

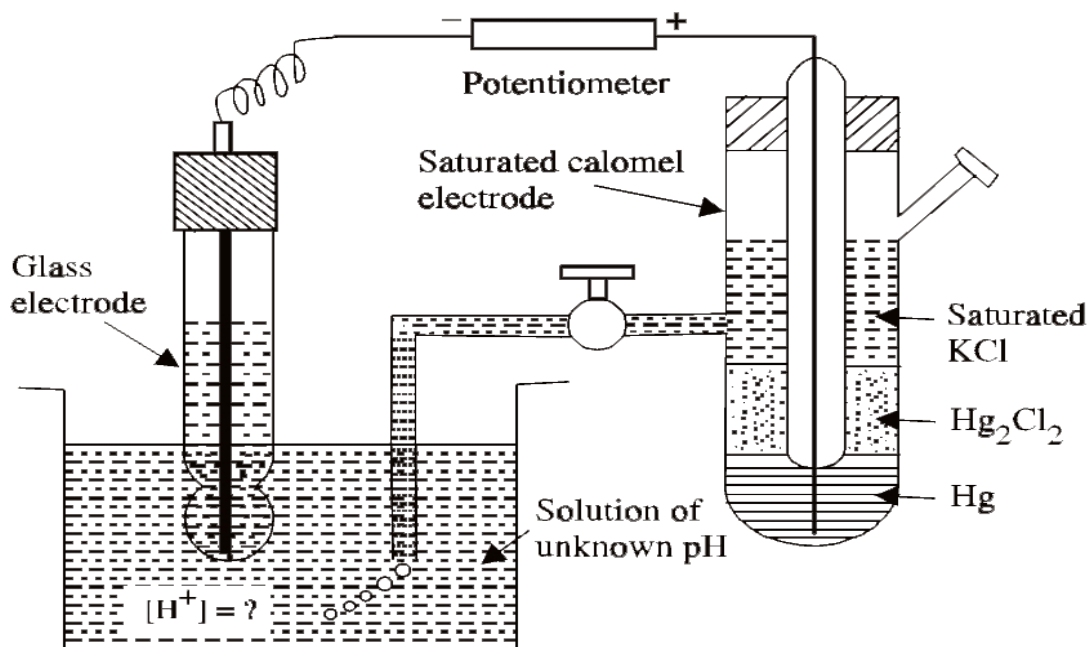
## 19CH201 - ENGINEERING CHEMISTRY

### UNIT-1 - ELECTROCHEMISTRY

#### 1.5 Measurement of pH by glass electrode

#### Determination of pH of a Solution using Glass Electrode

The glass electrode is placed in the solution under test and is coupled with saturated calomel electrode as shown in the figure 1.6.



**Fig. 1.6 Determination of pH by using glass electrode**

The emf of the cell is measured. From the emf, the pH of the solution is calculated as follows

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

$$E_{\text{cell}} = E_{\text{cal}} - E_{\text{G}}$$

$$= E_{\text{cal}} - (E^{\circ}_{\text{G}} + 0.0592 \text{ pH})$$

$$= E_{\text{cal}} - E^{\circ}_{\text{G}} - 0.0592 \text{ pH}$$

$$\text{pH} = \frac{E_{\text{cal}} - E^{\circ}_{\text{G}} - E_{\text{cell}}}{0.0592}$$

$$\therefore E_{\text{cal}} = 0.2422 \text{ V}$$



$$\therefore \text{pH} = \frac{0.2422 - E^{\circ}_{\text{G}} - E_{\text{cell}}}{0.0592}$$

### **Advantages of Glass Electrode**

- i. It can be easily constructed and readily used.
- ii. The results are accurate.
- iii. It is not easily poisoned.
- iv. Equilibrium is rapidly achieved.

### **Disadvantages (Limitations)**

- i) Since the resistance is quite high, special electronic potentiometers are employed for measurement.
- (ii) The glass electrode can be used in solutions only with pH range of 0 to 10. However above the pH 12 (high alkalinity), cations of the solution affect the glass and make the electrode useless.

### **Applications of ISEs**

- (i) ISEs are used in determining the concentrations of cations like  $\text{H}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ag}^+$ ,  $\text{Li}^+$ .
- (ii) ISEs are used for the determination of hardness ( $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions).
- (iii) Concentrations of anions like  $\text{NO}_3^-$ ,  $\text{CN}^-$ ,  $\text{S}^{2-}$ , halides ( $\text{X}^-$ ) can be determined.
- (iv) ISEs are used in the determination of concentration of a gas by using gas-sensing electrodes.
- (v) pH of the solution can be measured by using gas-sensing electrode.



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