Topic:- Combinations of Resistances, Colour Coding of Carbon Resistances.

[6] Combination of Resistances :-

There are two Combination of Resistances

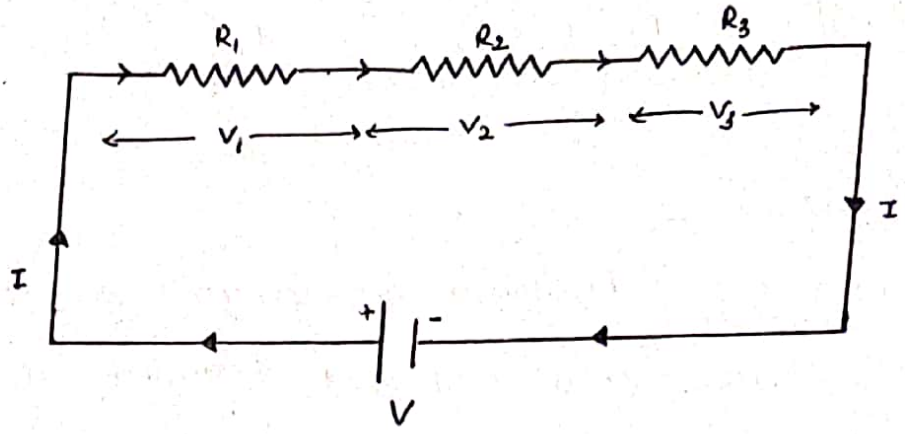
- Resistances in Series.
- Resistances in Parellel.

[1] Resistances in Series :- If No. of Resistances are connected end to end so that the same Current flows through each one of them in succession, then they are said to be Connected in Series.

Key point :-

- Current through all the resistor is same.
- Potential difference across a resistor is proportional to its resistances.
- Total Potential drop = Sum of the potential drop across the individual resistances.

Formula for Equivalent Resistances :-



Let us Consider above Circuit diagram in which three resistances R_1, R_2 & R_3 Connected in Series.

Since the total Potential drop = Sum of the potential drop across each resistance

$$\Rightarrow \quad V = V_1 + V_2 + V_3 \qquad \text{——— (1)}$$

By ohm's law

$$V_1 = I R_1 \,, \quad V_2 = I R_2 \,, \quad V_3 = I R_3 \qquad \text{——— (2)}$$

if R_s is the equivalent Resistances of the Series Combination

$$V = I R_s \qquad \text{——— (3)}$$

Putting the value of equation (3) & (2) in equation (1)

we get -

$$IR_s = IR_1 + IR_2 + IR_3$$

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

or $$\boxed{R_s = R_1 + R_2 + R_3}$$

for n Resistances ...

$$\boxed{R_s = R_1 + R_2 + R_3 + \dots + R_n}$$

Conclusion :-

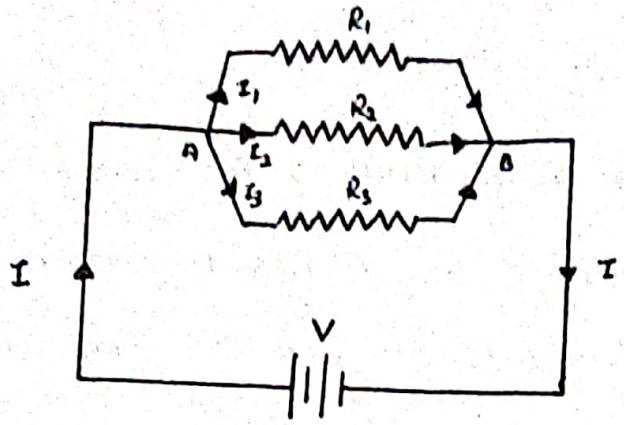
- when No. of Resistances are connected are connected in series, their equivalent Resistance is equal to the sum of the individual Resistances.
- Equivalent Resistance is larger than the largest individual resistances.

[2] **Resistances in Parallel** :- if a Number of Resistances are connected in between two common points so that each of them provides a separate path for current, then they are said to be connected in parallel.

Key points :-
- Potential difference across all of them is same
- Current through any resistor is inversely proportional to its resistance.
- Total Current = Sum of the current through

individual resistances.

Formula for equivalent Resistances :-



let us Consider above Circuit diagram in which three resistances are Connected in parellel.

Since the total Current = sum of the current through individual resistances.

$$\Rightarrow \quad I = I_1 + I_2 + I_3 \qquad \text{——— (1)}$$

by ohm's law

$$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3} \qquad \text{——— (2)}$$

if R_P is the equivalent Resistance of the parallel Combination

$$I = \frac{V}{R_P} \qquad \text{——— (3)}$$

Putting the value of eqn (3) & (2) in equation (1)

$$\frac{V}{R_P} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

or $$\boxed{\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

for n Resistances.

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

Conclusion :-

- When a No. of resistances are connected in parallel the reciprocal of the equivalent resistance of the parallel combination is equal to the sum of the reciprocals of the individual resistances.
- Equivalent resistance is less than the smallest individual resistances.