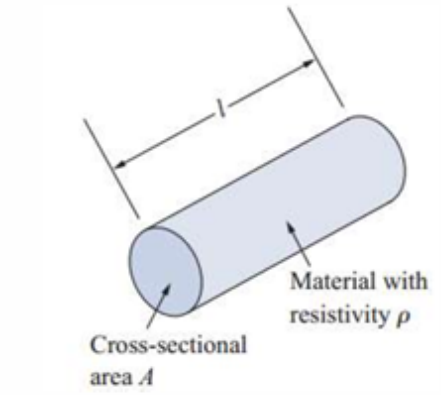
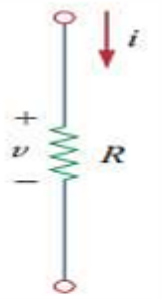
2 - Law

Resistor

Materials in general have a characteristic behavior of resisting the flow of electric charge. **The physical property, or ability to resist current, is known as resistance** and is represented by the symbol R



Resistor



Circuit symbol of resistance

The resistance of any material with uniform cross-sectional area A depends on A and its length l, that is

$$R = \rho \frac{l}{A}$$

Where, ρ is known as the resistivity of the material

Good conductors, such as copper and aluminium, have low resistivity, while insulators, such as mica and paper, have high resistivity.

Ohm's Law

Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points

$$i \propto v$$

$$i = vG$$

Where, G is the proportionality constant

$$G = \frac{1}{R}$$

$$v = iR$$

Conductance

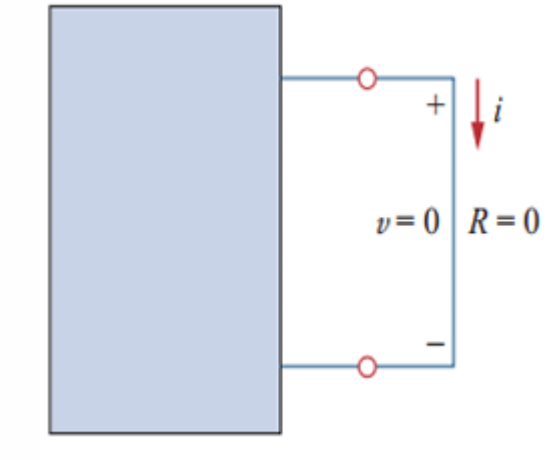
Reciprocal of resistance is known as conductance (G).

The resistance R of an element denotes its ability to resist the flow of electric current; it is measure in ohms (Ω).

Conductance is the ability of an element to conduct electric current; it is measure in mhos or siemens (S).

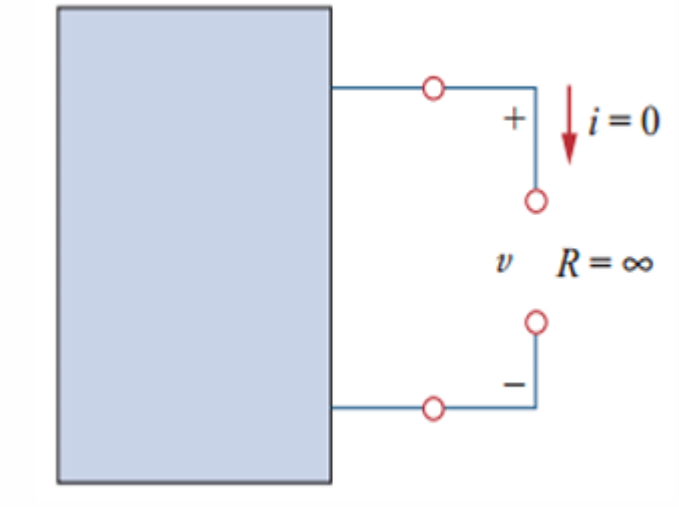
Short Circuit

A short circuit is a circuit element with resistance approaching zero.



Open Circuit

An open circuit is a circuit element with resistance approaching infinity

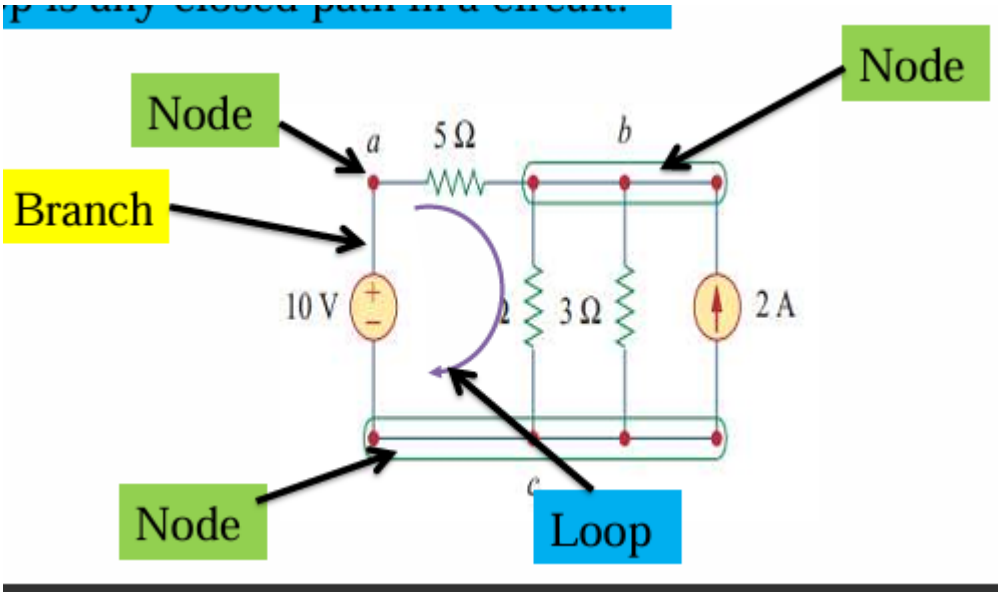


Nodes, Branches and Loops

A branch represents a single element such as voltage source source or a resistor. A branch represents any two-terminal element.

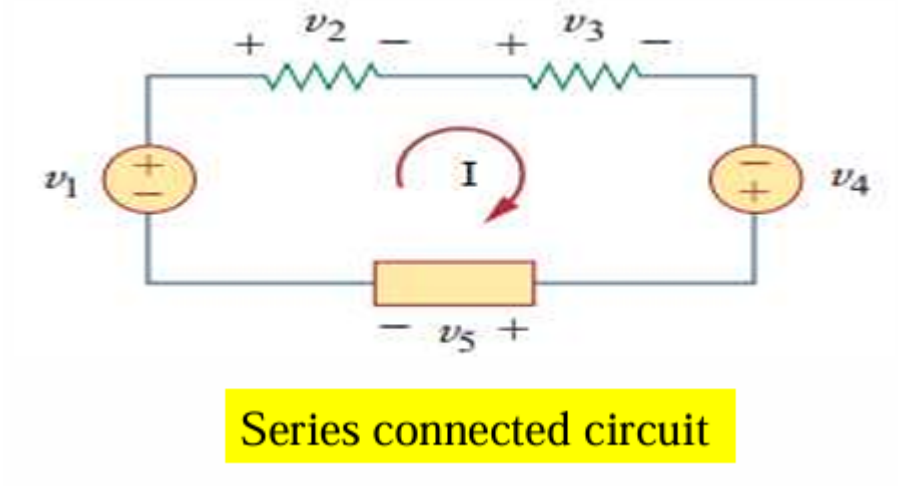
A node is the point of connection between two or more branches

A loop is any closed path in a circuit



Series Connection

Two or more elements are in series if they carry the same current



Series connected circuit

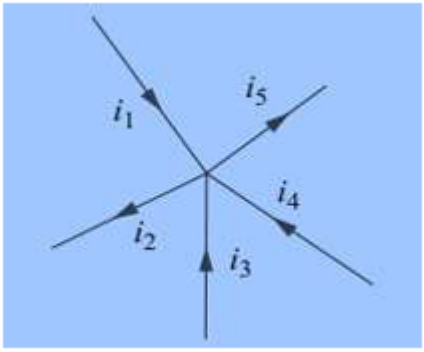
Elements are in series when they are chain-connected or connected sequentially, end to end

Parallel Connection

Two or more elements are in parallel if they are connected to the same two nodes and consequently have the same voltage across them.

Kirchhoff's Current Law (KCL)

Kirchhoff's Current Law (KCL) states that the algebraic sums of currents entering a node is zero.



$$i_1 + (-i_2) + i_3 + i_4 + (-i_5) = 0$$

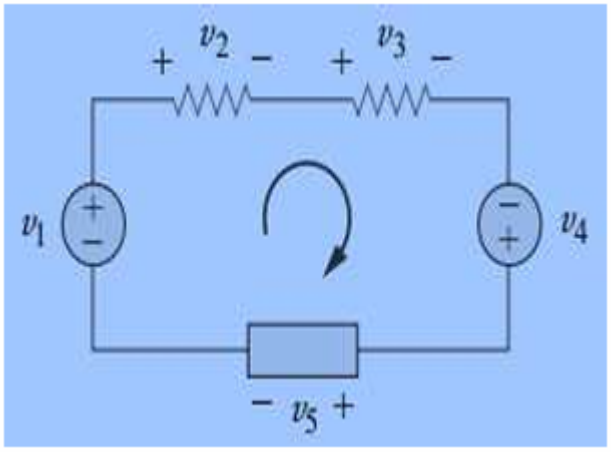
$$i_1 + i_3 + i_4 = i_2 + i_5$$

The sum of the currents entering a node is equal to the sum of the currents leaving the node.

Kirchhoff's Voltage Law (KVL)

Kirchhoff's Voltage Law (KVL) states that the algebraic sum of all voltages around a closed path (or loop) is zero

$$\sum_{m=1}^{M} V_m = 0$$



$$-v_1 + v_2 + v_3 - v_4 + v_5 = 0$$