

Department of Artificial Intelligence and Data Science

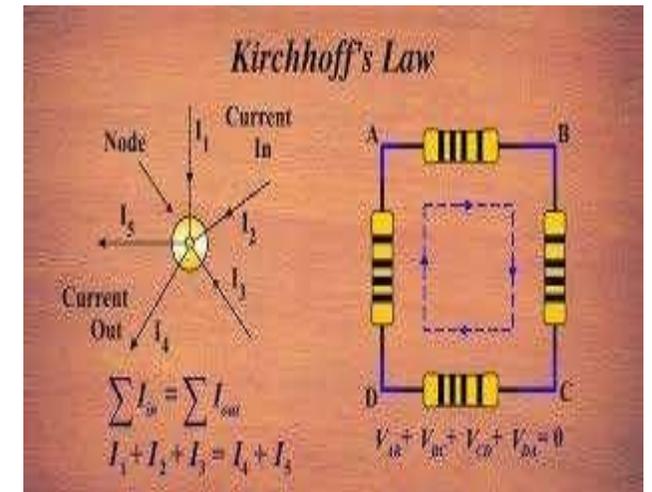
23EET103-Electric Circuits and Electron Devices



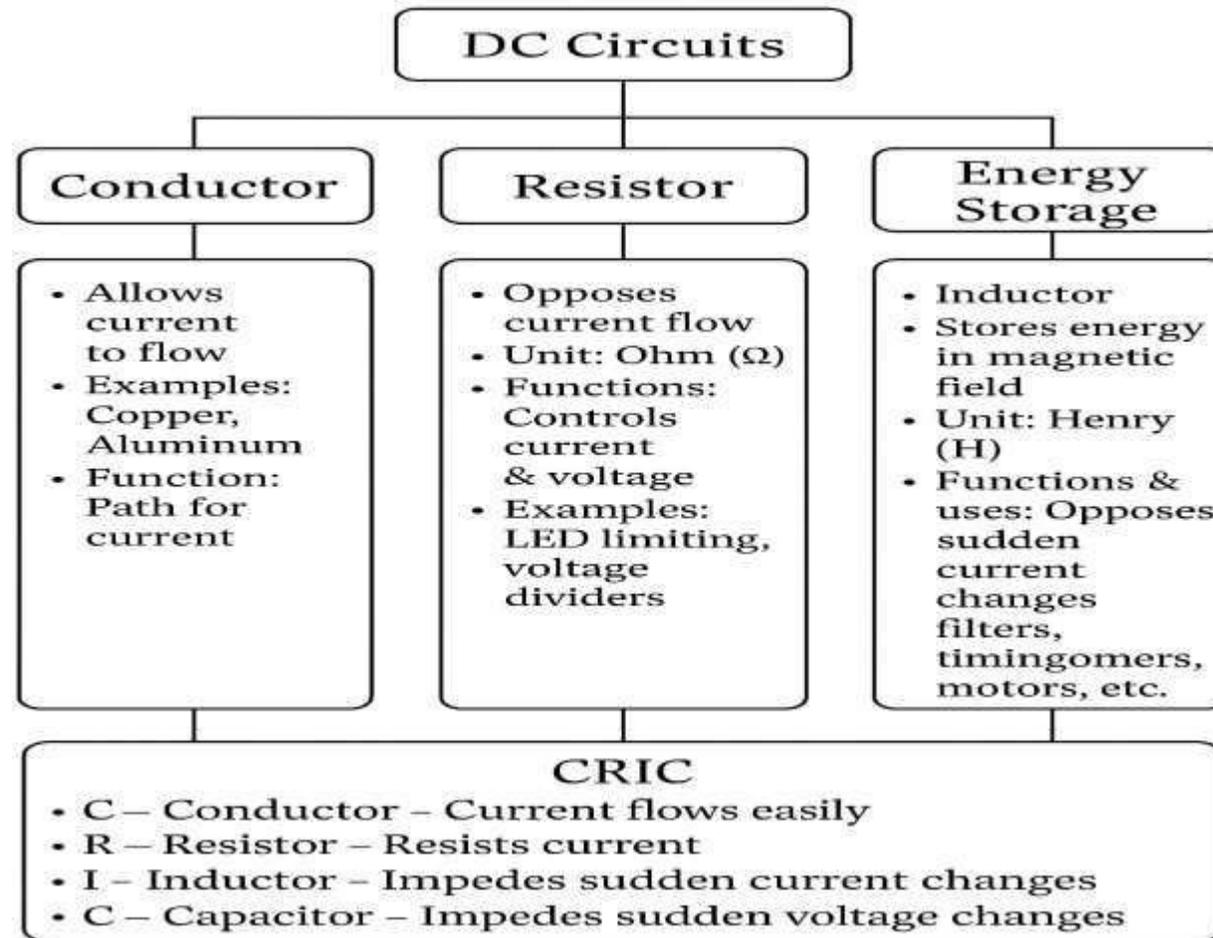
I B.Tech. AIDS / II SEMESTER

UNIT I : DC CIRCUITS

Topic 7 : Kirchhoff's law



Let's Recall !!



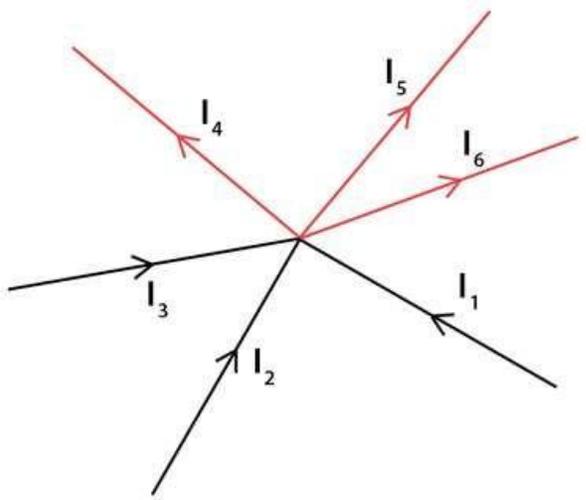
Topics for discussion

- Fundamentals and History
- Kirchhoff's Current Law (KCL)
- Kirchhoff's Voltage Law (KVL)
- Application in Circuit Analysis
- Real-World Examples and Advanced Concepts

Lets explore !!

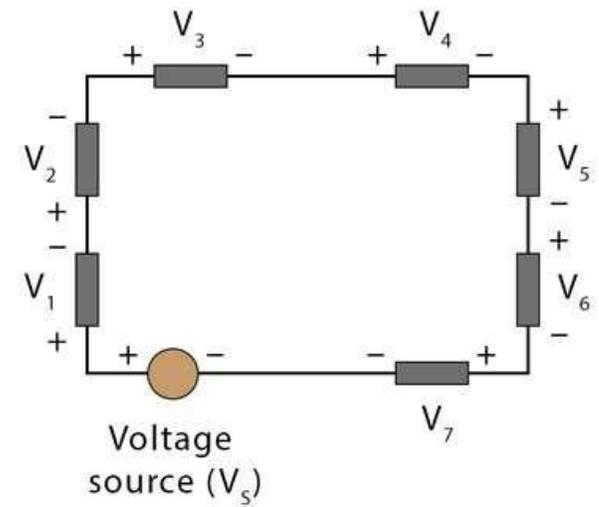
Kirchhoff's Law

Kirchhoff's Current Law



$$I_1 + I_2 + I_3 = I_4 + I_5 + I_6$$

Kirchhoff's Voltage Law



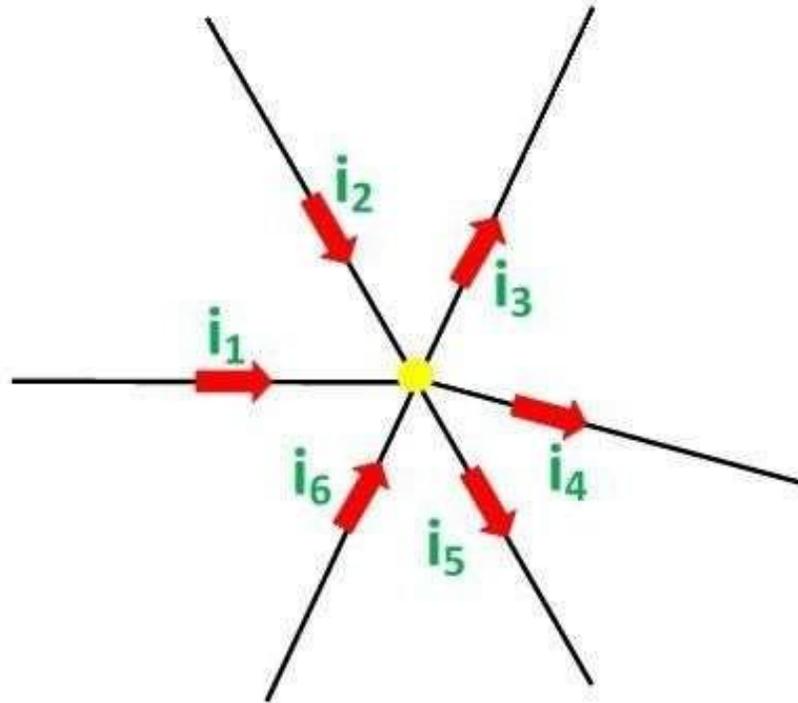
$$V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + V_7 - V_s = 0$$

ScienceFacts.net

Introduction to Electrical circuits:
Basic components (resistors, voltage sources, currents).

- **History:** Gustav Kirchhoff (1845), based on conservation of charge and energy.
- **Why important?** Foundation for analyzing complex DC circuits beyond Ohm's Law.

Kirchhoff's Current Law (KCL)

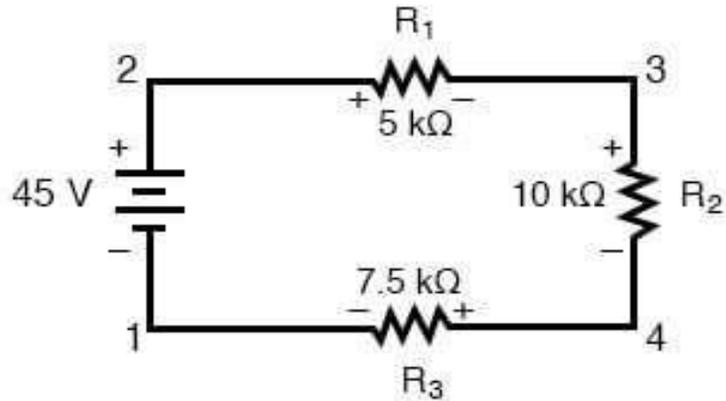


CircuitGlobe

Statement: At any node (junction), the sum of currents entering equals the sum of currents leaving ($\sum I_{in} = \sum I_{out}$).

- Based on conservation of charge.
- Equation: $I_1 + I_2 = I_3 + I_4$ (example).
- Simple example: Node with three branches.

Kirchhoff's Voltage Law (KVL)

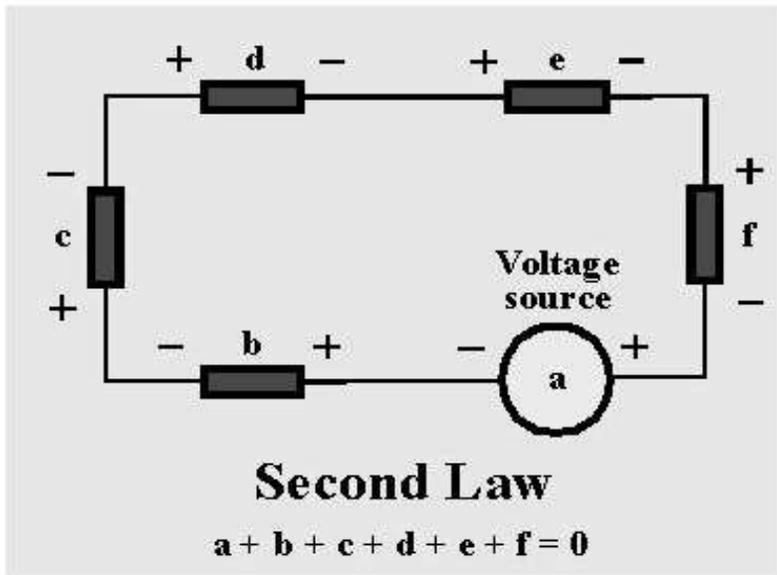


Statement: In any closed loop, the sum of voltage drops equals the sum of voltage rises ($\sum V = 0$).

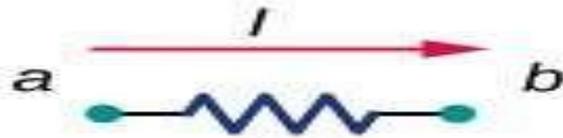
Based on conservation of energy.

Equation: $V_{\text{source}} - V_{R1} - V_{R2} = 0$ (example).

Simple example: Series circuit loop.



Loop- Rule



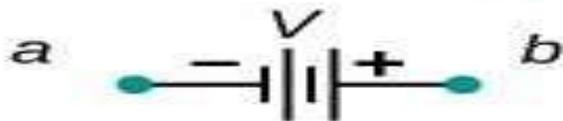
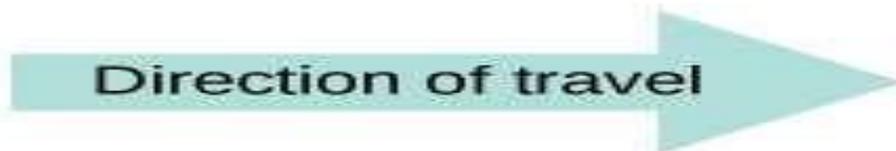
$$\Delta V = V_b - V_a = -IR$$

(a)



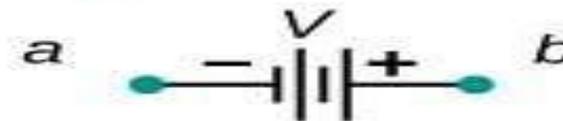
$$\Delta V = V_a - V_b = IR$$

(b)



$$\Delta V = V_b - V_a = +V$$

(c)

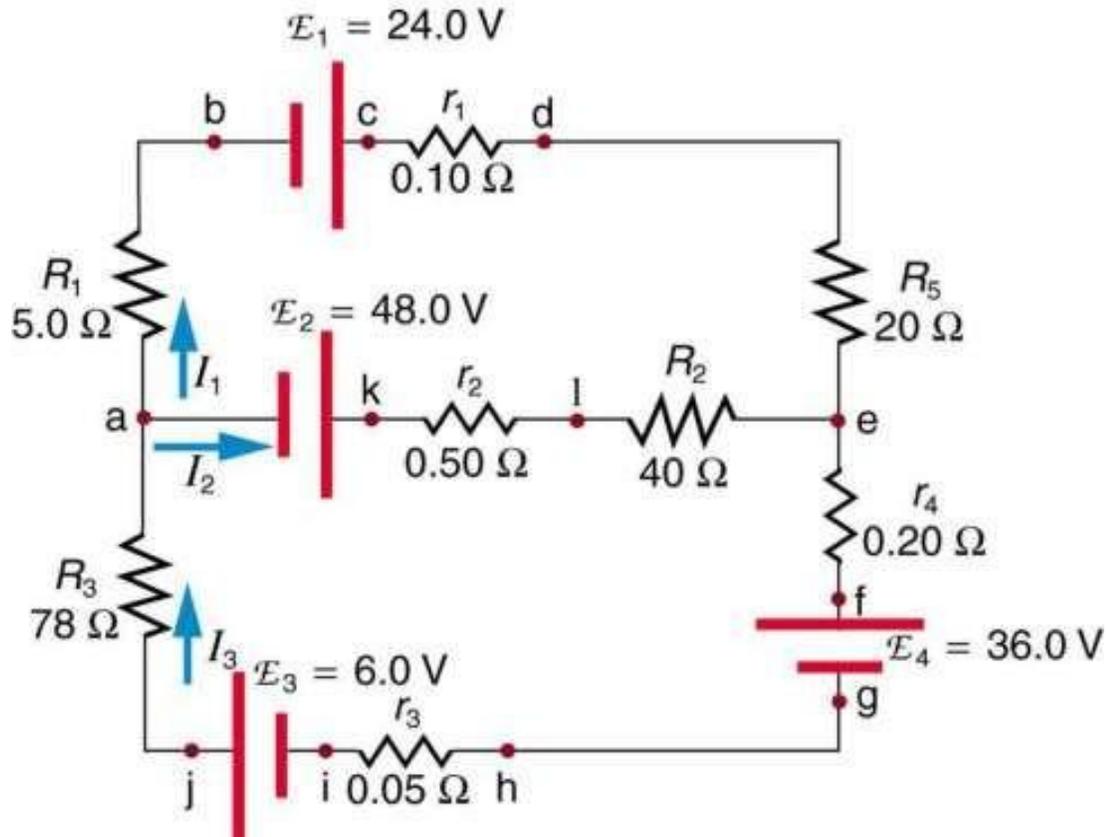


$$\Delta V = V_a - V_b = -V$$

(d)

Kirchhoff's Law

DT-Empathize



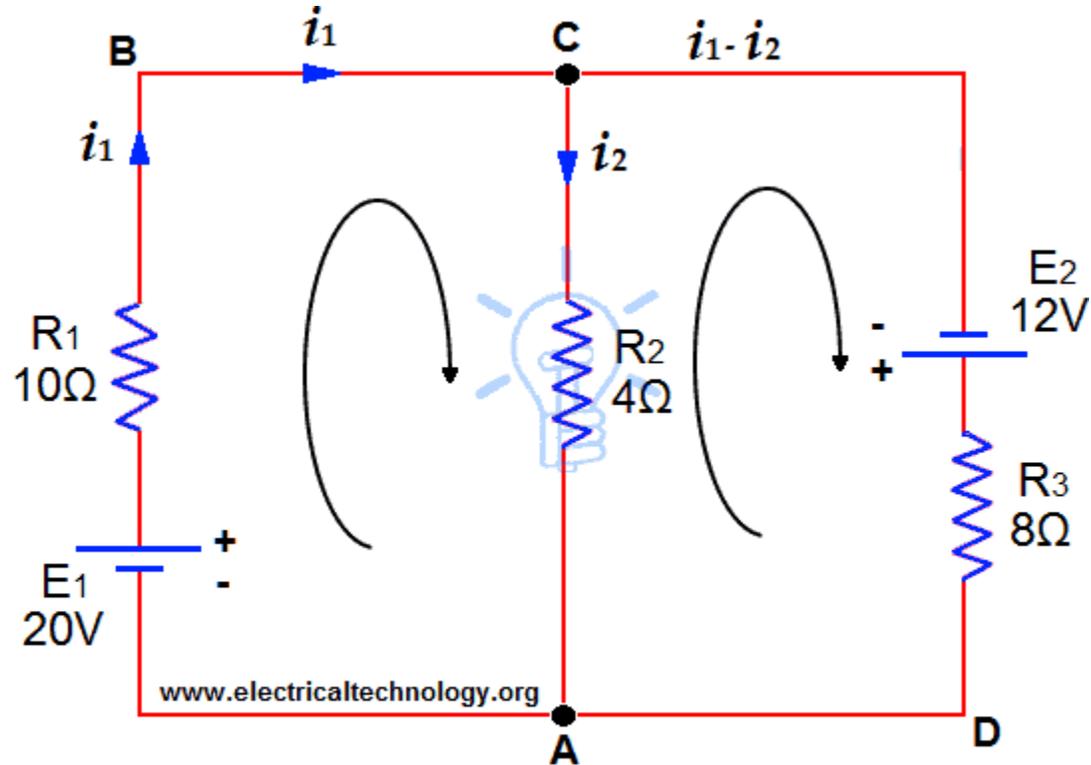
What are circuits?

Systems that power devices like phones or lights.

- **Kirchhoff's Laws (1845):** Rules to predict how electricity flows, like water in pipes.
- **Empathetic Example:** Imagine planning a family budget—money in equals money out, like current in a circuit.
- **Why it matters?**
Helps design devices you use daily.(e.g., Chargers).

DC circuit components

DT-Define



Circuit Solving by Kirchhoff's Laws

- ❖ Kirchhoff's laws are fundamental principles of physics used to analyze electrical circuits, and they have no connection to empathy.
- ❖ The user's query combines a physics concept with a psychological one, indicating a misunderstanding of the terms.

Application in Circuit Analysis



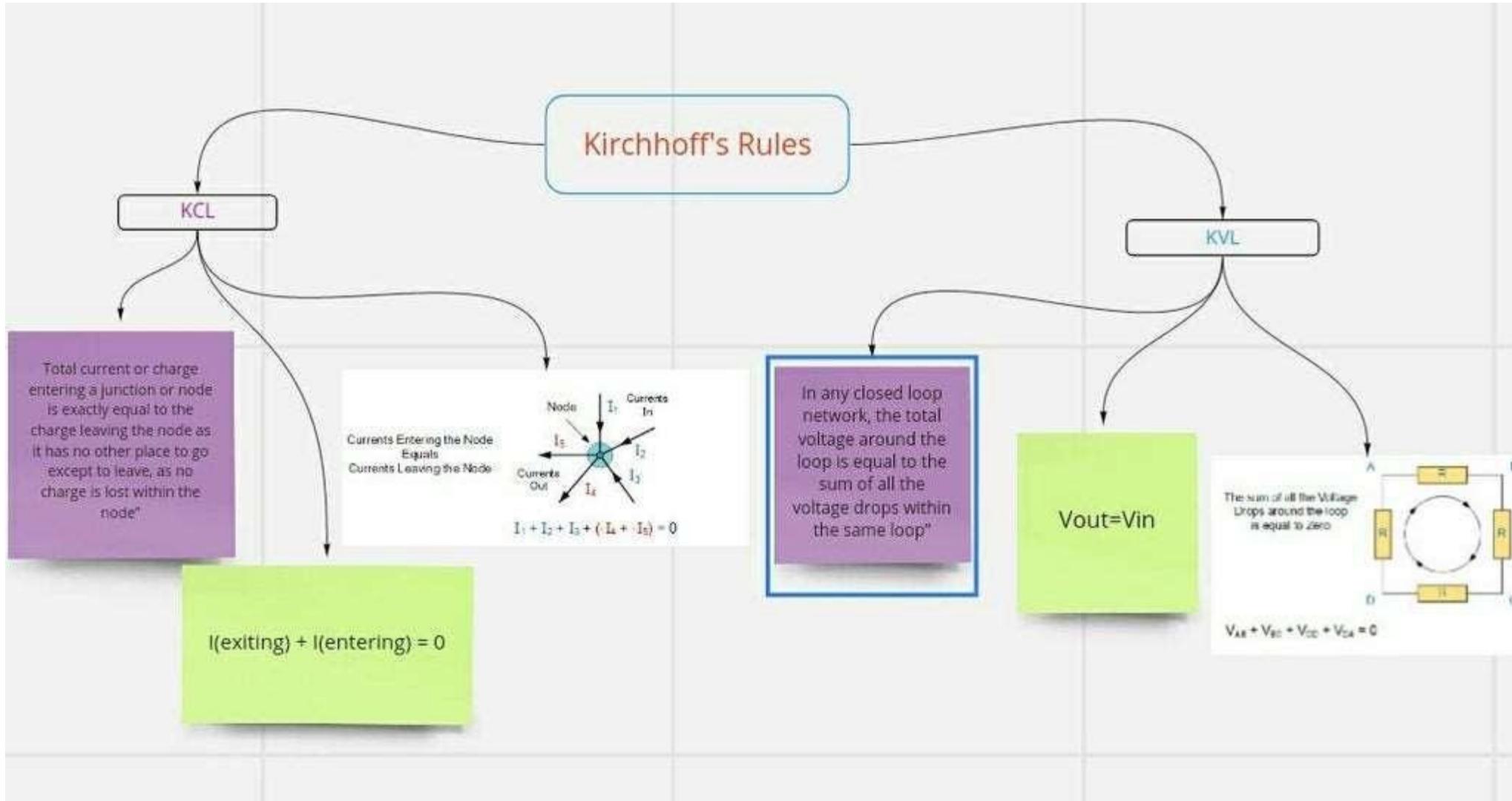
Applications: Electronics design (e.g., smartphones), power systems, mesh/nodal analysis.

Limitations: Assumes lumped elements; not for high-frequency or non-linear circuits.

Advanced: Superposition theorem integration, software simulation (e.g., SPICE).

Empathetic Example: Designing a home lighting system—use KCL to ensure current splits correctly for each bulb, KVL to balance voltage.

Let's summarize



ASSESSMENTS

1. At a node, currents entering are 4A and 6A. Current leaving is I.

☞ Find I.

Ans: Currents entering = 4A + 6A

$$I=10A$$

2. At a junction, 10A enters. Two currents leave: 3A and I.

☞ Find I

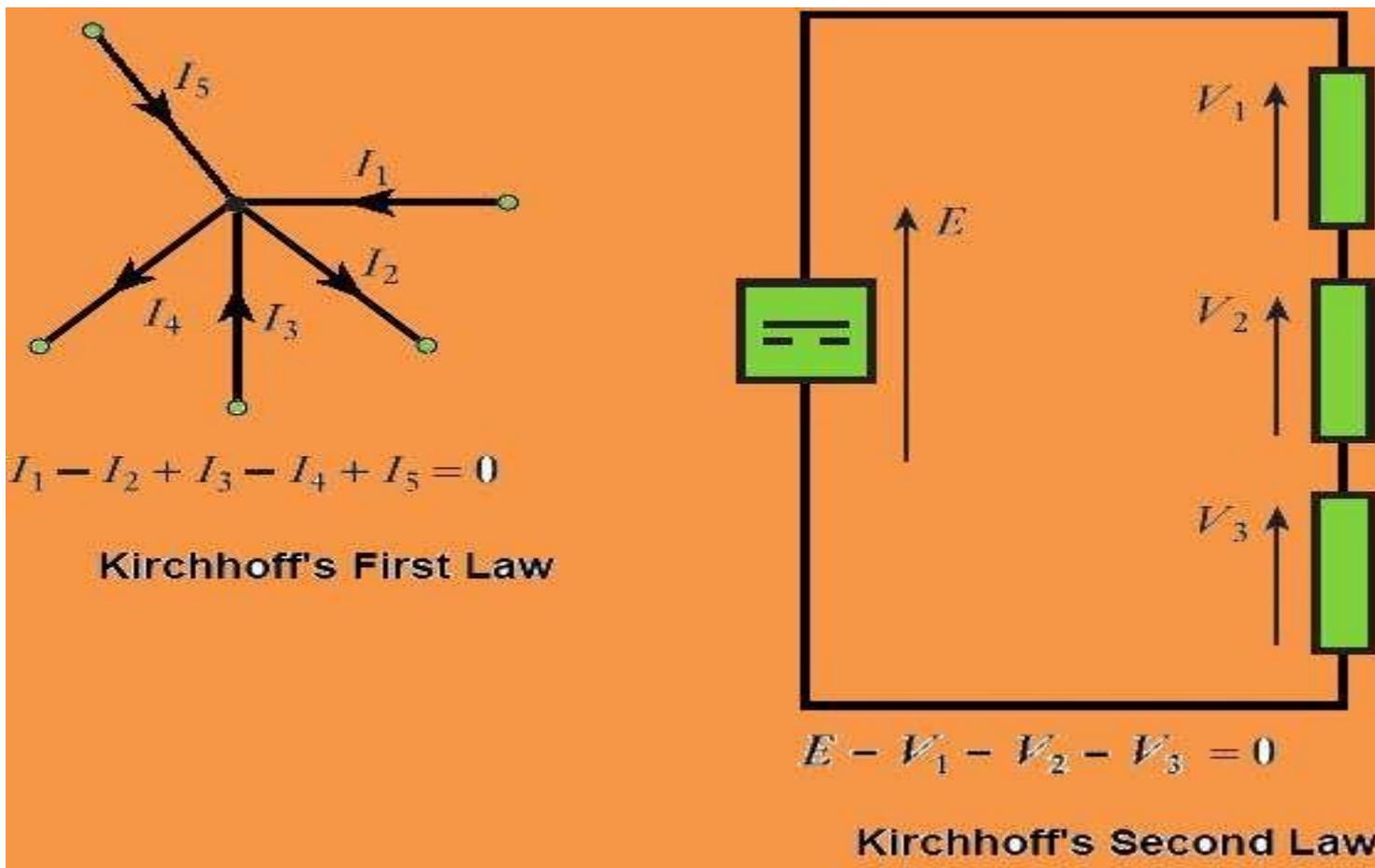
Ans: Incoming = 10A

Outgoing = 3A + I, $10=3+I$

$$I=7A$$

References

- https://courses.lumenlearning.com/suny-physics/chapter/21-3-kirchhoffs-rules/?utm_source=chatgpt.com
- <https://www.khanacademy.org/science/ap-physics-2/x0e2f5a2c:electric-circuits/x0e2f5a2c:current-resistivity-ohms-law/a/ee-kirchhoffs-laws>
- <https://www.sciencedirect.com/topics/engineering/kirchhoff-law>



*Thank
you!*