KCL AND KVL

CIRCUIT ANALYSIS METHOD

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TOPIC OUTLINE

Circuit Convention

Kirchhoff's Current Law (KCL)

Kirchhoff's Voltage Law (KVL)

CIRCUIT CONVENTION

CONVENTION

A **convention** is a widely accepted practice, method, or behavior that is followed by common **agreement** or tradition, rather than by formal rules.

Example:

Color coding in Offices:

red – urgent documents
blue – general files
green – financial records

This is a common practice but not formally regulated.

STANDARD

A **standard** is a formal, established guideline, rule, or specification that is often **mandatory** and enforced by an authoritative body or organization.

Example:

IEC 60062 Resistor Color Code:

black – 0

brown – 1

red – 2

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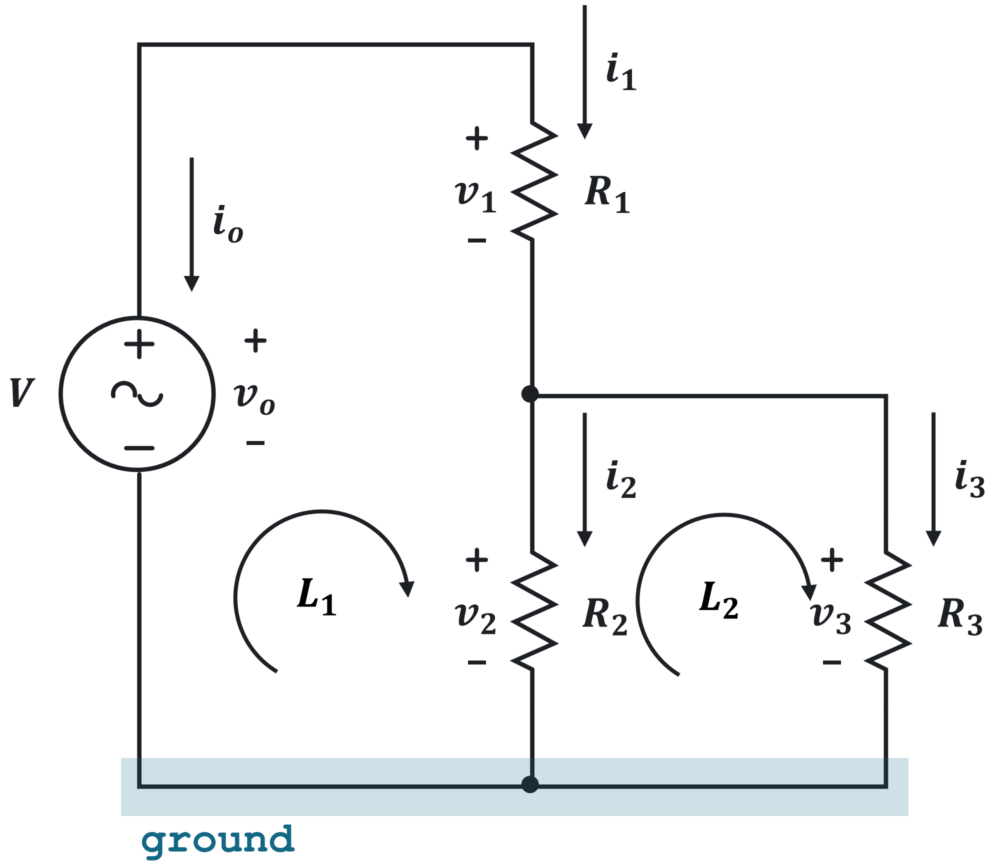
white – 9

Resistors have colored bands that represent specific digits, multipliers, and tolerance values.

LABELING VARIABLES



Steps in Labeling Variables:

1. **Label the Reference Node (ground):**

Select a reference node with the most connections or the negative **(−)** terminal of a voltage source.

2. **Label Node Voltages:**

Mark higher potentials as positive **(+)** relative to the reference node.

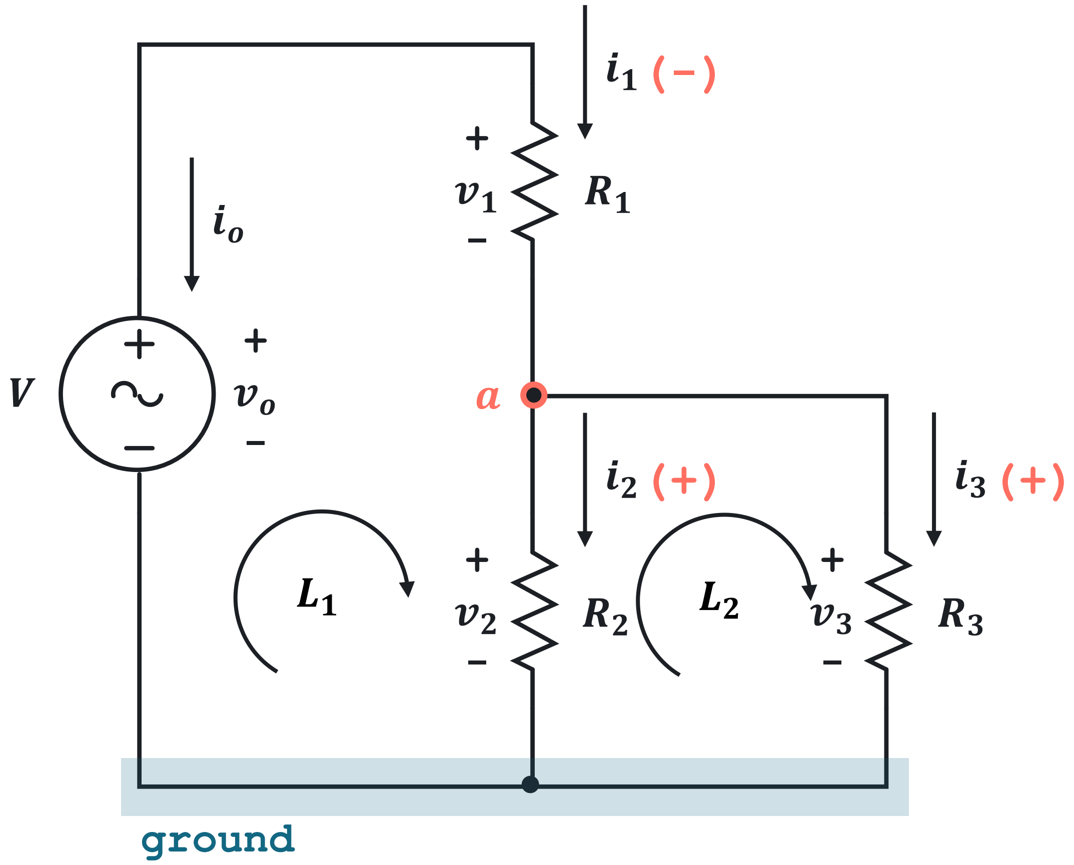
3. **Label Currents:**

Entering the positive **(+)** terminal of a component.

4. **Create a voltage loop:**

Follow the defined current directions.

CURRENT FLOW CONVENTION



Current Flow Convention:

- Current **entering** a node is negative (−)
- Current **leaving** a node is positive (+)

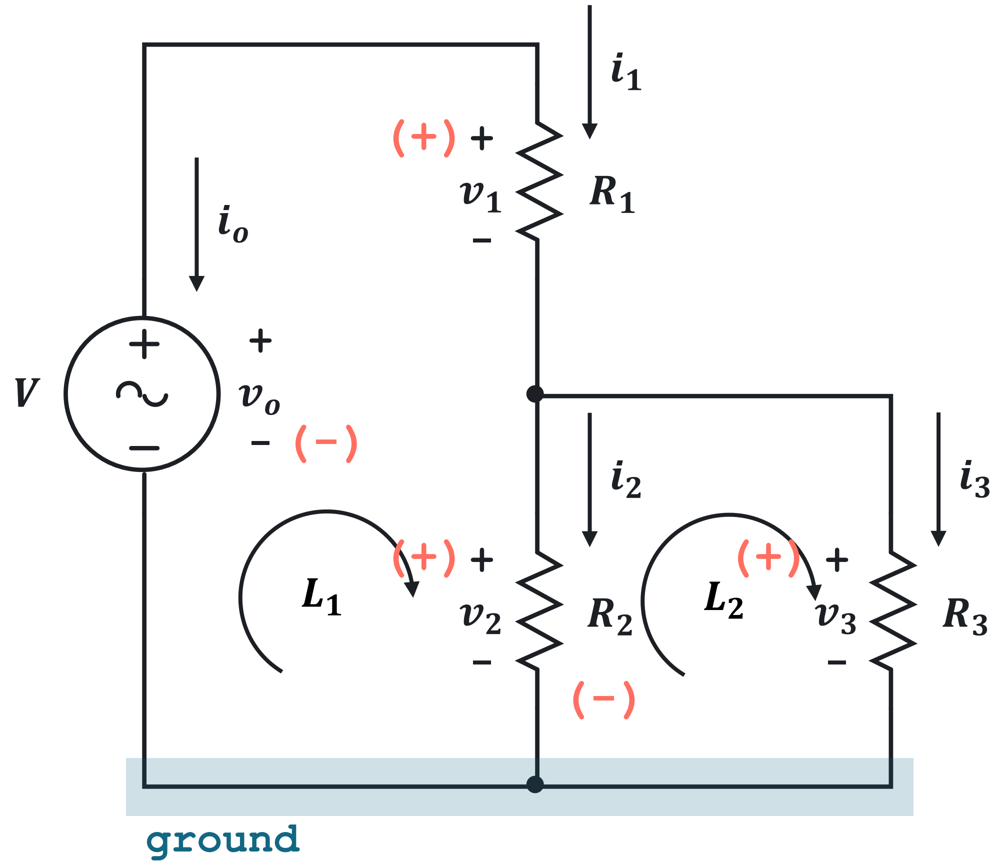
@$\boldsymbol{a}$:

$-i_1$

$+i_2$

$+i_3$

VOLTAGE LOOP CONVENTION



Voltage Loop Convention:

The **"sign"** of voltage of the element is the **first sign** the loop encounters.

@L_1:

$-v_o$

$+v_1$

$+v_2$

@L_2:

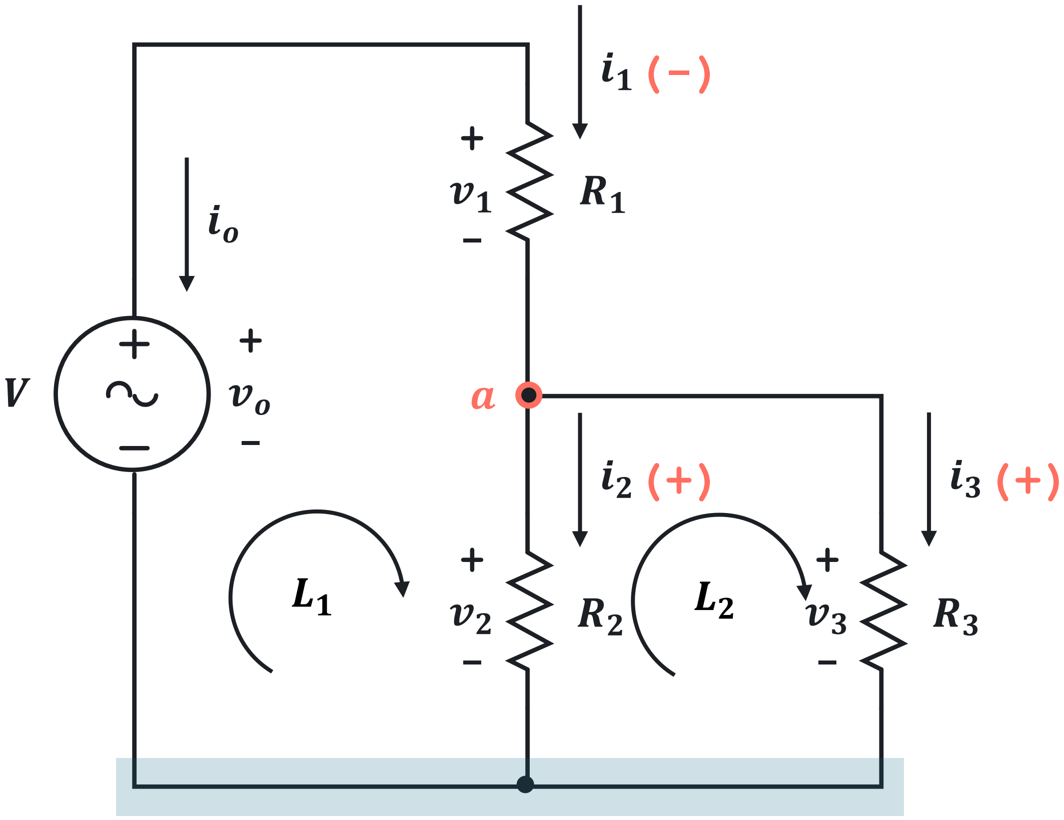
$-v_2$

$+v_3$

KIRCHHOFF'S

CURRENT LAW AND VOLTAGE LAW

KCL



Kirchhoff's Current Law:

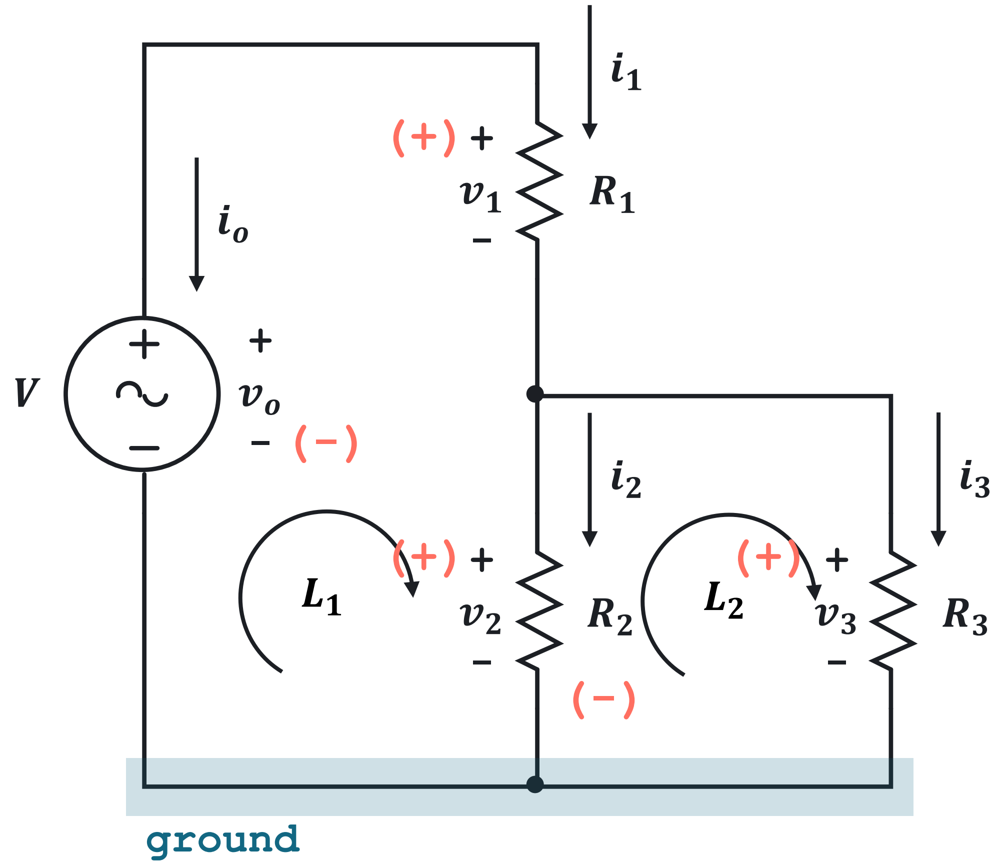
The summation of currents going-in and going-out a node is zero.

$$\sum i_j = 0$$

KCL @a:

$$-i_1 + i_2 + i_3 = 0$$

KVL



Kirchhoff's Voltage Law:

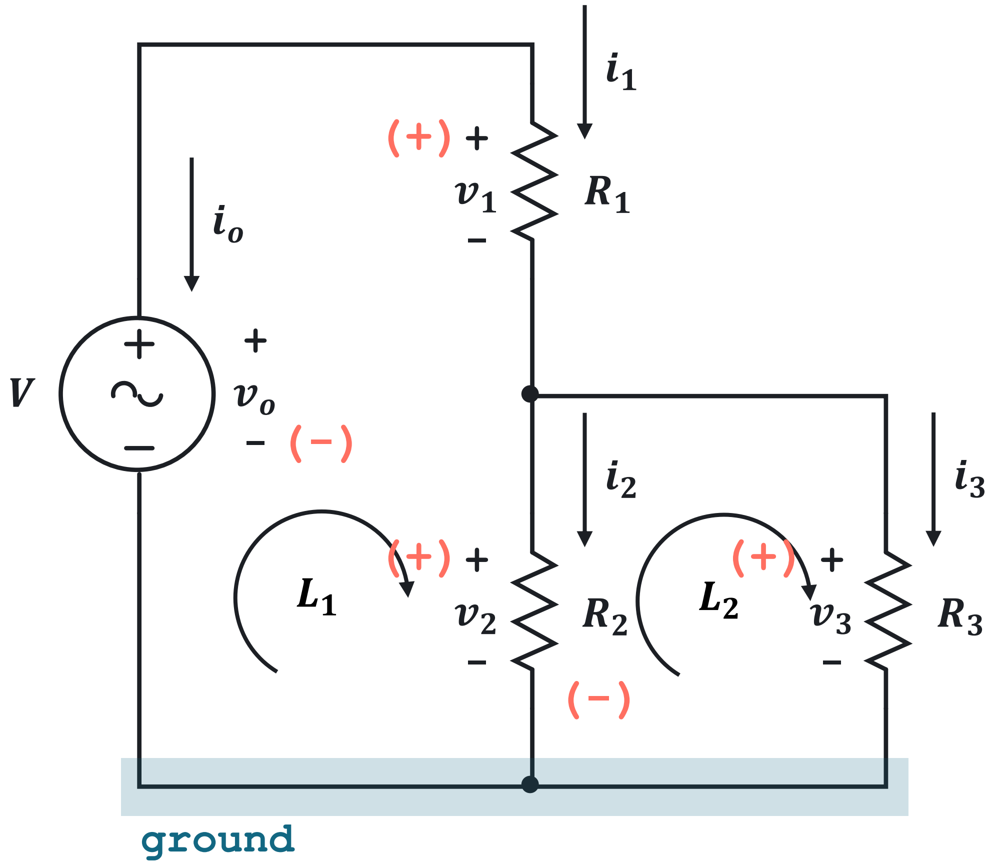
The summation of voltages in a closed-loop is zero.

$$\sum v_j = 0$$

KVL @L_1:

$$-v_o + v_1 + v_2 = 0$$

KVL



Kirchhoff's Voltage Law:

The summation of voltages in a closed-loop is zero.

$$\sum v_j = 0$$

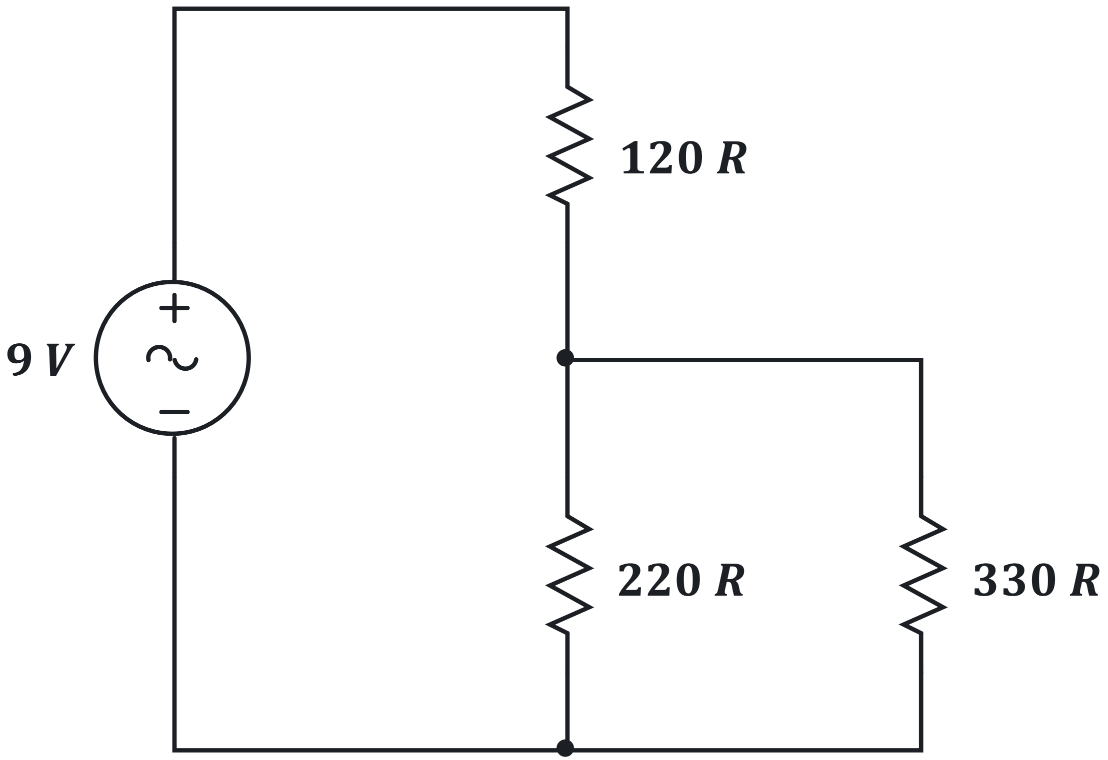
KVL @L_2:

$$-v_2 + v_3 = 0$$

EXERCISE

Determine the **current** flowing through each resistor and the **voltage** drop across each resistor in the given circuit.

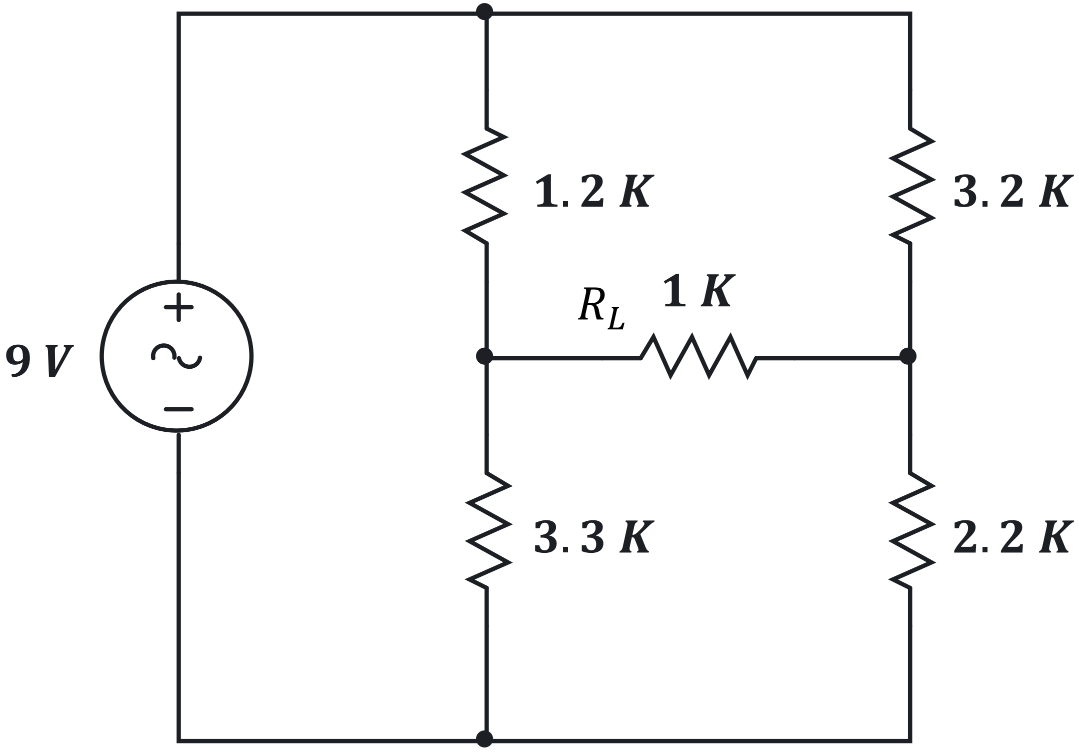
Solution:



EXERCISE

Determine the **load $\boldsymbol{R_L}$** **voltage** and **current** of the given circuit.

Solution:



LABORATORY