

# **pH meter**

**Measurement of  $H^+$  concentration in solution**

# pH Meter

- A pH meter is a precise instrument that weighs the hydrogen-ion movement in water-based suspensions, showing its acidity or alkalinity expressed as pH
- It is also called a "potentiometric pH meter" because it measures the variation in electrical potential between a pH electrode and a reference electrode
- The variation in electrical potential links to the acidity or pH of the suspension
- The word pH is acquired from "p," the scientific figure for negative logarithm, and "H," the chemical symbol for Hydrogen
- pH is a unit of measure that expresses the level of acidity or alkalinity of a solution and graded on a range of 0 to 14.  $\text{pH} = -\log[\text{H}^+]$
- In 1909 Nobel-Prize winning German chemist Fritz Haber and his student Zygmunt Klemensiewicz explained the glass electrode idea
- The modern, electronic pH meter was introduced in 1934, by an American chemist Arnold Beckman

# pH Measurement

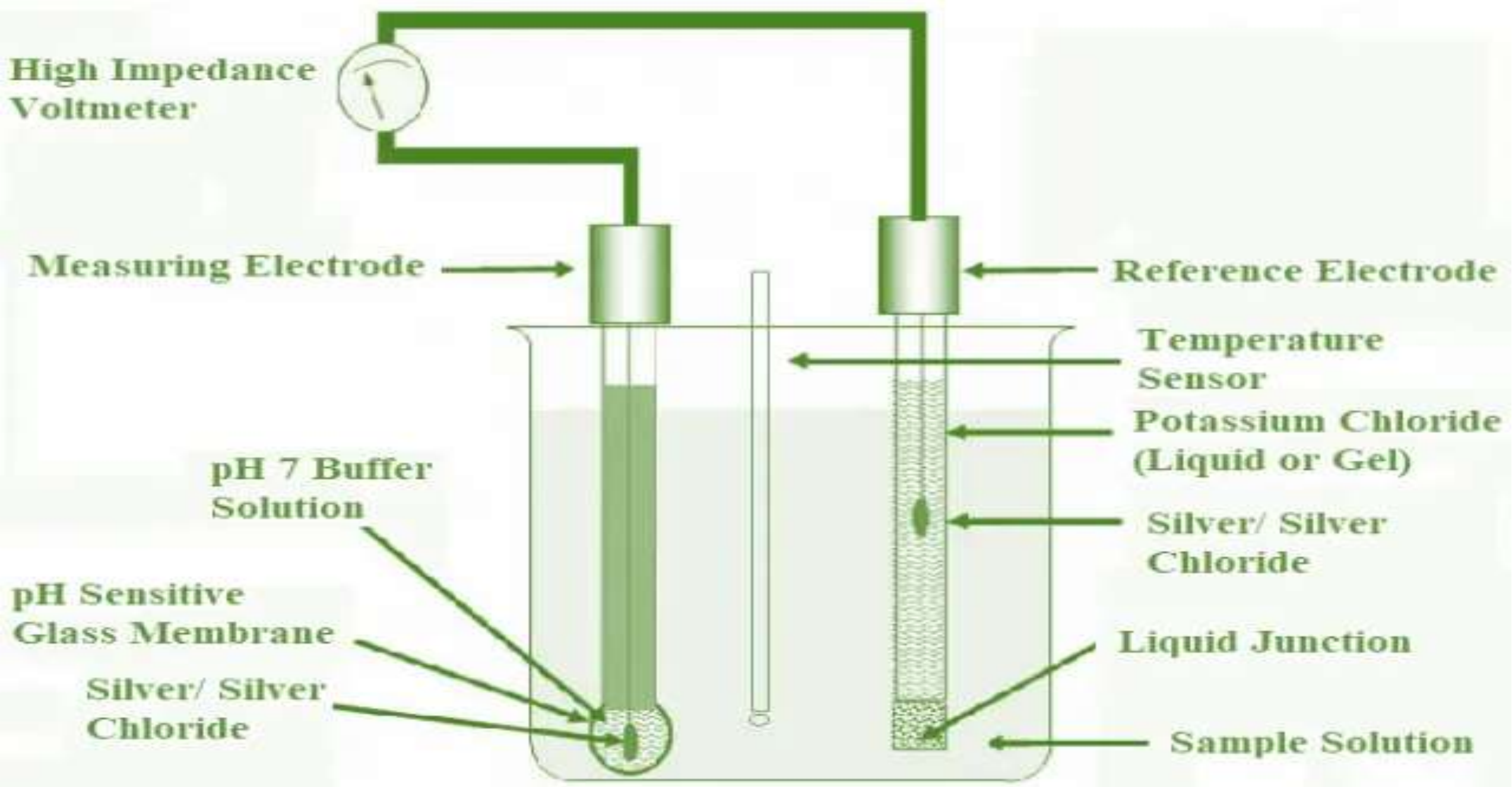
- The pH rate of a material is directly linked to the degree of the hydrogen ion  $[H^+]$  and the hydroxyl ion  $[OH^-]$  concentrations in its aqueous solution
- If the  $H^+$  density is higher than  $OH^-$ , the substance is acidic; i.e., the pH amount is less than 7
- If the  $OH^-$  intensity is higher than  $H^+$ , the substance is basic, including a pH value higher than 7
- If identical quantities of  $H^+$  and  $OH^-$  ions are present, the substance is neutral, with a pH of 7

# Principle of pH Meter

- A pH meter contains two electrodes i.e. a Measuring electrode and a reference electrode
- The Reference Electrode contains a neutral solution such as Potassium Chloride solution with a fixed concentration and gives a stable voltage
- On the opposite, the potential of the Measuring Electrode depends totally upon the pH of the suspension

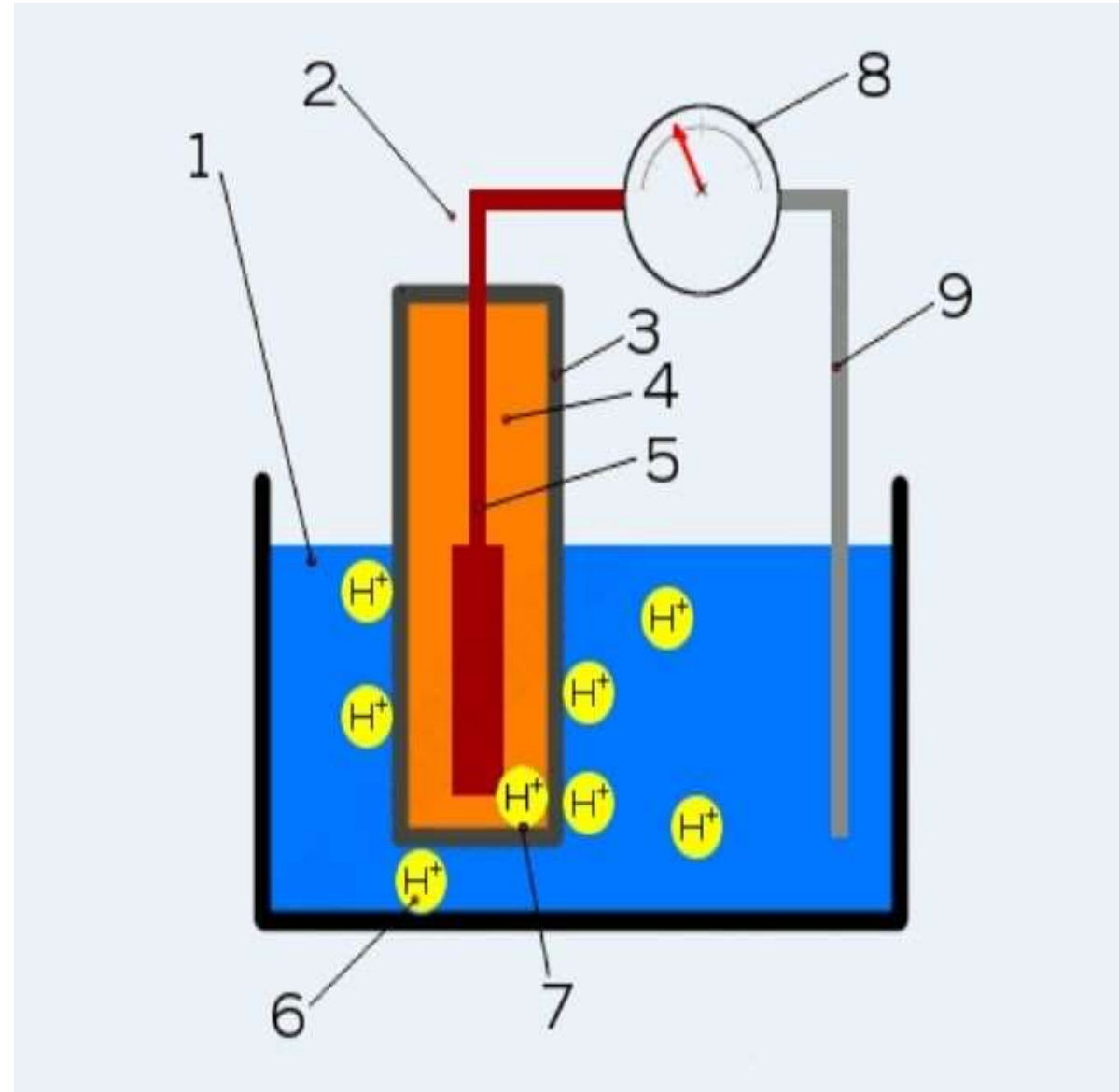
- **The algebraic total of the potentials of the Measuring Electrode, Reference Electrode, and the Liquid Junction is known as the overall potential or the voltage**
- **The potential variation (voltage) between a glass membrane of Measuring Electrode and a Reference Electrode which is immersed in the Sample Liquid to be examined is estimated**
- **When the two Electrodes are immersed into the Sample Suspension, the ion-exchange process transpires wherein some of the Hydrogen ions flow towards the outside surface of the Measuring Electrode and displace some of the metal ions within it**

- **Likewise, some of the to variation in pH is negligible or it is unaffected by variations in pH and therefore produces a stable voltage**
- **Ion-exchange takes place on the interior surface of the Glass Electrode from the sample suspension and generates a potential variation (Hydrogen- ion activity) among them**
- **The output of the Impedance Voltmeter is Voltage studies and it possesses to be calibrated to prepare precise pH Measurement**



# Key Parts of a pH meter

1. The Solution being examined.
2. The Glass electrode, consisting of,
  3. a slim layer of silica glass including metal salts, inside which there is a potassium chloride solution.
  4. and an internal electrode
  5. Constructed from silver/silver chloride.
6. Hydrogen ions produced in the experiment solution communicate with the outer surface of the glass.
7. Hydrogen ions produced in the potassium chloride solution communicate with the inside surface of the glass.
8. The meter regulates the variation in voltage between the two surfaces of the glass and turns this "potential difference" into a pH reading.
9. Reference electrode serves as a baseline or reference for the analysis-or you can think of it as simply completing the circuit.





# Operating Procedure of pH Meter

- 1. Turn on the pH meter**
- 2. Then wash the electrodes with distilled water.**
- 3. Maintain the sample's temperature at 25 degrees centigrade.**
- 4. Immersed the electrodes within the sample and stir it to create a homogenous sample.**
- 5. Make sure the tip of the electrode is completely dipped into the sample.**
- 6. Wait until the reading becomes stable.**
- 7. Now record the pH.**
- 8. Finally, wash the electrodes with distilled water and store it with the buffer solution.**

# Types of pH Meter

Based on the types of requirement pH meter is divided into several classes such as;

## 1. Based on portability:

- **Portable pH meter:** the use of compact DC power equipment
- **Desktop pH meter:** Same as Portable pH meter
- **Pen pH meter:** normally composed of a single scale, conventional measurement range, easy and handy equipment

## 2. Based on purpose:

- **Laboratory pH meter:** multi-function, high accuracy
- **Industrial online pH meter:** excellent stability, steady work, a specific level of measurement efficiency, environmental flexibility

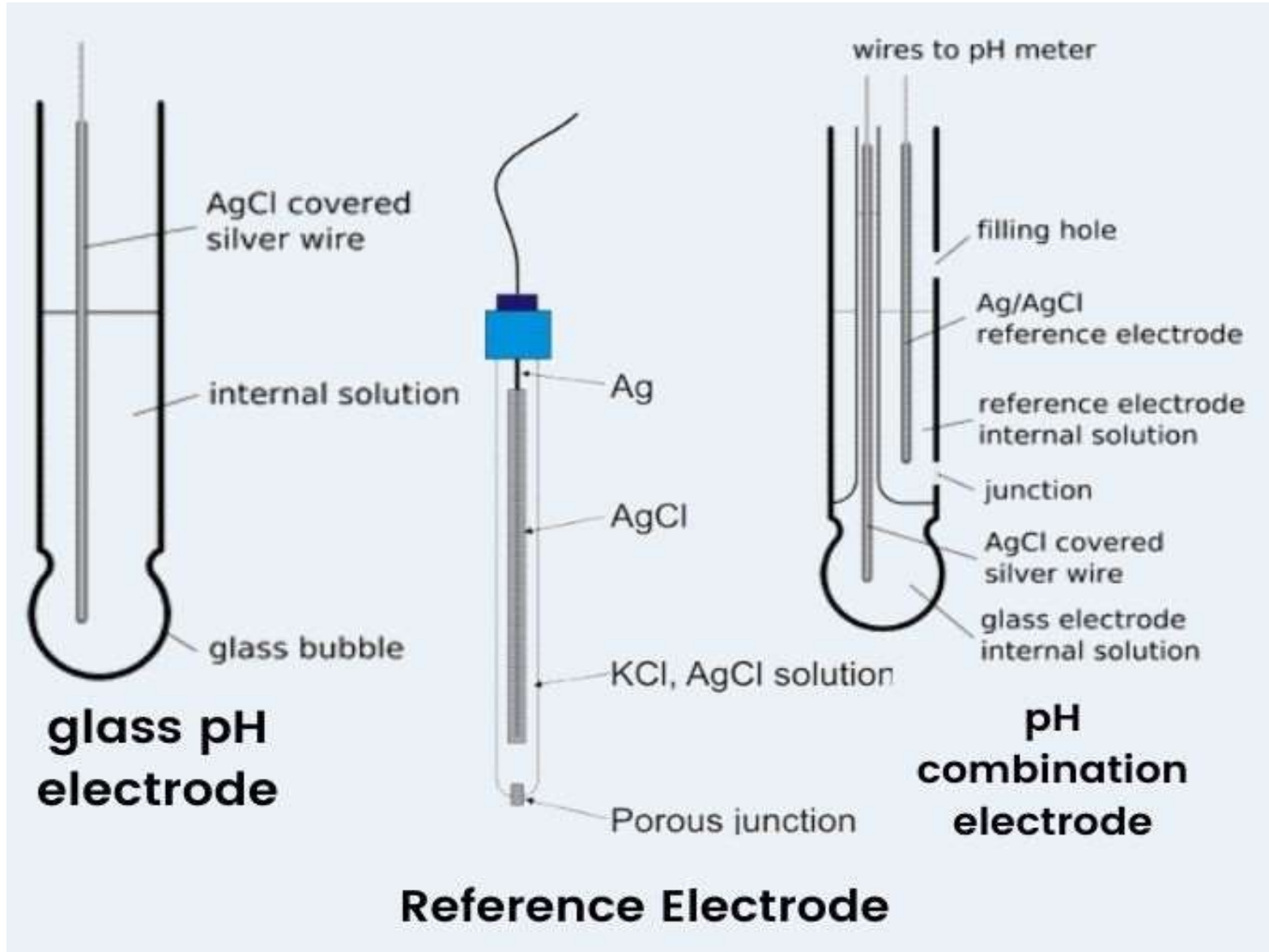
## 3. Based on advanced level:

- **Economic pH meter**
- **Intelligent pH meter**
- **Precision pH meter or digital pH meter**

# Types of Electrodes

Three types of pH electrodes:

1. Glass electrode
2. Reference electrode
3. Combination gel electrode



# Application of pH Meter

- **In agriculture industries to measure the pH of soil**
- **It is also used to measure water quality for municipal water supplies, swimming pools**
- **In many chemical and pharmaceutical industries, it is used to measure the pH value of solutions**
- **pH Meter is additionally employed in the Food industry particularly for dairy products like cheese, curds, yogurts, etc.**
- **It becomes a vital circumstance in the making of detergents**

## **Advantages of pH Meter**

- **pH Calibration is low-priced and robust**
- **Pocket size pH Meters are user friendly**
- **Accounts are reliable and specific**

## **Disadvantages of pH Meter**

- **Heat affects the output readings**
- **pH Calibration utilizing glass electrodes need to be clean as deposition on the electrodes influences the readings**