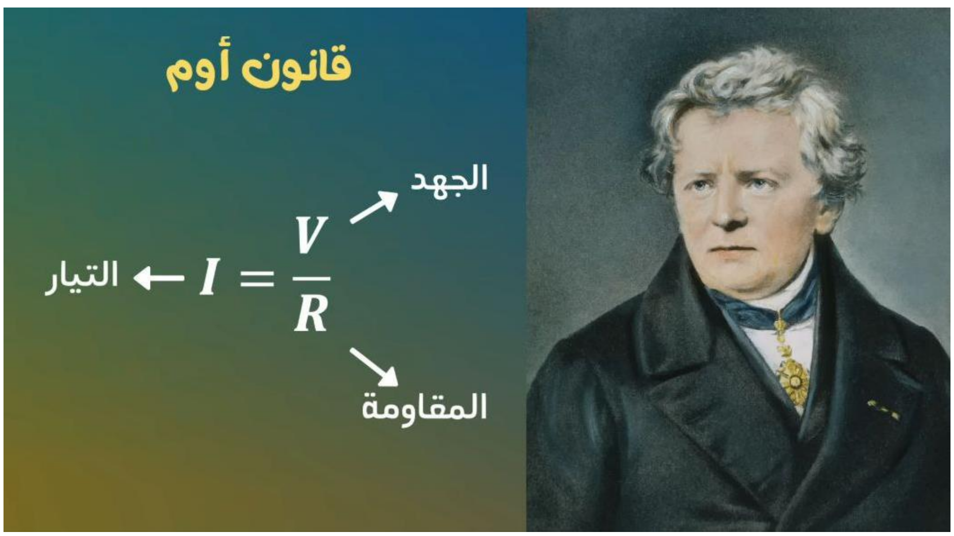
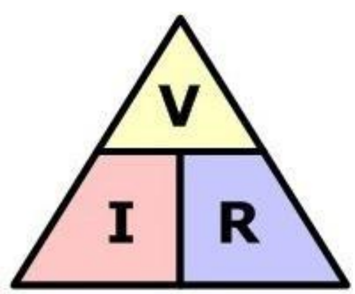
Al-Mustaqbal University
College Of Engineering Technology
Department Of Cyber Security Techniques Engineering
Class: 1st
Subject: fundamental of electrical engineering
Lecturer: Dr. Rami Qays Malik
1st term – Lecture: 2- Ohms Law

Introduction

Georg Ohm found that, at a constant temperature, the electrical current flowing through a fixed linear resistance is directly proportional to the voltage applied across it. But it is also inversely proportional to its resistance. This relationship between the Voltage, Current and Resistance forms the basis of Ohms Law. But what is Ohm’s Law, and how does it relate to electrical circuits.



$$Current, (I) = \frac{Voltage, (V)}{Resistance, (R)} \ in \ Amperes, (A)$$



By knowing any two values of the Voltage, Current or Resistance quantities we can use Ohms Law to find the third missing value.

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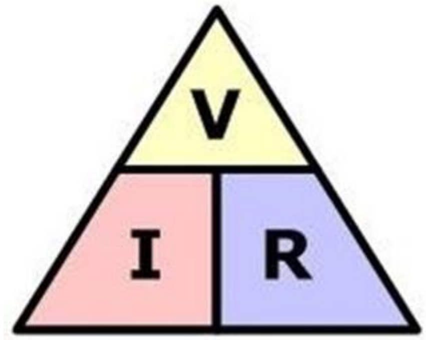
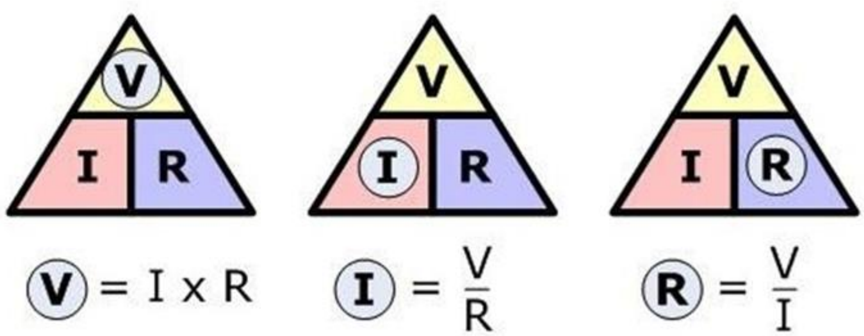
To find the Voltage, (V) [V = I x R] V (volts) = I (amps) x R (Ω) To find the Current, (I) [I = V ÷ R] I (amps) = V (volts) ÷ R (Ω) To find the Resistance, (R) [R = V ÷ I] R (Ω) = V (volts) ÷ I (amps)	

Ohms Law Triangle

Transposing the standard Ohms Law equation above will give us the following combinations of the same equation:



Then by using Ohms Law we can see that a voltage of 1V applied to a resistor of 1Ω will cause a current of 1A to flow and the greater the resistance value, the less current that will flow for a given applied voltage source.

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Electrical Power in Circuits

Electrical Power, (P) in a circuit is the rate at which electrical energy is absorbed or produced within a circuit. A source of energy such as a voltage will produce or deliver power while the connected load absorbs it.

The quantity symbol for power is "P". It is the product of voltage multiplied by the current with the standard electrical units of measurement being the Watt (W). Prefixes are used to denote the various multiples or sub-multiples of a watt, such as: milliwatts (mW = 10^{-3}W) or kilowatts (kW = 10^{3}W).

Light bulbs and heaters for example, absorb electrical power and convert it into either heat, or light, or both. The higher their value or rating in watts the more electrical power they are likely to consume.

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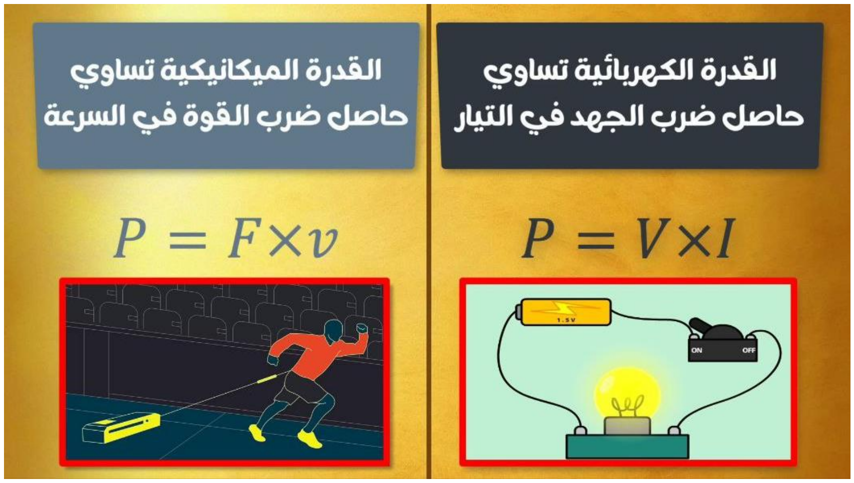
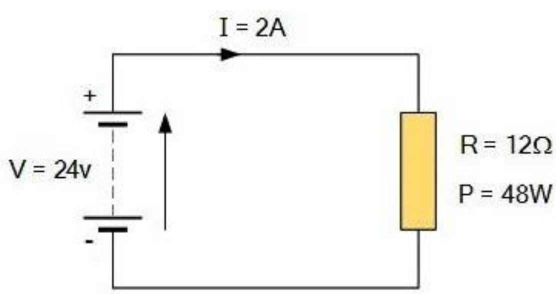


Ohms Law Example No1

For the circuit shown below, use Ohms law to find the Voltage (V), the Current (I), the Resistance (R) and the Power (P) around the circuit.



Voltage $[V = I \times R] = 2 \times 12\Omega = 24V$

Current $[I = V \div R] = 24 \div 12\Omega = 2A$

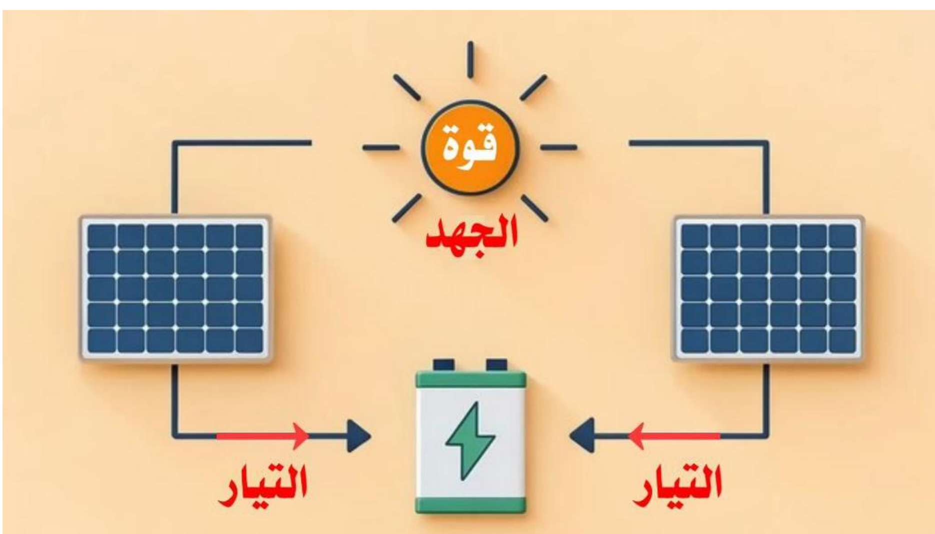
Resistance $[R = V \div I] = 24 \div 2 = 12\,\Omega$

Power $[P = V \times I] = 24 \times 2 = 48W$

Power within an electrical circuit is only present when **BOTH** voltage and current are present. For example, in an open-circuit condition, voltage is present but there is no current flow I = 0 (zero), therefore V*0 equals 0 (zero) so the power dissipated within the circuit must also be zero (0).

Likewise, if we have a short-circuit condition, current flow is present but there is no voltage V = 0 (zero), therefore 0*I equals 0 so again the power dissipated within the circuit is zero (0).

As electrical power is the product of V*I, the power dissipated in a circuit is the same whether the circuit contains high voltage and low current or low voltage and high current flow. Generally, electrical power is dissipated in the form of **Heat** (heaters), **Mechanical Work** such as motors, **Energy** in the form of radiated (Lamps) or as stored energy (Batteries).



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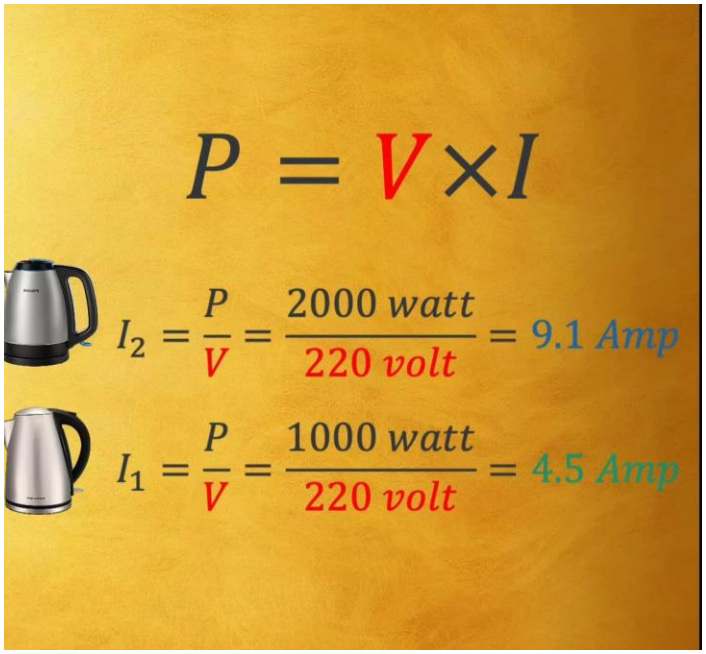

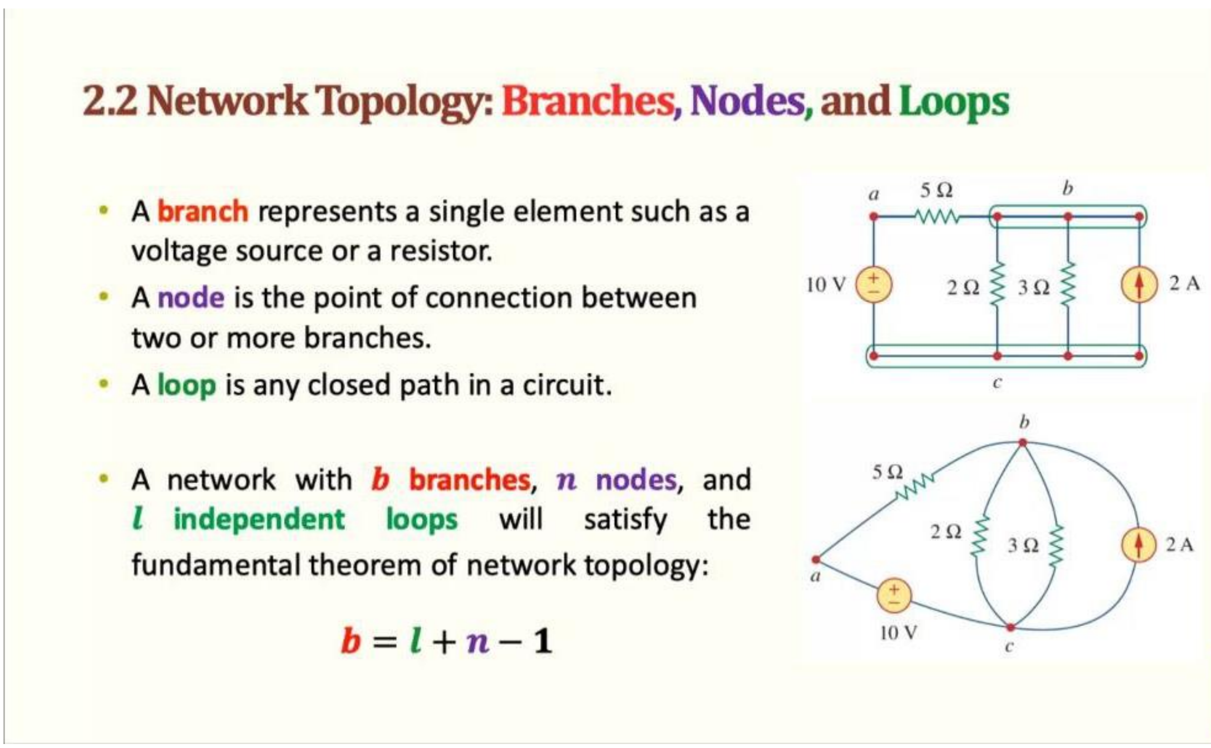

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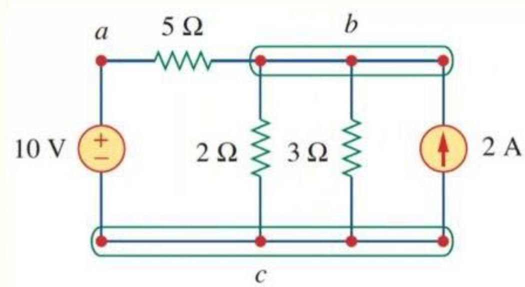
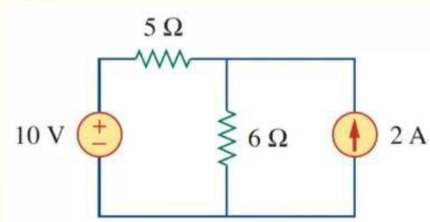
2.2 Network Topology: Series and Parallel Connection

- Two or more elements are in **series** if they exclusively share a **single node** and consequently carry the same **current**.



2.1 Ohm's Law (Example)

Determine the number of branches and nodes in the circuit shown in Fig. Identify which elements are in series and which are in parallel.

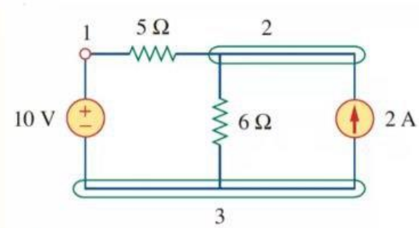


Four branches

Three nodes

The 5-Ω resistor is in series with the 10-V voltage source

The 6-resistor is in parallel with the 2-A current source



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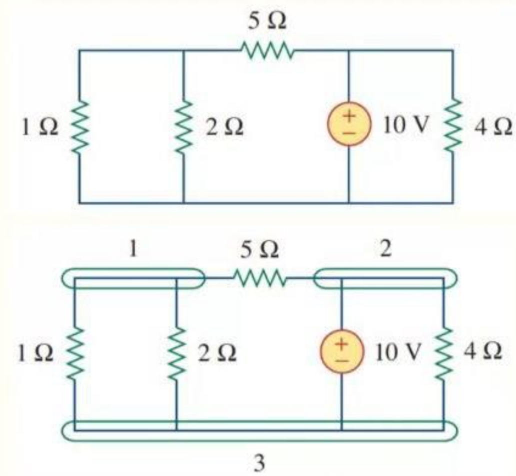
2.1 Ohm's Law (Example)

How many branches and nodes does the circuit in Fig. have? Identify the elements that are in series and in parallel.



Five branches

Three nodes

The 1-Ω and 2-Ω resistors are in parallel.

The 4-Ω resistor and 10-V source are also in parallel.