



## Reference Electrode

*The potential of unknown electrode can be measured by coupling it with another electrode, called reference electrode whose potential is already known or arbitrarily fixed as zero.*

The important reference electrode is standard hydrogen electrode, whose standard electrode potential is taken as zero at all temperature. So, it is called *primary reference electrode*.

It is very difficult to set up a hydrogen electrode. So, other electrode called *secondary reference electrode* (like calomel electrode) is used.

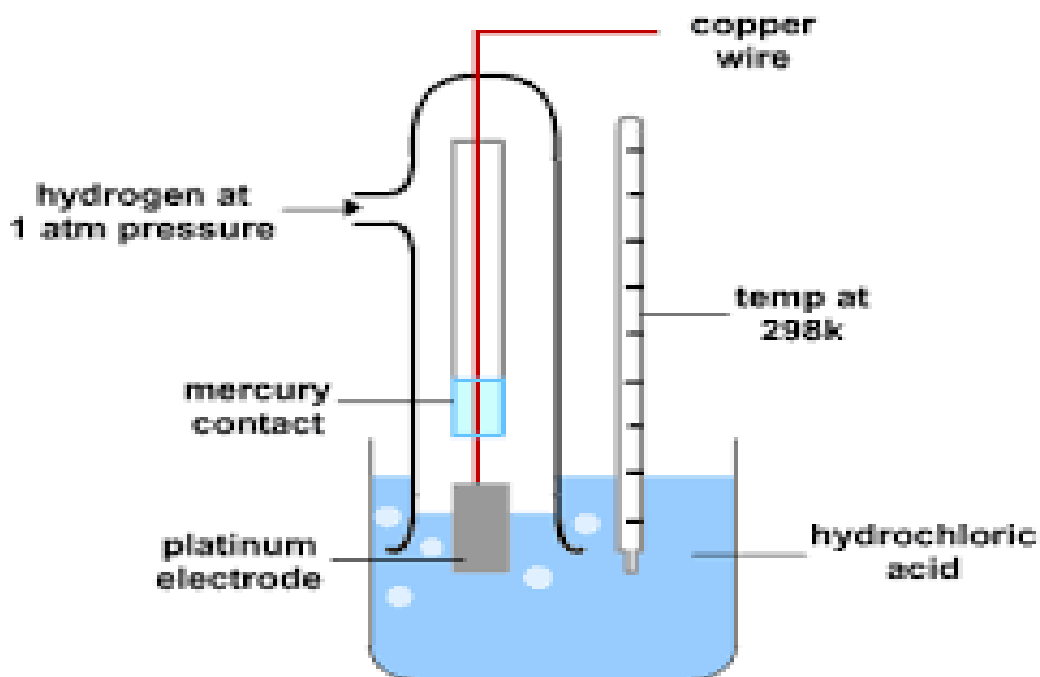
## Standard Hydrogen Electrode

Standard Hydrogen electrode is called a primary reference electrode because

- 1) The emf developed by the standard hydrogen electrode is arbitrarily fixed as zero at 1 atm pressure and the value of which is treated as constant at all temperature.
- 2) It is an only electrode with which the potential of all other electrodes are compared.

## Construction of a Standard Hydrogen Electrode

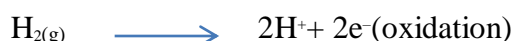
The typical standard hydrogen electrode is shown in





It consists of rectangular platinum foil which is connected to a platinum wire and sealed in a glass tube. A glass jacket surrounds the tube carrying the platinum foil. The jacket is closed at the top and opened at the bottom. A side tube attached to the outer jacket is used for the injection of hydrogen gas into the cell. This electrode, when dipped in a 1 M HCl solution at 25 °C and hydrogen gas at 1 atm is passed, forms a standard hydrogen electrode.

When this electrode acts as anode, the electrode reaction is as follows :



When this electrode acts as cathode, the electrode reaction is as follows:



The standard hydrogen electrode is represented as,  
Pt, H<sub>2</sub>(1 atm) / H<sup>+</sup>(1 M); E° = 0 V

## Development of EMF of SHE

When hydrogen gas is bubbled through the solution, it is adsorbed by the platinum foil. Due to the adsorption of hydrogen gas, the equilibrium is established between hydrogen molecules and H<sup>+</sup> ions. The electrode potential developed during this equilibrium is taken as zero and treated as constant at all temperature.

## Limitation

- It requires H<sub>2</sub> gas and is difficult to set up and transport.
- It requires considerable volume of test solution.
- The solution may affect the surface of the platinum electrode.
- The potential of the electrode is altered by changing the pressure of H<sub>2</sub> gas.