

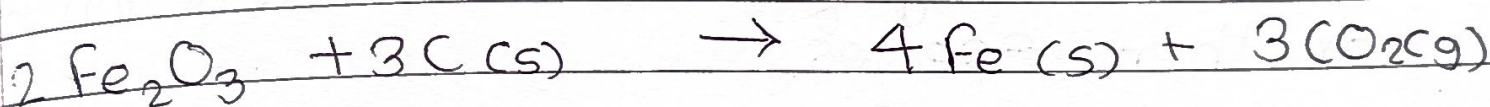
Redox Reactions

Introduction

Redox is an abbreviation used for the terms 'oxidation and reduction'. A large number of phenomena such as respiration, rusting, combustion of fuel involve redox reactions.

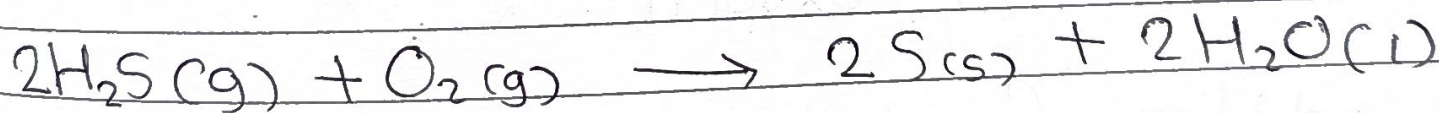
Classical ideas of redox reactions

Consider the reaction



In this reaction there is removal of oxygen from Fe_2O_3 . Hence it is a reduction reaction.

Further



In this reaction there is removal of hydrogen and is also called **oxidation**.

Oxidant / oxidising agent

A reagent / substance which itself undergoes reduction and causes oxidation of another species is called oxidant / oxidising agent.

Reductant / reducing agent :

A reagent / reducing agent is defined as a substance / reagent which itself undergoes oxidation bringing about the reduction of another species.

Key points

Oxidation it is defined as :

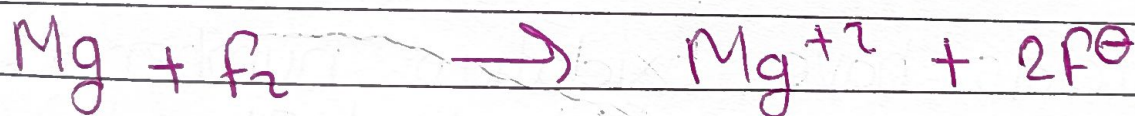
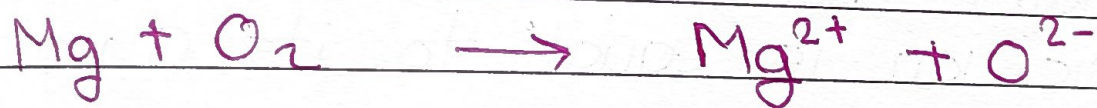
- addition of oxygen
- addition of electronegative element.
- removal of hydrogen
- removal of electropositive element.
- loss of electrons by any species

Reduction it is defined as:

- a. Removal of oxygen.
- b. removal of electronegative element.
- c. addition of hydrogen
- d. addition of electropositive element
- e. gain of electrons by any species.

Redox reaction in terms of electron transfer.

Redox reaction can be described as electron transfer as shown below



Displacement reactions can also be looked upon as redox reactions. In such reactions an ion (or atom) in a compound is replaced by an ion (or an atom) of another element.



This reaction is displacement reaction



Oxidation number:

Oxidation number of an element in a compound is defined as the number of electrical charges it carries (assuming complete electron transfer in the case of covalent bond).

Rules to assign oxidation number

1. The oxidation number of each atom of an element in free state is zero.

Thus : Each atom in H_2 , Cl_2 , O_3 , S_8 , P_4 , O_2 , Ca , etc. has oxidation number of zero.

2. The oxidation number of an atom in a monoatomic ion is equal to its charge.

- Alkali metals have oxidation number $+1$ in all their compounds ($NaCl$, KCl , etc)

- Alkaline earth metals have oxidation number $+2$ in all their compounds ($CaCO_3$, $MgCl_2$, etc)

- Al is considered to have $+3$ as its oxidation number in all its compounds.

The oxidation number of O is usually -2 in all of its compounds except in peroxide or peroxide ion where it has oxidation number of -1 and in superoxide each oxygen has oxidation number $-1/2$.

Stock notation:

Oxidation number represents the state of an atom and is also denoted by Roman numeral after the chemical element in the molecular representation of the concerned formula. This is called stock notation.

ex.



Redox reaction in terms of oxidation number

Oxidation: An increase in the oxidation number of an element in a given substance.

Reduction: A decrease in the oxidation number of an element in a given substance.

Oxidizing agent: A substance which increases the oxidation number of an element in a given substance, and itself undergoes decrease in oxidation number of a constituent element.

Reducing agent :

A substance that lowers the oxidation number of an element in a given substance, and itself undergoes an increase in the oxidation number of a constituent element in it.

Balancing of redox

Two methods are used to balance chemical equation for redox processes:

- ★ Oxidation number method
- ★ Ion electron method

★ Oxidation number method :