

## Chapter -11

# Electric Current

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### SYNOPSIS

According to Drude and Lorentz, metals contain a large number of free electrons while the positive ions are fixed in their locations. When the conductor is in open the net charge moving along a conductor through any cross section is Zero. When the ends of the conductor are connected to the battery through a bulb the bulb glows.

If 'Q' is the charge crossing through any cross section of the conductor in a time interval 't', then electric current  $I = \frac{Q}{t}$ . A conductor with cross section is 'A' and  $V_d$  is the drift speed of the electron,  $n$  is the number of electrons then electric current  $I = nqAv_d$ , where q is the charge of an electron.

Potential is the work done by the electric force on unit positive charge to move it through a certain distance. The S.I unit of potential is "Volt".

1 volt = 1 joule/coulomb.

Ohm's law is an empirical law which connects voltage and current. It states that "at constant temperature the current through the conductor (I) is directly proportional to voltage difference between the ends of conductor". i.e.  $V \propto I$  or  $V = IR$ , where 'R' is the resistance. When resistors are connected in series then the effective resistance.

$$R_{eq} = R_1 + R_2 + R_3 + \dots$$

When resistors are connected in parallel then the effective resistance is-

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \dots$$

To DC circuits there are two Kirchhoff's laws. 1) Junction law, 2) Loop law. Electric power can be calculate by the formula

$$p = I^2R = \frac{v^2}{R}$$

## 2 Mark Questions

1. **Are the headlights of a car connected in series or parallel? Why? [AS2]**

A. The headlights of car are connected in parallel due to following reasons.

- 1) Same potential (Voltage) will be maintained in two head lights.
- 2) If one of the lights be damaged, the other light will work without any disturbance.

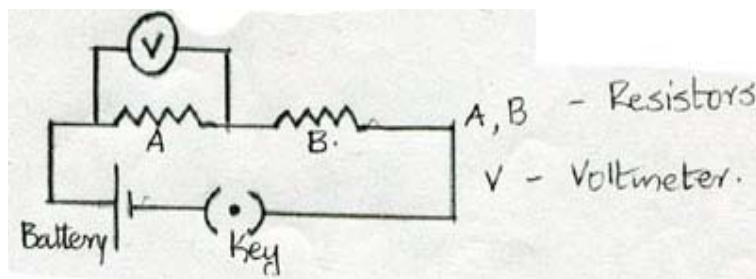
2. **Why should we connect electric appliances in parallel in household circuit? What happens if they are connected in series? [AS2]**

A. The household appliances are connected in parallel in a household circuit.

**Reason:** If they are connected in series, if any appliance switched off, other appliances get off. So to avoid this we use parallel connection.

3. **Draw a circuit diagram for a circuit in which two resistors A and B are connected to measure the potential difference across the resistor A [AS5]**

A.



A, B – Resistors

V – Voltmeter

## 1 Mark Questions

**1. What is a value of 1KWh in joules [AS1]**

A. Given

$$\begin{aligned} 1\text{KWh} &= 1000 \text{ w} \times 1 \text{ hour} \\ &= 1000 \times 3600 \text{ sec} \quad (1\text{w}= 1\text{Joule/ sec}) \\ &= 36 \times 10^5 \text{ Joules} \\ &= 3.6 \times 10^6 \text{ Joules.} \end{aligned}$$

**2. Silver is a better conductor of electricity than copper. Why do we use copper wire for conduction for electricity? [AS1]**

A. Silver is a better conductor of electricity than copper. But silver is a costly metal than copper. Hence copper is widely used for conduction for electricity.

**3. Why don't we use series arrangement of electrical appliances like bulb, television, fan and others in domestic circuits? [AS1]**

A. In series combination same current passes through all resistors in circuit. So, this series combination is not suggestible for household appliances like T.V, bulb, fan.

**4. Why do we consider tungsten as suitable material for making the filament of a bulb? [AS2]**

A. The filament of an electric bulb is usually made of tungsten, because of its higher resistivity value ( $5.56 \times 10^{-8} \Omega\text{m}$ ) and its high melting point ( $3422^{\circ}\text{c}$ ).

**5. a) Take a battery and measure the potential difference make a circuit and measure the potential difference when the battery is connected in a circuit. Is there any difference in potential difference in battery? [AS4]**

A. No. We don't find any change in potential difference in either case.

**b) Measure the resistance of a bulb (filament) in open circuit with a millimeter. Make a circuit with elements such as bulb, battery of 12v and key in series. Close the key. Then again measure the resistance of same bulb for every 30 seconds. Record the observations in a proper table. What can you conclude from above results? [AS4]**

- A. When the bulb is connected in a circuit and key is closed the resistance increase for every 30 seconds.

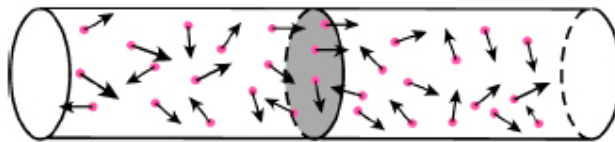
**Conclusion:**

1. The potential difference never changes in open circuit and closed circuit. The resistance of conductor increases when temperature of conductor increases.

**4 Mark Questions**

**1. Explain how electron flow causes electric current with Lorentz – Drude theory of electrons. [AS1]**

- A. 1. Drude and Lorentz, scientists of 19th century, proposed that conductors like metals contain large number of free electrons while the positive ions are fixed in their locations. The arrangement of positive ions is called lattice.
2. When the conductor is in an open circuit, the electrons move randomly in lattice space as shown in below figure (1)



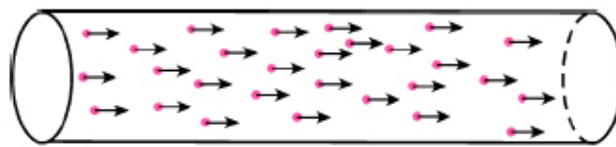
*fig-1: Random motion of electrons (in open circuit)*

3. If we imagine any cross section as shown above the number of electrons, crossing the cross section from left to right in one second is equal to that of electrons passing the cross section from right to left in one second. Hence net charge moving along a conductor through any cross section is zero.

4. When the ends of the conductor are connected to battery through a bulb, the bulb glows because of energy flows takes place from battery to bulb.

5. This happens only due to orderly motion of electron.

6. When the electrons are in ordered motion there will be a net charge crossing through any cross section of the conductor as shown in figure(2).



*fig-2: Ordered motion of electrons*

7. The ordered motion of electrons is called electric current.

## **2. How does a battery work? Explain [AS1]**

A. 1. A battery consists of two metal plates and a chemical [electrolyte]

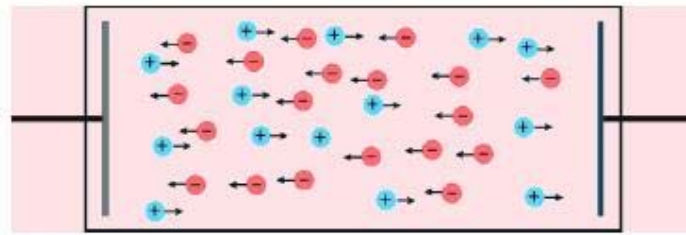
2. The electrolyte consist positive and negative ions which move in opposite directions.

3. This electrolyte exerts a force called chemical force ( $F_c$ ) to make ions move in a specified direction.

4. Positive ion move towards one plate and accumulate on that, as a result this plate becomes positively charged (Anode).

5. Negative ions move to another plate and accumulate on that. As a result this plate becomes negatively charged.

6. This accumulation continues till both plates are sufficiently charged.



Ordered motion of electrons

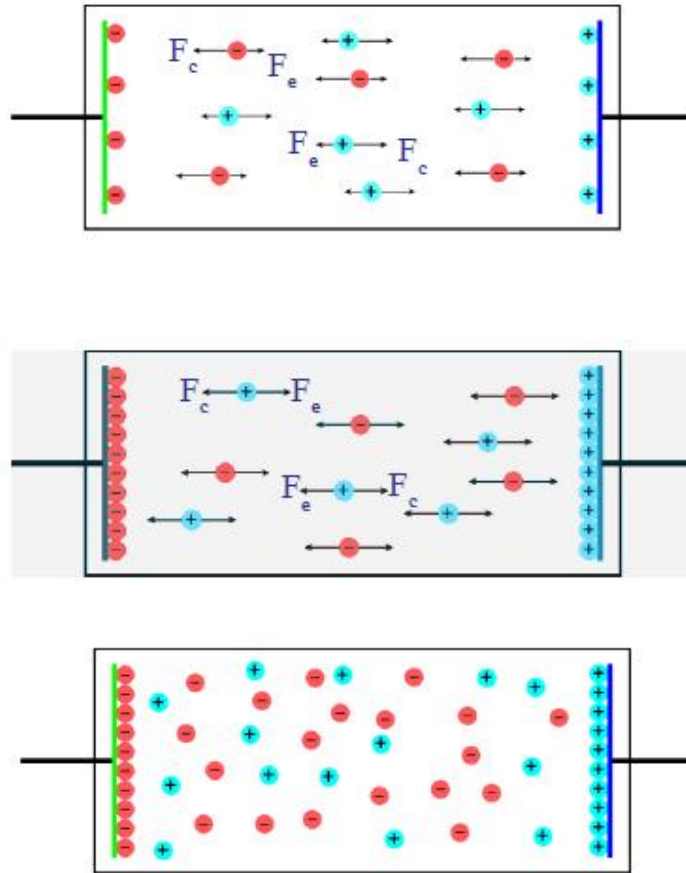
7. But the ions experience another force called electric force ( $F_e$ ), when sufficiently number of charges accumulated on the plates.

8. The direction of  $F_e$  is opposite to  $F_c$  and magnitude depends on the amount of charges accumulated on plates

9. The accumulation of charges on plates is continuous till  $F_e$  becomes equal to  $F_c$ . Now there will not be any motion due to balance of  $F_e$  and  $F_c$ .

10. The new battery that we buy from the shop is under the influence of balanced forces. This is the reason for constant potential difference between the terminals of battery.

11. When a conducting wire is connected to terminals of the battery, a potential difference is created between the ends of the conductor which sets up an electric field throughout the conductor.



12. The large number of electron in the conductor near the positive terminal of battery is attracted by it and start to move towards positive terminal. As a result the amount of positive charge on this plate decreases. So  $F_e$  becomes weaker than  $F_c$  and  $F_c$  pulls negative ions from anode towards cathode.

13. The negative terminal pushes one electron into the conductor because of stronger repulsion between negative terminal and negative ion.

14. Hence, total number of electrons in a conductor remains constant during current flow.

**3. Write the differences between potential difference and EMF? [AS1]**

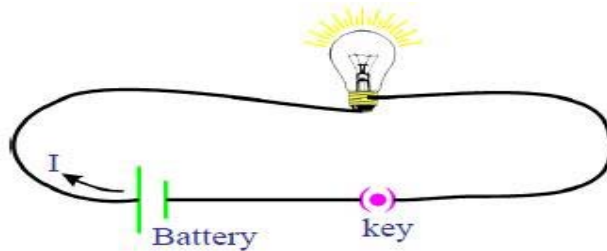
**A.**

Potential Difference	Electro Motive Force (EMF)
<p>1. Work done by electric force (<math>F_e</math>) on unit positive charge to move it through a distance '<math>l</math>' in the direction of electric field is called potential difference</p> <p>2. Potential difference <math>= \frac{w}{q} = \frac{F_e l}{q}</math></p> <p>3. S.I unit of potential difference is volt</p> <p>4. Potential difference is effect</p> <p>5. It depends upon resistance of circuit</p> <p>6. Potential difference is always less than EMF</p> <p>7. It doesn't remain constant</p> <p>8. Potential difference takes place between two points</p>	<p>1. EMF is defined as work done by the chemical force (<math>F_c</math>) to move unit positive charge from negative to positive terminal of battery.</p> <p>2. EMF <math>= \frac{W}{q} = \frac{F_c d}{q} = \frac{F_e d}{q}</math>  <math>d =</math> distance between terminals</p> <p>3. S.I unit of EMF is volt</p> <p>4. EMF is cause</p> <p>5. It doesn't depend upon resistance of circuit</p> <p>6. EMF is always greater than potential difference</p> <p>7. It remains constant.</p> <p>8. EMF creates potential difference in entire circuit</p>



**4. How can you verify that resistance of conductor is temperature dependent? [AS1]**

- A.
1. Measure the resistance of the bulb when it is in open circuit, using a multimeter.
  2. Note the reading in your book.
  3. Connect the circuit as shown in figure



4. Switch on the circuit after a few minutes switch off the circuit and measure the resistance of bulb using multimeter.
5. Note this reading in your note book.
6. The value of resistance in second instance is more than the resistance bulb in open circuit.
7. When bulb is connected in a circuit and current is passed through it, the bulb gets heated. This is responsible for increase in the resistance of bulb.
8. Hence the value of resistance of conductor depends on temperature for constant potential difference between the ends of conductor.

**5. What do you mean by electric shock? Explain how it takes place. [AS1]**

- A.
- An electrical shock can be experienced when there a potential difference exists between one part of body and another part.
1. When current flows through human body, it chooses the path which offers low resistance.

2. The resistance of body is not uniform throughout it.
3. As long as current flow continues inside the body the current and resistance of human body goes on changing inversely.
4. Hence, the electric shock is a combined effect of potential difference, electric current and resistance of human body.

**6. Derive  $R = \frac{\rho l}{A}$  [AS1]**

- A. 1. Resistance of conductor (R) is directly proportional to its length for a constant potential difference.

$$R \propto l \longrightarrow (i)$$

2. Resistance of a conductor is inversely proportional to cross section area.

$$R \propto \frac{1}{A} \longrightarrow (ii)$$

3. From (i) and (ii) we get

$$R \propto \frac{l}{A} \quad [\text{At constant temperature}]$$

$$R = \frac{\rho l}{A}$$

Where ' $\rho$ ' is proportionality constant and it is called as specific resistance or resistivity

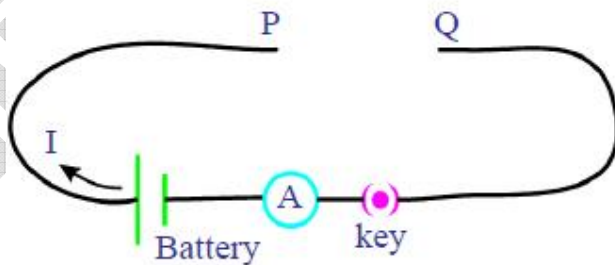
4. S.I unit of resistivity is  $\Omega - m$

**7. How do you verify that resistance of a conductor is proportional to the length of the conductor for constant cross section area and temperature? [AS1]**

- A. Following is the procedure-

1. We shall collect iron spokes of different lengths with the same cross sectional area
2. Make the circuit or shown in figure.
3. Then connect one of the iron spokes between P and Q
4. Measure the value of current using the ammeter connected to circuit and note it in your note book.
5. Repeat this for other lengths of iron spokes. Note the corresponding values of currents in your note book as shown below

Length of spoke	Current



6. We observe that current decreases as the length of spoke increases.
7. We know that resistance increases as current decreases
8. Hence we resistance of iron spoke increases as its length increases.
9. Hence we conclude that

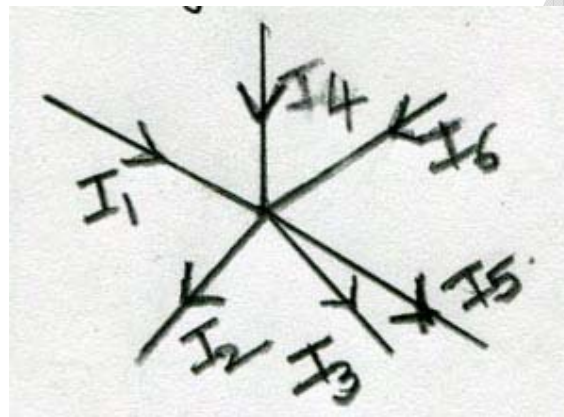
Resistance of conductor is directly proportional to length

$$R \propto l$$

**8. Explain Kirchhoff's laws with examples. [AS1]**

**A. 1. Kirchhoff's first law or Junction law:**

At any junction point in a circuit where the current can divide. The sum of current INTO the junction is EQUAL to the sum of currents LEAVING the junction.



From the figure, we have

$$I_1 + I_4 + I_6 = I_2 + I_3 + I_5$$

This is based on conservation of energy

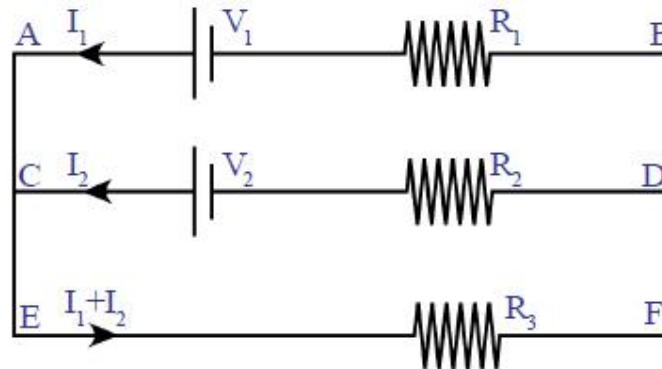
**2. Kirchhoff's second law or loop's law:**

1. The algebraic sum of the potential difference across the various components and EMFs in a closed circuit loop is Zero.

2. This law is based on conservation of energy

**Example:**

Let us imagine that in a circuit loop the potential difference between two points at beginning of loop has certain value. As we move around the circuit loop and measure the potential difference across each component in the loop, the potential difference across each component in the loop, the potential difference may decrease or increase depending upon the nature of the element like a resistor or a battery. But when we have completely transverse the circuit loop and arrive back to our starting point, the net change in the potential difference must be zero.



Applying loop law

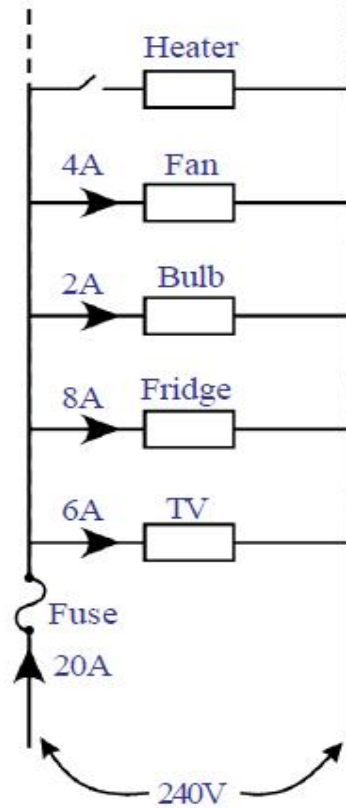
For the loop ACDBA  $-V_2 + I_2R_2 - I_1R_1 + V_1 = 0$

For the loop EFDCE  $-(I_1 + I_2)R_3 - I_2R_2 + V_2 = 0$

For the loop EFBAE  $-(I_1 + I_2)R_3 - I_1R_1 + V_1 = 0.$

**9. Explain overloading of household circuit. [AS1]**

A. 1. Electricity enters our homes through two wires called lines. These lines have low resistance and potential difference between the wires is usually about 240v.



2. All electric devices are connected in parallel in our home. Hence, the potential drop across each device is 240V.

3. Based on the resistance of each electric device. It draws some current from supply. Total current drawn from the main is equal to sum of currents passing through each device.

4. If we add more devices to the household circuit the current drawn from the mains also increases.

5. This leads to overheating and may cause fire. This is called overloading.

### 10. Why do we use fuses in household circuits? [AS1]

- A. 1. The fuse consists of a thin wire; the entire current from mains must pass through the fuse.

2.To prevent damages due to overloading we connect an electric fuse to the household circuit.

3.Generally the fuse consists of thin wire of low melting point.

4.When the current in the fuse overloaded, the wire gets heated and melted.

5.Now the circuit becomes open and prevents the flow of current.

6.So, all electrical devices are saved from damage that could be caused by overload.

**11. Deduce the expression for equivalent resistance of three resistors connected in series? [AS1]**

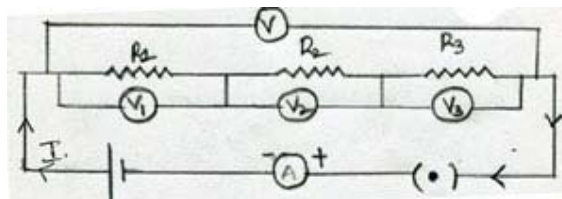
A. Two or more resistors are said to be connected in series. If the current flowing through one resistor, also flows through the others,

In same combination we know that-

a) Same current passes through the resistors

b) The potential difference across combination of resistor is equal to sum of voltage across the individual resistors. Connect the circuit as shown in figure.

The cell connected across the series combination of 3 resistors maintains a potential difference ( $V$ ) across the combination. Current flowing through combination is  $I$ .

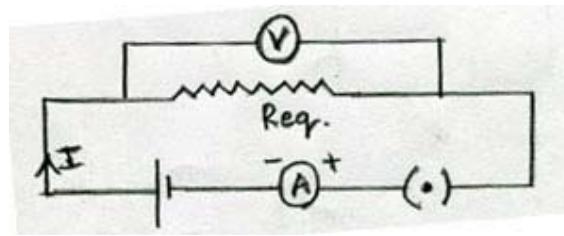


Let us replace the combination of resistors of 3 resistors by a single resistor  $R_{eq}$ , such that current doesn't change

$R_{eq}$  is given by

$$R_{eq} = \frac{V}{I}$$

$$V = I R_{eq}$$



The potential differences  $V_1, V_2, V_3$  across the resistors  $R_1, R_2, R_3$  respectively are given by Ohm's law

$$V_1 = IR_1; V_2 = IR_2; V_3 = IR_3$$

Since resistors connected in series

$$V = V_1 + V_2 + V_3$$

$$= IR_1 + IR_2 + IR_3$$

$$= I (R_1 + R_2 + R_3)$$

$$I R_{eq} = I (R_1 + R_2 + R_3)$$

$$R_{eq} = R_1 + R_2 + R_3$$

Similarly, for  $n$  resistors connected in series.

$$R_{eq} = R_1 + R_2 + R_3 + \dots + R_n.$$

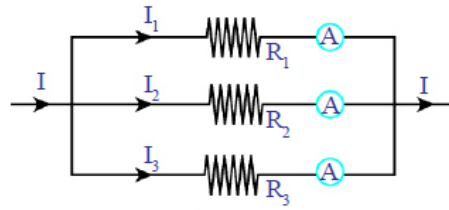
**12. Deduce the expression for equivalent resistance for three resistors connected in parallel? [AS1]**

A. If resistances are connected in such a way that the same potential difference gets applied across each of them, they are said to be connected in parallel.



For parallel combination, we know that

1. The total current flowing into the combination is equal to the sum of currents passing through the individual resistors.
2. The potential difference is same in all resistors connect the circuit as shown.
3. The cell connected across three resistors maintains the same potential difference across each resistor.



4. The current (I) divided into  $I_1, I_2, I_3$  which flows through resistors  $R_1, R_2, R_3$  Respectively.
5. Let replace the all resistors with equivalent resistance  $R_{eq}$ .

Equivalent resistance  $R_{eq} = \frac{V}{I}$

$$I = \frac{V}{R_{eq}}$$

Similarly  $I_1 = \frac{V}{R_1}; I_2 = \frac{V}{R_2}; I_3 = \frac{V}{R_3}$

Since Resistance in parallel

$$I = I_1 + I_2 + I_3$$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{Y}{Req} = Y \left[ \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right]$$

$$\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} .$$

**13. State Ohm's law? Suggest an experiment to verify it and explain the procedure?**  
**[AS3]**

**A. Ohm's law:**

At constant temperature, the potential difference between the ends of a conductor is directly proportional to electric current passing through it.

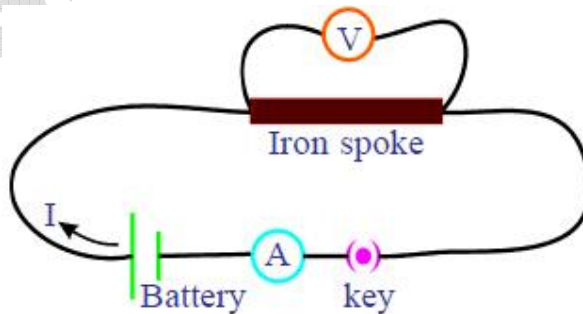
**Verification:**

**Aim:** To verify Ohm's law. (or) To show that the ratio  $\frac{V}{I}$  is a constant for a conductor.

**Materials required:** 5 dry cells, of 1.5v each, conducting wires, an ammeter thin iron spoke, a voltmeter, LED and key.

**Procedure:**

1. Connect a circuit as shown in figure.



- Solder the connecting wires to the ends of iron spoke.
- Close the key.
- Note the readings of current from ammeter and voltmeter reading in following table.

S.No.	Potential diff(v)	Current I	(V/I)

- Now connect two cells instead of one cell in circuit. Note the values of ammeter and voltmeter and record then in above table.
- Repeat the same for three cells, four cells and five cells respectively.
- Record the values of V and I respectively to each case in the table.

8. Find  $\frac{V}{I}$  for each set of values

9. We notice the  $\frac{V}{I}$  is constant

$$V \propto I$$

$$\Rightarrow \frac{V}{I} = \text{constant.}$$

This constant is known as resistance

$$\frac{V}{I} = R$$

$$V = IR.$$

**14. How can you appreciate the role of a small fuse in house wiring circuit in preventing damage to various electrical appliances connected in a circuit? [AS7]**

- A.
1. The fuse consists of a thin wire; the entire current from mains must pass through the fuse.
  2. To prevent damages due to overloading we connect an electric fuse to household circuit.
  3. Generally the fuse consists of thin wire of low melting point.
  4. When the current in the fuse overloaded, the wire get heated and melted.
  5. Now the circuit becomes open and prevents the flow of current. So, all electrical appliances are saved from damage that could be caused by overload.

**Problems**

**1. Two bulbs have ratings 100W, 220V, and 60W, 220V which one has greater resistance? [AS1]**

Sol: Resistance of first bulb  $R_1 = \frac{v^2}{p}$

$$= \frac{220 \times 220}{100}$$

$$= 484\Omega$$

Resistance of second bulb  $R_2 = \frac{v^2}{p}$

$$= \frac{220 \times 220}{60}$$

$$= 806.6\Omega$$

The bulb rated 60W, 220V has higher resistance.

**2. A wire of length 1m and 0.1mm radius has a resistance of 100Ω. Find resistivity of material. [AS1]**

**Sol:** Given

$$\text{Resistance } R = 100\Omega$$

$$\text{Length } l = 1\text{m} = 1000 \text{ mm}$$

$$\text{Radius } r = 0.1\text{mm}$$

$$\text{Area of cross section } A = \pi r^2$$

$$= \frac{22}{7} \times 0.1 \times 0.1$$

$$= \frac{22}{7} \times 0.01$$

$$= 3.14 \times 0.01$$

$$= 0.0314 \text{ mm}^2$$

$$\text{Resistivity } \rho = \frac{RA}{L} = \frac{100 \times 0.0314}{1000}$$

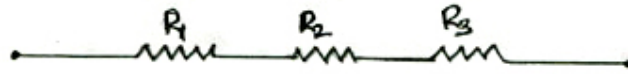
$$\text{Resistivity } \rho = 0.00314\Omega \text{ mm.}$$

**3. Suppose that you have three resistors each of value 30Ω. How many resistors can you obtain by various combinations of these three resistors? Draw diagrams in support your predictions. [AS2]**

**Sol:** Let  $R_1 = R_2 = R_3 = 30$ .

We get three combinations

1. Series:

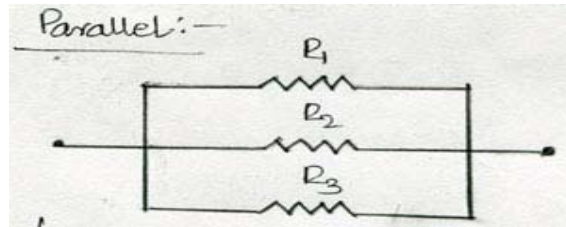


$$R_{eq} = R_1 + R_2 + R_3$$

$$= 30 + 30 + 30 = 90 \Omega$$

$$R_{eq} = 90 \Omega$$

2. Parallel:



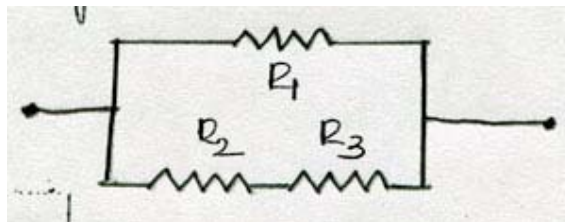
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \frac{1}{30} + \frac{1}{30} + \frac{1}{30}$$

$$= \frac{3}{30} = \frac{1}{10}$$

$$R_{eq} = 10 \Omega$$

3. Using both parallel and series:



$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2 + R_3}$$

$$= \frac{1}{30} + \frac{1}{30+30}$$

$$= \frac{3}{30} + \frac{1}{60}$$

$$\frac{1}{R_{eq}} = \frac{1}{20}$$

$$R_{eq} = 20$$

4. In the following figure, the potential at A is \_\_\_ when the potential at B is zero [AS5].



**Sol:** Potential difference between A and B.

$$V_{AB} = V_A - V_B$$

$$= V_A - 0$$

$$V_{AB} = V_A = 5 \times 1 - 2v$$

$$= 5-2$$

$$= 3v$$

Potential at A = 3V

5. Observe the circuit and answer the questions given below.

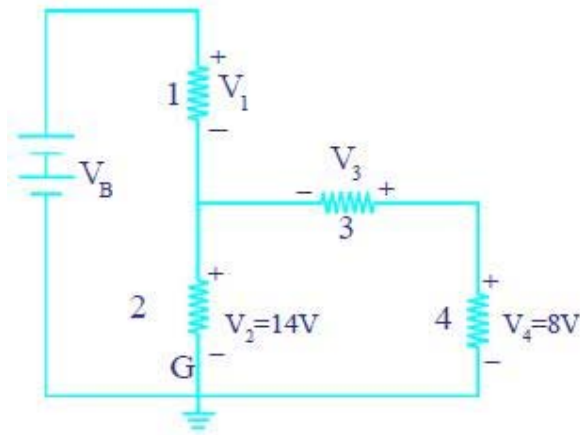
i) Are resistors 3 and 4 in series?

ii) Are resistors 1 and 2 in series?

iii) Is the battery in series with any resistor?

iv) What is the potential drop across the resistor 3?

v) What is the total EMF in the circuit if the potential drop across resistor is 6v? [AS5]



i. No, resistors 3 and 4 are not in series.

ii. Yes, resistors 1 and 2 are in series.

iii. No, battery is not in series with any resistor.

iv. As 3 and 4 resistors are in parallel, same potential difference will be allowed through them

$$V_4 = V_3 = 8v$$



v. Total EMF =  $v_1 + v_2 + v_3$

$$= 6 + 14 + 8 \quad [∵ V_1 = 6v]$$

$$= 28v.$$

- 6. If the resistance of your body is  $100000\Omega$ , what would be the current that flows in your body when you touch the terminals of 12v battery?**

Sol: Resistance of the body (R) =  $100000 \Omega$

Potential difference of battery (v) = 12V

Current that flows in body I = i (say)

According to ohm's law

$$V = iR$$

$$i = \frac{v}{R}$$

$$= \frac{12}{1,00,000}$$

$$i = 0.00012A.$$

Current flows in body = 0.00012A.

- 7. A uniform wire of resistance  $100\Omega$  is melted and recast into wire of length doubles that of the original. What would be the resistance of new wire formed?  
[AS7]**

Sol: Before recasting

Resistance  $R_1 = 100 \Omega$

Length ( $l_1$ ) = l

After casting

Resistance  $R_2 = ?$

Length ( $l_2$ ) = 2l

we know that

Resistance  $\propto$  length i.e.,  $R \propto l$

$$\frac{R_1}{R_2} = \frac{l_1}{l_2}$$

$$\frac{100}{R_2} = \frac{l}{2l}$$

$$\frac{100}{R_2} = \frac{1}{2}$$

$$R_2 = 200 \Omega$$

Resistance of new wire formed = 200  $\Omega$

- 8. A house has three tube lights, two fans and a television. Each tube light draws 40W. The fan draws 80W and the television draws 60W. On the average, all the tube lights are kept on for four hours, two fans for 12 hours and the television for five hours a day. Find the cost of electric energy used in 30 days at the rate of Rs. 3.00 per KWh. [AS7]**

**Sol:** Given

Device	Rated power	Time utilized
Tube light	40W	5 hours
Fan	80W	12 hours

Television	60W	5 hours
------------	-----	---------

Power consumed by tube lights in a day =  $40W \times 3 \times 5H$

$$= 600 \text{ watt hour}$$

$$= 0.6 \text{ KWh.}$$

Power consumed by fans in a day =  $80W \times 2 \times 12H$

$$= 1920 \text{ watt hour}$$

$$= 1.920 \text{ KWh.}$$

Power consumed by television in a day =  $60W \times 1 \times 5H$

$$= 300 \text{ watt hour}$$

$$= 0.300 \text{ KWh.}$$

Total power consumed in 1 day =  $0.6 + 1.920 + 0.300$

$$= 2.820 \text{ KWh}$$

Power consumed in 30 days =  $2.820 \times 30$

$$= 84.6 \text{ KWh.}$$

Rate of 1kwh = Rs 300/-

Rate of 84.6kwh =  $84.6 \times 3$

$$= \text{Rs. } 253.8/-$$

Cost of electric energy used = Rs. 253.8.

Fill in the Blanks

1. The kilowatt hour is that unit of \_\_\_\_\_.
2. A thick wire has a \_\_\_\_\_ resistance than a thin wire.
3. An unknown circuit draws a current of 2A and 12V battery its equivalent resistance is \_\_\_\_\_.
4. S.I. unit of potential difference is \_\_\_\_\_.
5. S.I. unit of current is \_\_\_\_\_.
6. Three resistors of values  $2\Omega$ ,  $4\Omega$ ,  $6\Omega$  are connected in series. The equivalent resistance of combination of resistors \_\_\_\_\_.
7. Three resistors of  $2\Omega$ ,  $4\Omega$ ,  $6\Omega$  are connected in parallel. The equivalent resistance of combination of resistors \_\_\_\_\_.
8. The power delivered by a battery of EMF 10V is 10W then the current delivered by battery is \_\_\_\_\_.
9. \_\_\_\_\_ is used to measure current.
10. \_\_\_\_\_ is used to measure voltage (potential difference).
11. S.I. unit of power \_\_\_\_\_.
12. S.I. unit of electric energy \_\_\_\_\_.
13. Filament of electric bulb is made of \_\_\_\_\_.
14. The ordered motion of electron is \_\_\_\_\_.
15. Symbol of rheostat \_\_\_\_\_.

**Key.**

- 1. Electrical energy,      2. Less,      3.  $6\Omega$ ,      4. Volt,
- 5. Ampere,      6. 12 ohm,      7.  $\frac{11}{12} ohm$ ,      8. 1 ampere,
- 9. Ammeter,      10. E voltmeter,      11. Watt,
- 12. Kilo Watt Hour (KWh),      13. Tungsten      14. Electric current



**Objective Type Questions**

- 1. A uniform wire of resistance  $50\Omega$  is cut into five equal parts. These parts are now connected in parallel, then the equivalent resistance of combinations is? [   ]  
A.  $2\Omega$     B.  $12\Omega$     C.  $250\Omega$     D.  $6250\Omega$
- 2. A charge is moved from a point A to a point B. The work done to move unit charge during this process is called- [   ]  
A. Potential at A      B. Potential at B  
C. Potential difference between A and B    D. Current from A to B
- 3. Joule/coulomb is the same as? [   ]  
A. 1 watt      B. 1 volt      C. 1 ampere    D. 1 ohm

4. **The current in wire depends?** [ ]

- A. Only on the potential difference applied
- B. Only on the resistance of wire
- C. On both of them
- D. None of them

5. **Consider following statements-**

**A: In series connection, the same current flows through each element**

**B: In parallel connection, the same potential difference gets applied across each element** [ ]

- A) Both A and B are correct
- B) A is correct but B is wrong
- C) A is wrong but B is correct
- D) Both A and B are wrong

6. **Electricity conducts freely in?** [ ]

- A) Conductor
- B) Insulator
- C) Semiconductor
- D) None of these

7. **Kilowatt hour is the unit of?** [ ]

- A) Potential difference
- B) Energy
- c) Electrical energy
- D) Electrical resistance

8. **The obstruction of the flow of electrons is called?** [ ]

- A) Current
- B) Potential difference

c) Resistance      D) Voltage

9. If two or more resistors are connected in series, then \_\_\_\_\_ flows through them is same. [   ]

A) Potential difference      B) Current

C) Resistance      D) Heat

10. If two or more resistors connected in parallel, then \_\_\_\_\_ is same in them. [   ]

A) Potential difference      B) Current

C) Resistance      D) Heat

Key:

1. A, 2. C, 3. B, 4. C, 5. A, 6. A, 7. C, 8. C, 9. B, 10. A,

### Match the Following

1. **Group-I**  
Variable

**Group-II**  
S.I.Units

- |                               |       |                  |
|-------------------------------|-------|------------------|
| 1. Resistance                 | [   ] | A) Watt          |
| 2. Current                    | [   ] | B) Volt          |
| 3. Electrical energy          | [   ] | C) Kilowatt hour |
| 4. Electrical power           | [   ] | D) Ohm           |
| 5. Electro Motive Force (EMF) | [   ] | E) Ampere        |

Key:

1. D, 2. E, 3. C, 4. A, 5. B

2. **Group-I**

Measuring device

**Group-II**

Variable

- |                   |     |                                    |
|-------------------|-----|------------------------------------|
| 1. Ammeter        | [ ] | A) Current, voltage and resistance |
| 2. Volt meter     | [ ] | B) Power                           |
| 3. Energy - meter | [ ] | C) Voltage and EMF                 |
| 4. Watt- meter    | [ ] | D) Current                         |
| 5. Multimeter     | [ ] | E) Electric energy                 |

**Key:**

1. D, 2. C, 3. E, 4. B, 5. A



**3. Group-I**

**Group-II**

- |  |  |
|--|--|
| <p>1. All resistors are in series [   ]</p> <p>2. All resistors are in parallel [   ]</p> <p>3. <math>R_1, R_2</math> are in series and <math>R_3</math> is parallel to both of them [   ]</p> <p>4. <math>R_1, R_2</math> are in parallel and <math>R_3</math> is in series with them [   ]</p> <p>5. <math>R_3</math> in series with <math>R_2</math> and <math>R_1</math> in parallel to both of them [   ]</p> <p><math>R_1, R_2, R_3</math> are three resistors</p> | <p>A) <math>\frac{R_3R_1 + R_2R_1}{R_1 + R_3 + R_2}</math></p> <p>B) <math>\frac{R_1R_3 + R_2R_3}{R_1 + R_2 + R_3}</math></p> <p>C) <math>R_1 + R_2 + R_3</math></p> <p>D) <math>\frac{R_1R_2R_3}{R_1R_2 + R_2R_3 + R_3R_1}</math></p> <p>E) <math>\frac{R_1R_2 + R_1R_3 + R_2R_3}{R_1 + R_2}</math></p> |
|--|--|

**Key:**

1. C, 2. D, 3. B, 4. E, 5. A