1. The accompanying figure shows some electrical appliances connected in a circuit in a house. Answer the following questions.

A. By which method are the appliances connected ?

Parallel connections.

B. What must be the potential difference across individual appliances ?

The same as the supply voltage.

C. Will the current passing through each appliance be the same? Justify your answer.

Different in general. We have I = V/R. Even if the voltage (V) is the same, the resistance (R) can be different. Hence, the current (I) through each appliance may not be the same.

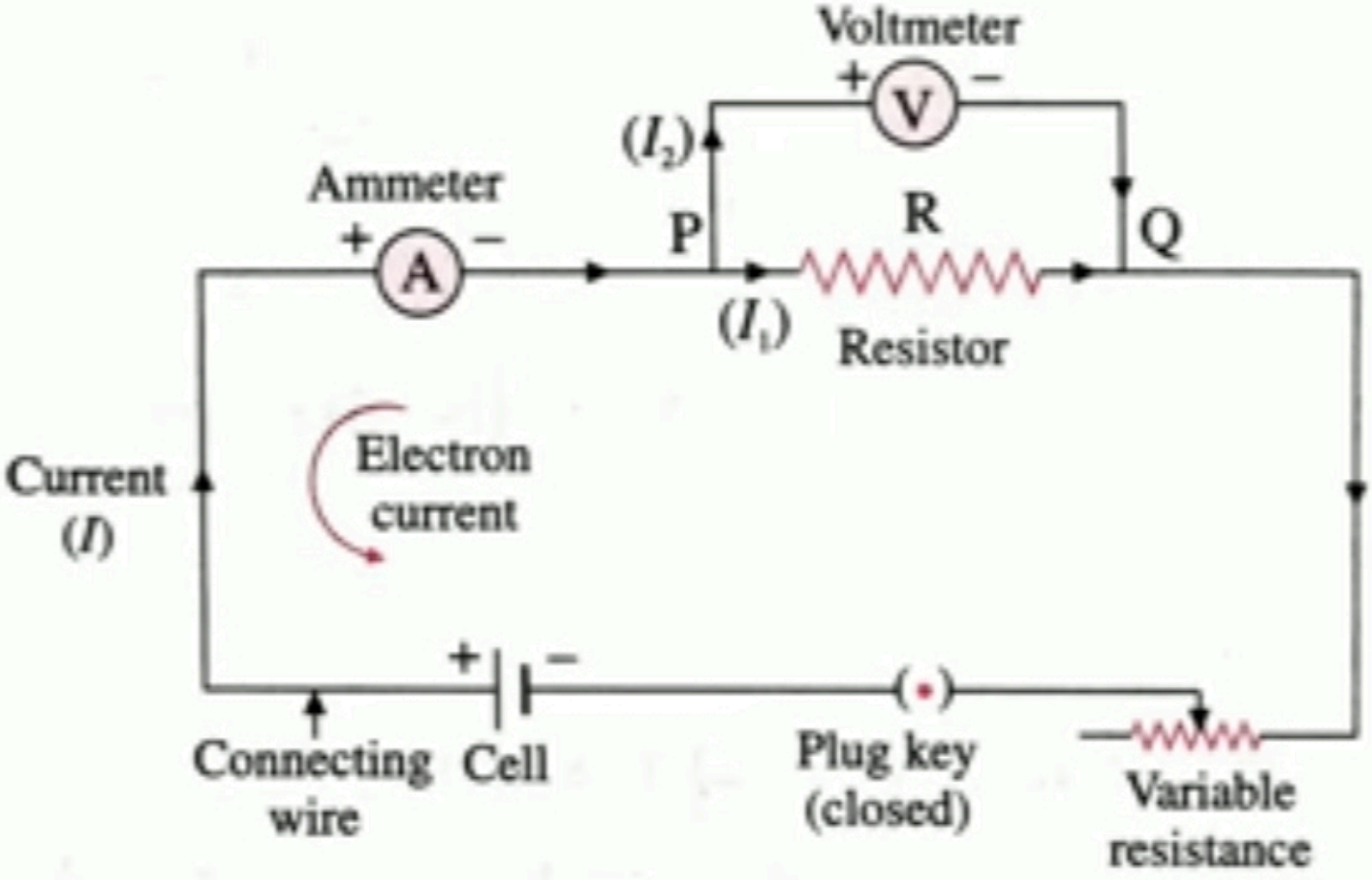
D. Why are the domestic appliances connected in this way ?

Even if one of the appliances in out of order, other appliances can be used.

E. If the T.V. stops working, will the other appliances also stop working ? Explain your answer.

Even if the TV stops working, other appliance will not stop working as they are connected in parallel across the supply.

2. The following figure shows the symbols for components used in the accompanying electrical circuit. Place them at proper places and complete the circuit.



Circuit diagram showing how different components are connected.

Which law can you prove with the help of the above circuit ?

Ohm's law can be verified with the help of the above circuit.

3. Umesh has two bulbs having resistances of 15 Ω and 30 Ω. He wants to connect them in a circuit, but if he connects them one at a time the filament gets burnt. Answer the following.

A. Which method should he use to connect the bulbs ?

Parallel combination.

B. What are the characteristics of this way of connecting the bulbs depending on the answer of question A above ?

Characteristic of a parallel combination of resistors :

(1) The voltage (potential difference) across each of the resistors is the same.

(2) The total current is equal to the sum of the currents through the individual resistors.

(3) The reciprocal of the effective resistance of the combination is equal to the sum of the reciprocals of the individual resistances.

(4) The effective resistance of the combination is less than any of the individual resistances.

(5) The current through each resistor is inversely proportional to the resistance of the resistor.

(6) This combination can be used to decrease the resistance in a circuit.

C. What will be the effective resistance in the above circuit ?

$$\frac{1}{R_p} = \frac{1}{15} + \frac{1}{30} = \frac{2+1}{30}$$

$$= \frac{3}{30} = \frac{1}{10} \quad \therefore R_p = 10\ \Omega$$

4. The following table shows current in Amperes and potential difference in Volts.

V (Volts)	I (Amp)
4	9
5	11.25
6	13.5

a. Find the average resistance.

$$R_1 = \frac{4\ V}{9\ A} = \text{about } 0.04\ \Omega$$

$$R_2 = \frac{5\ V}{11.25\ A} = \text{about } 0.04\ \Omega$$

$$R_3 = \frac{6\ \text{V}}{13.5\ \text{A}} = \text{about } 0.04\ \Omega$$

Average resistance = 0.44 Ω

b. What will be the nature of the graph between the current and potential difference? (Do not draw a graph.)

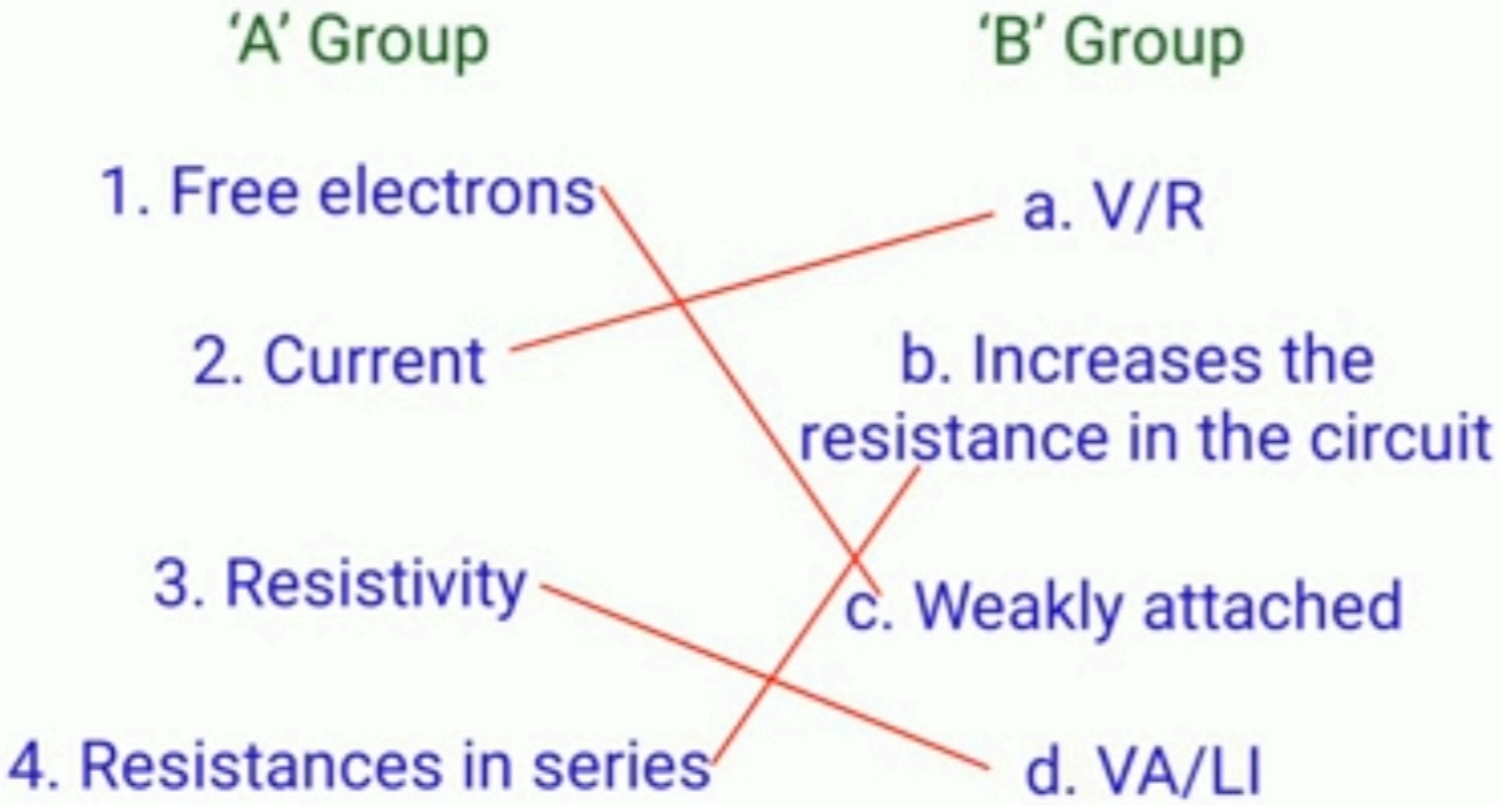
A straight line passing through the origin (0, 0).

c. Which law will the graph prove ? Explain the law.

Ohm's law.

The electric current flowing in a metallic conductor is directly proportional to the potential difference across its terminals, provided the physical conditions of the conductor such as its length, area of cross section, temperature and material remain constant.

5. Match the pairs.


'A' Group
'B' Group
1. Free electrons
a. V/R
2. Current
b. Increases the resistance in the circuit
3. Resistivity
c. Weakly attached
4. Resistances in series
d. VA/LI

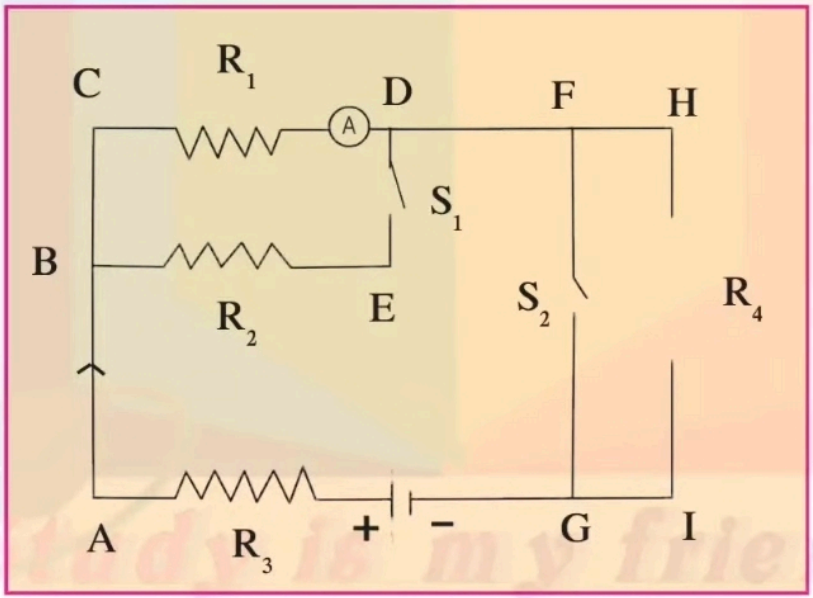
(Q.6) The resistance of a conductor of length x is r. If its area of cross section is a, what is its resistivity? What is its unit?

Ans = In the usual notation.

$$R = \rho\frac{L}{A} \qquad \therefore \text{Resistivity } \rho = \frac{RA}{L}$$

$$\therefore \text{Here, } \rho = \frac{ra}{x} \qquad \text{Unit : } \Omega.m$$

(Q.7) Resistances R_1, R_2, R_3 and R_4 are connected as shown in the figure. S_1 and S_2 are two keys. Discuss the current flowing in the circuit in the following cases.



(a) Both S_1 and S_2 are closed.

Ans - In this case, the total current will flow through branch FG and branch HI will not conduct any current. Hence, the current flow only through a resistance R_1, R_2 and R_3 but not through R_4.

(b) Both S_1 and S_2 are open.

Ans - In this case, current will flow through resistances R_1, R_3 and R_4. But the key S_1 joined in the branch DE is open, current will not flow through .R_2

(c) S_1 is closed but S_2 is open.

Ans - In this case, current will flow through resistances R_1, R_2, R_3, and R_4.

Question 8:

Three resistances x_1 , x_2 and x_3 are connected in a circuit in different ways. x is the effective resistance. The properties observed for these different ways of connecting x_1 , x_2 and x_3 are given below. Write the way in which they are connected in each case. (I-current, V potential difference, x-effective resistance)

a. Current I flows through x_1 , x_2 and x_3

b. x is larger than x_1 , x_2 and x_3

c. x is smaller than x_1 , x_2 and x_3

d. The potential difference across x_1 , x_2 and x_3 is the same

e. $x = x_1 + x_2 + x3$

f. $x = \frac{1}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3}}$

ANSWER:

a. In this case, x_1 , x_2 and x_3 are connected in series.

b. In this case, x_1 , x_2 and x_3 are connected in series.

c. In this case, x_1 , x_2 and x_3 are connected in parallel.

d. In this case, x_1 , x_2 and x_3 are connected in parallel.

e. In this case, x_1 , x_2 and x_3 are connected in series.

f. In this case, x_1 , x_2 and x_3 are connected in parallel.

The resistance of a 1m long nichrome wire is 6 ohm. If we reduce the length of the wire to 70 cm. what will its resistance be?

Resistance of a wire is directly proportional to its length. Let R_1 and R_2 be the resistances of the nichrome wire at 100 cm (1 m) and 70 cm, respectively. Therefore,

$R_1 \propto 100$ .....(i)

and

$R_2 \propto 70$ ..... (ii)

Dividing (ii) by (i) , we get

$$\frac{R_2}{R_1} = \frac{70}{100}$$

$$\Rightarrow R_2 = \frac{70}{100} \times R_1$$

Now , $R_1 = 6\Omega$

$$\Rightarrow R_2 = \frac{70}{100} \times 6 = 4.2\Omega$$

When two resistors are connected in series, their effective resistance is 80 W. When they are connected in parallel, their effective resistance is 20 W. What are the values of the two resistances?

When connected in series

$R_1 + R_2 = 80\Omega$ .....[1]

When connected in parellel

$$\frac{R_1 R_2}{R_1 + R_2} = 20\Omega \text{ .....[2]}$$

Equation [2] can also be written as

$$\frac{R_1 R_2}{80} = 20 \text{ .....[}\because \text{ From (1)]}$$

$$R_1 R_2 = 1600$$

$$R_1 = \frac{1600}{R_2}$$

Substitute this value in equation [1]

$$\left(\frac{1600}{R_2}\right) + R_2 = 80$$

$$R_2^2 - 80R_2 + 1600 = 0$$

$$(R_2 - 40)(R_2 - 40) = 0$$

$$\Rightarrow R_2 = 40\Omega$$

Solve the above polynomial equation

We will get $R_2 = 40\Omega$

If $R_2\ is\ 40\Omega$ then from equation [1] R_1 is also 40Ω

Therefore,

The values of two resistance are 40Ω

Solve the following problem.

If a charge of 420 C flows through a conducting wire in 5 minutes what is the value of the current?

Current flowing through the conducting wire is

$$I = \frac{\text{Charge (Q)}}{\text{Time (t)}}$$

$$\Rightarrow I = \frac{420}{5 \times 60} = 1.4A$$

Hence , the current flowing through th wire is 1.4 A .