UNIT IV

How Things Work

Experiment 48

AIM

To study the dependence of the potential difference across a resistor on the current through it and to determine its resistance and to verify the Ohm's law.

THEORY

According to the Ohm's law, the potential difference (V) across the ends of a resistor is directly proportional to the current (I) through it provided its temperature remains the same. That is

$$V \propto I$$

or $$\frac{V}{I} = \text{constant} = R$$

or $$V = RI.$$

Here R is a constant for the given resistor at a given temperature and is called its resistance. The SI unit of resistance is ohm (Ω). A graph between the potential difference across the two ends of a resistor and the current through it is a straight line pasing through the origin. The slope of this graph gives the resistance R of the resistor. To verify the Ohm's law, we measure the potential difference across the two ends of a resistor at different currents through it in an electric circuit. The current through the resistor is measured by connecting an ammeter in series with it. The potential difference across the two ends of the resistor is measured by connecting the voltmeter in parallel with it. A straight line graph obtained between V and I verifies the ohm's law.

Materials Required

A resistor of about 5 Ω, an ammeter (0 - 3 A), a voltmeter (0 - 10 V), four dry cells of 1.5 V each with a cell holder (or a battery eliminator), a plug key, connecting wires, and a piece of sand paper.

Procedure

1. Note the range and least count of the given ammeter and the voltmeter.
2. Fresh connecting wires have an insulating layer on it. Similarly the connecting wires lying unused for some time may also develop an insulating layer. (How?) It is therefore important to clean the ends of connecting wires using a sand paper.
3. Draw a circuit diagram for studying the Ohm's law as shown in Fig. 48.1 in your notebook. Observe how different components like the ammeter, voltmeter, resistor, and the plug key are connected with the cells (or battery eliminator).
4. Set up the circuit by connecting different components with the help of connecting wires. Initially connect only one cell in the circuit (that is make cell connections between points A and B). In case a battery eleminator is used, keep the rating of the eliminator at the minimum (say at 2 V).

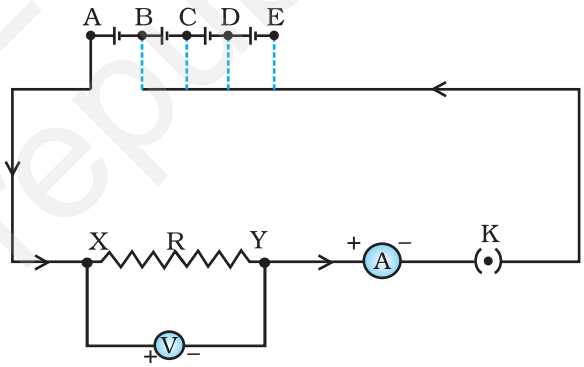

Fig. 48.1 **:** *An electric circuit for studying Ohm's law*

5. Make sure that the positive and negative terminals of the ammeter and voltmeter are **correctly** connected in the circuit as shown in Fig. 48.1. **Get the circuit set up by you checked by the teacher, before inserting the key into the plug**.
6. Insert the key in the plug to let the current establish in the circuit. Note the readings of the ammeter and voltmeter and record them. The voltmeter measures the potential difference (V) across the two ends X and Y of the resistor, and the ammeter measures the current I through it. Remove the key from the plug to avoid unnecessary heating of wires. (How does it happen? Think it in accordance with the Joule's law of heating.)
7. Now instead of using one cell in the circuit, connect two cells in the circuit (that is make cell connections between points A and C, in case