# 8.4 Reactions in Aqueous Solutions

# 1. Review!

Will these reactions happen?

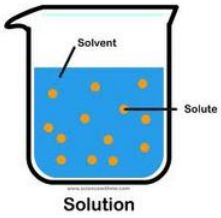
A. $F_2$ + 2 NaBr = 2 Na + 2 F Br
No - halogens replace other halogens

B. 2 Al + 3 $Cu(NO_3)_2$ = 2 $Al(NO_3)_3$ + 3 Cu
Yes - aluminum is more reactive than copper.

## Reactions in Aqueous Solutions

Double replacement reactions occur between substances in aqueous solutions producing solids (called precipitates), water, or gases.

Aqueous solutions contain one or more solutes (substance that is dissolved) with water acting as a solvent (substance that dissolves something).




## Ionic Equations

Ionic equations show details of reactions.

Complete Ionic Equation: All ions in solution shown.

Spectator Ions: Ions that don't react are removed.

Net Ionic Equation: Only reacting ions are shown.

## 2. Reactions that Form Precipitates

Equation:
$2\ NaOH_{(aq)} + CuSO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + Cu(OH)_{2(s)}$

Complete Ionic Equation:
$2\ Na^+_{(aq)} + 2\ OH^-_{(aq)} + Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow$
$2\ Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} + Cu(OH)_{2(s)}$

Identify and remove spectator ions.

Net Ionic Equation:
$2OH^-_{(aq)} + Cu^{2+}_{(aq)} \rightarrow Cu(OH)_{2(s)}$

## 3. Reactions that Form Water

Acids and bases react to form water. No evidence is visible: water is colorless!

Ex: $HBr_{(aq)} + NaOH_{(aq)} \rightarrow NaBr_{(aq)} + H_2O_{(l)}$

Complete Ionic Equation:
$H^+_{(aq)} + Br^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightarrow Na^+_{(aq)} + Br^-_{(aq)} + H_2O_{(l)}$

Remove Spectators.

Net Equation:
$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

## 4. Reactions that form Gases

Gases can form during reactions, making bubbles.

Ex: $2\ HI_{(aq)} + Li_2S_{(aq)} \rightarrow H_2S_{(g)} + 2\ LiI_{(aq)}$

Complete Ionic Equation:

$2H^+_{(aq)} + 2I^-_{(aq)} + 2Li^+_{(aq)} + S^{2-}_{(aq)} \rightarrow H_2S_{(g)} + 2Li^+_{(aq)} + 2I^-_{(aq)}$

Remove Spectators.

Net Ionic Equation:

$2H^+_{(aq)} + S^{2-}_{(aq)} \rightarrow H_2S_{(g)}$

## 5. Overall Equations

Sometimes two reactions combine into one:

Step 1. Double Replacement:

$HCl_{(aq)} + NaHCO_{3(aq)} \rightarrow H_2CO_{3(aq)} + NaCl_{(aq)}$

Step 2. Decomposition:

$H_2CO_{3(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)}$

Net Equation: Eliminate duplicates:

$HCl_{(aq)} + NaHCO_{3(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

Net ionic equation:

$H^+_{(aq)} + HCO_3^-{}_{(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)}$

## Sodium Demo (If not already Done)!

In a single replacement reaction, sodium metal reacts with water, forming sodium hydroxide and hydrogen gas.

Balance this:

$\_\_\_\ Na_{(s)} + \_\_\_\ H_2O_{(l)} \rightarrow \_\_\_\ NaOH_{(aq)} + \_\_\_\ H_{2(g)}$

## Homework

8.4 Problems

Due: next class.