SNS COLLEGE OF ENGINEERING

Coimbatore-35
An Autonomous Institution
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New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

II ECE / II SEMESTER

Unit 1 –BASIC CIRCUITS ANALYSIS
Topic 1 -Ohm's Law

Ohm's Law & series and parallel circuits

Ohm's Law

Ohm's law is a formula that describes the relationship between voltage, current, and resistance in an electrical circuit. It's used to calculate the current flowing through a circuit, or to determine the resistance of a circuit.

Formula

$$V = IR$$

V: Voltage, measured in volts (V)

I: Current, measured in amperes (A)

R: Resistance, measured in ohms (Ω)

Calculate current

If you know the voltage and resistance of a circuit, you can calculate the current using Ohm's law.

Calculate resistance

If you know the voltage and current of a circuit, you can calculate the resistance using Ohm's law.

Design circuits

You can use Ohm's law to design circuits and select components to create efficient power.

Analyze circuits

You can use Ohm's law to analyze circuits and determine the power loss.

Limitations

Ohm's law only applies to linear devices and circuits.

Ohm's law may not be accurate in extreme conditions, such as very high voltages or very low temperatures.

Known values	Resistance (R)	Current (I)	Voltage (V)	Power (P)
Current & Resistance	·············	·············	$V = I \times R$	$P = I^2 \times R$
Voltage & Current	$R = \dfrac{V}{I}$	·············	·············	$P = V \times I$
Power & Current	$R = \dfrac{P}{I^2}$	·············	$V = \dfrac{P}{I}$	·············
Voltage & Resistance	·············	$I = \dfrac{V}{R}$	·············	$P = \dfrac{V^2}{R}$
Power & Resistance	·············	$I = \sqrt{\dfrac{P}{R}}$	$V = \sqrt{P \times R}$	·············
Voltage & Power	$R = \dfrac{V^2}{P}$	$I = \dfrac{P}{V}$	·············	·············

10 multiple-choice questions

1. Question:

Ohm's Law states that the voltage across a resistor is directly proportional to the current. What is the formula for Ohm's Law?

A) $V = I \times R$

B) $V = I/R$

C) $V = R/I$

D) $V = I + R$

Answer:

The correct formula for Ohm's Law is **A)** $V = I \times R$.

2. Question:

If the current in a circuit is 3A and the resistance is 5Ω, what is the voltage across the resistor?

A) 15V

B) 8V

C) 5V

D) 3V

Answer:

Using Ohm's Law:

$$V = I \times R = 3A \times 5\Omega = 15V$$

So, the correct answer is **A) 15V**.

3. Question:

In a circuit with a 12V battery and a 4Ω resistor, what is the current flowing through the resistor?

A) 3A

B) 0.33A

C) 6A

D) 2A

Answer:

Using Ohm's Law:

$$I = \frac{V}{R} = \frac{12V}{4\Omega} = 3A$$

So, the correct answer is **A) 3A**.

4. Question:

A 9V battery is connected to a resistor, and the current measured is 3A. What is the resistance of the resistor?

A) 0.3Ω

B) 3Ω

C) 27Ω

D) 9Ω

Answer:

Using Ohm's Law:

$$R = \frac{V}{I} = \frac{9V}{3A} = 3\Omega$$

So, the correct answer is **B) 3Ω**.

4. Question:

A 9V battery is connected to a resistor, and the current measured is 3A. What is the resistance of the resistor?

A) 0.3Ω

B) 3Ω

C) 27Ω

D) 9Ω

Answer:

Using Ohm's Law:

$$R = \frac{V}{I} = \frac{9V}{3A} = 3\Omega$$

So, the correct answer is **B) 3Ω.**

Series and Parallel circuits

A series circuit is a circuit where all components are connected in a single path, with the same current flowing through each component. The voltage drop across each component is different.

Characteristics of a series circuit

The current is the same throughout the circuit

The total voltage is the sum of the individual voltages

The total resistance is the sum of the individual resistances

The voltage across each component is proportional to its resistance
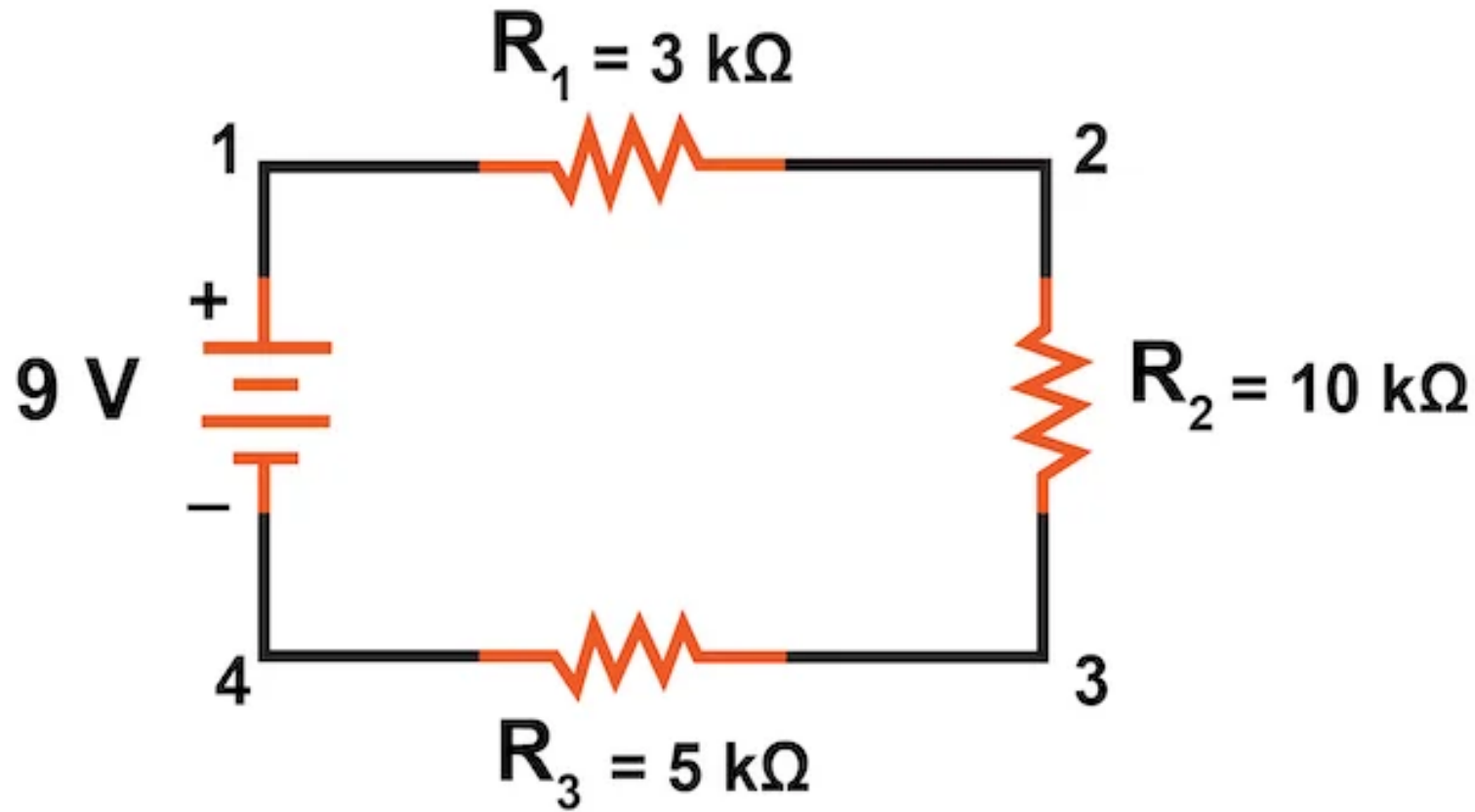
Figure 1. Series circuit with a battery and three resistors.

Current in a Series Circuit

       In a series circuit, the same amount of current flows through each component in the circuit. This is because there is only one path for the current flow. Since electric charge flows through conductors like marbles in a tube, the rate of flow (marble speed) at any point in the circuit (tube) at any specific point in time must be equal.

An important caveat to Ohm's law is that all quantities (voltage, current, resistance, and power) must relate to each other in terms of the same two points in a circuit. Before we examine the more complex series circuit in Figure 1, let's examine this concept for a single resistor circuit.

Using Ohm's Law in a Single Resistor Circuit

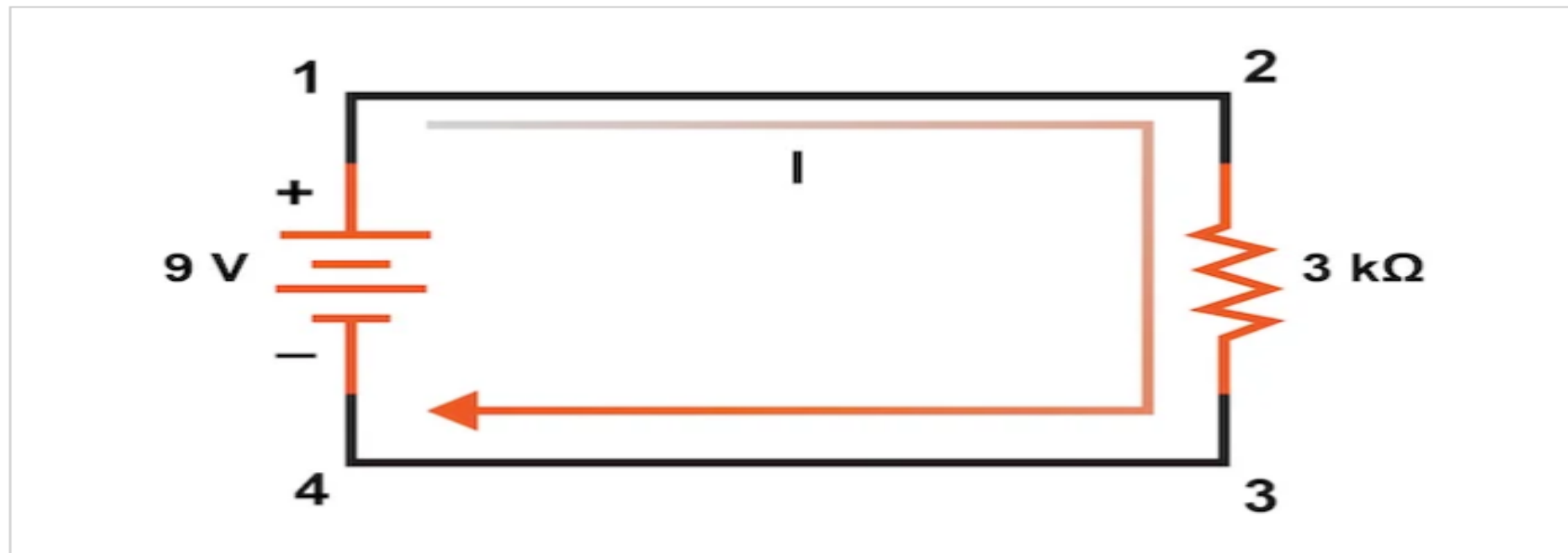For this initial analysis, we will evaluate the current and voltage for the single resistor circuit in Figure 2.

Figure 2. Series circuit with a battery and a single resistor.

The total resistance of a series circuit is equal to the sum of all the individual resistances in the circuit.

$Rt = R1 + R2 + R3\ldots$

Using this formula, you find that the total resistance of the circuit is:
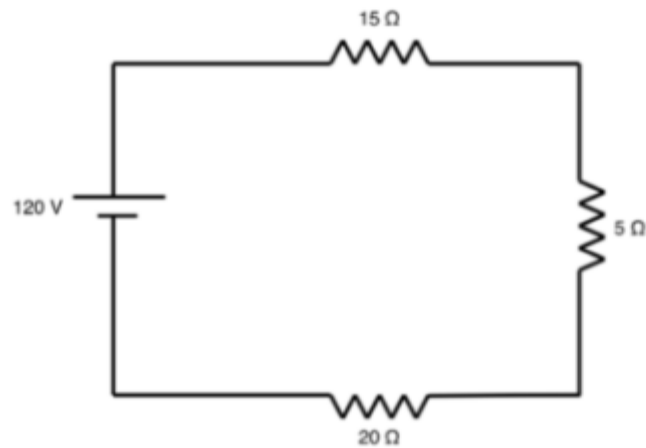
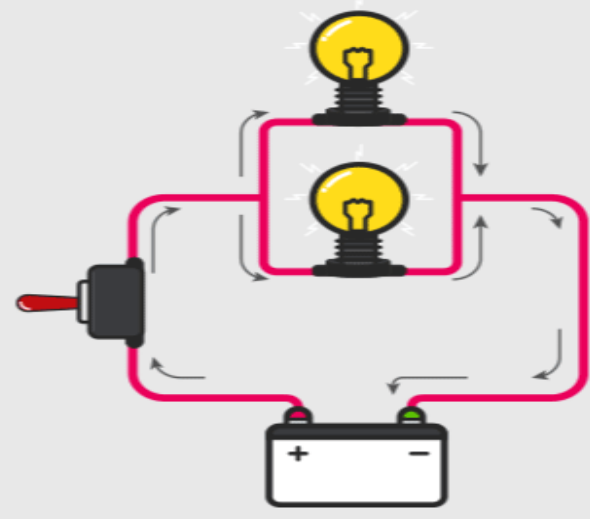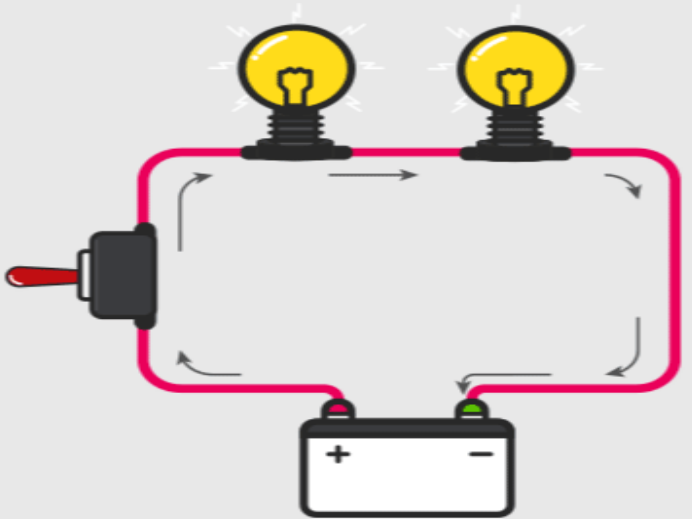$RT = 15\ \Omega + 5\ \Omega + 20\ \Omega = 40\ \Omega$

Figure 16. Series circuit

What is a Parallel Circuit?
A circuit is said to be parallel when the electric current has multiple paths to flow through. The components that are a part of the parallel circuits will have a constant voltage across all ends.

DIFFERENCE BETWEEN SERIES AND PARALLEL CIRCUITS

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SERIES CIRCUITS
A series circuit is made by connecting the end of one device to the beginning of another.

PARALLEL CIRCUITS
In parallel circuits, the same terminals of both devices are connected together.

Difference Between Series and Parallel Circuits

Series	Parallel
The same amount of current flows through all the components	The current flowing through each component combines to form the current flow through the source.
In an electrical circuit, components are arranged in a line	In an electrical circuit, components are arranged parallel to each other
When resistors are put in a series circuit, the voltage across each resistor is different even though the current flow is the same through all of them.	When resistors are put in a parallel circuit, the voltage across each of the resistors is the same. Even the polarities are the same
If one component breaks down, the whole circuit will burn out.	Other components will function even if one component breaks down, each has its own independent circuit
If V_t is the total voltage then it is equal to $V_1 + V_2 + V_3$	If V_t is the total voltage then it is equal to $V_1 = V_2 = V_3$

Multiple choice question

Q1

In which type of circuit connection, the same amount of current flows through all the components?

Series Connection.

Q2

What are the two types of circuit connections?

The two types of circuit connections are:

•Series connection

•Parallel connection

Q3

What is a parallel circuit?

A circuit is said to be parallel when the electric current has multiple paths to flow through.

Q4

How is the total resistance of any series circuit calculated?

Total resistance in a series circuit is equal to the sum of the individual resistances.

Q5

What is the total resistance of a circuit, which has 2kΩ, 3kΩ and 4kΩ resistance connected in series with each other?

Total Resistance(R) = 2kΩ + 3kΩ + 4kΩ = 9kΩ

1. Question:

In a series circuit, if the total voltage is 12V and there are two resistors, R1 = 4Ω and R2 = 6Ω, what is the total resistance of the circuit?

A) 10Ω

B) 8Ω

C) 2Ω

D) 12Ω

Answer:

In a series circuit, the total resistance is the sum of the individual resistances:

$$R_{total} = R_1 + R_2 = 4\Omega + 6\Omega = 10\Omega$$

So, the correct answer is **A) 10Ω**.

2. Question:

In a parallel circuit, if R1 = 6Ω and R2 = 3Ω, what is the total resistance?

A) 9Ω

B) 2Ω

C) 1.5Ω

D) 8Ω

Answer:

In a parallel circuit, the total resistance is given by:

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6\Omega} + \frac{1}{3\Omega} = \frac{1}{2\Omega}$$

So, the total resistance is:

$$R_{total} = 2\Omega$$

So, the correct answer is **B) 2Ω**.

3. Question:

In a parallel circuit with a total voltage of 24V, if the total resistance is 6Ω, what is the current flowing through the circuit?

A) 2A

B) 4A

C) 6A

D) 12A

Answer:

Using Ohm's Law:

$$I = \frac{V}{R} = \frac{24V}{6\Omega} = 4A$$

So, the correct answer is **B) 4A**.

4. Question:

In a series circuit, what happens to the current when more resistors are added to the circuit?

A) The current increases

B) The current decreases

C) The current stays the same

D) The current becomes zero

Answer:

In a series circuit, when more resistors are added, the total resistance increases, which causes the

current to decrease.

So, the correct answer is **B) The current decreases.**