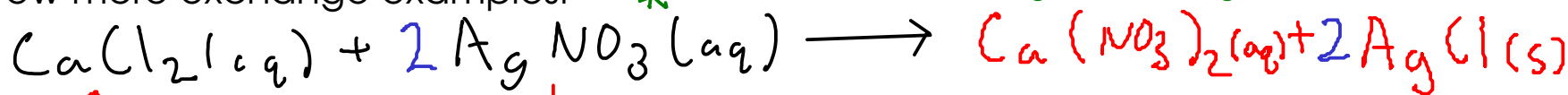
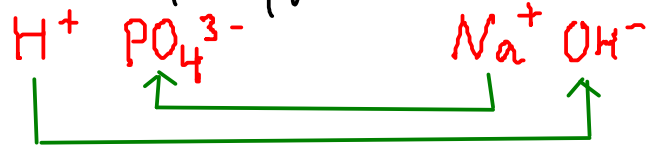
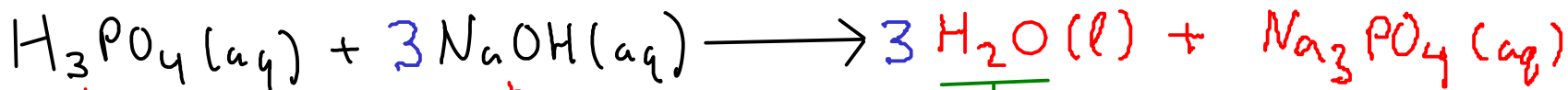


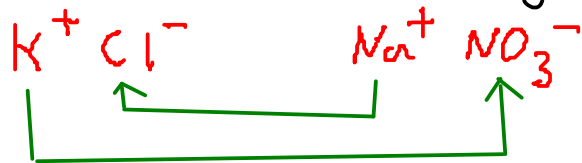
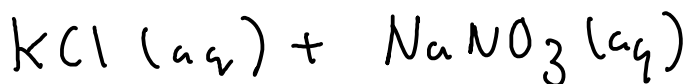
A few more exchange examples:



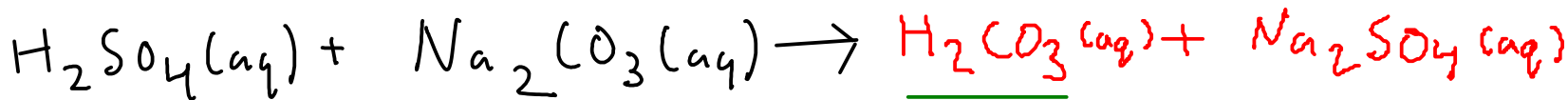
PRECIPITATION of AgCl drives this reaction!



Formation of WATER is the driving force. Detect this reaction by looking for HEAT RELEASE



Both "products" are water-soluble ionic compounds; present in water as FREE ions (same as they were before being mixed). There's no DRIVING FORCE for a reaction here.



Driving force is the formation of CARBONIC ACID and its decomposition into WATER MOLECULES and CARBON DIOXIDE GAS (which escapes as bubbles)

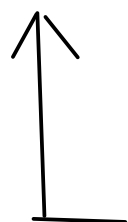
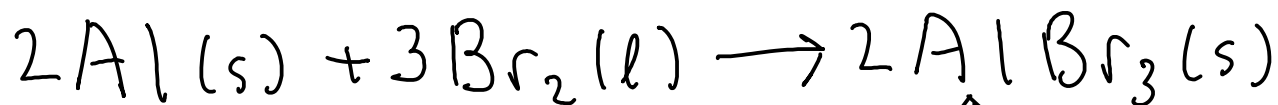
* Transition metals DO NOT change their charge in exchange reactions!

OXIDATION / REDUCTION CHEMISTRY

- Exchange reactions involve ions pairing up, but the ions themselves are not formed in exchange reactions. Exchanges start with pre-existing ions.

... but the ions have to be produced somehow - through a chemistry that involves the transfer of electrons.

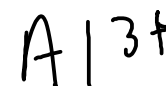
- oxidation / reduction chemistry ("redox" chemistry) involves transfer of electrons and can make ions.



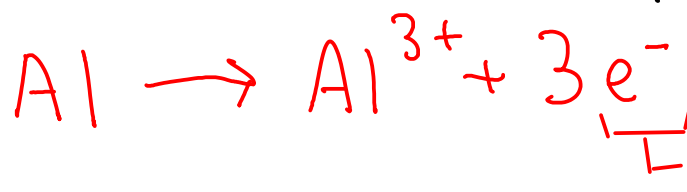
Elemental,
metallic
aluminum.
Uncharged!



Aluminum
cation



These are called
"half-reactions"



electron

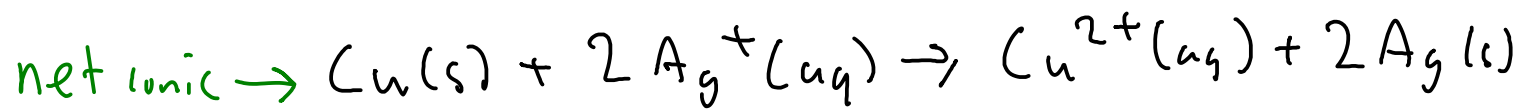
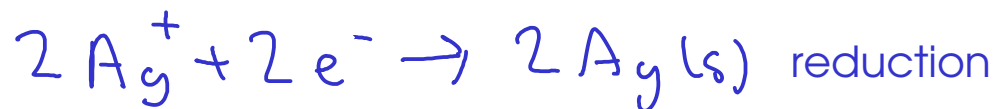
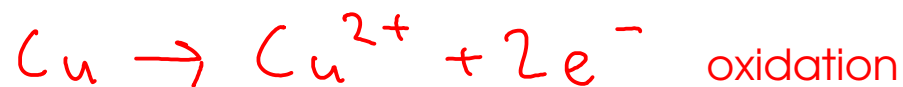
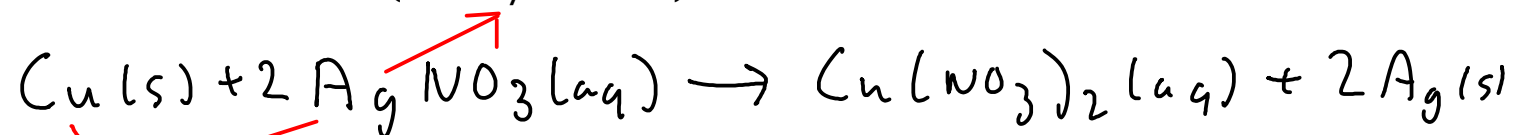
oxidation: loss
of electrons



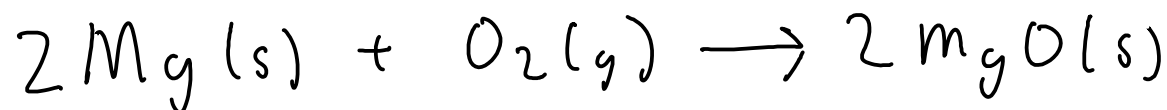
reduction: gain of
electrons

- oxidation and reduction always occur together. In other words, we can't just make free electrons using oxidation without giving them somewhere to go.
- Many of the types of reactions that we learned about in previous courses are redox reactions!

- COMBINATIONS (often but not always redox)
- DECOMPOSITIONS (often redox)
- SINGLE REPLACEMENT (always redox)



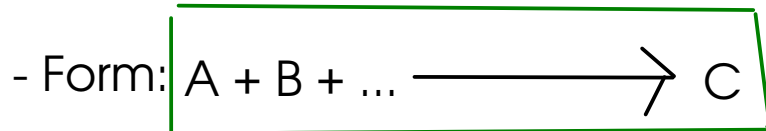
- COMBUSTION



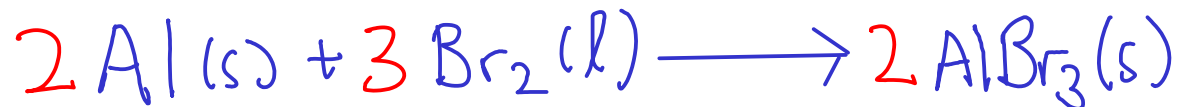
A review of the reaction types we just mentioned:

① COMBINATION REACTIONS

- Reactions that involve two or more simple substances COMBINING to form a SINGLE product
- Often involve large energy changes. Sometimes violent!

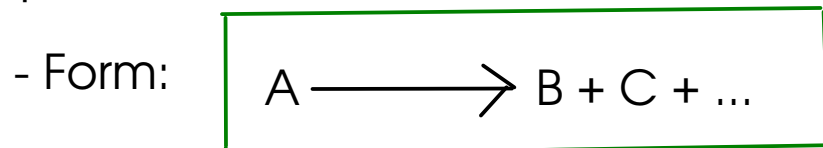


Example:

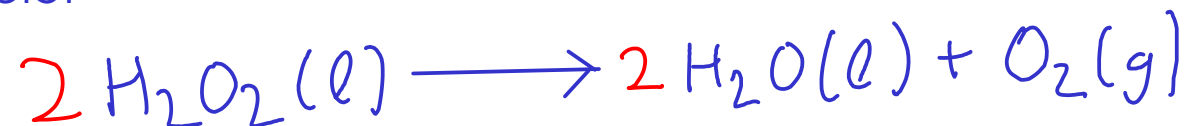


② DECOMPOSITION REACTIONS

- Reactions where a SINGLE REACTANT breaks apart into several products



Example:



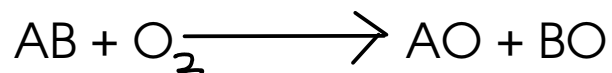
* This reaction is NOT a combustion reaction, even though O_2 is involved!

* Combustion reactions CONSUME O_2 , while this reaction PRODUCES O_2

3 COMBUSTION REACTIONS

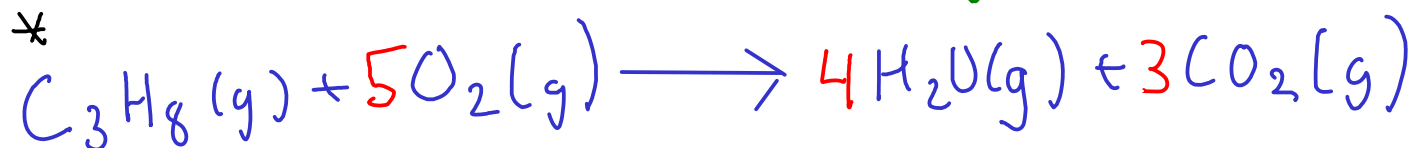
- Reactions of substances with MOLECULAR OXYGEN (O_2) to form OXIDES.
- Combustion forms an OXIDE of EACH ELEMENT in the burned substance!

- Form:



Oxide: a compound containing OXYGEN and one other element!

Examples:



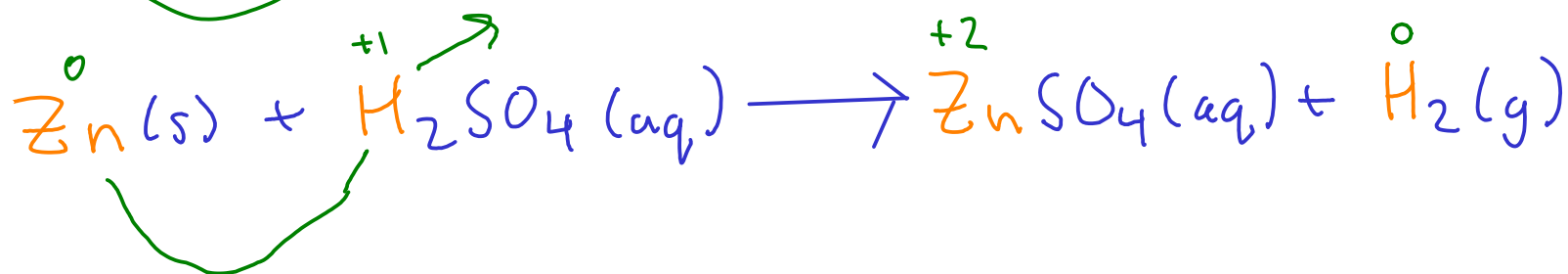
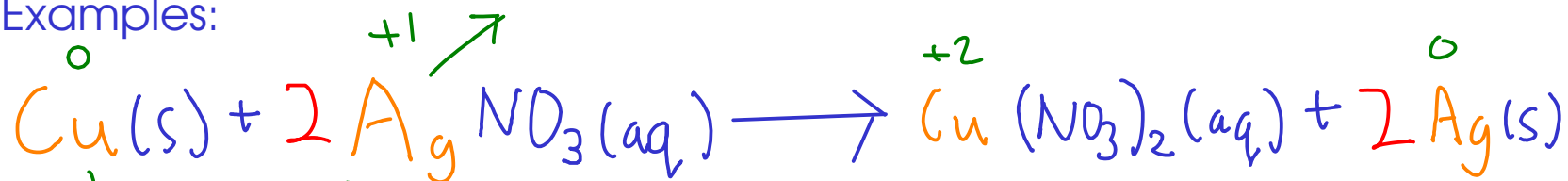
* Combustion of hydrocarbons makes carbon dioxide and water, if enough oxygen is present. In low-oxygen environments, carbon monoxide is made instead!

This reaction can also be called a combination!
Two reactants form a single product.

4 SINGLE REPLACEMENT REACTIONS

- Reactions where one element REPLACES another element in a compound.
- Can be predicted via an ACTIVITY SERIES (p151, 9th edition)
- Form: $A + BC \longrightarrow AC + B$ "A" and "B" are elements., often metals.
- Easy to spot, since there is an element "by itself" on each side of the equation.

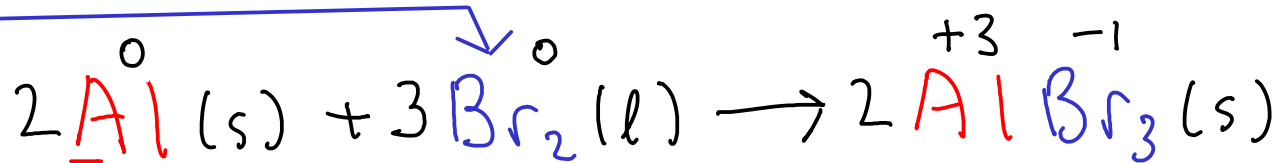
Examples:



REDOX LANGUAGE

"oxidizer"

- "Oxidation" is loss of electrons, but an OXIDIZING AGENT is something that causes ANOTHER substance to lose electrons. An oxidizing agent is itself reduced during a redox reaction.
- "Reduction" is gain of electrons, but a REDUCING AGENT is something that causes ANOTHER substance to gain electrons. Reducing agents are themselves oxidized during a redox reaction.



Aluminum is OXIDIZED during this process. We say that metallic aluminum is a REDUCING AGENT!

Bromine is REDUCED during this process. We say that bromine is an OXIDIZING AGENT!

* Strong oxidizers (oxidizing agents) can cause spontaneous fires if placed into contact with combustibles (safety issue!).

* Reactive metals tend to be REDUCING AGENTS, while oxygen-rich ions like NITRATES tend to be OXIDIZING AGENTS. HALOGENS (Group VIIA) also tend to be OXIDIZING AGENTS

END OF CHAPTER 4 MATERIAL