

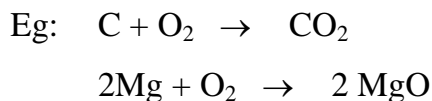
Oxidation – Reduction Titrations

What are Redox titrations? Define oxidation & reduction.

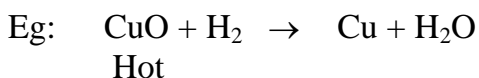
Ans: Redox Titrations: These are the titrations in which substance to be determined is either oxidized or reduced by means of a solution with which the titration is done.

Oxidation & Reduction:

Oxidation: According to older concept; oxidation is defined as addition of oxygen.

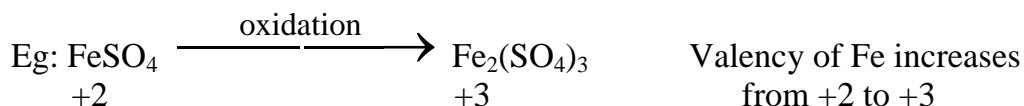


Reduction: According to older concept; reduction is defined as removal of oxygen by use of Hydrogen.



According to newer concept:

Oxidation involves an increase in valency.

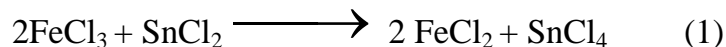


Reduction involves decrease in valency

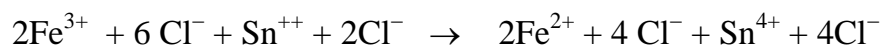


Explain Redox Reactions/Concept of Redox reactions

Ans: Redox Reactions involve electron transfer during the process. Taking the following example the redox reactions can be explained as follows:

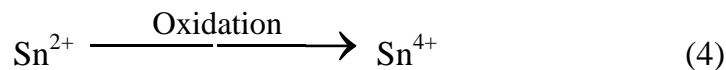
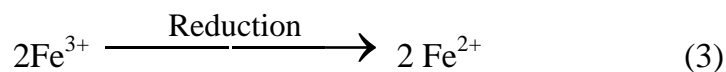


in terms of ions the above equation can be written as



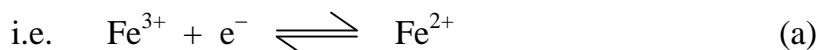


Or, partial ionic equation can be written as

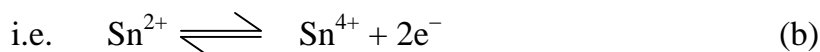


Equations must be balanced not only with regard to number & kind of atoms; but also electrically, i.e. the net electric charge on each side must be the same.

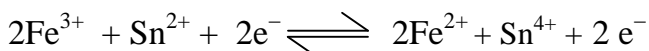
Therefore, Equation (3) can be balanced by adding one electron to left hand side.



& eq. (4) can be balanced by adding 2e^{-} on right hand side

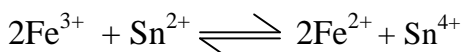


Adding a' & b'



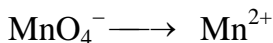
Cancel e^{-} of both the sides.

Therefore, Net Equation obtained is :

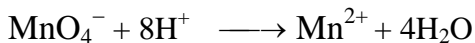


Explain Reduction of KMnO_4 by Fe(II)SO_4 in presence of H_2SO_4 .

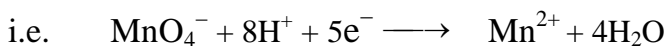
Ans: The first partial equation (Reduction) is as follows.



To balance it atomically, 8H atoms are added.

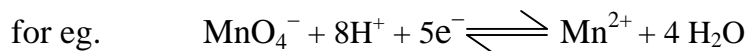


To balance electrically 5e^{-} are required on left hand side



Define equivalent of oxidant/reductant.

Ans: Equivalent of an oxidant or a reductant is defined as mole divided by number of electrons, which one mole of the substance gains or loses in the reaction.



$$\text{Equivalent} = \text{MnO}_4^- / 5 \text{ OR Equivalent of } \text{KMnO}_4 / 5$$



$$\text{Equivalent} = \text{Cr}_2\text{O}_7^{2-} / 6 \text{ OR Equivalent of } \text{K}_2\text{Cr}_2\text{O}_7 / 6$$

Define Oxidation Number.

Ans: Oxidation number of an element is the number, which when applied to that element in a particular compound; indicates the amount of oxidation or reduction which is required to convert one atom of element from the Free State to that in the compound. If oxidation is important to effect the change, oxidation number is positive. If Reduction is important to effect the change, oxidation number is negative.

what are the rules to determine oxidation number?

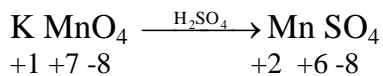
Ans: Following are the rules to determine oxidation number.

- (i) Oxidation no. of free or uncombined element is zero.
- (ii) Oxidation no. of H (except in hydrides) has a value of +1.
- (iii) Oxidation no. of O (except in peroxides) is -2
- (iv) Oxidation no. of metal in combination (except in Hydrides) is +ve.
- (v) Oxidation no. of a radical or ion is that of its electrovalency with the correct sign attached i.e. is equal to its electrical charge.
- (vi) Oxidation no. of a compound is always zero, and is determined by sum of oxidation no. of individual atom, each multiplied by no. of atom of that element in molecule.

Calculate the equivalent of an oxidizing agent.

Ans: Equivalent of an oxidizing agent is determined by change in oxidation number which the reduced element experiences.

Ex. Reduction of KMnO_4 in presence of dil. H_2SO_4 to Mn (II) salt

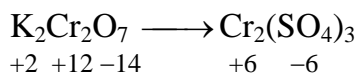


Change in oxidation number of Mn is from +7 to +2 i.e. by 5 units

Equivalent of KMnO_4 is therefore; $1/5$ mole.

\therefore Equivalent wt. of $\text{KMnO}_4 = \text{Mol. Wt. of KMnO}_4 / 5$

Calculate the equivalent of potassium dichromate.

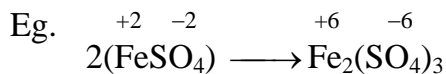


Change in oxidation number of two atoms of Cr is from +12 to +6 i.e. by 6 units

\therefore Equivalent wt. of $\text{K}_2\text{Cr}_2\text{O}_7 = \text{Mol. Wt. of K}_2\text{Cr}_2\text{O}_7 / 6$

Calculate the equivalent of FeSO_4 . (Equivalent of Reducing agent)

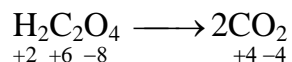
Ans. Equivalent of reducing agent is determined by change in oxidation number which the oxidized element suffers.



The Change in oxidation number is from +2 to +3 per atom of Fe or by one unit

\therefore Equivalent wt. of $\text{FeSO}_4 = \text{Mol. Wt. of FeSO}_4 / 1$

Eg. Oxidation of $\text{H}_2\text{C}_2\text{O}_4 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$



For 2 C atoms, the charge on R.H.S. would be +8.

Therefore, change in oxidation no. of Carbon will be +6 to + 8 i.e. by 2 units.

\therefore Equivalent wt. of oxalic acid = Mol. Wt. / 2