Q 8: Thermoelectric Probe

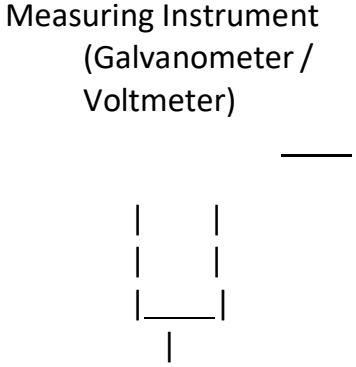
A thermoelectric probe is a temperature-measuring device based on the thermoelectric (Seebeck) effect, in which an electromotive force (emf) is produced when two dissimilar metals forming a closed circuit have their junctions maintained at different temperatures. It is widely used to measure body temperature, tissue temperature, and small temperature variations in biomedical and physiological studies. **Principle**

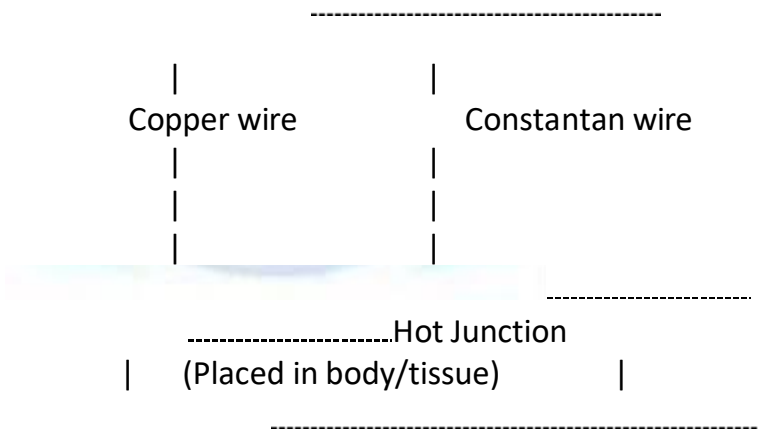
The thermoelectric probe works on the Seebeck effect. When two dissimilar metals are joined to form two junctions and a temperature difference exists between the junctions, a thermoelectric voltage is generated. The magnitude of the generated emf is directly proportional to the temperature difference between the hot and cold junctions.

Construction

The thermoelectric probe consists of:

Two dissimilar metal wires such as copper and constantan or iron and constantan. One end of the wires joined to form the hot (measuring) junction. The free ends form the cold (reference) junction. A sensitive galvanometer or digital voltmeter connected to measure the emf. The hot junction is enclosed in a thin metallic probe for easy contact with the body or tissue.





When the hot junction of the thermoelectric probe is placed in contact with the body or tissue whose temperature is to be measured, it attains the temperature of the object. The cold junction is maintained at a known reference temperature. Due to the temperature difference between the two junctions, a thermoelectric emf is produced in the circuit. This emf causes a current to flow, which is detected by the galvanometer or voltmeter. The instrument is calibrated so that the emf reading directly gives the temperature of the object.

Advantages

- High sensitivity to small temperature changes
- Fast response time
- Simple construction
- Reliable and accurate
- Suitable for continuous temperature monitoring

Limitations

- Measures temperature difference, not absolute temperature
- Requires calibration
- Sensitive to environmental temperature changes

Applications

- Measurement of body and skin temperature
- Monitoring tissue temperature during surgery
- Physiological and biomedical experiments
- Clinical diagnostics
- Research laboratories

Q 9: Lithotrophy

Lithotrophy refers to the metabolic process in which organisms, known as lithotrophs, obtain energy by oxidizing inorganic compounds such as hydrogen (H_2), sulfur (S), ammonia (NH_3), methane (CH_4), and iron (Fe^{2+}), among others. Lithotrophs include certain bacteria, archaea, and other microorganisms that are capable of oxidizing inorganic substances.

The key feature of lithotrophs is their ability to extract electrons from these inorganic substances, which are used in cellular processes like ATP synthesis to meet their energy needs.

Key Steps in Lithotrophy:

1. **Oxidation of Inorganic Compounds:** Lithotrophs oxidize compounds like H_2, NH_3, CH_4, or sulfur to release electrons.
2. **Electron Transfer:** The electrons generated from the oxidation process are transferred via electron transport chains.
3. **Proton Gradient Formation:** As electrons move through the electron transport chain, protons (H^+) are pumped across the membrane, creating an electrochemical gradient.
4. **ATP Synthesis:** The proton gradient is used by ATP synthase to generate ATP, providing energy for cellular functions.

Applications

- Measurement of body and skin temperature

- Monitoring tissue temperature during surgery
- Physiological and biomedical experiments
- Clinical diagnostics
- Research laboratories
- Sensitive to environmental temperature changes