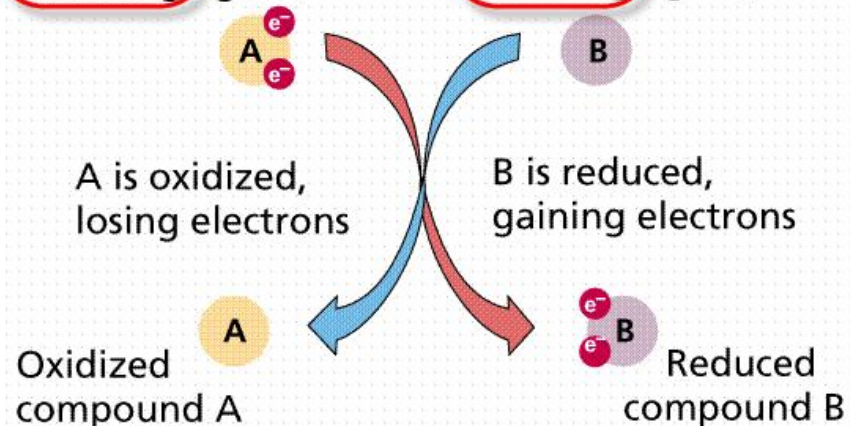


# Oxidants and Reductants

Reduced compound A (reducing agent)      Oxidized compound B (oxidizing agent)



<http://www.emc.maricopa.edu/faculty/farabee/BIOBK/redox.gif>

## Oxidants and Reductants

An **oxidant** is a substance that oxidizes another species by removing electrons from it (it becomes reduced).

A **reductant** is a substance that reduces another species by donating electrons to it (it becomes oxidized).

Reducing agents;  
lose e<sup>-</sup>

Oxidizing agents;  
gain e<sup>-</sup>

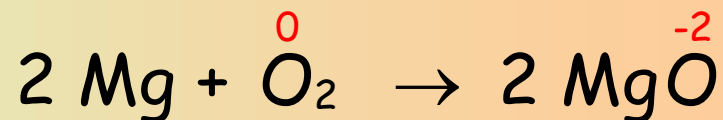


# Oxidants and Reductants

## Oxygen gas as an oxidant

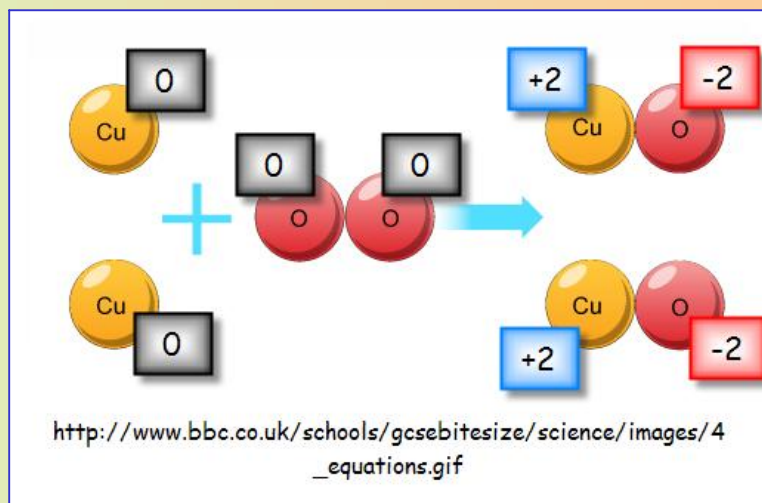


Molecular oxygen ( $O_2$ ) usually acts as an oxidant in reactions (in formation of oxides, for instance).

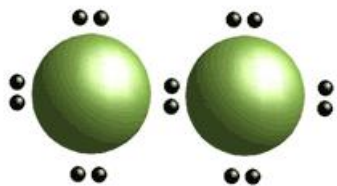


Oxygen acts as an oxidant because it has a very high electronegativity value and, therefore, it tends to gain electrons.

COMBUSTION OF MAGNESIUM  
[http://catalog.miniscience.com/Catalog/Metals/Images/Magnesium\\_burning.jpg](http://catalog.miniscience.com/Catalog/Metals/Images/Magnesium_burning.jpg)



# Oxidants and Reductants

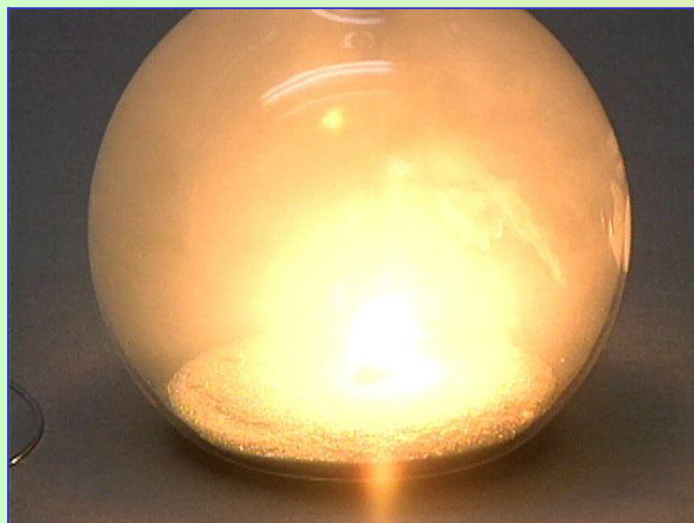
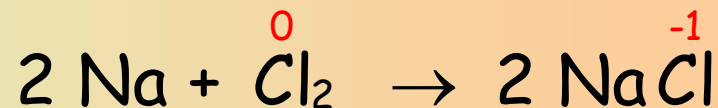


<http://www.green-planet-solar-energy.com/images/chlorine-gas.gif>

## Halogens as oxidants

Oxygen acts as an oxidant because it has a high electronegativity value and so removes electrons from other species.

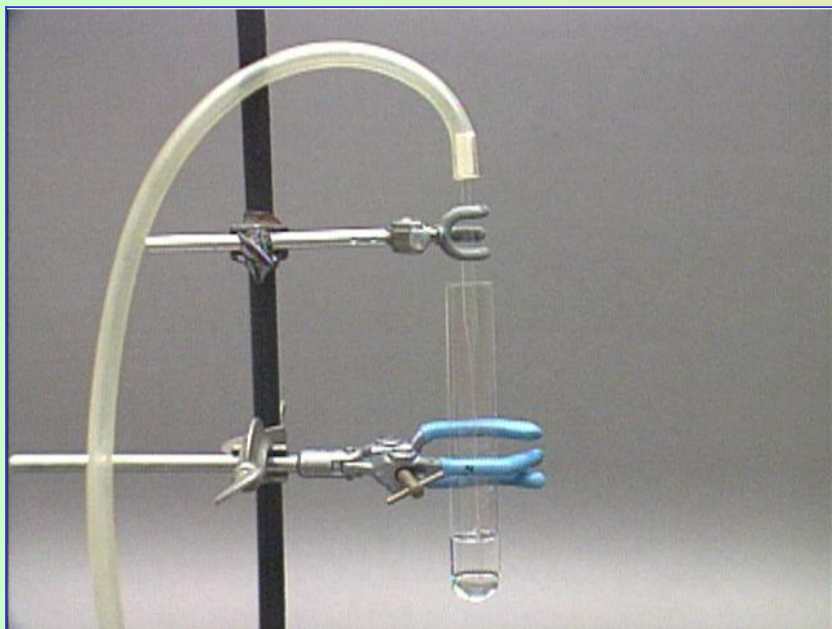
The halogens fluorine and chlorine also have high electronegativity values. Fluorine is an extremely powerful oxidant and chlorine is comparable with oxygen.



Reaction of chlorine with sodium

<http://jchemed.chem.wisc.edu/jcesoft/cca/CCA3/STILLS/NACL/NACL1/64JPG48/20.JPG>

# Oxidants and Reductants

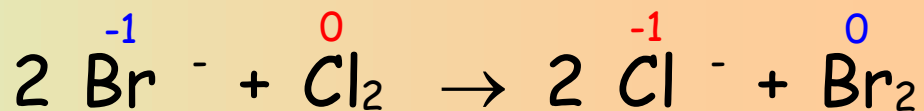


Chlorine is bubbled through potassium bromide

<http://jchemed.chem.wisc.edu/jcesoft/cca/cca3/STILLS/CLKBR/CLKBR/64JPG48/1.JPG>

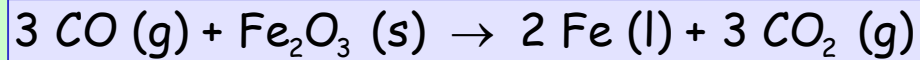
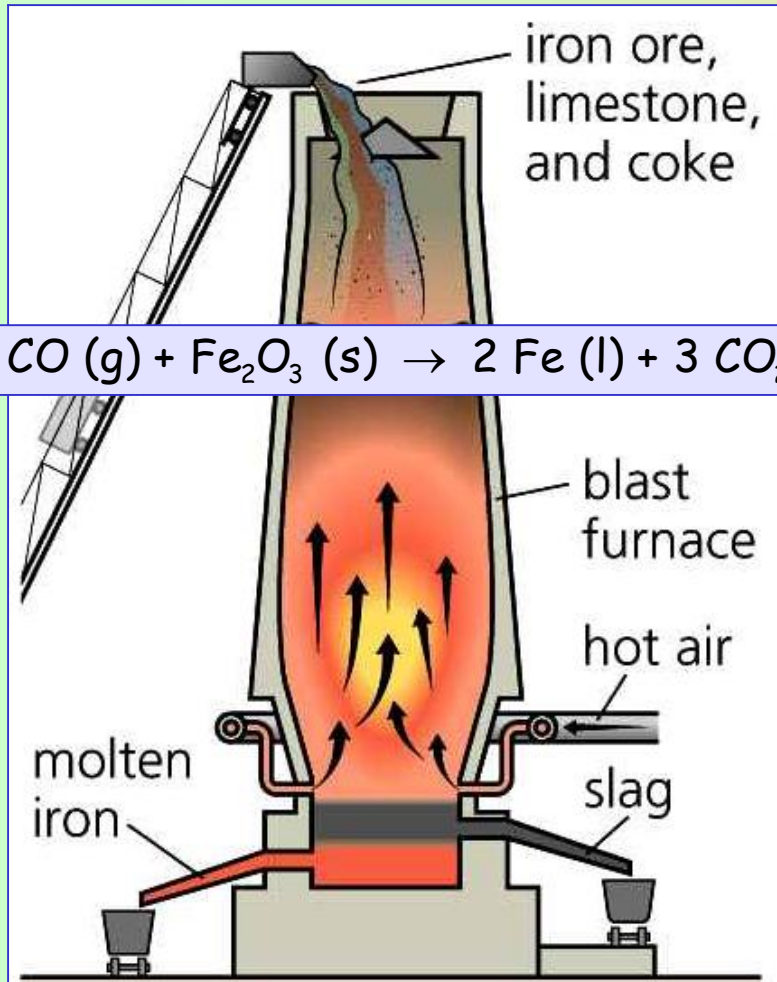
## Non-metal displacement reactions

Redox reactions may be considered as a competition between two species for control of electrons. For example, chlorine removes electrons from aqueous bromide ions, oxidizing them to bromine.



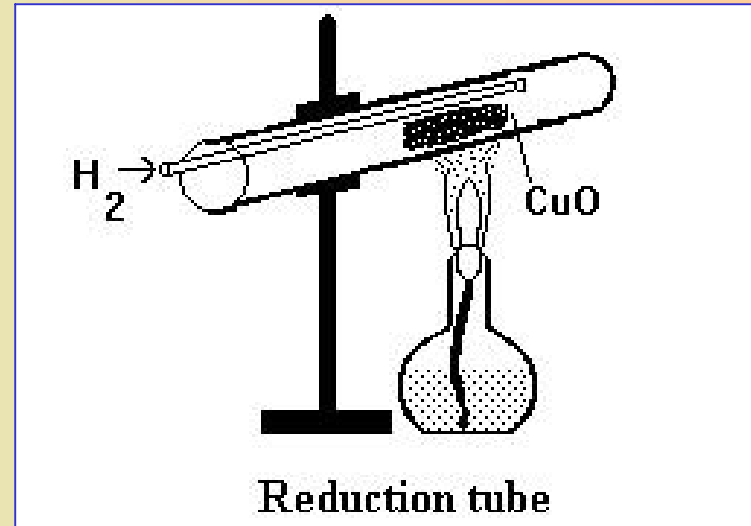
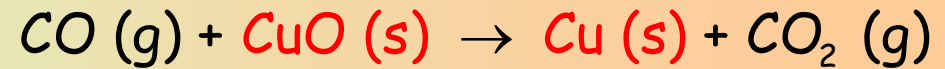
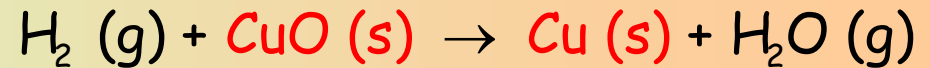
Chlorine is a more powerful oxidant than bromine.

# Oxidants and Reductants



## Gases as reductants

Hydrogen and carbon monoxide can act as reductants.



[http://www.solarnavigator.net/history/explorers\\_history/iron\\_making\\_blast\\_furnace.jpg](http://www.solarnavigator.net/history/explorers_history/iron_making_blast_furnace.jpg)

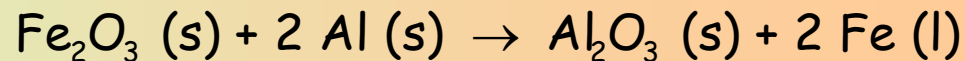
# Oxidants and Reductants

Metal	Oxidation Reaction				
Lithium	Li	$\rightleftharpoons$	Li <sup>+</sup>	+	e <sup>-</sup>
Rubidium	Rb	$\rightleftharpoons$	Rb <sup>+</sup>	+	e <sup>-</sup>
Potassium	K	$\rightleftharpoons$	K <sup>+</sup>	+	e <sup>-</sup>
Barium	Ba	$\rightleftharpoons$	Ba <sup>2+</sup>	+	2e <sup>-</sup>
Calcium	Ca	$\rightleftharpoons$	Ca <sup>2+</sup>	+	2e <sup>-</sup>
Sodium	Na	$\rightleftharpoons$	Na <sup>+</sup>	+	e <sup>-</sup>
Magnesium	Mg	$\rightleftharpoons$	Mg <sup>2+</sup>	+	2e <sup>-</sup>
Aluminum	Al	$\rightleftharpoons$	Al <sup>3+</sup>	+	3e <sup>-</sup>
Manganese	Mn	$\rightleftharpoons$	Mn <sup>2+</sup>	+	2e <sup>-</sup>
Zinc	Zn	$\rightleftharpoons$	Zn <sup>2+</sup>	+	2e <sup>-</sup>
Chromium	Cr	$\rightleftharpoons$	Cr <sup>3+</sup>	+	3e <sup>-</sup>
Iron	Fe	$\rightleftharpoons$	Fe <sup>2+</sup>	+	2e <sup>-</sup>
Cobalt	Co	$\rightleftharpoons$	Co <sup>2+</sup>	+	2e <sup>-</sup>
Nickel	Ni	$\rightleftharpoons$	Ni <sup>2+</sup>	+	2e <sup>-</sup>
Tin	Sn	$\rightleftharpoons$	Sn <sup>2+</sup>	+	2e <sup>-</sup>
Lead	Pb	$\rightleftharpoons$	Pb <sup>2+</sup>	+	2e <sup>-</sup>
Hydrogen	H <sub>2</sub>	$\rightleftharpoons$	2 H <sup>+</sup>	+	2e <sup>-</sup>
Copper	Cu	$\rightleftharpoons$	Cu <sup>2+</sup>	+	2e <sup>-</sup>
Silver	Ag	$\rightleftharpoons$	Ag <sup>+</sup>	+	e <sup>-</sup>
Mercury	Hg	$\rightleftharpoons$	Hg <sup>2+</sup>	+	2e <sup>-</sup>
Platinum	Pt	$\rightleftharpoons$	Pt <sup>2+</sup>	+	2e <sup>-</sup>
Gold	Au	$\rightleftharpoons$	Au <sup>3+</sup>	+	3e <sup>-</sup>

Metals at the top of the table are most easily oxidized.

## Metals as reductants

Most metallic elements act as reductants, donating electrons to other species. For example, aluminum will reduce iron (III) oxide to metallic iron.



In general terms, a more reactive metal will reduce the oxide of a less reactive metal.

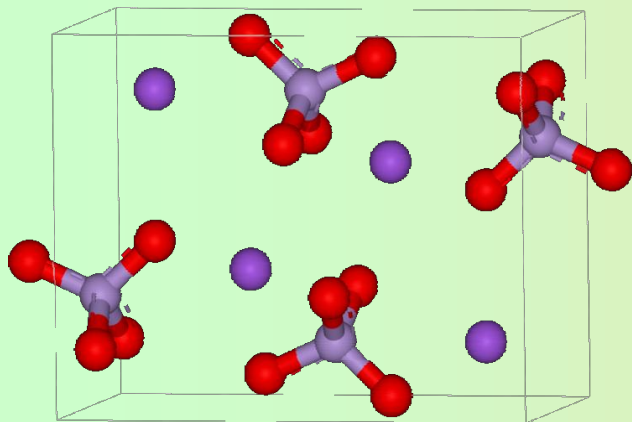
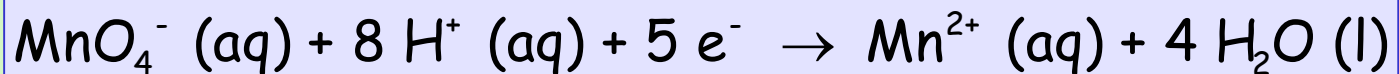
# Oxidants and Reductants



The permanganate ion as an oxidant

Potassium permanganate,  $\text{KMnO}_4$ , can act as an oxidant in acidic solution.

The half-equation for the reduction of permanganate ion is:



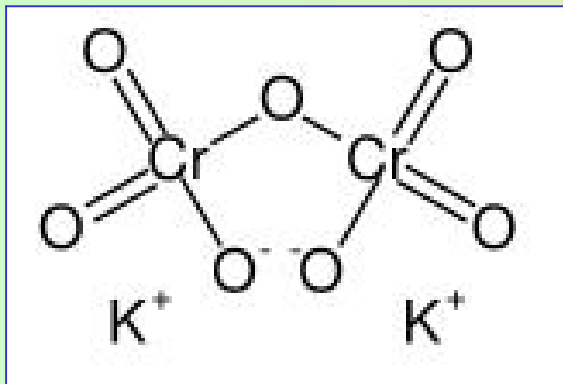
# Oxidants and Reductants



The dichromate ion as an oxidant

Potassium dichromate,  $K_2Cr_2O_7$ , can act as an oxidant in acidic solution.

The half-equation for the reduction of dichromate ion is:



# Oxidants and Reductants



The thiosulfate ion as a reductant

Sodium thiosulfate,  $\text{Na}_2\text{S}_2\text{O}_3$ , can act as a reductant in acidic solution.

The half-equation for the reduction of dichromate ion is:

