CHAPTER-06
REDOX REACTIONS

Stock notations Expressing the oxidation state of a metal by Roman numerals like I, II, III etc. within parenthesis is called Stock notation

e.g. $FeSO_4$ = Iron (II) sulphate;

Na_2CrO_4 = Sodium chromate (VI) etc.

Valency of an element is only a number and as such there is no positive or negative sign attached to it. It can neither be zero nor fractional. Oxidation number, on the other hand, refers to charge and hence has either positive or negative sign. It can also be zero or fractional. For example, oxidation state of C in CH_2Cl_2 is zero while that of Fe in Fe_3O_4 is 8/3 and of S in $Na_2S_2O_3$ is 2.0.

Valence factor of reducing agent (R.A.):

= Increasing in O.N per unit formula of R.A.

= No. of electrons loss by unit formula of R.A.

Valence factor of oxidation agent (O.A.):

= Decreasing in O.N per unit formula of O.A.

= No. of electrons gain by unit formula of O.A.

- The oxidation number of metals in amalgams and metal carbonyls, i.e., $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$ etc. is zero.
- A substance acts only as an oxidising agent if the oxidation number of one of its elements is in its highest oxidation state and as a reducing agent if the oxidation number of one of its elements is in its lowest oxidation state. However, if the oxidation number of one of the elements of a substance is in its intermediate oxidation state, it can act both as an oxidising as well as a reducing agent.

For Example

- The O.N. of N in HNO3, i.e. + 5 is the maximum, therefore, it can act only an oxidising agent by accepting one or more electrons. For example,

$$I_2 + 10\overset{+5}{H}NO_3 \rightarrow 2HIO_3 + 10\overset{+4}{N}O_2 + 4H_2O$$

Here, the O.N. of N decreases from +5 in HNO_3 to +4 in NO_2 and hence it acts an oxidising agent.

The O.N. of S in H_2S, i.e., –2 is the minimum and hence it can act only as a reducing agent by losing one or more electrons. For example,

$$Br_2 + H_2^{-2}S \rightarrow \overset{0}{S} + 2HBr$$

Hence the O.N. of S increase from –2 in H_2S to 0 in elemental sulphur and hence it acts as a reducing agent

The O.N. of N in HNO_2 i.e., + 3 is neither maximum (i.e., + 5) nor minimum (i.e.–3), therefore, it can act both as an oxidising as well as a reducing agent.

For example:-

(i) $2KMnO_4 + 3H_2SO_4 + 5\overset{+3}{H}NO_2 \rightarrow K_2SO_4 + 2MnSO_4 + 5\overset{+5}{H}NO_3 + 3H_2O$

(ii) $2\overset{+3}{H}NO_2 + 2HI \rightarrow 2\overset{+2}{N}O + 2H_2O + I_2$

In equation (i), the O.N. of N increases from +3 in HNO_2 to +5 in HNO_3, therefore, it acts as a reducing agent.

In equation (ii), the O.N. of N decreases from +3 in HNO_2 to +2 in NO, therefore, it acts as an oxidising agent.

- **Redox reactions** are also called electron - transfer reactions since electrons are transferred from the reductant to the oxidant.
- Oxidation is also called de-electronation while reduction is called electronation.
- If a compound contains two or more atoms of the same element, all of them may or may not have same oxidation number e.g.

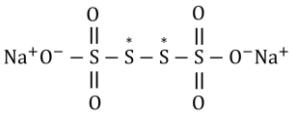
✓ In $Na_2S_2O_3$, one S-atom has oxidation number = –2 while the other has oxidation number = + 6.

✓ In $CaOCl_2$ i.e., Ca(OCl)Cl (bleaching powder), oxidation number of one Cl = –1 while oxidation number of the other Cl = +1.

✓ In $Fe3O_4$ i.e., FeO. Fe_2O_3 oxidation number of one Fe = +2 while that of each of the other two = +3.

✓ In NH_4NO_3, oxidation no. of N of $NH_4^+ = -3$ while that of N in $NO_3^- = +5$.

✓ In $Na_2S_4O_6$ (sodium tetrathionate) having the structure



✓ The oxidation number of both S* is equal to 0 (pure covalent nature) and other to Sulphur atoms have O.No. = +5