Redox potential

- Redox potential or oxidation reduction potential is a quantitative measure of the tendency of a redox pair to lose or gain electrons (ie. It is the electron transfer potential of a system).
- The redox pairs are assigned specific standard redox potential (E_0 volts) at PH 7 and at 25°C
- Oxidation is the loss of electrons and reduction is the gain of electrons.
- When a substance exists both in the reduced state and in the oxidized state, the pair is called a redox couple.

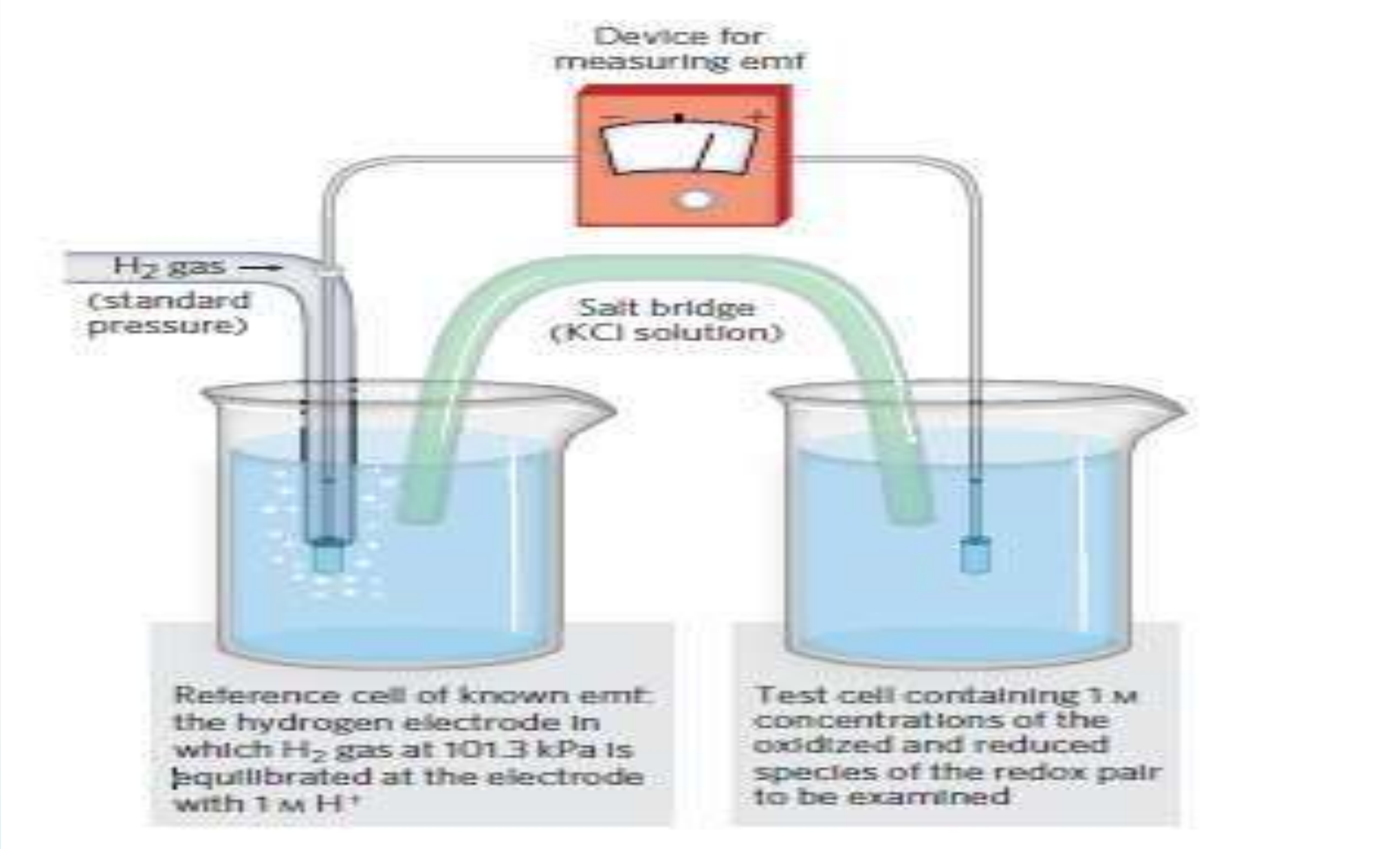
- The flow of electrons in oxidation-reduction reactions is responsible, directly or indirectly, for all work done by living organisms

- Electrons are transferred from one molecule (electron donor) to another (electron acceptor) in one of four ways:

1. Directly as electrons.
2. As hydrogen atoms.
3. As a hydride ion (:H-), which has two electrons.
4. Through direct combination with oxygen.

- The redox potential of this couple is estimated by measuring the electromotive force (EMF) of a sample half cell connected to a standard half cell.

- The sample half cell contains one molar solution each of the reductant and oxidant.
- The reference standard half cell has 1 M H^+ solution in equilibrium with hydrogen gas at one atmosphere pressure.
- The reference half cell has a reduction potential of zero meV.
- When a substance has lower affinity for electrons than hydrogen, it has a negative redox potential.
- If the substance has a higher affinity for electrons than hydrogen, it has a positive redox potential.



Measurement of the standard reduction potential of a redox pair.

- Standard reduction potential can be used to calculate free energy change.
- Electrons tend to flow to the half-cell with the more positive reduction potential, and the strength of that tendency is proportional to ΔE, the difference in reduction potential.
- The energy made available by this spontaneous electron flow (the free-energy change, ΔG, for the oxidation-reduction reaction) is proportional to ΔE:

$$\Delta G^o = -n\ F\ \Delta E_o.$$

- where
- **n** is the no: of electrons transferred in the reaction.
- F = Faraday constant (23.1 kcal/volt mol)
- **ΔE_o** = Eo of the electron-accepting pair minus the Eo of the electron-donating pair
- **ΔG^o** = change in the standard free energy

Oxidant	Reductant	E_0' (in V)
NAD^+	$NADH + H^+$	– 0.32
Cytochrome b^{+++}	Cytochrome b^{++}	+ 0.07
Coenzyme Q	Coenzyme QH_2	+ 0.10
Cytochrome c^{+++}	Cytochrome c^{++}	+ 0.22
Cytochrome a^{+++}	Cytochrome a^{++}	+ 0.29
½ O_2 + 2H	H_2O	+ 0.82

The redox potentials of some of the important redox couples of the biological system.