Redox Reactions.

Oxidation – It may be defined as a process which involves the addition of oxygen or any other electronegative element or as a process which involves the removal of hydrogen or any other electropositive element.

– oxidising agent or oxidant – It is a substance which supplies oxygen or any other electronegative element, or remove hydrogen or any other electropositive element. An oxidising agent after carring out oxidation is itself reduced in a chemical reaction.

– Reduction :- It may be defined as a process which involves the addition of hydrogen or any other electropositive element, or removal of oxygen or any other electronegative element.

– Reducing agent or reductant – It may be defined as a substance which supplies hydrogen or any other electropositive element, or removes oxygen or any other electronegative element. A reducing agent after carrying out reduction is itself oxidised in a chemical reaction.

Whenever any substance is oxidised, another substance is always reduced at the same time. In other wards oxidation and reduction reactions are complementary.

– Oxidation and Reduction – Electron transfer concept :-

a. Oxidation – It may be defined as a process in which an atom or an ion loses one or more electrons. So oxidation is also called de-electronation.

b. Reduction – It may be defined as a process in which an atom or an ion gains one or more electrons. So reduction is called electronation.

— A substance (atom, ion or molecule) which can readily lose electrons to other substance is called reducing agent or a reductant, while a substance which can readily accept electrons from other substances is called an oxidising agent or an oxidant.

In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidised by losing electrons.

— oxidation number — It may be defined as the charge which an atom of the element has in its ion or appears to have when present in the combined state with other atoms. oxidation number is also called oxidation state.

— Rules for Assigning oxidation numbers.

1. The oxidation number of all the atoms of different elements in their respective elementary states and allotropic forms is taken to be zero. like N_2, H_2, O_2, S_8 etc.
2. The oxidation number of a monoatomic ion is the same as the charge on it.
3. The oxidation number of hydrogen is +1 when combine with non-metals and is −1 when combine with active metals called metal hydrides.
4. The oxidation number of oxygen is −2 in most of its compounds except in peroxides.
5. In compound formed by union of metals with non-metals, the metal atoms will have positive oxidation number and non-metals will have negative oxidation numbers
6. In compound formed by the union of different elements, the more electronegative atom will have negative oxidation number whereas the less electronegative atom will have positive oxidation number.

7. In neutral compounds the sum of the oxidation numbers of all the atoms is zero.
8. In Complex ions, the sum of the oxidation numbers of all the atoms in the ion is equal to the charge on the ion.
9. In Polyatomic ions, the algebraic sum of the oxidation number of all the atoms in the ion is equal to charge on the ion.

— Oxidation and Reduction in term of oxidation number: oxidation may be defined as a chemical change in which there occurs an increase in the oxidation number of an atom while reduction may be defined as a chemical change in which there occurs a decrease in the oxidation number of an atom or atoms. A redox reaction may then be defined as a reaction in which the oxidation number of atoms undergoes a change.

- oxidising agent or oxidant - It may be defined as a substance the oxidation number of whose atom decreases.

- Reducing agent or reductents! - It may be defined as a substance, the oxidation number of whose atom is increases.

Difference.

	Valency	oxidation number.
1.	Valency is the combining capacity of an element.	It is the charge which an atom has or appears to have when present in the combined state.
2.	Valency is only a number, it does not have Plus or minus sign.	oxidation number refers to the charge, it can be Plus or minus.
3.	Valency of an atom can not be zero.	oxidation number of an element can be zero.

4. Valency of an element is always a whole number.	oxidation number may have fractional value.
5. In some cases, the valency of an element is fixed in all its Compounds.	The oxidation number of an element may be different in different Compounds.
6. The valency of an element may be variable but the variation is limited to only two values.	The oxidation number of an element may also be variable, but variation is too large.

Types of Redox reactions.

a. Combination reactions — A reaction in which two atoms or molecules combine together to form a third molecule is called a combination reaction.

$$A + B \longrightarrow C.$$

For this reaction to be a redox reaction, either one or both A and B must be in the elemental form.

b. Decomposition reaction — A reaction in which a molecule break down to form two or more components is called a decomposition reaction.

For a decomposition reaction to be a redox reaction, it is essential that one of the Products of decomposition must be in the elemental state.

c. Displacement reaction — A reaction in which an atom or ion in a Compound is replaced by an atom or ion of some other element is called a displacement reaction.

$$x + yz \longrightarrow xz + y.$$

1. metal displacement reaction — In these reactions, a metal in the Compound is displaced by some other metal in the elemental state.

The reducing metal are better reducing agent then the metal being reduced. In other words, the reducing metals have greater ability to lose electron

c. Non-metal displacement reactions — In these reactions, a metal or a non-metal displaces another non-metal from its Compound. In most of these reactions, the non metal displaced is hydrogen.

d. Disproportionation reactions — A reaction in which the same species is simultaneously oxidised as well as reduced is called a disproportionation reaction.

For such redox reaction to occur the reacting species must Contain an element which has at least three oxidation States. All the remaining oxoanions have oxidation states lower than the highest (+7) and higher than the lowest (-1)

— Iodometric titrations :- All such titrations in which iodine liberated from Potassium iodide with the help of an oxidising agent is titrated against a standerd solution of sodium thiosulphate are called iodometric titrations.

— Stoichiometry of redox reactions :- It means Calculation of the Quantities of the oxidising and reducing agent and their Product in oxidation-reduction reaction.

— Direct redox reaction — Such redox reactions in which the oxidation and reduction reactions occur in the same vessel are Called direct redox reaction.

— Indirect redox reaction :- Such redox reactions in which the oxidation and reduction reactions take place in different vessels are Called indirect redox reactions.

— Electrochemical cell — It may be defined as a device to convert chemical energy produced in an indirect redox reaction into electrical energy. Electrochemical cell are also called galvanic cells or Voltaic cell.

— Redox Couple — It may be defined as combination of the oxidised and reduced forms of the same substance taking part in an oxidation and reduction half reaction.

Some important generalization about an electrochemical cell.

1. Oxidation occurs at the anode while reduction occurs at the cathode.
2. Anode acts as a negative pole while cathode acts as a positive pole.
3. Electrons flow from anode to cathode in the external circuit while current flow from cathode to anode.
4. Chemical energy of the redox reaction occuring in the galvanic cell is converted into electrical energy.

— Salt Bridge and its function.

The two main functions of the salt bridge are.

a. It allow the movement of ions from one solution to the other without mixing of the two solution, thus whereas electrons flow in the outer circuit in the wire, the inner circuit is completed by the flow of ions from one solution to the other.
b. It help to maintain the electrical neutrality of the solution in the two half cell due to flow of ions
c. If the salt bridge is not employed, the flow of electric current will not occur

only those electrolytes for which cations and anions have nearly the same ionic mobilities (distance travelled by

an ion per second under a potential gradient of one volt/meter) are used as electrolytes in the salt bridge. like KCl, KNO_3 K_2SO_4, NH_4NO_3

Among cations H^+ ion has the highest ionic mobility and among anions OH^- has the highest ionic mobility.

- Agar-Agar :- It is a seaweed colloid, It is a mixture of two polysaccharides (Agarose (main) and Agarpectin). It dissolves in hot water and sets, on colling, to a Jelly at concentration as low as 0.5%. Its chief used are as a solid medium for cultivating micro-organisms, as a thickner, as an emulsion stabilizer in the food industry and as a laxative.

- Electrode Potential :- The tendency of an electrode to lose or gian electrons is called electrode Potential, Since each electrode represents a half cell, therefore, electrode Potential is also called Potential for half cell.

The electrode Potential of any electrode depends upon the concentrations of the ions and temperature.

If the Concentration is taken as 1 mol/L and temperature is taken as 298 K, the electrode Potential thus determined are called standerd electrode Potential

- Oxidation Potential – If the electrode loses electrons, is called oxidation Potential.
- Reduction Potential – If the electrode gains electrons, is called reduction Potential.

Oxidation and reduction Potential are just reverse to each other.

The absolute value of Potential for a single electrode

Cannot be measured directly because.

1. A half cell reaction cannot take place independently.
2. It is a relative tendency to lose or gain electron
3. For purpose of measurement, as soones another metal conductor is put into the solution, it will setup its own potential.

The reference electrode used is the standerd or normal hydrogen electrode. The electrode potential of the standerd hydrogen electrode is taken as zero.

Standerd electrode potential is given a positive sign if reduction occurs at that electrode w.r.t the standerd hydrogen electrode. and is given a negative sign if oxidation occurs at the electrode w.r.t. the standerd hydrogen electrode.

A list of oxidising agents arranged in decreasing order of their strength is called the activity or electromotive or electrochemical series

All substances which have positive electrode potentials are stronger oxidising agent than H^+ while all substances which have negative electrode potentials are stronger reducing agents than H_2 gas.

— EMF (electro motive force) :- Emf of a cell is defined as the difference in the electrode potentials of the two half cells when the cell is not sending current through the circuit.

Emf = Standerd electrode potential of Cathode
— Stenderd electrode potential of anode.