equation

Cancel out spectator ions. They must be exact!

$F_2(g) + 2\ Cl^-(aq) \rightarrow Cl_2(g) + 2\ F^-(aq)$

The ions are not the same as the elements

Watch for:

- Occasionally there are no spectator species. Then the total and the net are the same.
- Occasionally all species in the total ionic equation are spectators! Everything cancels. What does this mean?