A few more double replacement / exchange examples:

See page 170 for a solubility chart

$$CaCl_2(aq) + 2AgNO_3(aq) \longrightarrow 2AgCl(s) + Ca(NO_3)_2(aq)$$

Ca^{2+} Cl^- Ag^+ NO_3^-

PRECIPITATION of silver(I) chloride drives this reaction!

In exchange reactions, transition metal ions DO NOT change charge!

$$H_3PO_4(aq) + 3NaOH(aq) \longrightarrow 3H_2O(l) + Na_3PO_4(aq)$$

H^+ PO_4^{3-} Na^+ OH^-

The FORMATION OF WATER drives this neutralization reaction.

Sign of reaction: HEAT EVOLVED

$$KCl(aq) + NaNO_3(aq) \longrightarrow \cancel{NaCl(aq) + KNO_3(aq)}$$

NO REACTION

K^+ Cl^- Na^+ NO_3^-

NO REACTION occurs. There is no driving force, since both sodium chloride and potassium nitrate are both soluble ionic compounds. (No water or gas formed, either!)

$$H_2SO_4(aq) + 2NaHCO_3(aq) \longrightarrow 2H_2CO_3 + Na_2SO_4(aq)$$

H^+ SO_4^{2-} Na^+ HCO_3^-

CARBONIC ACID decomposes under these conditions to form WATER and GASEOUS CARBON DIOXIDE. The release of carbon dioxide forms the bubbles we see when performing this reaction in the lab!

$$H_2SO_4(aq) + 2NaHCO_3(aq) \rightarrow 2H_2O(l) + 2CO_2(g) + Na_2SO_4(aq)$$

$Fe(NO_3)_3(aq) + 3NaOH(aq) \rightarrow 3NaNO_3(aq) + Fe(OH)_3(s)$

Fe^{3+} NO_3^- Na^+ OH^-

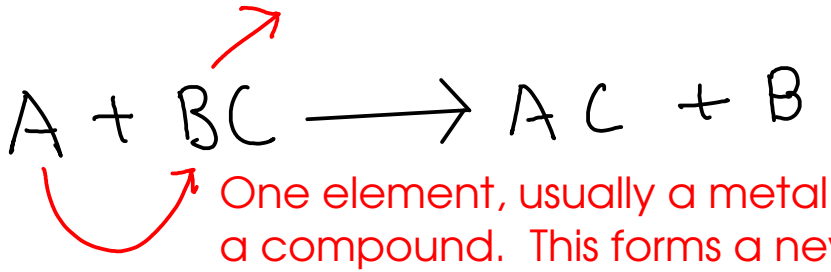
Formation of insoluble iron(III) hydroxide drives this PRECIPITATION reaction.

$2HCl(aq) + Pb(NO_3)_2(aq) \rightarrow 2HNO_3(aq) + PbCl_2(s)$

H^+ Cl^- Pb^{2+} NO_3^-

Formation of insoluble lead(II) chloride drives this PRECIPITATION reaction.

SINGLE REPLACEMENT REACTIONS



One element, usually a metal, replaces another element in a compound. This forms a new compound and leaves behind a new free element!

example: $Cu(s) + 2\,AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2\,Ag(s)$

Cu: 0 → +2 ; Ag: +1 → 0

Copper loses electrons, goes from 0 charge to +2 charge!

Silver gains electrons, goes from +1 charge to 0 charge!

... but just because you combine an element and a compound doesn't mean that a reaction will occur. Some combinations react, some don't!

- Whether a reaction occurs depends on how easily the replacing and replaced elements lose electrons. An atom that loses electrons more easily will end up in IONIC form (in other words, in the compound). An atom that loses electrons less easily will end up as a free element.

- We say that an atom that loses elecrons more easily that another is MORE ACTIVE than the other element. But how would you get information about ACTIVITY?

A single replacement reaction is an example of a reaction where ELECTRON TRANSFER is a driving force. Electron transfer reactions are generally called OXIDATION-REDUCTION reactions.

ACTIVITY SERIES

- comes from experiental data. It's a list of elements in order of their ACTIVITY - more active elements are higher in the series!

A sample activity series