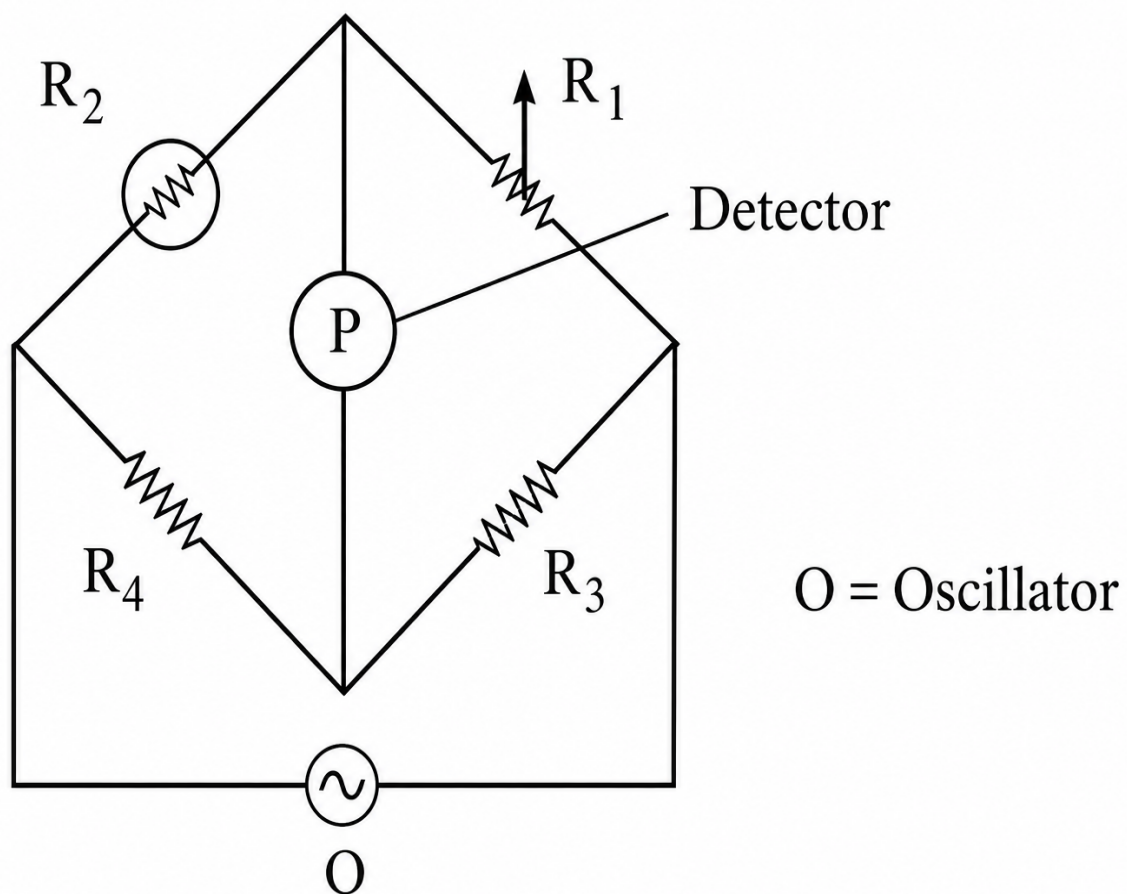


Wheat Stone Bridge

Wheatstone bridge in chemistry is a specialized electrical circuit used to accurately measure the electrical resistance (or conductance) of electrolytic solutions.

While a standard DC bridge measures solid resistors, the chemistry setup replaces the battery with an audio-frequency oscillator (AC source) and the galvanometer with a detector like headphones or an electronic null indicator to prevent chemical changes in the solution.

1. Setup and Definition



The bridge consists of four "arms" arranged in a diamond shape. In conductometric chemistry:

- **Arm 1 (R_x):** A conductivity cell containing the electrolytic solution with unknown resistance.
- **Arm 2 (R_1):** A variable resistance box used to balance the bridge.
- **Arms 3 & 4 (R_3, R_4):** Known fixed resistances.
- **The Oscillator:** An AC source (500 to 5,000 Hz) that prevents polarization of the electrodes by constantly reversing the current direction.
- **The Detector:** Headphones or a visual indicator that signals the "null point" (minimum sound/signal) when the bridge is balanced.

Wheatstone Bridge Balancing Formula:

$$R_x / R_1 = R_3 / R_4$$
$$R_x = R_1 \times (R_3 / R_4)$$

2. Balancing Formula

The bridge is balanced when no current flows through the detector, meaning the potential at both midpoints is equal.

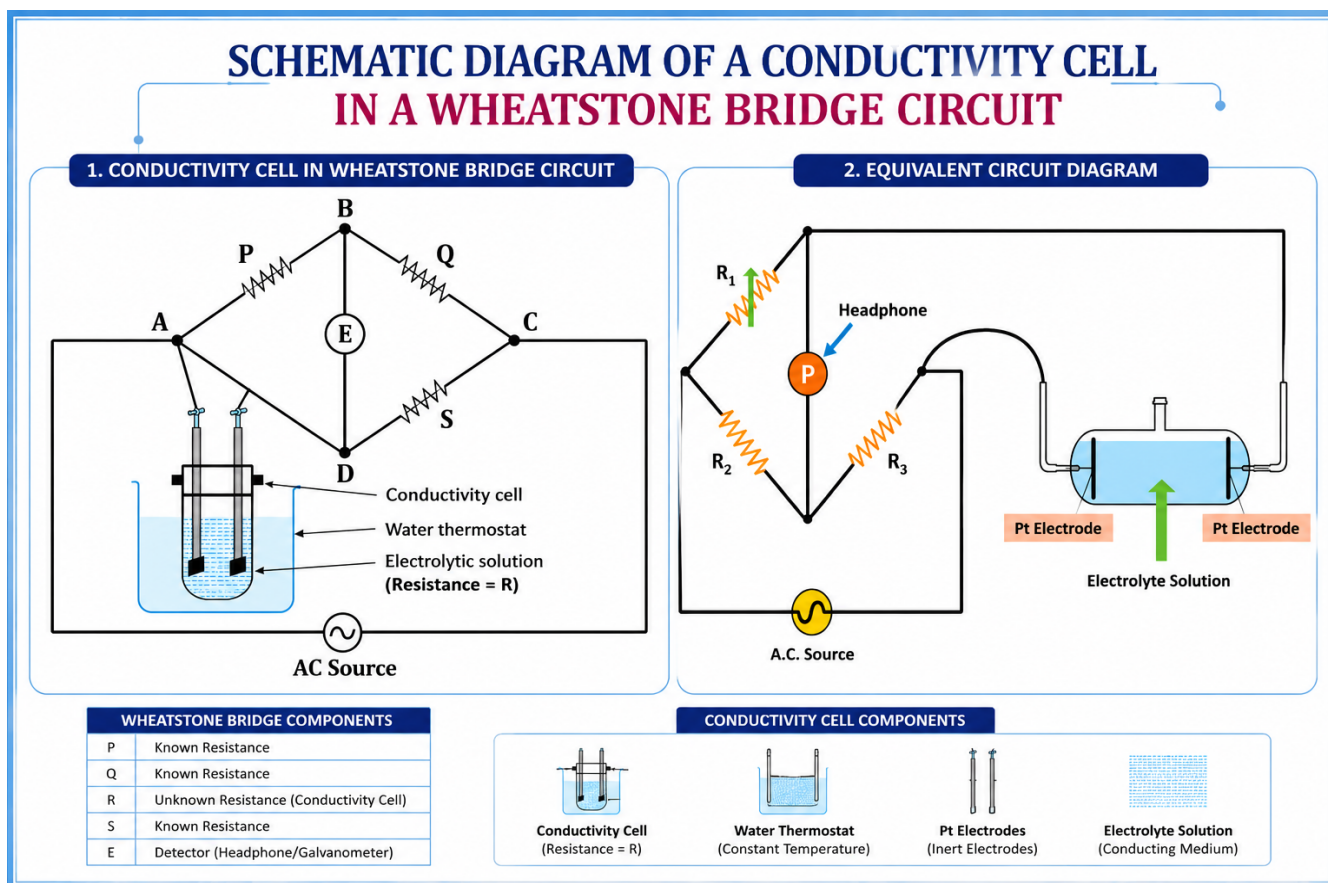
$$R_x / R_1 = R_3 / R_4$$
$$R_x = R_1 \times (R_3 / R_4)$$

Once R_x is found, the specific conductance (κ) is calculated using the cell constant (G^*):

$$\kappa = G^* / R_x$$

3. Key Difficulties

Measuring electrolytic conductance presents two unique challenges compared to standard metallic circuits:



Electrolysis and Polarization: Using direct current (DC) would cause chemical decomposition (electrolysis) at the electrodes, changing the solution's concentration and creating a back-EMF that gives a false resistance reading.

Contact Resistance: Physical connection between the bridge and a liquid is impossible; special platinized platinum electrodes (coated in "platinum black") must be used to increase surface area and reduce resistance errors at the interface.