Standard

Unit 4

KIRCHOFF'S LAW

ACMA Syllabus February 2024

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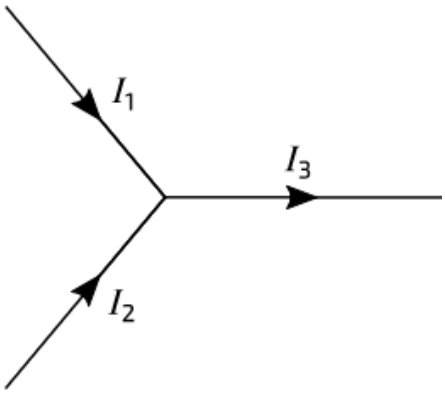
Kirchhoff's Laws

Gustav Robert Kirchhoff was a German physicist who contributed to the fundamental understanding of electrical circuits. His two laws for current and voltage define how current flows through a circuit and how voltage varies around a loop in a circuit.

Kirchhoff's First Law

Kirchhoff's current law (1st Law) states that the current flowing into a node (or a junction) must be equal to the current flowing out of it.



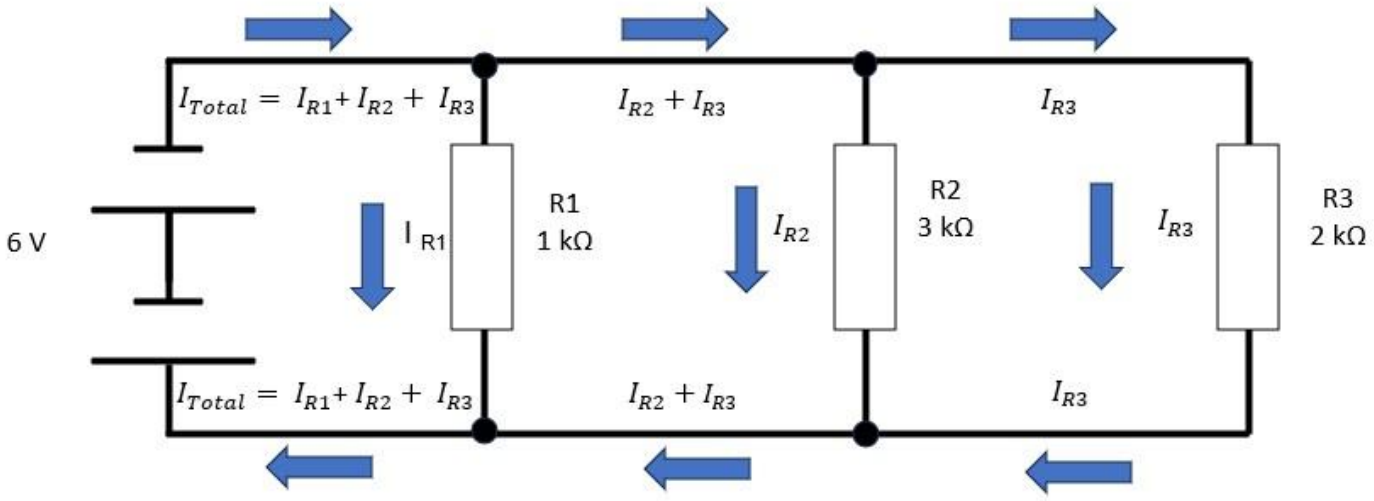
$I_1 + I_2 = I_3$

First Law Example

The sum of all currents entering and exiting a node must equal zero.

The current entering a node is **+** and current exiting a node is **-**. In the circuit below, the black circles are nodes. R1 and R2 are on a branch.

$$I_{Entering} + (-I_{Exiting}) = 0$$



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	R1	R2	R3	Total
Volts (E) across Rs	6	6	6	6
Current through Rs	6 mA	2 mA	3 mA	11 mA
Resistance of Rs	1 kΩ	3 kΩ	2 kΩ	545.45 Ω

$I_{Total}\ In$	I_{R1}	I_{R2}	I_{R3}	$I_{Total}\ Out$
11 mA	6 mA	2 mA	3 mA	11 mA

Note

- Small value resistor more current flow.
- High value resistor less current flow.

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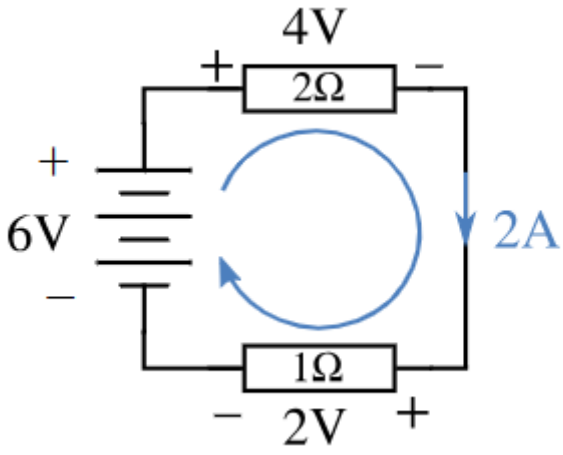
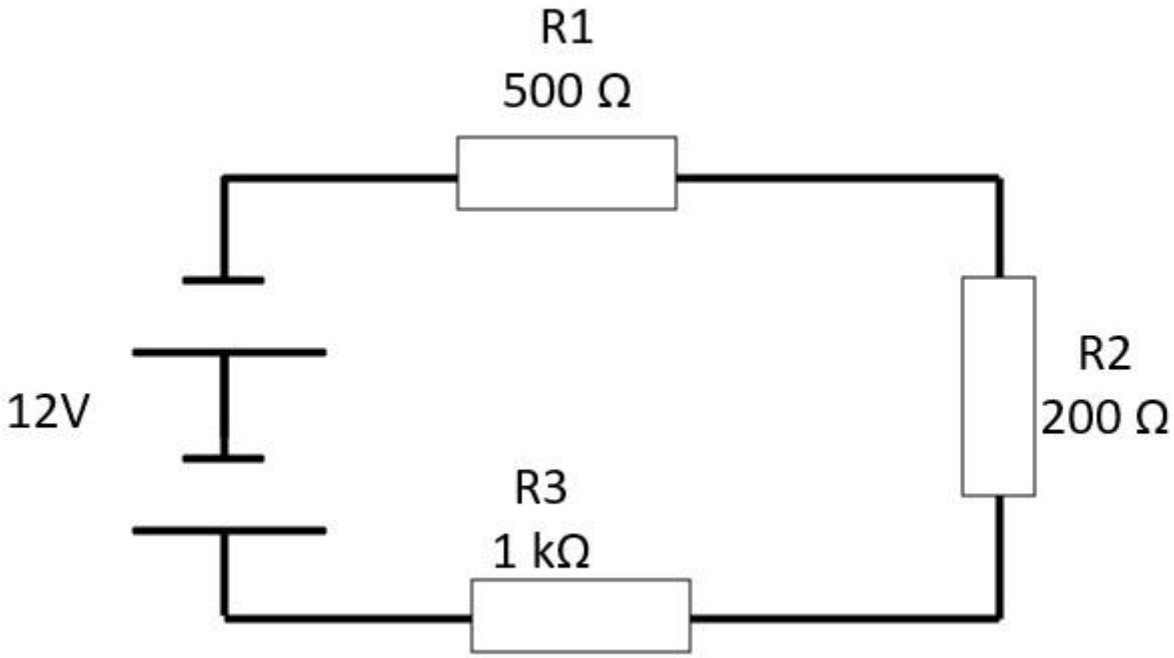
Kirchhoff's Second Law

Kirchhoff's voltage law (2nd Law) states that in any complete loop within a circuit, the sum of all voltages across components which supply electrical energy (such as cells or generators) must equal the sum of all voltages across the other components in the same loop.



Second Law Example

Kirchhoff's voltage law states that in any complete loop within a circuit, the sum of all voltages across components which supply electrical energy must equal the sum of all voltages across the other components in the same loop.



Rt = R1 + R2 + R3
= 500 + 200 + 1000
=1700 Ω

I = E / R
= 12 / 1700
=0.007 mA

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V in	V R1	V R2	V R3	V Total
12 V	3.53 V	1.41 V	7.05 V	12 V

Note

- Small value resistor small voltage drop.
- High value resistor large voltage drop.

Go to Unit 4 Questions.

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