

substance is called as reducing agent (reductant) i.e. reducing agent losses electron and itself oxidized to higher valency state.

The oxidizing agents are potassium permanganate, potassium dichromate, potassium iodate, ceric salts and  $I_2$  solution etc. The reducing agents are sodium oxalate, oxalic acid, Ferrous sulphate, ferrous ammonium sulphate (Mohr's Salt) etc.

Electrode potential measures the electron releasing tendency of a redox system. The electrode potential of redox system can be determined by the combination of two half cells. One half cell which release electron (oxidation) and other half cell which gain electron (reduction)

## 2.15 Important oxidation- reduction titration reagent

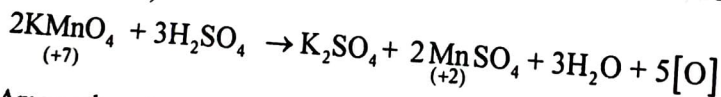
### a) Potassium permagnate ( $KMnO_4$ )

Potassium permagnate ( $KMnO_4$ ) is most useful oxidizing agent. The colour of  $KMnO_4$  solution is pink. In order to prepare 1M solution  $KMnO_4$ , 158 g  $KMnO_4$  dissolve while 31.6 g  $KMnO_4$  dissolve to prepare 1N solution.

$$\text{Equivalent weight of } KMnO_4 = \frac{\text{Molecular weight of } KMnO_4}{\text{Number of } e^- \text{ accepted by one molecule of oxidising agent}}$$

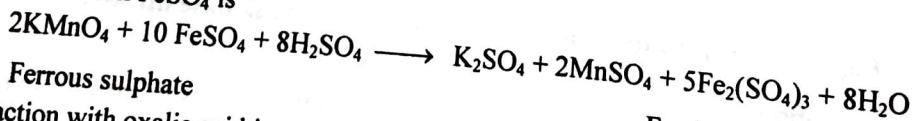
$$= \frac{158}{5}$$

Potassium permagnate widely used in acidic medium. In acidic medium, manganese in  $KMnO_4$  reduces from  $Mn^{+7}$  to  $Mn^{+2}$ . The chemical reaction of  $KMnO_4$  in acidic medium represented as follow,



Among the mineral acids  $HCl$ ,  $HNO_3$  and  $H_2SO_4$ , only  $H_2SO_4$  is most suitable for use with potassium permanganate. Potassium permanganate cannot be used with  $HCl$  because of its reducing action and cannot be used with  $HNO_3$  because  $HNO_3$  is itself oxidizing agent. The redox titration with  $KMnO_4$  can be performed using reducing agent like  $FeSO_4$ , oxalic acid, etc.

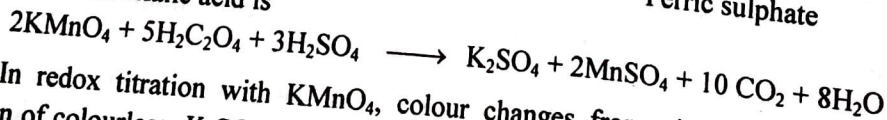
The reaction with  $FeSO_4$  is



Ferrous sulphate

Ferric sulphate

The reaction with oxalic acid is



In redox titration with  $KMnO_4$ , colour changes from pink to colourless due to formation of colourless  $K_2SO_4$  and  $2MnSO_4$ . The advantage of potassium permanganate is that it itself act as an indicator. The following are drawbacks of its,

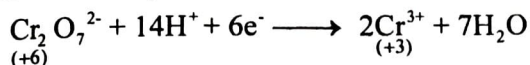
- i) Its solution protected from sunlight.
- ii) It is less stable in alkaline and acidic medium.
- iii) It cannot be used as a primary standard.

**b) Potassium dichromate ( $K_2Cr_2O_7$ )**

Potassium Dichromate is strong oxidizing agent and more useful than  $KMnO_4$ . Potassium dichromate is a salt of chromic acid  $K_2Cr_2O_7$ . The chemical reaction of Potassium dichromate in acidic solution gives three atoms of oxygen.



The ionic reaction represented as

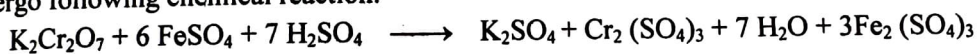


During reaction of potassium dichromate in acidic solution, a molecule of potassium dichromate gain 6 electron and oxidation state of chromium reduces from +6 to +3.

$$\text{Equivalent wt. of } K_2Cr_2O_7 = \frac{\text{Molecular wt. of } K_2Cr_2O_7}{6}$$

$$= \frac{294}{6} = 49$$

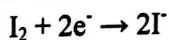
The acidic solution of  $K_2Cr_2O_7$  with Ferrous ammonium sulphate (Mohr's salt) undergo following chemical reaction.



Potassium dichromate solution is stable towards light and used as a primary standard.

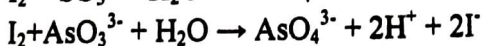
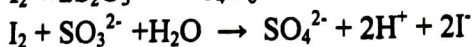
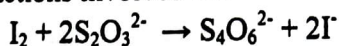
**c) Iodine ( $I_2$ ) solution**

Iodine is mild oxidizing agent and oxidizes ions such as thiosulphate ( $S_2O_3^{2-}$ ), sulphite ( $SO_3^{2-}$ ), arsenite ( $AsO_3^{3-}$ ) and Ferrous ions quantitatively in neutral or moderately acid solution. There are two types of titration involving iodine namely iodimetry and iodometry.

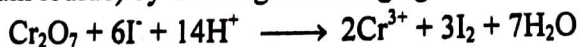


**i) Iodimetry:** The titration in which standard iodine solution is used as oxidant and directly treated with a reducing agent is known as Iodimetry. It includes the determination of thiosulphate, sulphilite, arsenites, etc.

The reactions involved are



**ii) Iodometry:** The titration in which Iodine is liberated by oxidation of an iodine ion (usually potassium iodide) by a strong oxidizing agent in neutral or slightly acidic solution.



Iodine is involved in an equivalent amount and is titrated with a standardized solution of a reducing agent, generally sodium thiosulphate.