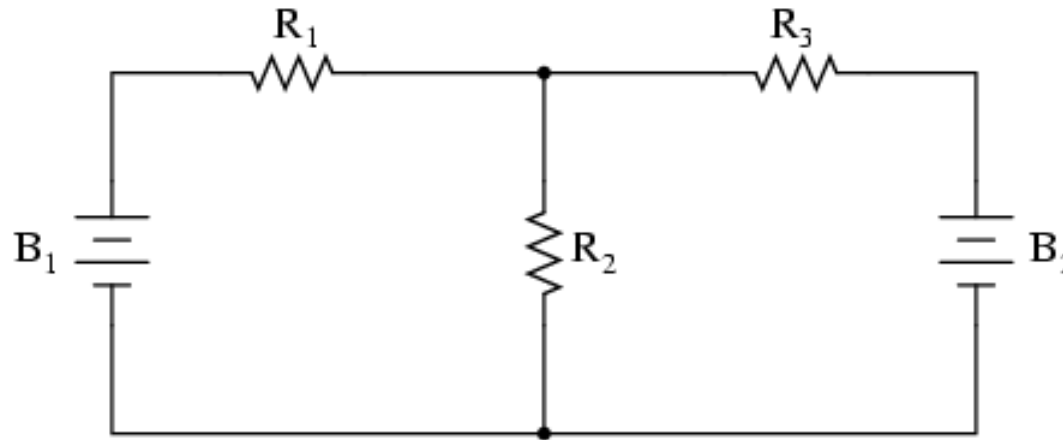


Section 8.2 cont.

Electrical Circuits



Battery – a source of electric energy
+ pole (long line) / - pole (short line)
Current flows **out** of + pole and **into** the - pole
Measured in **volts** (V)

Resistor – an element that dissipates energy
example: light bulb
Measured in **ohms** (Ω)

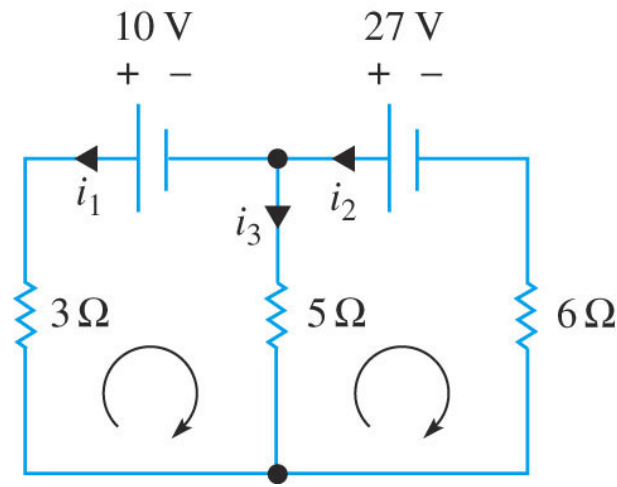
Current – rate of flow of electrons in a wire
Measured in **amperes** or amps (A)

Node – a point at which 3 or more wires are joined

Branch – wire connecting two nodes

Closed loop – a succession of connected branches that begin and end at the same node

The chosen direction in each loop is by convention chosen to be **clockwise**



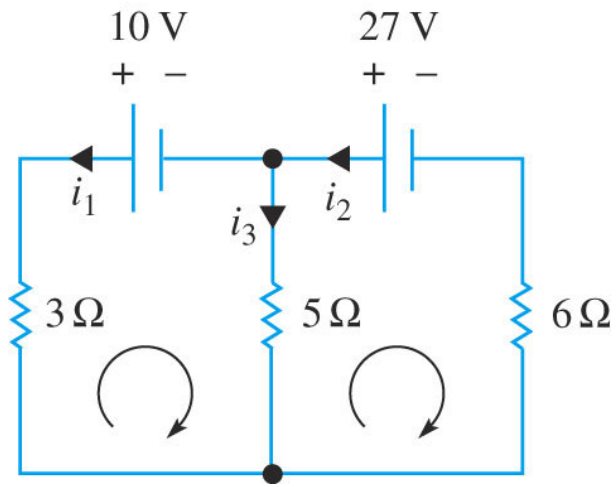
Ohm's Law – If a current of I amperes passes through a resistor with a resistance of R ohms, then there is a resulting drop of E volts in electrical potential that is the product of the current and resistance. $E = IR$

Kirchoff's Current Law – the sum of the currents flowing into any node is equal to the sum of the currents flowing out.

Kirchoff's Voltage Law – in one traversal of any closed loop, the sum of the voltage rises is equal to the sum of the voltage drops.

A voltage **drop** (rise) occurs at a **resistor** if the direction assigned to the current through the resistor is the **same** (opposite) as the direction assigned to the loop

A voltage **rise** (drop) occurs at a **battery** if the direction assigned to the loop is from **- to +** (+ to -) through the battery.



$$\begin{aligned}
 -i_1 + i_2 - i_3 &= 0 \\
 3i_1 - 5i_3 &= 10 \\
 6i_2 + 5i_3 &= 27
 \end{aligned}$$

$$\left(\begin{array}{ccc|c}
 -1 & 1 & -1 & 0 \\
 3 & 0 & -5 & 10 \\
 0 & 6 & 5 & 27
 \end{array} \right)$$

3 *unknowns* means you need 3 *equations*

Choose any node:
current in = current out

$$i_2 = i_1 + i_3$$

Choose any loop:
voltage rise = voltage drop

$$3i_1 = 5i_3 + 10$$

$$5i_3 + 6i_2 = 27$$

$$\begin{aligned}
 &-R_1 \\
 &-3R_1 + R_2 \\
 &\downarrow \\
 \left(\begin{array}{ccc|c}
 1 & -1 & 1 & 0 \\
 0 & 3 & -8 & 10 \\
 0 & 6 & 5 & 27
 \end{array} \right)
 \end{aligned}$$

$$\begin{aligned}
 &\frac{1}{3}R_2 \\
 &-6R_2 + R_3 \\
 &\frac{1}{21}R_3 \\
 &\downarrow
 \end{aligned}$$

$$\left(\begin{array}{ccc|c}
 1 & -1 & 1 & 0 \\
 0 & 1 & -\frac{8}{3} & \frac{10}{3} \\
 0 & 0 & 1 & \frac{1}{3}
 \end{array} \right)
 \begin{aligned}
 i_1 &= i_2 - i_3 \Rightarrow i_1 = \frac{35}{9} \\
 i_2 &= \frac{10}{3} + \frac{8}{3}i_3 \Rightarrow i_2 = \frac{38}{9} \\
 i_3 &= \frac{1}{3}
 \end{aligned}$$