

Oxidation-Reduction Reactions

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Acid-base reactions can be characterized as proton-transfer

oxidation-reduction reactions or redox, reactions are considered electron transfer reactions

Oxidation number

also called *oxidation state*

**useful tool for understanding electron transfer
in oxidation-reduction reactions**

**signifies the number of charges the atom
would have in a molecule (or an ionic
compound) if electrons were transferred
completely.**

Reference points for assigning oxidation numbers

(1) The oxidation number of an element is 0.

Na, Fe, Cl₂, F₂, P₄,

Reference points for assigning oxidation numbers

(2) The oxidation numbers in compounds of the metals in group 1A are always +1, those in group 2A are always +2, those in group 3A are +3.

Sodium is **+1** NaCl

Calcium is **+2** CaO

Aluminum is **+3** Al₂O₃

Reference points for assigning oxidation numbers

(3) Oxygen has an oxidation number of -2 in most of its compounds.

Since the oxidation number of hydrogen of +1, each oxygen in H_2O_2 must have an oxidation number of -1.

Reference points for assigning oxidation numbers

(4) The oxidation number of hydrogen is usually **+1**.

Since the oxidation state of fluorine is **-1**, in all of its compounds, hydrogen must be **+1** in HF. Likewise, the oxidation number of hydrogen is **+1** in HCl, HBr, and HI.

Reference points for assigning oxidation numbers

A notable exception is that when hydrogen is bonded to a metal, the oxidation number of hydrogen is -1.

The compounds NaH and CaH₂ contain hydrogen in the **-1 oxidation state.**

Reference points for assigning oxidation numbers

(5) The halogens (fluorine, chlorine, bromine, and iodine) have an oxidation number of -1 in most of their compounds Fluorine always has an oxidation number of -1 in its compounds.

The oxidation number of bromine is **-1** in NaBr, CaBr₂, AlBr₃, and NiBr₂.

Reference points for assigning oxidation numbers

(6) The sum of oxidation numbers in a neutral molecule must equal 0 .

$$2(+1) = +2$$

$$3(-2) = -6$$

Example:



$$+4$$

$$2(+3) = +6$$

$$12(-2) = -24$$

Example:



$$3x = +18$$

$$x = +6$$

$$2(+1) = +2$$

$$7(-2) = -14$$

Example:



$$2x = +12$$

$$x = +6$$

Oxidation-Reduction Reactions

oxidation is an increase in oxidation state

loss of electrons from an atom or ion

reduction is a decrease in oxidation state

gain of electrons by atoms or ions

Oxidation-Reduction Reactions

oxidizing agent

gains electrons

reducing agent

gives up electrons

Types of Redox Reactions

combination

decomposition

displacement

of hydrogen

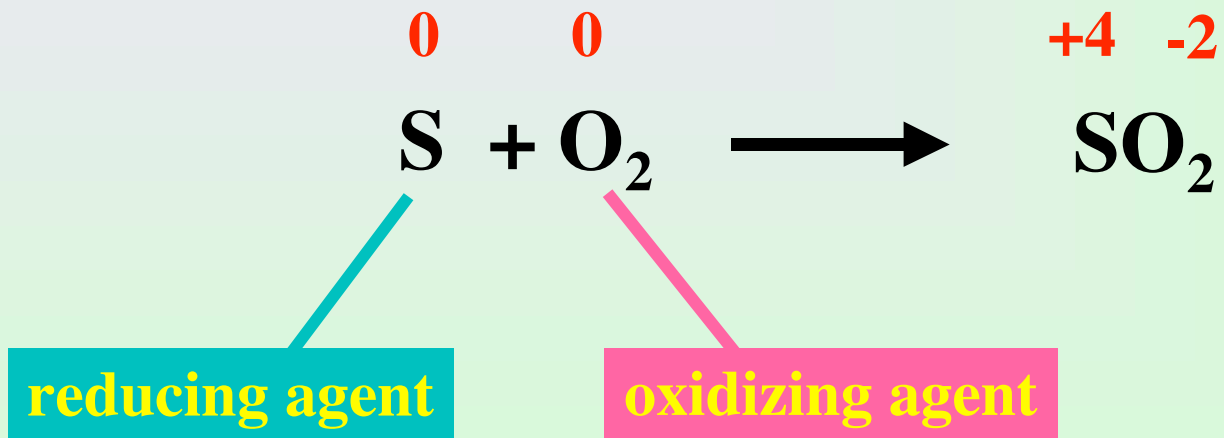
of a metal

of halogens

Combination reactions



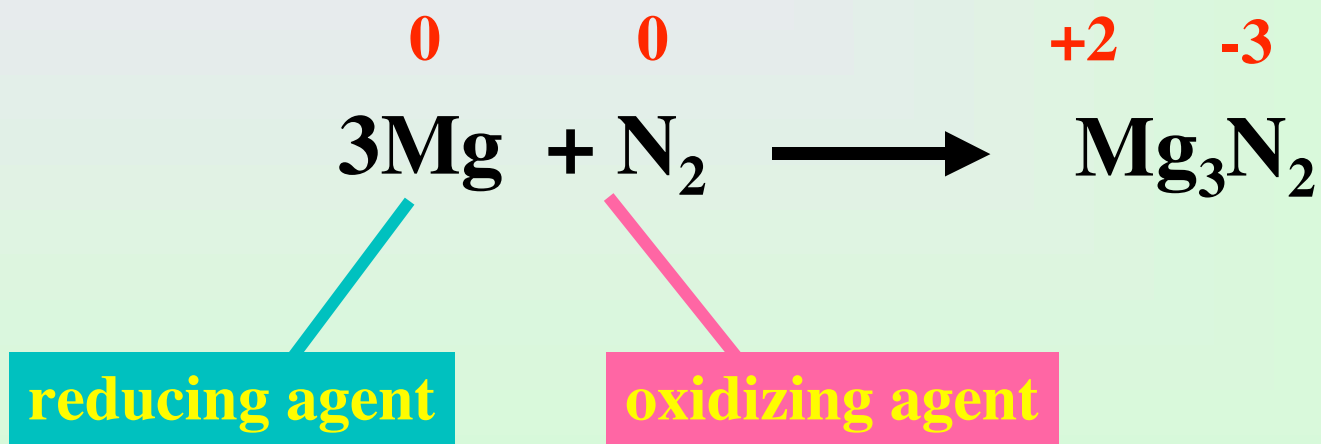
redox if A or B is an element



Combination reactions



redox if A or B is an element



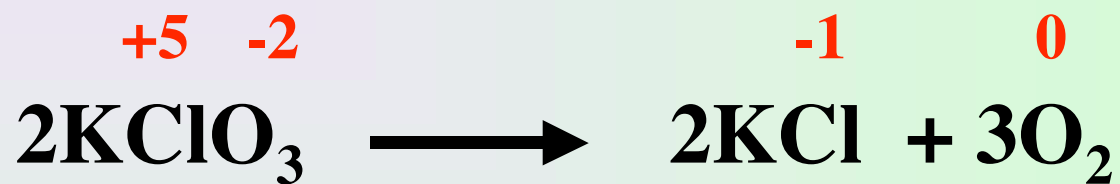
Decomposition reactions



oxidizing agent

reducing agent

Decomposition reactions



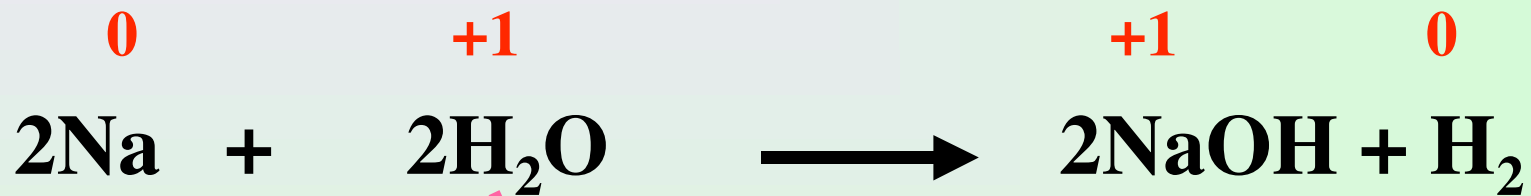
oxidizing agent

reducing agent

Displacement reactions



of hydrogen



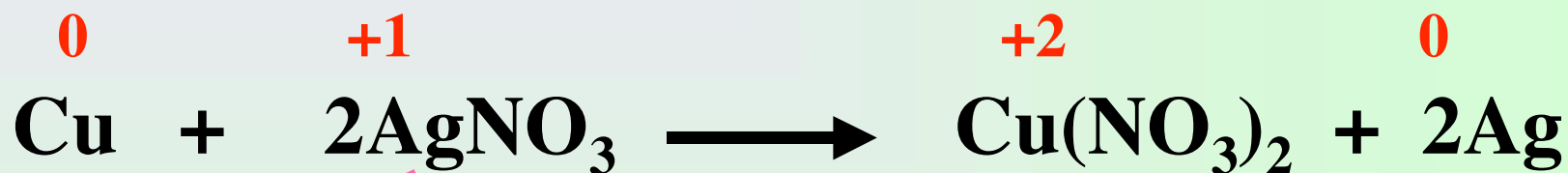
reducing agent

oxidizing agent

Displacement reactions



of metals



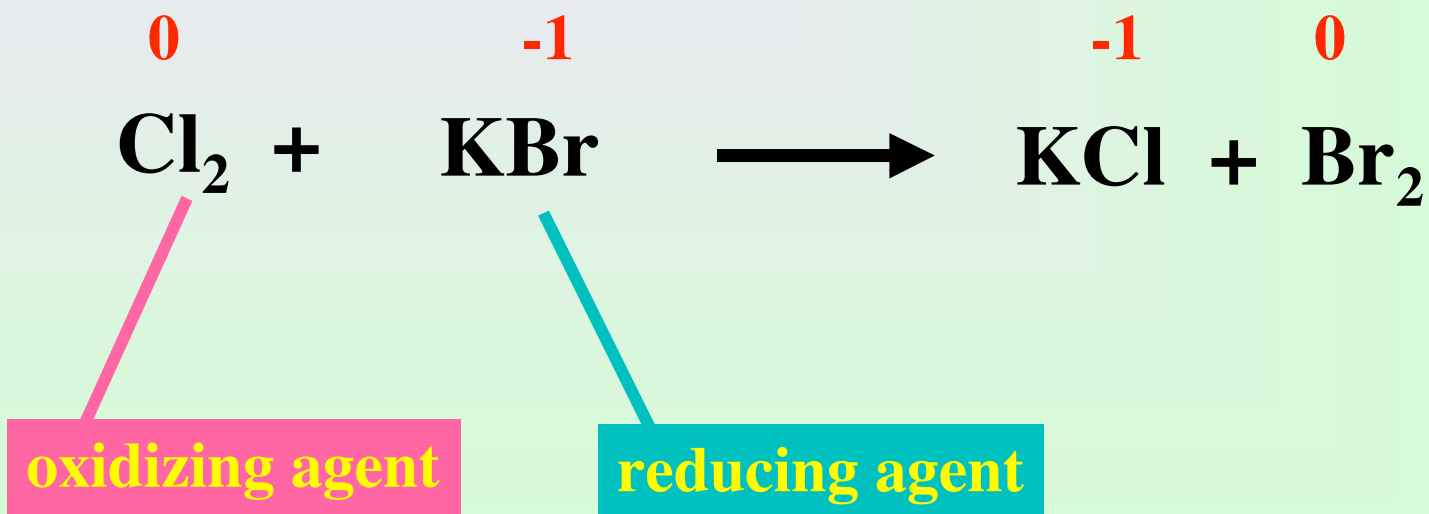
reducing agent

oxidizing agent

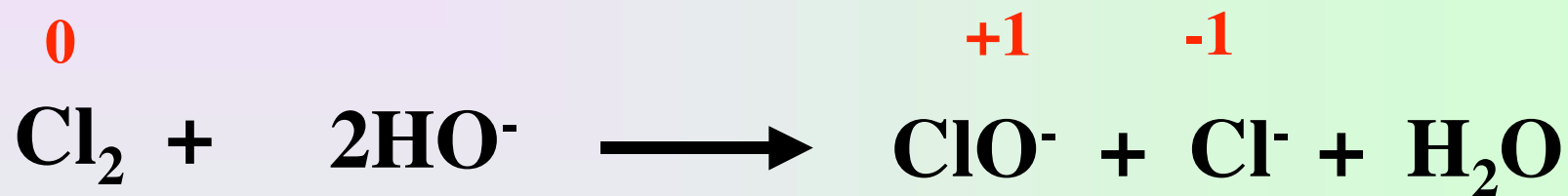
Displacement reactions



Of Halogens



Disproportionation reactions



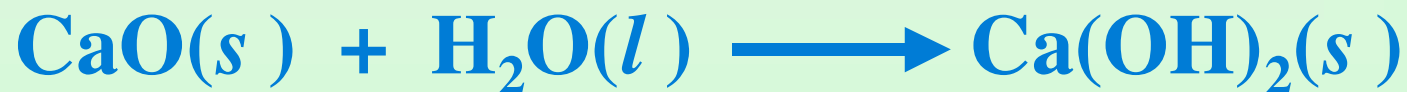
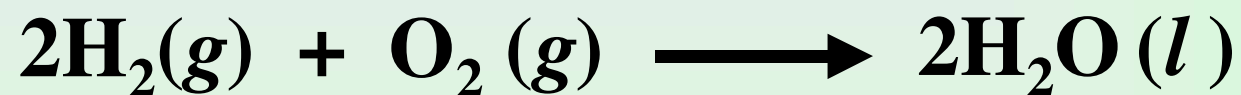
Classifying chemical reactions *(in high school chemistry)*



synthesis

two or more substances combine to produce a single (more complex) substance

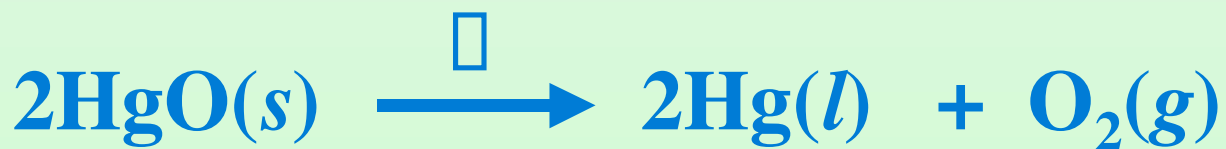
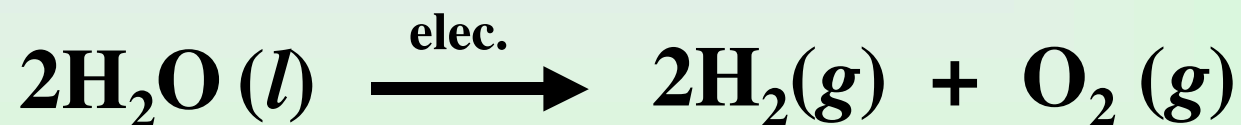
(oxidation reduction reactions)



decomposition

a single substance is broken down into two or more simpler substances

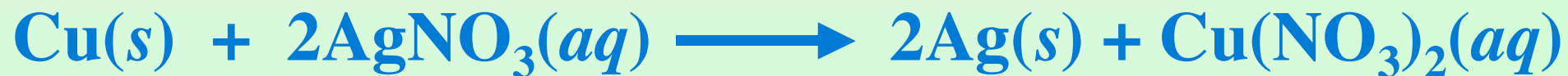
(oxidation reduction reactions)



single replacement reactions

a free element becomes an ion, and an ion in solution becomes a neutral atom

(oxidation reduction reactions)



double replacement reactions

the cation of one aqueous compound replaces the cation in another aqueous compound

(precipitation reactions)

