3.4 Ion sensitive electrode:

Ion sensitive electrodes have the ability to respond only to a specific ion and develop a potential ignoring other ions in the solution.

The types (classification) of ion-sensitive electrode:

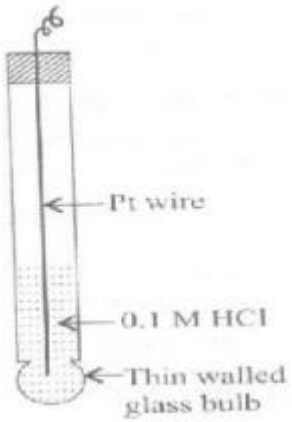
a. Glass membrane electrodes
b. Solid state electrode
c. Pungor or precipitate electrodes
d. Liquid – liquid electrode

Glass Electrode (or) Measurement of pH using glass electrode:

Glass electrode contains a thin-walled glass bulb. The glass has low melting point and high electrical conductivity. 0.1M HCl is present in the bulb. A platinum wire is inserted in the acid.

When the glass membrane separates two solutions differing in pH, exchange of H^+ ions takes place between the solutions. As a result, a potential is developed across the membrane. The potential EG is given by,

$$EG = EG + 0.0591\ pH$$



Measurement of pH:

The glass electrode is dipped in the given solution. This system is connected to saturated calomel electrode as in the figure. The emf of the resulting cell is measured using a potentiometer.

From the emf, the pH of the solution is calculated as below:

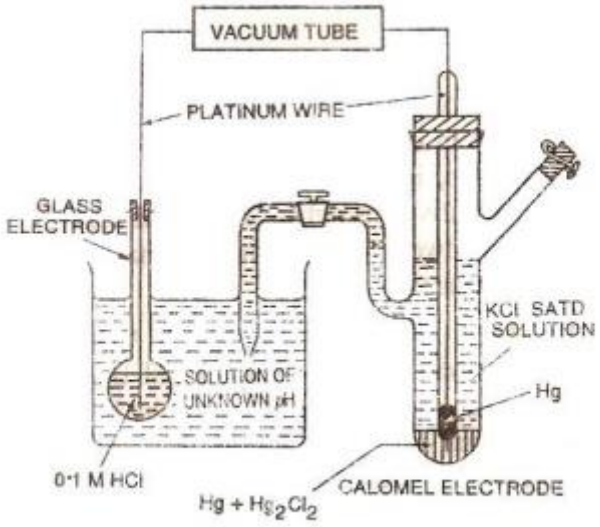
$$E_{cell} = E_{right} - E_{left}$$

$$E_{cell} = E_{cal} - E_{glass}$$

$$E_{cell} = 0.242 - (EG° + 0.0591v\ pH)$$

$$E_{cell} = 0.242 - EG° - 0.0591\ pH$$

$$P^H = E_{cell} - 0.2422 + E^0_{Glass}/0.0592$$



Determination of *p*H by glass electrode.

Advantages of Glass Electrode:

- It is easily constructed and used
- Results are accurate
- Electrode is not easily poisoned
- Equilibrium is quickly attained
- It can be used in strong oxidizing solutions, coloured solutions and
- in presence of metal ions
- Using special glass electrode, pH can be measured from 0 to 12.
- It is used in chemical, industrial, biological and agricultural laboratories.

Disadvantages or Limitations:

- Glass has high resistance. So special electronic potentiometer must be used.
- It cannot be used in highly alkaline solutions, in pure ethanol or in acetic acid. If the solution pH is more than 12, glass membrane is affected by cations.

Applications of Ion-sensitive electrode:

- To determine ions like H^+, K^+, Li^+, etc.
- To determine hardness of water (Ca^{+2} and Mg^{+2} ions)
- To determine concentration of F^-, $NO3^-$, CN^- etc.
- To determine concentration of a gas using gas-sensing electrodes.
- To determine pH of a solution using H^+ ion sensitive electrode.