

# Oxidation Reduction Potential

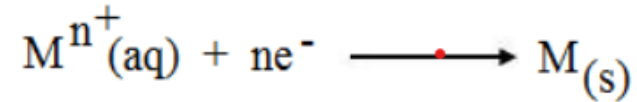
- Oxidation is defined as the process, in which a substance takes up positive, or parts with negative charges, while reduction is the process in which a substance takes up negative or parts with positive charges.
- Oxidation reduction potential (ORP) covers a large pH range. It is an electrochemical test and can easily measured using simple and portable instruments
- $\text{Cu(s)} - 2\text{e}^- \rightleftharpoons \text{Cu}^{2+}(\text{aq})$  (oxidation, loose electron)
- $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu(s)}$  (Reduction, gain electron)

# DEFINITION

- Oxidation Reduction Potential is a measure of the tendency of a chemical species to acquire electrons and thereby be reduced.
- Reduction potential is measured in volts (V), millivolts (mV), or Eh ( $1 \text{ Eh} = 1 \text{ mV}$ ).
- Each species has its own intrinsic reduction potential; the more positive (negative) the potential is, the greater the species' affinity for electrons and tendency to be reduced.

# NERNST EQUATION

For a general reduction reaction,



Nernst developed an equation, known as: Nernst equation:

$$E = E^{\circ} - \frac{RT}{nF} \ln \frac{[M_{(s)}]}{[M^{n+}_{(aq)}]}$$

Where,

E is the electrode potential

E° is the standard electrode potential (for 1M solution of metal ions at 298 K)

R is gas constant

T is temperature n is the number of electrons accepted during the change and

F is Faraday of electricity (96500 coulombs)

The molar concentration of solids in the pure state is assumed to be unity i.e.  $[M(s)] = 1$ .

Substituting the values,

$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $T = 298 \text{ K}$ ,  $F = 96500 \text{ coulombs}$ ,

the quantity  $\frac{2.303RT}{F}$  becomes a constant.

$$\frac{2.303RT}{F} = \frac{2.303 \times (8.314 \text{ JK}^{-1} \text{ mol}^{-1}) \times (298 \text{ K})}{(96500 \text{ Cmol}^{-1})} = 0.059$$

Therefore, the Nernst equation for the general reduction reaction at  $25^\circ\text{C}$  is:

$$E = E^0 - \frac{0.059}{n} \ln \frac{1}{[M^{n+}(\text{aq})]}$$