

**Oxidising agents** give oxygen to another substance or gain electrons and are reduced in chemical reaction.

O<sub>2</sub>, F<sub>2</sub> etc.

**Reducing agents** remove oxygen from another substance or lose electrons and are oxidised in chemical.

H<sub>2</sub>, Li etc.

### **Oxidation in terms of oxidation number**

As oxidation is a process of losing of electron. During oxidation, oxidation number of an atom increases in positive side. For example : when copper loses 2 electrons its oxidation state becomes +2.

### **Oxidizing agent in terms of oxidation number.**

As oxidizing agent causes other elements or compounds to lose electron and it self gains electron therefore oxidation number of oxidizing agents always shows negative value.

### **Difference between valency and oxidation number.**

Oxidation number is the charge (real or imaginary) present on the atom of the element when it is in combination. It may have plus or minus sign. Valence is the combining capacity of the element. No plus or minus sign is attached to it. For example : In ammonia oxidation number of N is -3 where as its valency is +3.

### **Types of redox reaction**

1. Combination Reaction : A reaction in which two atoms or molecules combine to form third molecule is called combination reaction.
2. Decomposition : A reaction in which a molecule breaks down into two or more molecules.
3. Displacement : A reaction in which an atom or ion in a compound is replaced by an atom or ion of some other element.
4. Disproportionation Reaction : Reaction in which the same species is simultaneously oxidized as well as reduced .

### **combination redox reaction**

A reaction in which two atoms or molecules combine to form third molecule is called combination reaction.

### **Decomposition redox reaction.**

A reaction in which a molecule breaks down into two or more components is called as decomposition reaction.

### **Displacement redox reaction**

A reaction in which an atom or ion in a compound is replaced by an atom or ion of same other element.

- a) metal displacement
- b) non metal displacement .

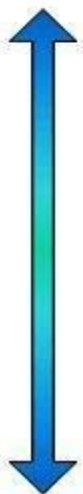
### **Metal displacement reaction**

Metal displacement: In this type of reaction, a metal present in the compound is displaced by another metal. These types of reactions find their application in metallurgical processes, where pure metals are obtained from their ores.

Non metal displacement: In this type of reaction, we can find a hydrogen displacement and sometimes rarely occurring reactions involving oxygen displacement.

### **Activity series**

# Activity Series



potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold	least reactive	Au

The reactivity series is a series of metals, in order of reactivity from highest to lowest. It is used to determine the products of single displacement reactions, whereby metal A will replace another metal B in a solution, if A is higher in the series.

## Reactivity series

The reactivity series is very helpful for explaining the direction of redox reactions. The series ranks metals by "oxidation potential". Top-ranked metals displace the ions of metals lower in the series from solution.

## Comproportionation reaction

Comproportionation or symproportionation is a chemical reaction where two reactants, each containing the same element but with a different oxidation number, will form a product in which the elements involved reach the same oxidation number.

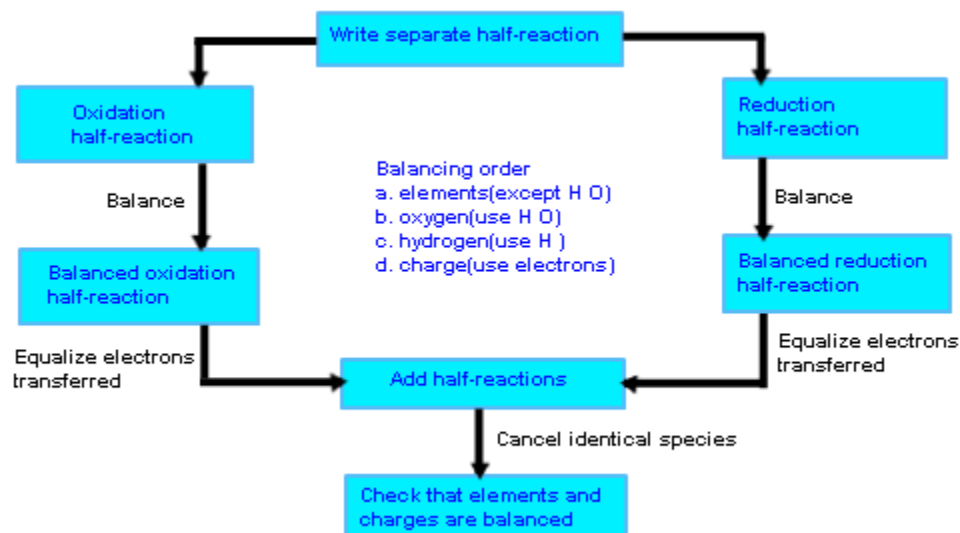
## Paradox of fractional oxidation states

The oxidation state of an element in a compound in reality is usually not in fraction. Actually, the calculated value of oxidation state in fraction of an element in a compound is the average oxidation state of the element under examination in the given compound

## Rules for balancing redox reaction using oxidation number rule

1. Write the equation, indicate the oxidation number of each element and identify the element which is undergoing change in oxidation number. Identify the oxidizing as well as reducing agent.
2. Multiply the formula of the oxidizing and reducing agent by suitable integers so as to equalize the total increase or decreases in oxidation number. Balance all atoms other than H and O, finally balance H and O by adding water molecules.

## Oxidation-number method



The oxidation number method, keeps track of electrons gained when a substance is reduced and the electrons lost when a substance is oxidized.

### **Balancing redox reaction using half reaction method**

Convert the unbalanced redox reaction to the ionic form.

Assign oxidation numbers and then write two half-reactions (oxidation and reduction) showing the chemical species that have had their oxidation numbers changed.

Balance O and H and remaining elements. Balance electron loss with electron gain between the two half-reactions. balance the ionic charge on each half-reaction by adding electrons.

### **Redox reaction basis of titration**

Titration is the process in which the solution of two reagent are allowed to react. Consider if one substance is acid and other is base then one must be going in oxidation and other one be in reduction, hence simultaneously redox reaction is going on.

### **Indicator for redox reaction**

Indicator can be internal and can be external. iodine can also be used as indicator.

#### **Internal indicator**

The indicator which is added to reactant taken in flask prior to the start of titration. Example are diphenylamine.

#### **External indicator**

External indicator is the one which is placed in the groove tile but is not added to the reaction mixture. Little reaction mixture (very minute quantity) is added with the help of glass rod to the groove tile containing the external indicator. The color changes will help to detect the reaction completeness/incompleteness. phenolphthalein, methyl orange, methyl red etc. are the example.

### **Type of redox titration**

Potassium permagnate titration

Potassium dichromate titration

Ceric sulphate titration

Iodometric titration

Iodimetric titration

### **Titrimetry**

A redox titration is a type of titration based on a redox reaction between the analyte and titrant.

#### **Analyse potassium dichromate titration**

In the titration of potassium dichromate as it is oxidizing agent reducing agents such as oxalic acid ,oxalate Mohr's salt etc are titrated so complete redox reaction takes place.

#### **Analyse titration of ceric sulphate.**

Being oxidizing agent Ceric sulfate reduces compounds such as arsenic, nitrites, oxalate etc.so complete redox reaction takes place in the titration flask.

#### **Analyse iodimetric titrations.**

These titration involve the direct use of iodine as the oxidizing agent using starch as an indicator.various reducing agents used in these titration are thiosulphates, sulphites etc.

### **Stoichiometry of redox reaction**

Stoichiometry of redox reactions means calculations of the quantities of the oxidizing and reducing agents and their products in oxidation reduction reactions.

### Direct and indirect redox reaction

The redox reaction in which oxidation and reduction reactions occur in the same vessel are called as direct redox reactions. For example when electron transfer takes place in same beaker no useful electrical work can be obtained. The reaction in which oxidation and reduction takes place in different vessel are called as indirect redox reactions. In this type of reaction useful electrical work can be done.

### Oxidation process according to classical concept

Oxidation is gain of oxygen or loss of electrons or loss of hydrogen according to classical concept.

Reduction is the removal of oxygen, addition of hydrogen or addition of electron.

### Oxidizing agent

A substance that has an ability to oxidize other substance is called as an oxidizing agent.

Oxidizing agent itself get reduce to oxidize other substance. So oxidizing agents gains electrons or loses oxygen or gains hydrogen to show its oxidizing property.

Example: Ozone, Hydrogen peroxide, Nitric acid ,etc.

### Reduction definition

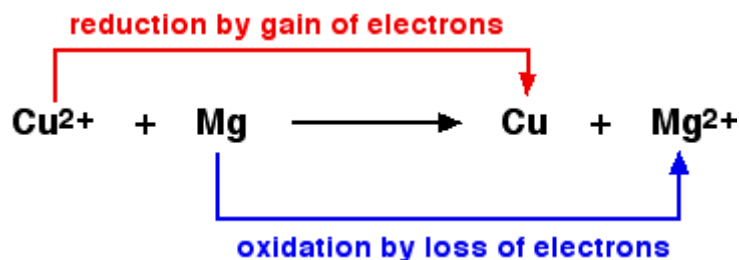


Reduction is a process of gain of H atom or loss of O atom. It is also consider as the process of addition of electron is also called as reduction according to classical concepts.

## Oxidation and reduction

Oxidation is the loss of electrons or an increase in oxidation state by a molecule, atom, or ion. Reduction is the gain of electrons or a decrease in oxidation state by a molecule, atom, or ion.

Identifying oxidising and reducing agent according to electron transfer concept



In this reaction  $\text{Cu}^{+2}$  gain 2 electron hence it is oxidizing agent and Mg lose 2 electron so it behaves as a reducing agent.

Electron transfer reaction based on activity series.

Metals in the activity series can only be oxidized by a metal ion below it. for example Na is oxidized by Al because Na is present at higher position in activity series hence it shows tendency to lose electron more than Al. so elements at top position in activity series undergoes oxidation and elements at lower position shows reduction.