To determine Resistance Per Cm Of a Given Wire by Plotting a graph Of Potential Difference Versus Current.

Aim

To determine resistance per cm of a given wire by plotting a graph of potential difference versus current.

Apparatus

A resistance wire, a voltmeter (0-3) V and an ammeter (0-3) A of appropriate range, a battery (battery eliminator), a rheostat, a metre scale, one way key, connecting wires and a piece of sand paper.

Theory

According to the Ohm's law the current flowing through a conductor is directly proportional to the potential difference across its ends provided the physical conditions (temperature, dimensions, pressure) of the conductor remains the same. If I be the current flowing through a conductor and V be the potential difference across its ends, then according to, Ohm's Law,

$$I \propto V$$

$$V \propto I \quad \text{or} \quad V = RI$$

where, R is the constant of proportionality. It is known as resistance of the conductor.

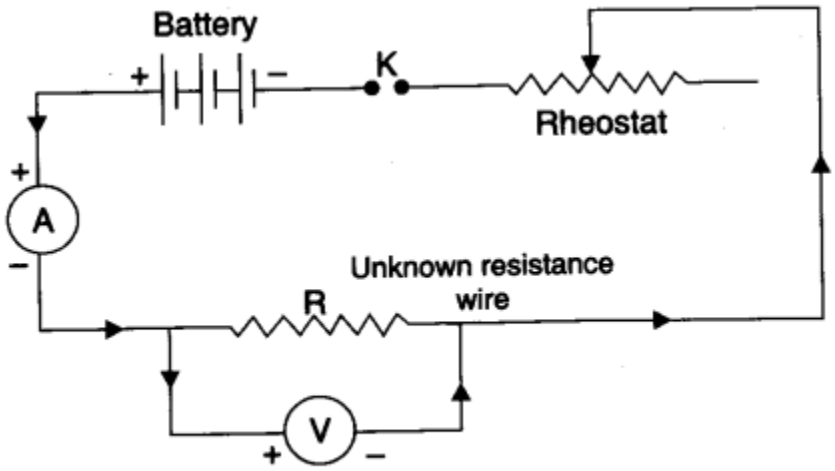
or $\boxed{\frac{V}{I} = R}$ ...Working formula

R depends upon the nature of material, temperature and dimensions of the conductor. In S.I. units, the potential difference V is measured in volt and the current I in ampere, the resistance R is measured in ohm.

(1) To establish the current-voltage relationship, it is to be shown that the ratio *V/I* remains constant for a given resistance, therefore a graph between the potential difference (V) and the current (*I*) must be a straight line.

(2) The constant ratio gives unknown value of resistance, $\left(\frac{V}{I} = R\right)$.

Circuit diagram

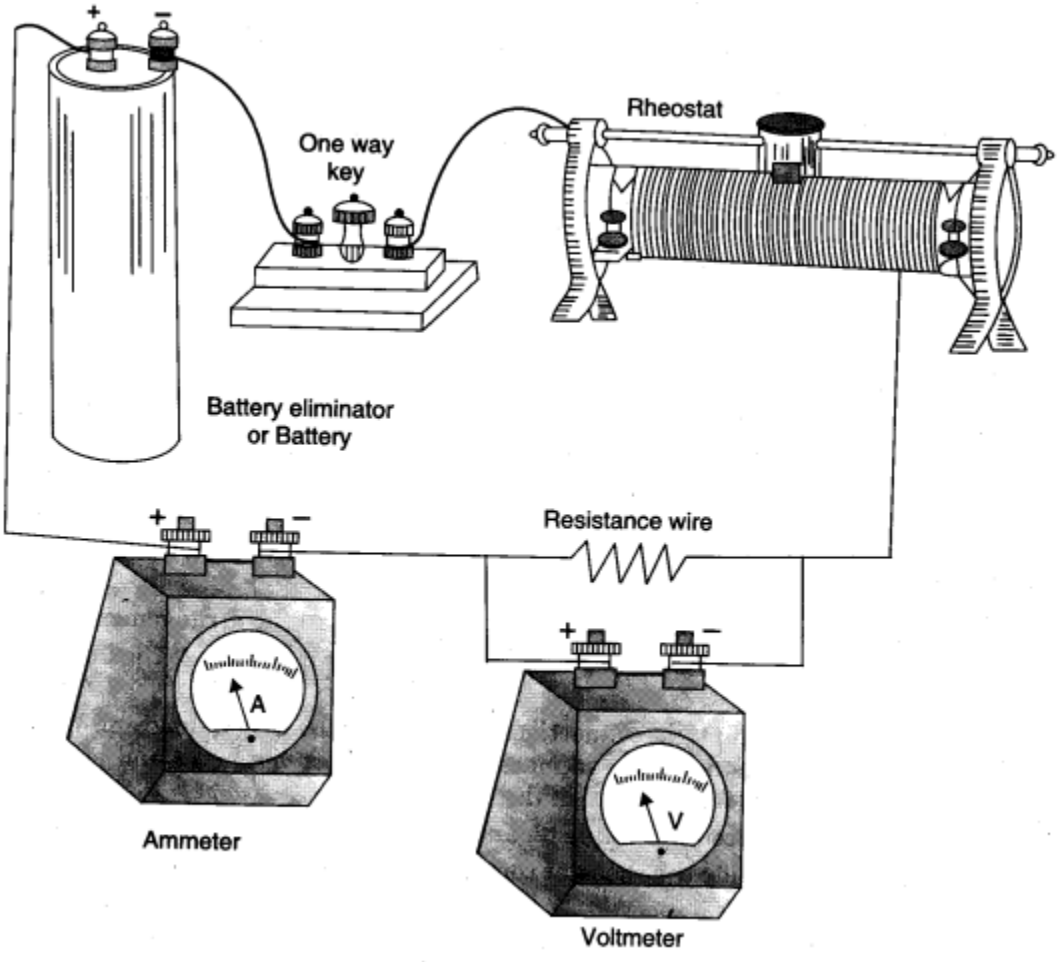


Circuit diagram.

Procedure

1. Arrange the apparatus in the same manner as given in the arrangement diagram.
2. Clean the ends of the connecting wires with sand paper to remove the insulations, if any.
3. Make neat, clean and tight connections according to the circuit diagram. While making connections ensure that +ve marked terminals of voltmeter and ammeter are joined towards the +ve terminal of the battery.
4. Determine the least count of voltmeter and ammeter, and also note the zero error, if any.
5. Insert the key K, slide the rheostat contact and see that ammeter and voltmeter are
   working properly.
6. Adjust the sliding contact of the rheostat such that a measurable current passes through the resistance coil or the resistance wire.
7. Note down the value of potential difference V" from voltmeter and current I from ammeter.
8. Shift the rheostat contact slightly so that both ammeter and voltmeter show full divisions readings and not in fraction.
9. Record the readings of the voltmeter and ammeter.
   Note. In case of battery eliminator, follow these steps:
   Turn the knob at 2 V in battery eliminator and put the constant point in rheostat at fixed position. Now record the reading in voltmeter and ammeter.
   Without disturbing the rheostat, turn the knob of battery to different voltage such that 4, 6, 8, 10 and 12 Volts and record corresponding readings in voltmeter and ammeter.
10. Take at least five sets of independent observations.

11. Cut the resistance wire at the points where it leaves the terminals, stretch it and find its length by the metre scale.
12. Record your observations.



Arrangement diagram.

Observations

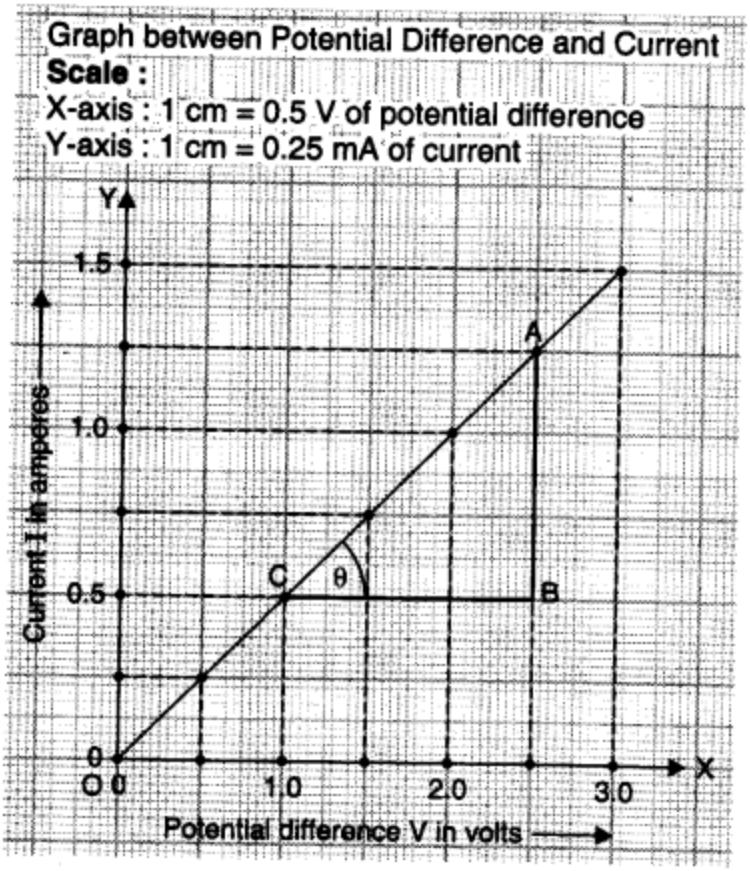
1. **Length**
   Length of the resistance wire *l* = …….
2. **Range**
   Range of the given ammeter = …….
   Range of the given voltmeter = …….
3. **Least count**
   Least count of ammeter = …….
   Least count of voltmeter = …….
4. **Zero error**
   Zero error in ammeter, e_1 = …….
   Zero error in voltmeter, e_2 = …….

5. **Zero correction**
   Zero correction for ammeter, $c_1 = -e_1$ = …….
   Zero correction for voltmeter, $c_2 = -e_2$ = …….
6. **Table for Ammeter and Voltmeter Readings**

	Voltmeter reading	Ammeter reading
A.	unchanged	decreases
B.	decreases	increases
C.	increases	unchanged
D.	unchanged	increases

Calculations

1. Find ratio of V and I for each set of observations.
2. Plot a graph between potential difference V (column 36) and current I (column 26), taking V along X-axis and I along Y-axis. The graph comes to be a straight line.



Graph between potential difference and current. It is a straight line.

From graph, the resistance can be calculated.

In ΔABC, $$\tan\theta = \frac{AB}{CB} = \frac{\Delta I}{\Delta V} \quad ...(1)$$

$$\cot\theta = \frac{\Delta V}{\Delta I} \quad ...(2)$$

but $$R = \frac{\Delta V}{\Delta I} \quad ...(3)$$

then, $$R = \cot\theta \quad ...(4)$$

$$R = \ldots\ldots\ \Omega.$$

3. Constant ratio $\frac{V}{I}$ gives resistance of the wire.
4. Resistance of the wire per cm = ... $\Omega\ cm^{-1}$.

Result

1. Resistance per cm of the wire is …….. $\Omega\ cm^{-1}$.
2. The graph between V and *I* is a straight line.

Precautions

1. The connections should be neat, clean and tight.
2. Thick copper wires should be used for the connections after removing the insulations near their ends by rubbing with sand paper.
3. Voltmeter and ammeter should be of proper range.
4. A low resistance rheostat should be used.
5. The key should be inserted only while taking observations to avoid heating of resistance (otherwise its resistance will increase).

Sources of error

1. The instrument screws may be loose.
2. Thick connecting wires may not be available.
3. Rheostat may have high resistance.