

Chemical Reactions

Types of Chemical Reactions

Precipitation

Acid-Base

Oxidation-Reduction

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Precipitation Reactions

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characterized by the formation of an insoluble solid that separates from the solution

usually involve ionic compounds



$\text{Pb}(\text{NO}_3)_2(\text{aq})$



+

$\text{NaI}(\text{aq})$



$\text{NaNO}_3(\text{aq})$



$\text{PbI}_2(\text{s})$

Solubility Rules

Soluble in water are most compounds containing:

- **a Group 1A metal ion (usually Na^+ , K^+)**
- **an ammonium ion (NH_4^+)**
- **a nitrate (NO_3^-), chlorate (ClO_3^-), or perchlorate (ClO_4^-)**

(continued...)

Solubility Rules

Soluble in water are most compounds containing:

- **a sulfate ion (SO_4^{2-}) except when cation is Ag^+ , Pb^{2+} , Ca^{2+} , Ba^{2+} , or Hg^{2+}**
- **a chloride (Cl^-), bromide (Br^-), or iodide (I^-) ion, except when cation is Ag^+ , Pb^{2+} , or Hg_2^{2+}**

Solubility Rules

Insoluble (or slightly soluble) in water are most :

- **sulfides (S^{2-})**
- **carbonates (CO_3^{2-})**
- **phosphates (PO_4^{3-})**
- **metal hydroxides**

(NaOH , KOH and $Ba(OH)_2$ are soluble, $Ca(OH)_2$ is slightly soluble)

Example

Classify the following ionic compounds as soluble, insoluble or slightly soluble

(a) CuS

insoluble

(b) Ca(OH)₂

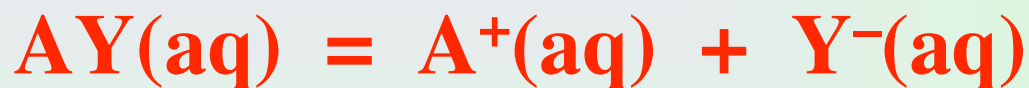
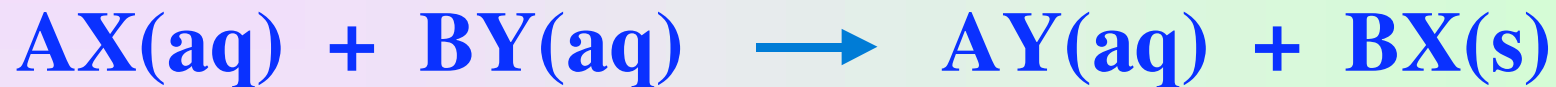
slightly soluble

(c) Zn(NO₃)₂

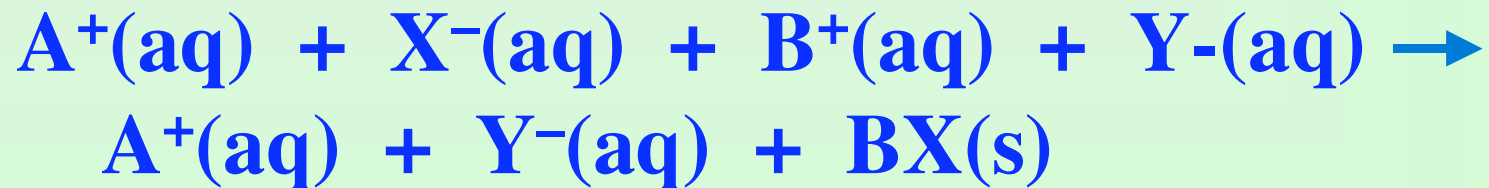
soluble

**Molecular Equations
And
Ionic Equations**

Molecular equation expressed via chemical formulas:



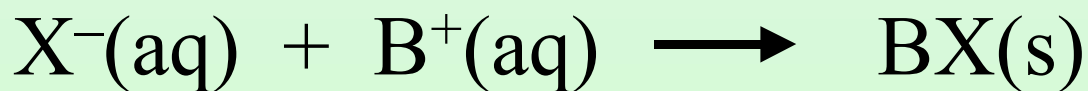
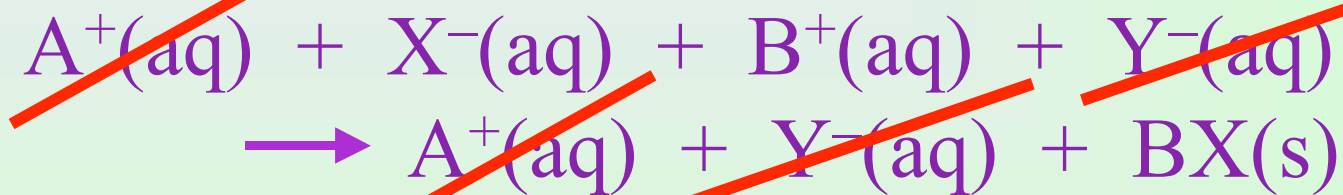
Ionic equation showing all of the ions:

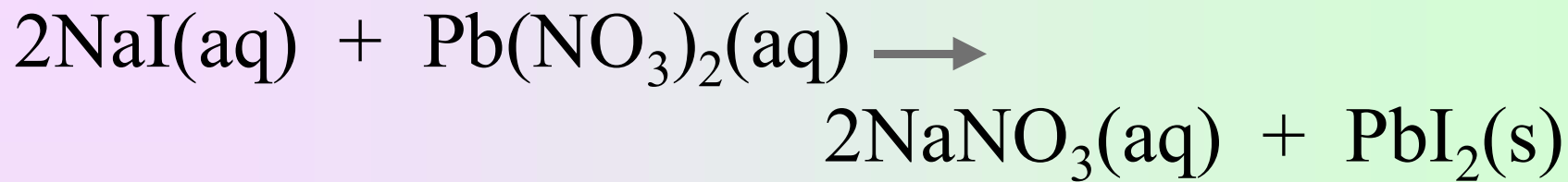


Net ionic equation

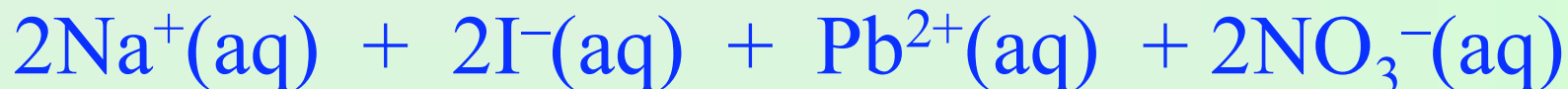
an equation that shows all of the ions is not very useful

identify and discard “spectator” ions



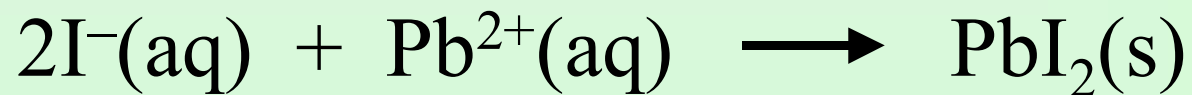
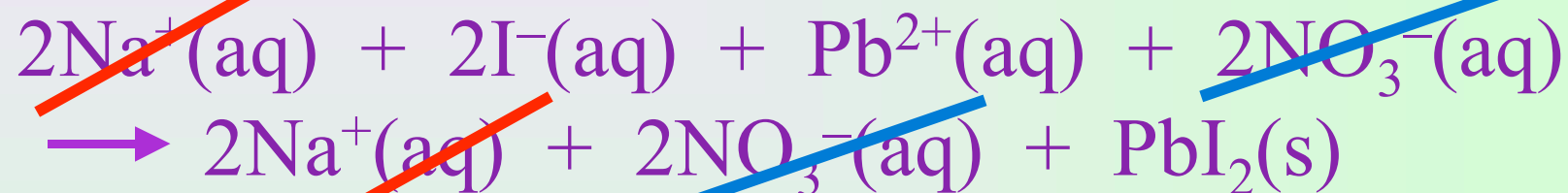


Equation showing all of the ions



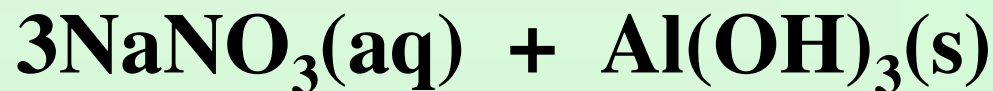
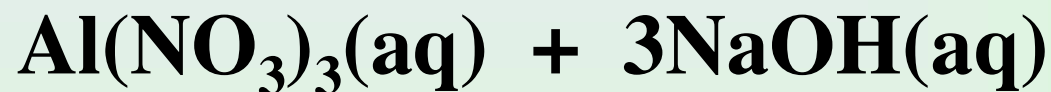
Net ionic equation

identify and discard “spectator” ions

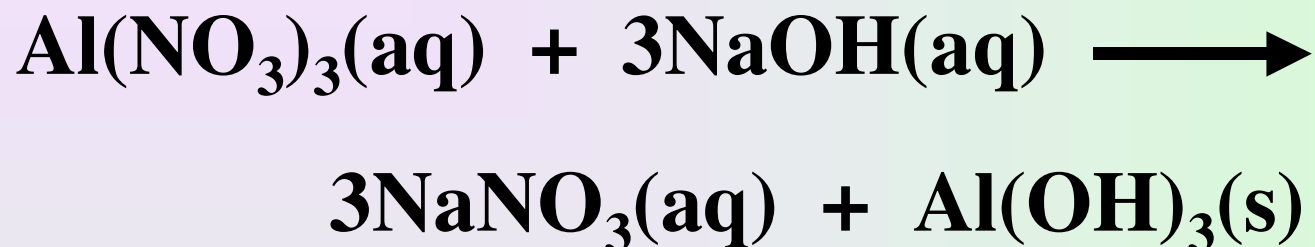


Example

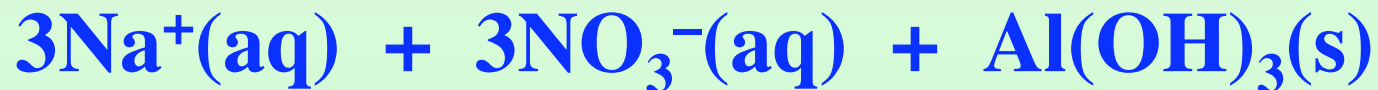
Predict the precipitate formed in the following reaction and write a net ionic equation for the reaction.



Example

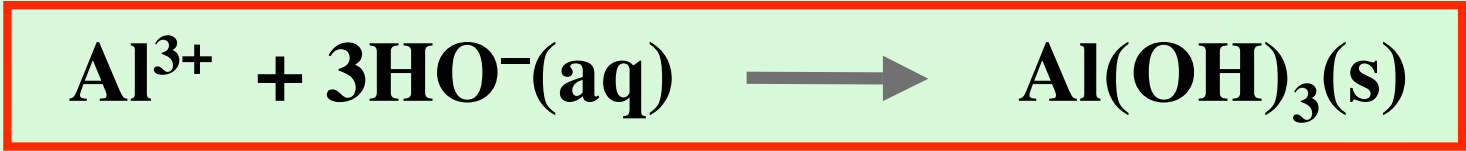
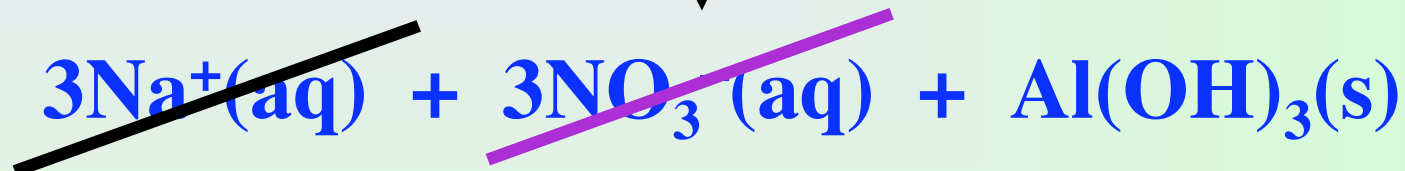
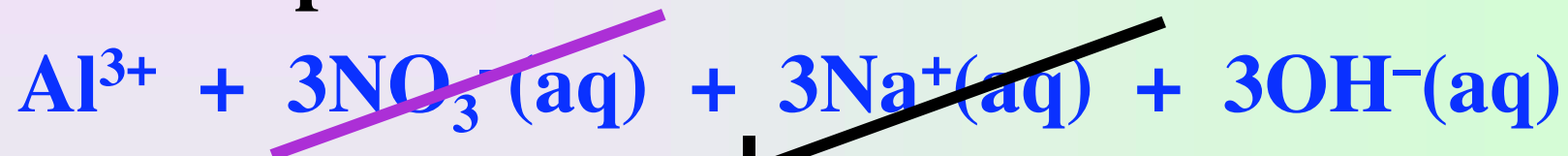


Rewrite as a complete ionic equation.



Example

Cancel spectator ions.



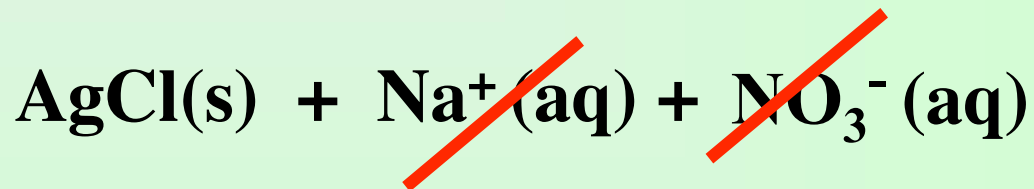
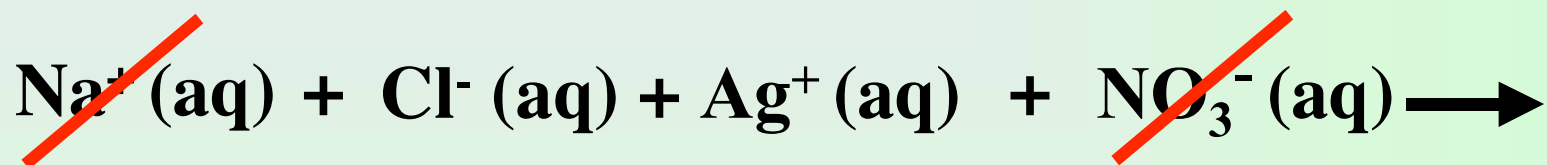
Stoichiometry of Precipitation Reactions

derive the net ionic equation

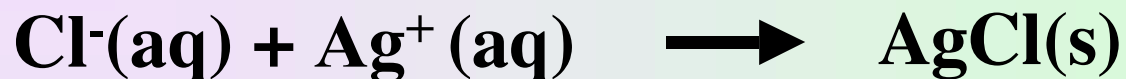
**obtain the moles of reactants from the
volume of the particular solution and its
molarity**

Example

Calculate the mass of solid NaCl that must be added to 1.50L of a 0.100 M AgNO₃ solution to precipitate all the Ag⁺ ions in the form of AgCl.



Example



$$\begin{aligned} & \cancel{1.50\text{L}} \times \frac{\cancel{0.100\text{ mol Ag}^{+}}}{\cancel{\text{L}}} \times \frac{\cancel{1\text{ mol Cl}^{-}}}{\cancel{1\text{ mol Ag}^{+}}} \times \frac{\cancel{1\text{ mol NaCl}}}{\cancel{1\text{ mol Cl}^{-}}} \\ & \times \frac{58.4\text{g NaCl}}{\cancel{1\text{ mol NaCl}}} = \mathbf{8.76\text{g NaCl}} \end{aligned}$$