LBNPS JAUNPUR

Subject - Science (Physics)

CHAPTER -1 (Electricity)

CLASS X

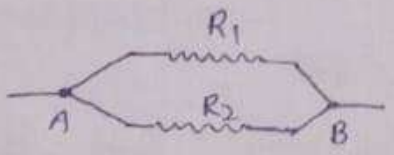
- **Combination of resistances (or resistors) :-**

The resistances can be combined in two ways -

1. in series
2. in parallel

1. **Series combination** - When two or more than two resistances are connected end to end consecutively, they are said to be connected in series.

2. **Parallel Combination** - When two or more than two resistances are connected between the same two points, the are said to be connected in parallel.

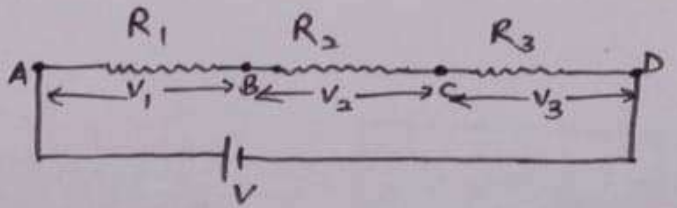


- **Series Combination** - The

Let $R_1, R_2, R_3 \ldots$ are connected in series -

for series combination -

The current in all resistors are same but potential differences are unequal.



Total voltage (V) = $V_1 + V_2 + V_3$

we know that — $V = iR$, $V_1 = iR_1$, $V_2 = iR_2$

$V_3 = iR_3$

So,

$$iR = iR_1 + iR_2 + iR_3$$

$$\Rightarrow iR = i(R_1 + R_2 + R_3)$$

$$\Rightarrow \boxed{R = R_1 + R_2 + R_3}$$

when n number of resistors are connected in series —

$$\boxed{R_{eq} = R_1 + R_2 + R_3 + \cdots + R_n}$$

Parallel Combination —

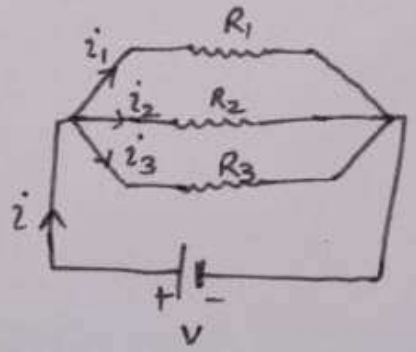
Let R_1, R_2 & R_3 resistors are connected in parallel combination.

For Parallel combination—

The voltages in all branches are same but current is different.

So,

$$i = i_1 + i_2 + i_3 \quad \cdots\cdots (i)$$



we know that

$$i = \frac{V}{R} \ , \ i_1 = \frac{V}{R_1}$$

$$i_2 = \frac{V}{R_2} \ , \ i_3 = \frac{V}{R_3}$$

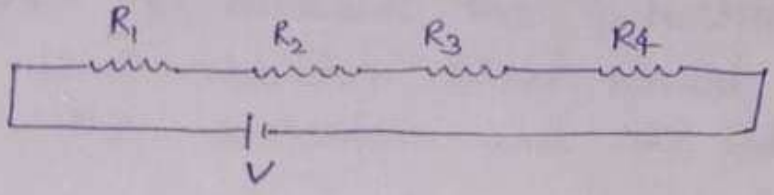
From equation (i)

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \Rightarrow \boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

When n number of resistors are connected — in

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

Ex- If four resistances, each of 1 Ω, connected in series, what will be the resultant resistance?



we know that —

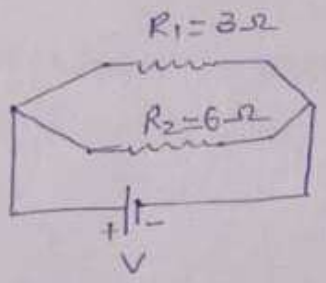
$$R_1 = R_2 = R_3 = R_4 = 1\,\Omega$$

So, $R_{eq} = R_1 + R_2 + R_3 + R_4$

$$\Rightarrow \quad R_{eq} = 1+1+1+1 = 4\,\Omega \quad \text{Ans.}$$

Ex- Calculate the equivalent resistance when two resistances of 3Ω and 6Ω are connected in parallel.

For parallel combination —



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

$$\Rightarrow \quad \frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6}$$

$$\Rightarrow \quad \frac{1}{R_{eq}} = \frac{3}{6}$$

$$\Rightarrow \quad R_{eq} = \frac{6}{3} = 2\,\Omega \quad \text{Ans.}$$

Ex- (a) Draw the diagram of a circuit consisting of a battery of three cells of 2V each, a 5Ω resistor, an 8Ω resistor and a 12Ω resistor and a plug key, all connected in series.

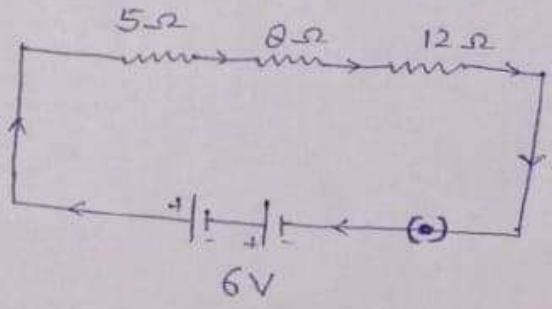
(b) Redraw the above circuit putting an ammeter to measure the current through the resistors and voltmeter to measure the potential difference across the 12Ω resistor. What would be the reading in the ammeter and the voltmeter.

Ans.

(a) Calculation of current flowing in the circuit –

Total resistance, $R = 5+8+12$

$R = 25\,\Omega$



Given, $V = 6\,V$

Current $i = \frac{V}{R}$

$i = \frac{6}{25} = 0.24\,A$ Ans.

(b) Calculation of potential difference across 12Ω —

$i = 0.24\,A$

$R = 12\,\Omega$

$V = iR$

$V = 0.24 \times 12$

$V = 2.88$ Volt Ans.

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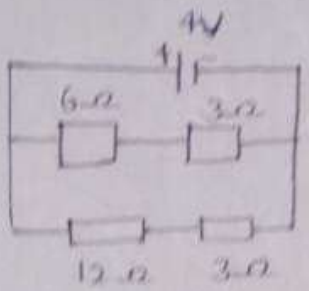
Questions

Que. 1. Give the laws of combination of resistances in series.

Que 2. State the laws of combination of resistances in parallel.

Que 3. A battery of 9 volt is connected in series with resistor of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω. How much current would flow through the 12 Ω resistor.

Que 4. For the circuit shown in the diagram below:-

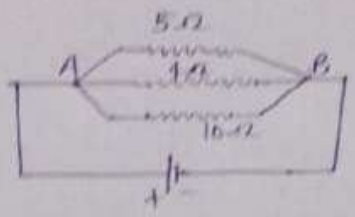


what is the value of:

(i) Current through 6 Ω resistor?

(ii) potetial difference across 12 Ω resistor?

Que 5. In the circuit diagram given below, the current flowing across 5 Ω resistor is 1 amp. Find the current flowing through the other two resistors



Que 6. A resistor has a resistance of 176 Ω. How many of these resistors should be connected in parallel so that their combination draws a current of 5 amperes from a 220 V supply line?