Experiment – 1

Aim

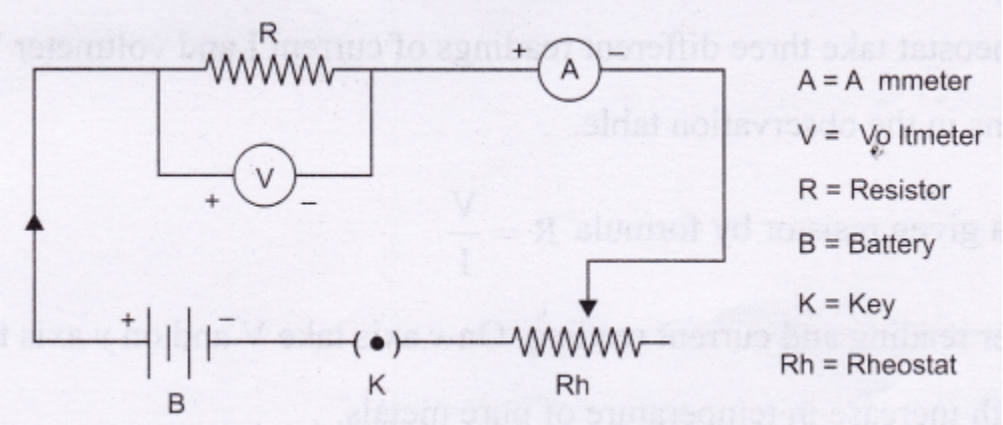
To study the dependence of potential difference (V) across a resistor on the current (I) passing through it and determine its resistance. Also plot a graph between V and I.

Materials Required

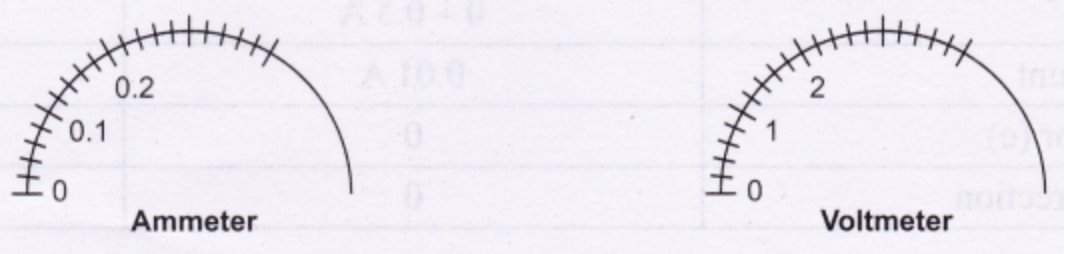
A battery, an insulated copper wire (cut into 10 pieces), a key, an ammeter, a voltmeter, a rheostat, a resistor and a piece of sand paper.

Theory

- **Ohm's Law:** The potential difference, V across the ends of a given metallic wire in an electric circuit is directly proportional to the current flowing through it, provided its temperature is the same. This is Ohm's law.
  $V \propto I$
  .'. $V = IR$, (Here R = Constant for the given metallic wire)
- The SI unit of resistance is Ohm (Ω).
  $R = \frac{V}{I}$
- **Circuit Diagram:**



- In a circuit ammeter is always connected in series and voltmeter is connected in parallel across the points between which potential difference is to be measured.
- A straight line graph obtained between V and I verifies the Ohm's law.
- **Least Count:** It is very important to find the least count of ammeter and voltmeter before using them.



If in the ammeter, there are 10 divisions from 0 to 0.1 A then each division indicates 0.01 A.

A. To calculate the least count of ammeter.

Range of ammeter = A_R.....

Number of divisions in ammeter = A_N.....

.' Least count of ammeter = $\frac{A_R}{A_N}$ = …….. ampere.

B. To calculate the least count of voltmeter.

Range of voltmeter = V_R……

Number of divisions in voltmeter = V_N

.'. Least count of voltmeter = $\frac{V_R}{V_N}$ = …… volt.

Procedure

1. Keep the devices as shown in the circuit diagram.
2. Connect them with the connecting wires and keep the key open.
3. Positive terminal of the battery is connected to the positive terminal of the ammeter.
4. Check the +ve and -ve terminals of voltmeter before connecting it in the circuit.
5. Once the circuit is connected, insert the key and check the rheostat, adjust its slider and see whether the ammeter and voltmeter readings are shown.
6. By using the slider of rheostat take three different readings of current 1 and voltmeter V.
7. Record your observations in the observation table.
8. Calculate resistance of a given resistor by formula $R = \frac{V}{I}$.
9. Plot a graph of voltmeter reading and current reading. On x axis take V and on y axis take I.
10. Resistance increases with increase in temperature of pure metals.

Observation Table

A. Least count of ammeter and voltmeter

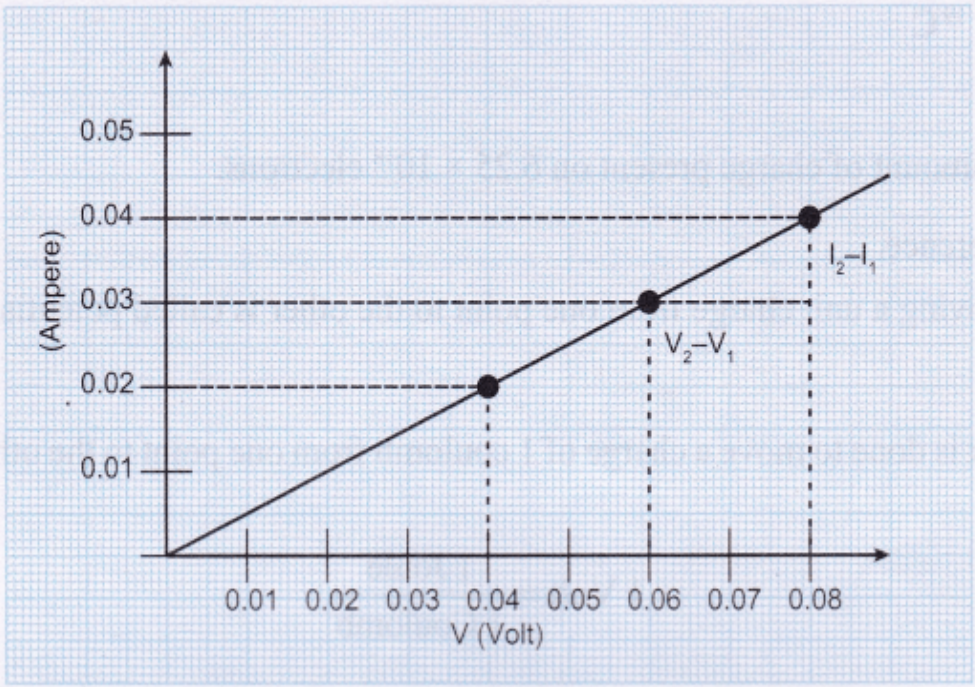
S. No.		Ammeter (A)	Voltmeter (V)
1.	Range	0 – 0.5 A	0-0.1 V
2.	Least Count	0.01 A	0.01 V
3.	Zero Error (e)	0	0
4.	Zero Correction	0	0

B. For reading of ammeter and voltmeter

S. No.	Current in Ampere (I) (Ammeter Reading)		Potential difference in Volts (V) (Voltmeter Reading)		Resistance in Ohms R = V/I(
	Observed	Corrected	Observed	Corrected	
1.	0	0.02	0	0.04	R_1 =2 Ω
2.	0	0.03	0	0.06	R_2 = 2 Ω

3.	0	0.04	0	0.08	$R_3 = 2\Omega$

$$\therefore \text{ Mean value of } R = \frac{R_1 + R_2 + R_3}{3} = \frac{2+2+2}{3} = 2\,\Omega$$



Graph between current and voltage

Conclusions

1. The value of R is found to be same and constant in all three readings.
2. The resistance of a resistor is ratio of potential difference V and current I.
3. The graph of V and I is a straight line. This shows that $V \propto I$. This verifies Ohm's law.

Precautions

1. The connecting wires should be thick copper wires and the insulation of their ends should be removed using the sand paper.
2. Connections should be tight otherwise some external resistance may introduce in the circuit.
3. Connections should be made as per the circuit. Before closing the circuit show the connections to the teacher to take the readings.
4. The ammeter should be connected in series with the resister such that the current enters at the positive terminal and leaves at the negative terminal of the ammeter.

5. Voltmeter should always be connected in parallel to resistor.
6. Calculate the least count of voltmeter and ammeter correctly.
7. The pointers of the ammeter and voltmeter should be at zero mark when no current flows through the circuit.
8. Current should be passed through the circuit for a short time while taking observations; otherwise current would cause unnecessary heating in the circuit. Heating may change the resistance of resisters.