Chapter 26: Direct current circuit

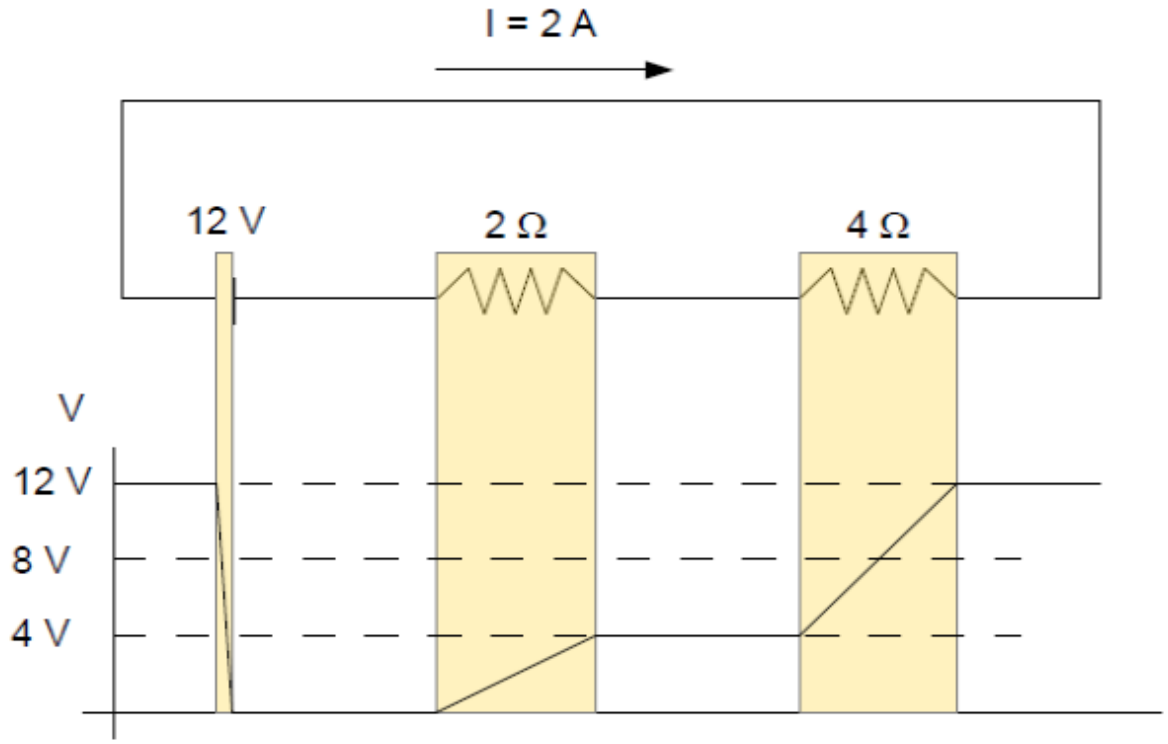
- Resistors in circuits
- Equivalent resistance
- The nature of the electric potential and current in circuit
- Kirchhoff's rules (for complicated circuit analysis)

Resistors in circuit

In circuits, resistors are the locations where **electric potential drops**. ➔ when there is no resistance, there will be no potential drop

Resistors in circuit

In circuits, resistors are the locations where **electric potential drops**. ➔ when there is no resistance, there will be no potential drop

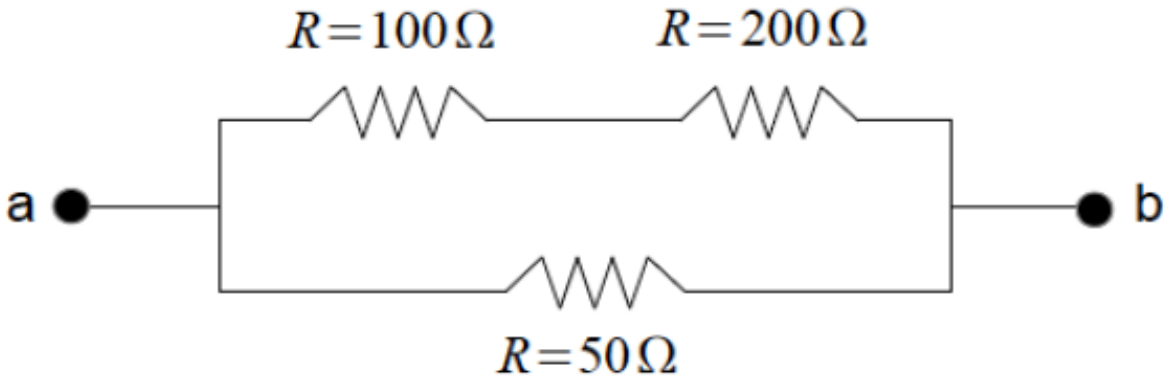


Resistors in circuit

Use Ohm’s law for each individual resistors: Each resistor has it’s own resistance, potential drop and current flow

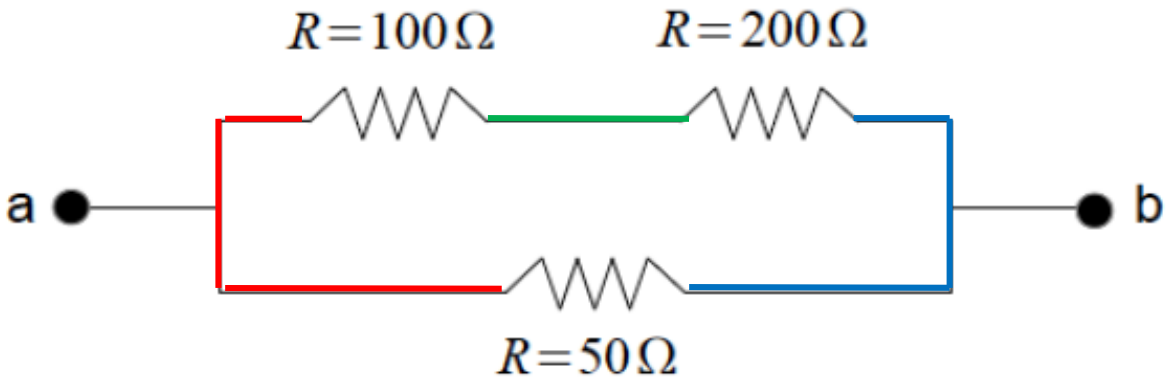
Resistors in circuit

Use Ohm's law for each individual resistors: Each resistor has it's own resistance, potential drop and current flow



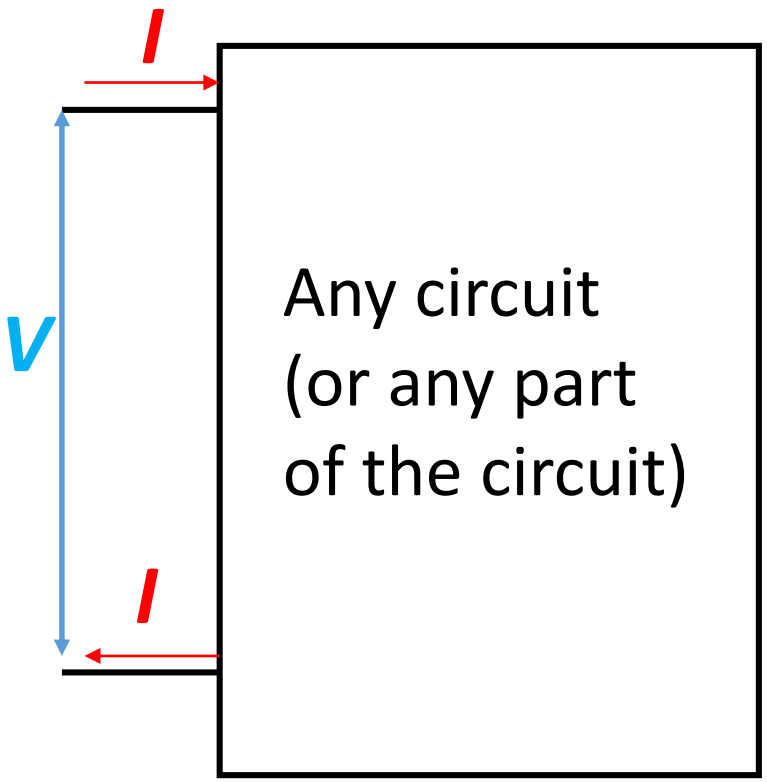
Resistors in circuit

Use Ohm's law for each individual resistors: Each resistor has it's own resistance, potential drop and current flow



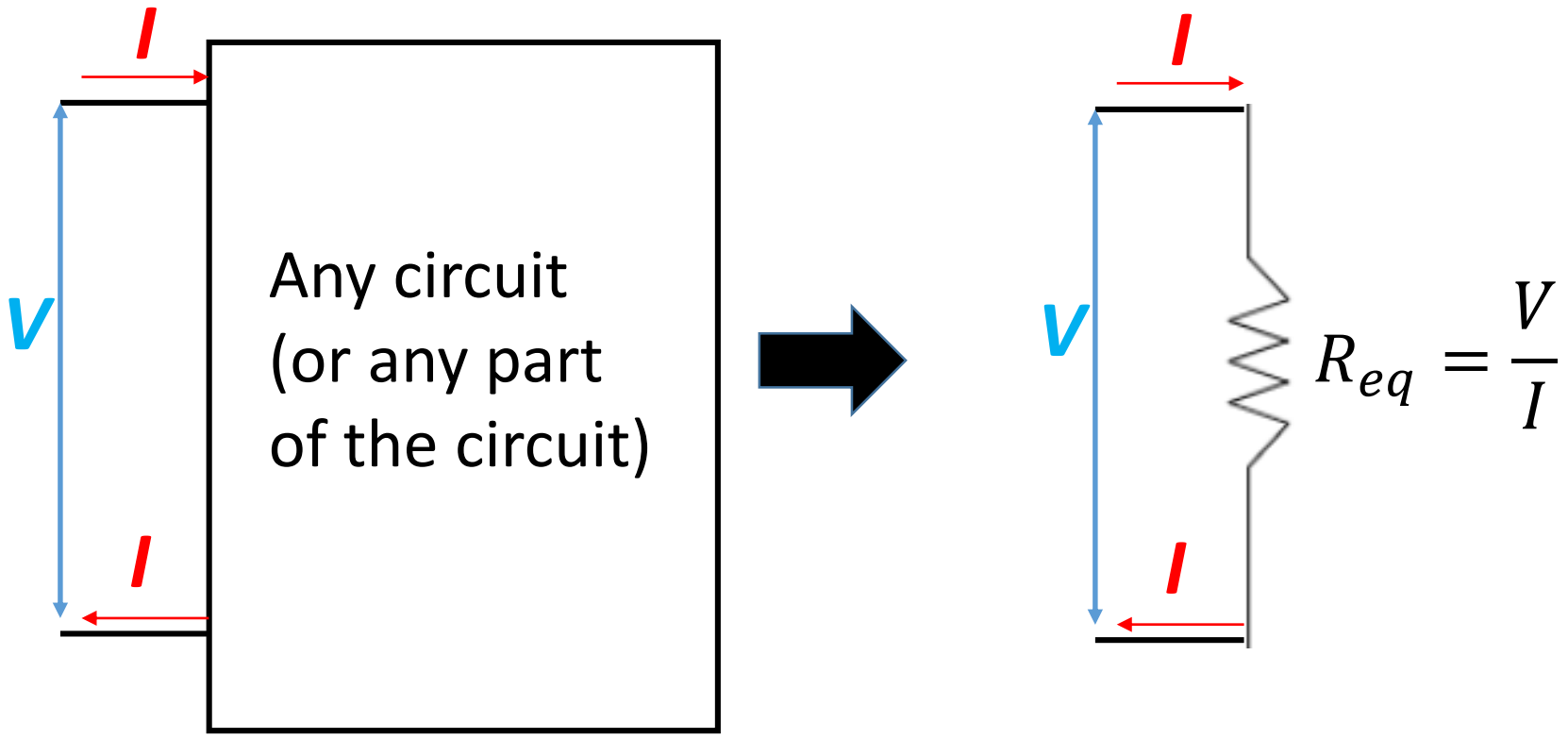
Equivalent resistance

Equivalent resistance is used to simplify circuit.

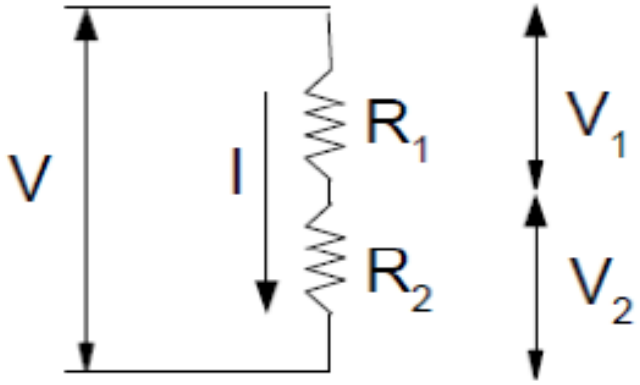


Equivalent resistance

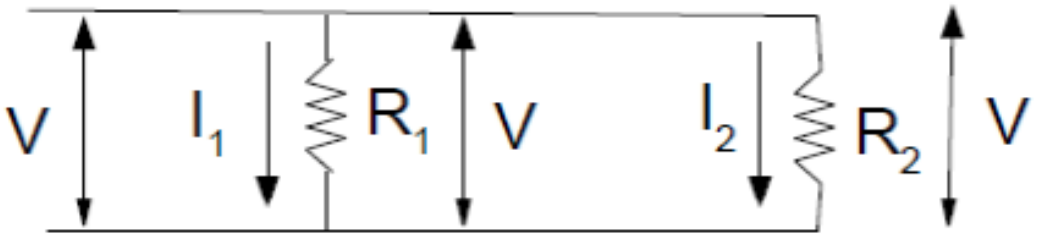
Equivalent resistance is used to simplify circuit.



Parallel and series connections

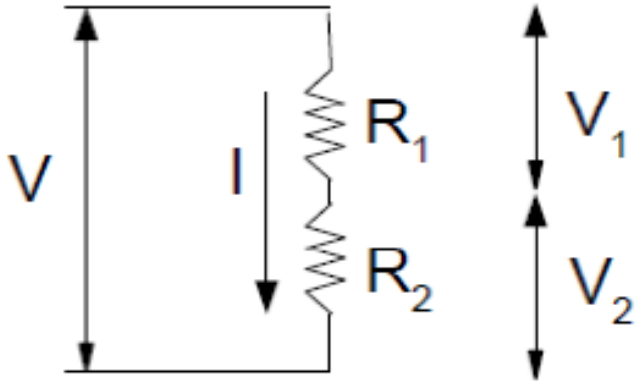


in series

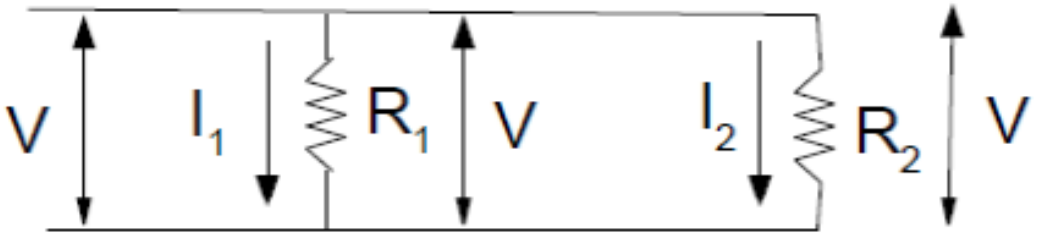


in parallel

Parallel and series connections



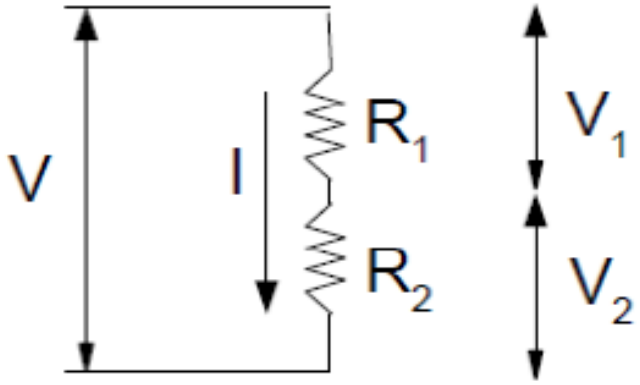
in series



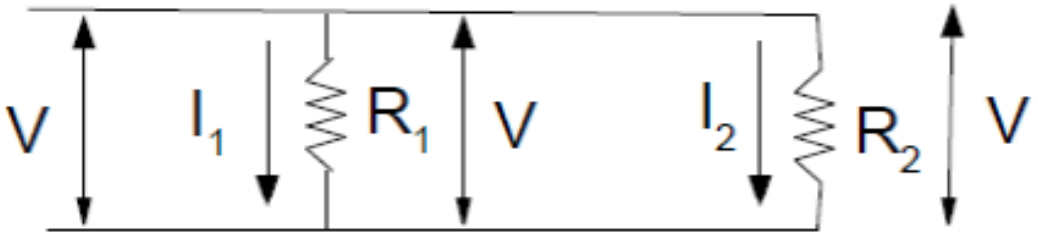
in parallel

Currents are the same for the two resistor

Parallel and series connections



in series

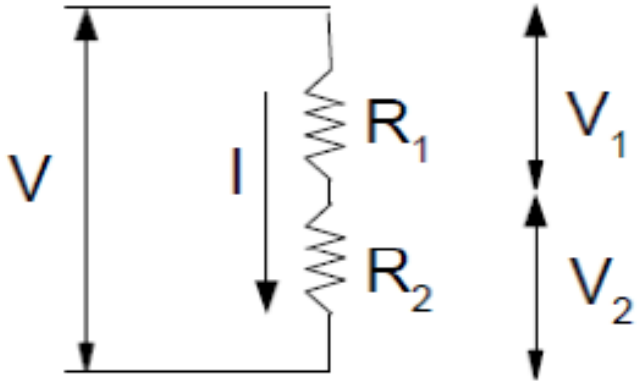


in parallel

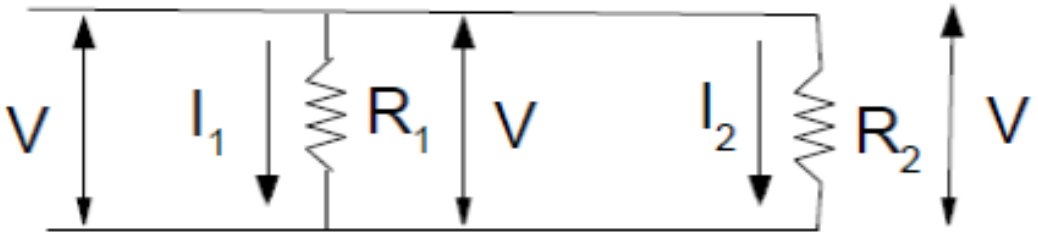
Currents are the same for the two resistor

Potential drop are the same for the two resistor

Parallel and series connections



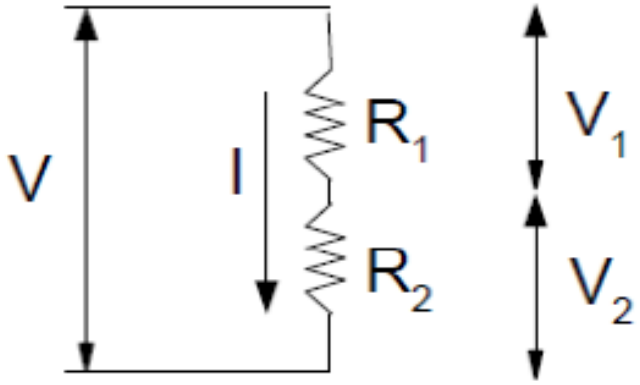
in series



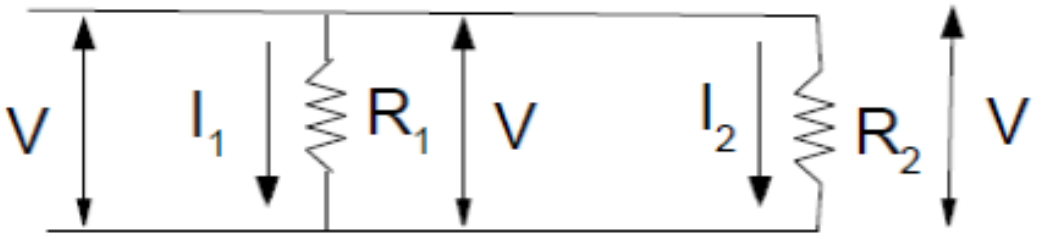
in parallel

$$R_{eq} = R_1 + R_2$$

Parallel and series connections



in series

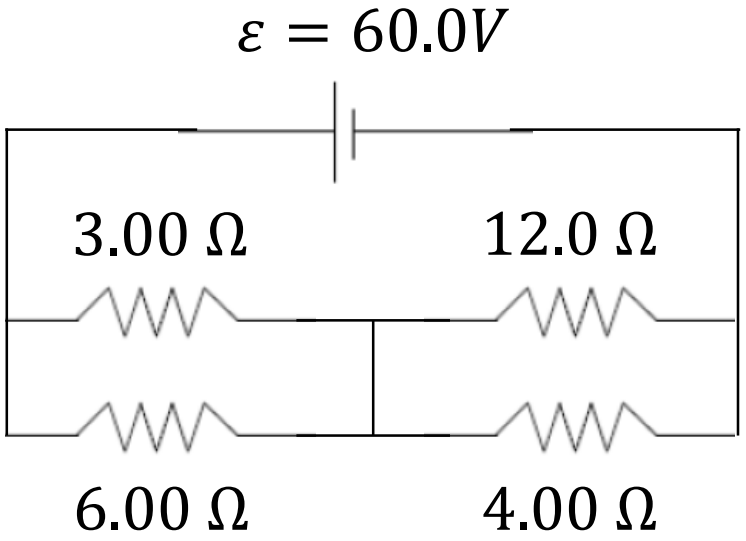


in parallel

$$R_{eq} = R_1 + R_2$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_1}$$

Example



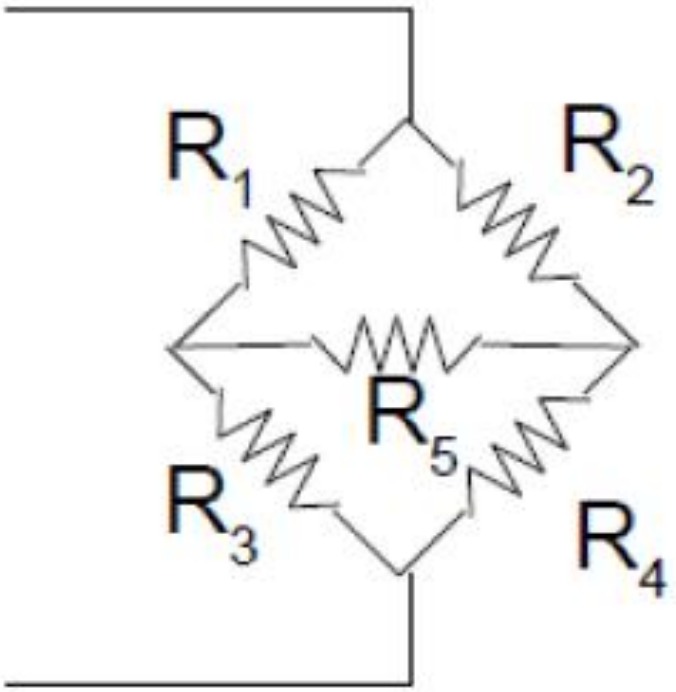
Find R_{eq}, and the current through each resistor

Equivalent resistance for complicated circuits

There are complicated circuits which could not be analyzed by the method mentioned above.

Equivalent resistance for complicated circuits

There are complicated circuits which could not be analyzed by the method mentioned above.



The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

➔In same line (path), currents are the same.

The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

➔In same line (path), currents are the same.

➔At a junction, “flow in” = “flow out”

The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

➔In same line (path), currents are the same.

➔At a junction, “flow in” = “flow out”

- Potential: related to energy. Drops when pass through a resistance along the direction of the current; increase when pass through a emf source along the direction of current

The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

➔In same line (path), currents are the same.

➔At a junction, “flow in” = “flow out”

- Potential: related to energy. Drops when pass through a resistance along the direction of the current; increase when pass through a emf source along the direction of current

➔In ideal wire, no resistance passed, no potential drop (same potential)

The nature of the electric potential and current in circuit

- Current: flow of charge, cannot accumulated at any point in the circuit.

➔In same line (path), currents are the same.

➔At a junction, “flow in” = “flow out”

- Potential: related to energy. Drops when pass through a resistance along the direction of the current; increase when pass through a emf source along the direction of current

➔In ideal wire, no resistance passed, no potential drop (same potential)

➔When go through a loop (any loop), the potential change is 0.

Kirchhoff's rules (for complicated circuit analysis)

Junction rule (about current): $\Sigma I = 0$ at any junction

Kirchhoff's rules (for complicated circuit analysis)

Junction rule (about current): $\Sigma I = 0$ at any junction

- Flow **into** the junction: **positive**
- Flow **out of** the junction: **negative**

Kirchhoff's rules (for complicated circuit analysis)

Junction rule (about current): $\Sigma I = 0$ at any junction

- Flow **into** the junction: **positive**
- Flow **out of** the junction: **negative**

Loop rule (about current): $\Sigma V = 0$ for any closed loop

Kirchhoff's rules (for complicated circuit analysis)

Junction rule (about current): $\Sigma I = 0$ at any junction

- Flow **into** the junction: **positive**
- Flow **out of** the junction: **negative**

Loop rule (about current): $\Sigma V = 0$ for any closed loop

- Potential **drop**: **negative**
- Potential **increase (pump)**: **positive**

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

1. Define **currents values** and **directions** at each section of path in the circuit.

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

1. Define **currents values** and **directions** at each section of path in the circuit.
2. Use **junction rule** for each junction in the circuit. Each junction will give one equation.

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

1. Define **currents values** and **directions** at each section of path in the circuit.
2. Use **junction rule** for each junction in the circuit. Each junction will give one equation.
3. Choose any certain point as **starting point**, then choose a travel route to complete a **close loop** (your choice, and has to go back to the starting point)

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

1. Define **currents values** and **directions** at each section of path in the circuit.
2. Use **junction rule** for each junction in the circuit. Each junction will give one equation.
3. Choose any certain point as **starting point**, then choose a travel route to complete a **close loop** (your choice, and has to go back to the starting point)
4. Use **loop rule** to construct electric potential equation for the loop you chose. (if the travel direction is the same with the current direction, the potential will drop; if opposite, the potential will raise).

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

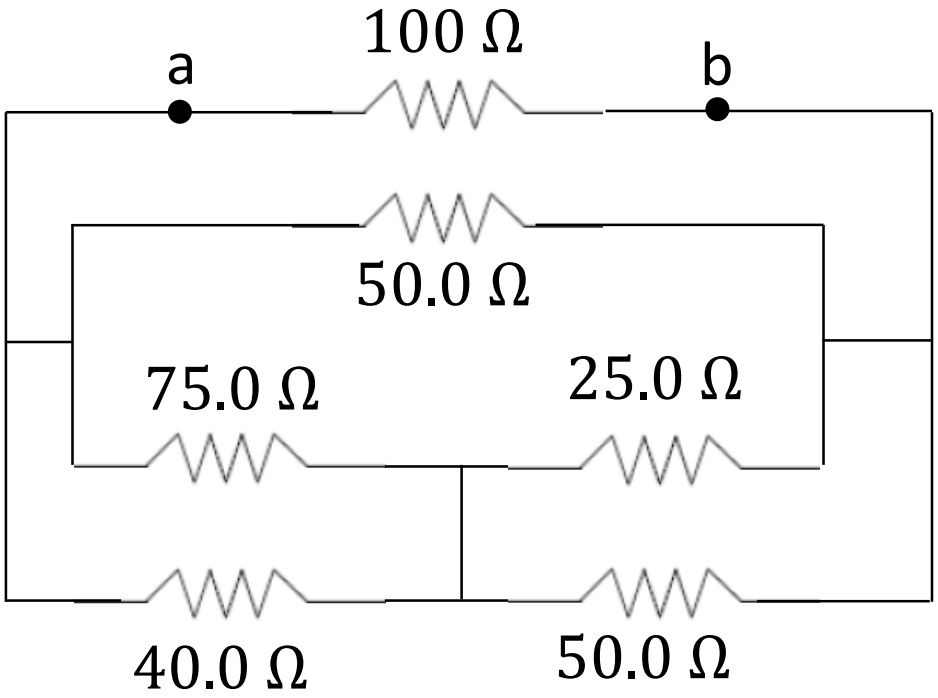
1. Define **currents values** and **directions** at each section of path in the circuit.
2. Use **junction rule** for each junction in the circuit. Each junction will give one equation.
3. Choose any certain point as **starting point**, then choose a travel route to complete a **close loop** (your choice, and has to go back to the starting point)
4. Use **loop rule** to construct electric potential equation for the loop you chose. (if the travel direction is the same with the current direction, the potential will drop; if opposite, the potential will raise).
5. Choose different closed loop which covers **sections that were not covered by other loops** (Some part of the route could be the same). Repeat step 4 until you cover all sections in the circuit)

Kirchhoff's rules (for complicated circuit analysis)

Strategy:

1. Define **currents values** and **directions** at each section of path in the circuit.
2. Use **junction rule** for each junction in the circuit. Each junction will give one equation.
3. Choose any certain point as **starting point**, then choose a travel route to complete a **close loop** (your choice, and has to go back to the starting point)
4. Use **loop rule** to construct electric potential equation for the loop you chose. (if the travel direction is the same with the current direction, the potential will drop; if opposite, the potential will raise).
5. Choose different closed loop which covers **sections that were not covered by other loops** (Some part of the route could be the same). Repeat step 4 until you cover all sections in the circuit)
6. Solve the unknown values using the equations constructed by junction rules and loop rules.

Example



If an ohmmeter is connected between points a and b, what will it read?