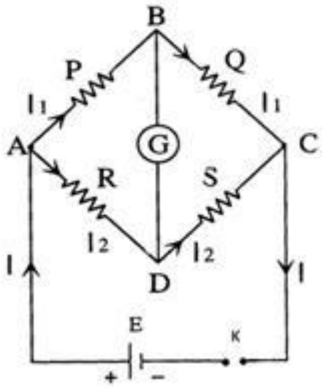
Determination of specific resistance of the material of a wire by meter bridge (length and diameter of the wire to be supplied)

Our Objective:

To find the resistance of a given wire using a meter bridge and hence determine the specific resistance of its material of the wire.

Theory:- **Wheatstone bridge principle**



The meter bridge operates following Wheatstone bridge principle. Here, four resistors P, Q, R, and S are connected to form the network ABCD. The terminals A and C are connected to a battery, and the terminals B and D are connected to a galvanometer. In the balancing condition, there is no deflection on the galvanometer. Then,

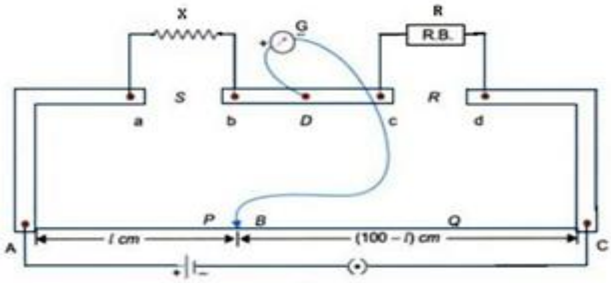
$$\frac{P}{Q} = \frac{R}{S}$$

Bridge apparatus

The bridge, also known as the slide wire bridge consists of a one long wire of uniform cross sectional area, fixed on a wooden block. A scale is attached to the block. Two gaps are formed on it by using thick metal strips in order to make the Wheat stone's bridge. The terminal B between the gaps is used to connect galvanometer and jockey.

A resistance wire is introduced in gap S and the resistance box is in gap R. One end of the galvanometer is connected to terminal D and its other end is connected to a jockey. As the jockey slides over the wire AC, it shows zero deflection at the balancing point (null point).

If the length AB is l, then the length BC is (100-l).



Then, according to Wheatstone bridge principle;

$$\frac{X}{R} = \frac{l}{(100 - l)}$$

Now, the unknown resistance can be calculated as,

$$X = R\frac{l}{(100 - l)}$$

Experimental Result:-

Length of the wire (L) = cm.

Diameter of the wire (D) = cm.

To find the resistance of the given wire:

Table

No. Obs.	Resistance R (Ω)	Resistance wire in left gap			Resistance wire in the right gap			Mean, $X = \frac{X_1 + X_2}{2}$ (Ω)
		Balancing length, AB =l (cm)	Length, BC =(100-l) (cm)	$X_1 = \frac{Rl}{(100 - l)}$ (Ω)	Balancing length, A'B' = l' (cm)	Length, B'C' =(100-l') (cm)	$X_2 = \frac{Rl'}{(100 - l')}$ (Ω)	
1								
2								
3								
4								
5								

The specific resistance or resistivity of the material of the wire can be then calculated by using the relation,

$$\rho = \frac{\pi r^2 X}{L};$$

Where, L be the length of the wire and r be its radius.

REMARKS

a) Current in the circuit should not be too high. Resistance may change due to Heating effect.

b) If the pointer of Ammeter or Voltmeter is deflected in the reverse direction, then the polarity of the cell should be interchanged.

c) Tapping key should not be closed for a long time. It may cause heating effect.

d) Ammeter is to be connected in series but Voltmeter in parallel.

Learning Outcomes:

- Students understand Wheatstone bridge and Wheatstone bridge principle.
- Students verify Wheatstone bridge principle.
- Students correlate the principle of Wheatstone bridge with bridge experiment.