Net Ionic Equations

Formation of Ions

- Ions or salts refer to cations (+) bound to anions (-)
- You know these as your typical m+nm, where the nm may be an oxyanion (or polyatomic ion)
  Examples: NaCl or NaClO
- (aq) means aqueous = dissolved in water
- Therefore:
  - $NaCl_{(aq)} \longrightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$
  - $NaClO_{(aq)} \longrightarrow Na^{+}_{(aq)} + ClO^{-}_{(aq)}$

Quick Practice

What are the resulting ions in $Na_3PO_{4\ (aq)}$?

adding to water = dissociation

$Na_3PO_{4\ (s)} \longrightarrow 3\ Na^{1+}_{(aq)} + 1\ PO_4^{3-}{}_{(aq)}$

Now try in $Ca_3(PO_4)_{2\ (aq)}$?

What are the resulting ions in aqueous potassium sulfide?

$K_2S_{\ (s)} \longrightarrow 2\ K^{+}_{(aq)} + S^{2-}_{(aq)}$

3 Ways of Showing Reactions

- Balanced Chemical Equation
- Ionic Equation (showing the cations and anions from the above chemical equation)
- Net Ionic Equation (eliminating ions that remain aqueous and are found on both sides of the ionic equation)

Balance Chemical Equation

This is the way you've seen chemical reaction done so far

Example: Show the reaction between lead (II) nitrate and potassium iodide

$Pb(NO_3)_{2\,(aq)} + 2\ KI_{(aq)} \longrightarrow PbI_{2\,(s)} + 2\ KNO_{3(aq)}$

insoluble according to your solubility chart

Ionic

We looked at this the other day...just representing your balanced chemical equation as the ions that exist in the solutions

Balanced Chemical Equation

$Pb(NO_3)_{2\,(aq)} + 2\ KI_{(aq)} \longrightarrow PbI_{2\,(s)} + 2\ KNO_{3(aq)}$

Ionic (balanced)

$Pb^{2+}_{(aq)} + 2\ NO_3^-{}_{(aq)} + 2\ K^+_{(aq)} + 2\ I^-_{(aq)} \longrightarrow$

you can only show the ions for (aq)

$PbI_{2\,(s)} + 2\ K^+_{(aq)} + 2\ NO_3^-{}_{(aq)}$

if the state of matter is (s), you must leave the compound intact - NO IONS

Use the solubility chart to determine which ionic compounds will be (s)

Net Ionic

Now we just eliminate anything that remains the same on either side of the equation

Ionic

$Pb^{2+}_{(aq)} + 2\ NO_3^-{}_{(aq)} + 2\ K^+_{(aq)} + 2\ I^-_{(aq)} \longrightarrow$

$PbI_{2\,(s)} + 2\ K^+_{(aq)} + 2\ NO_3^-{}_{(aq)}$

Net Ionic

$Pb^{2+}_{(aq)} + 2\ NO_3^-{}_{(aq)} + 2\ K^+_{(aq)} + 2\ I^-_{(aq)} \longrightarrow$

$PbI_{2\,(s)} + 2\ K^+_{(aq)} + 2\ NO_3^-{}_{(aq)}$

Therefore:

$Pb^{2+}_{(aq)} + 2\ I^-_{(aq)} \longrightarrow PbI_{2(s)}$

Implications

There are many ways to achieve a given precipitate. If we want lead (II) iodide we can...

$Pb(NO_3)_{2\,(aq)} + 2\ KI_{(aq)} \longrightarrow PbI_{2\,(s)} + 2\ KNO_{3(aq)}$

or

$Pb(C_2H_3O_2)_{2\,(aq)} + MgI_{2\,(aq)} \longrightarrow PbI_{2\,(s)} + Mg(C_2H_3O_2)_{2(aq)}$

Why???

Implications

There are many ways to achieve a given precipitate.
If we want lead (II) iodide we can...

$Pb^{2+}_{(aq)} + 2\ NO_3^-{}_{(aq)} + 2\ K^+_{(aq)} + 2\ I^-_{(aq)} \longrightarrow$

or

$PbI_{2\ (s)} + 2\ K^+_{(aq)} + 2\ NO_3^-{}_{(aq)}$

$Pb^{2+}_{(aq)} + 2\ C_2H_3O_2^-{}_{(aq)} + Mg^{2+}_{(aq)} + 2\ I^-_{(aq)} \longrightarrow$

$PbI_{2\ (s)} + 2\ C_2H_3O_2^-{}_{(aq)} + Mg^{2+}_{(aq)}$

Therefore: In both cases...and there are more (see pg. 333)

$Pb^{2+}_{(aq)} + 2\ I^-_{(aq)} \longrightarrow PbI_{2(s)}$

Do these:

$CuSO_4(aq) + BaCl_2(aq)$

$Fe(NO_3)_3(aq) + LiOH(aq)$

sodium phosphate + calcium chloride

sodium sulfide + silver acetate

solutions:

$Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + Ba^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow$

$Cu^{2+}_{(aq)} + 2Cl^-_{(aq)} + BaSO_{4(s)}$

Net: $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

$Fe^{3+}_{(aq)} + 3NO_3^-{}_{(aq)} + 3Li^+_{(aq)} + 3OH^-_{(aq)} \rightarrow$

$3Li^+_{(aq)} + 3NO_3^-{}_{(aq)} + Fe(OH)_{3(s)}$

Net: $Fe^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Fe(OH)_{3(s)}$

solutions:

$6Na^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} + 3Ca^{2+}_{(aq)} + 6Cl^-_{(aq)} \rightarrow$

$Ca_3(PO_4)_{2(s)} + 6Na^+_{(aq)} + 6Cl^-_{(aq)}$

Net: $3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

$2Na^+_{(aq)} + S^{2-}_{(aq)} + 2Ag^+_{(aq)} + 2C_2H_3O_2^-{}_{(aq)} \rightarrow$

$2Na^+_{(aq)} + 2C_2H_3O_2^-{}_{(aq)} + Ag_2S_{(s)}$

Net: $2Ag^+_{(aq)} + S^{2-}_{(aq)} \rightarrow Ag_2S_{(s)}$

Homework:

- p. 335 #s 3-8