Electric Circuits

The most basic electric circuit is formed by a voltage source and a resistor. When the circuit is closed, an electric current will flow through it.

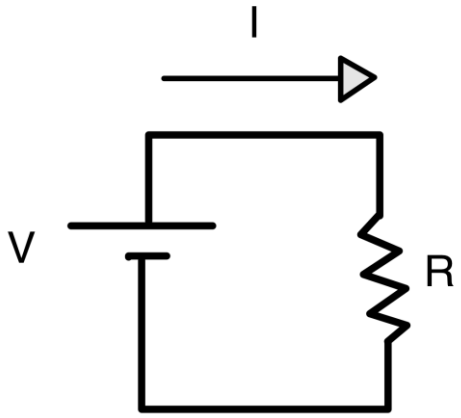
Voltage (V): Difference of electric potential. Intuitively, we can think of voltage as stored energy (similar to potential energy) that charged particles can use once the circuit is closed.

$$V = \frac{\Delta U}{Q}$$

Current (I): Amount of charge flowing through a specific point per unit of charge. Intuitively, this quantity gives us an idea of how many charged particles are moving through the circuit and how fast they're going.

$$I = \frac{\Delta Q}{\Delta t}$$

Resistance (R): Opposition to the flow of electric current. Intuitively, resistance can be thought of as friction in the circuit. The energy of the charged particles is deposited on the resistor, so if we are clever we can use this energy to do useful work !

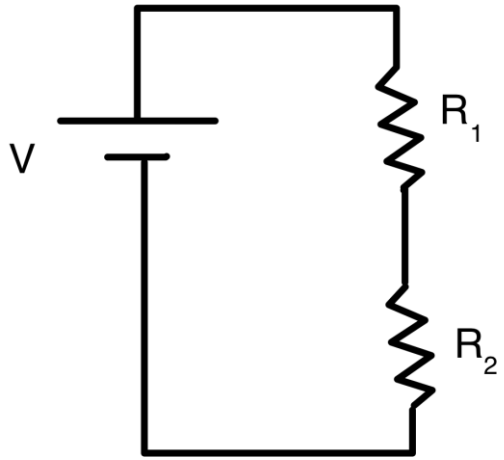


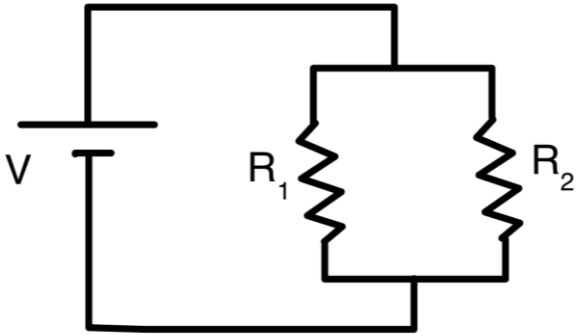
These are related to each other through Ohm's Law:

$$V = R \times I$$

Series and Parallel Circuits

If we consider a circuit with two resistors, we can make two different circuits that result in different currents.





Series: The current flowing through R_1 and R_2 is the same, so

$$I = I_1 = I_2$$

After each resistor, there is a voltage drop. The sum of these drops equals the total voltage in the circuit, so

$$V = V_1 + V_2$$

Parallel: The current splits between R_1 and R_2, so

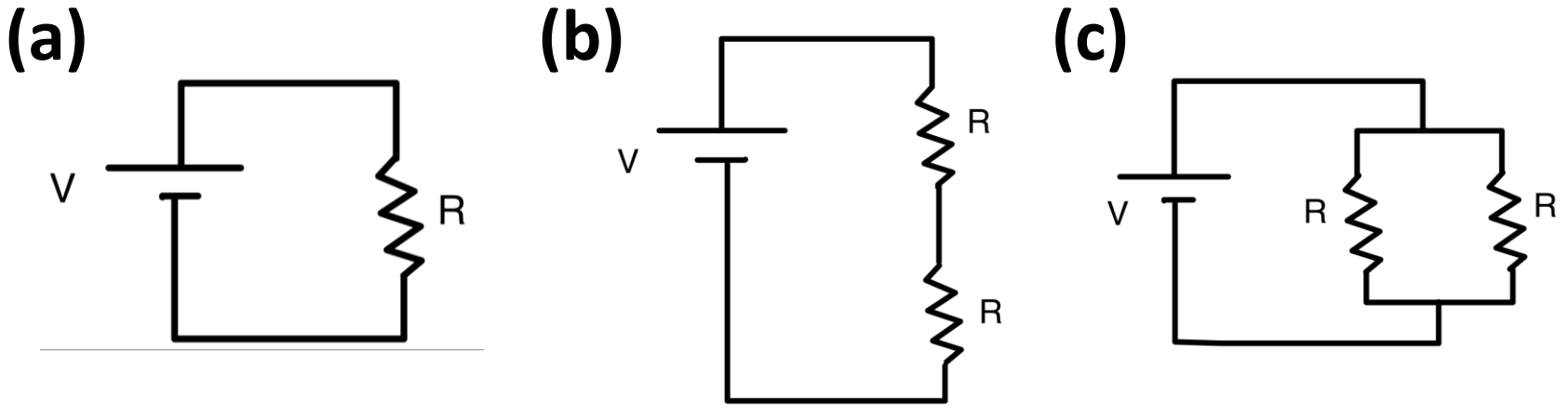
$$I = I_1 + I_2$$

The voltage drop at each resistor must be the same, and it must be equal to the total voltage, so

$$V = V_1 = V_2$$

Homework

Problem 1. Consider the three circuits shown below. In all of them, the resistance of each resistor is R = 1 Ω. Imagine that you want to organize them, and you decide that you will place the circuit with the largest current to the left, the circuit with the lowest current to the right, and between them the circuit whose current lies between the other two. How would you organize them?



Now, go to https://www.brainpop.com/games/circuitconstructionkitdc/ and click “Play game” and then select the “Intro” option. Create this circuits there and compare the current in the three cases. Does the behavior agree with your expectations? Can you come up with an explanation of this phenomena?

Homework

Problem 2. Three resistors: R_1=10 Ω , R_2=20 Ω and R_3=30 Ω are connected in series as shown in the figure below.

a) The current running through the first resistor is I=0.5A. Show the direction of the current. What are the currents that run through the other two resistors?

b) Find the voltage drop on each resistor and the voltage supplied by the battery.