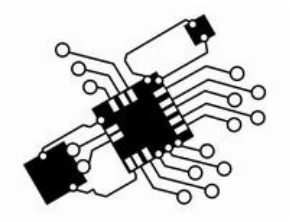
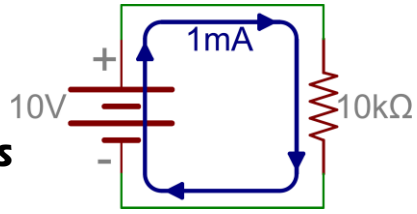


PHYSICS 12 - 2020

INTRODUCTION TO ELECTRIC CIRCUITS

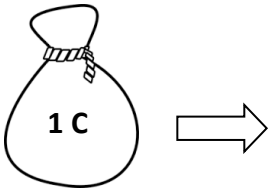


Electrical Current

In an electric circuit, **electrons** *flow* through wires. **Electric current** is defined as *the amount of electric charge that passes a point in a circuit in one second.*

The units for Electric **Current** are **Amperes or Amps or (A)**.

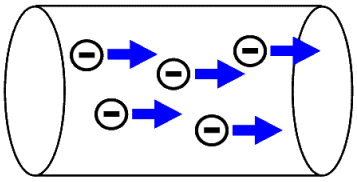
A large # of electrons **flow** (even in a simple circuit). So we use the following convention:



1 coulomb = 6.24 x 10^{18} electrons. *(sack of electrons)*

1 Amp = a flow of **1 Coulomb/second. (1 A = 1 C/s)**

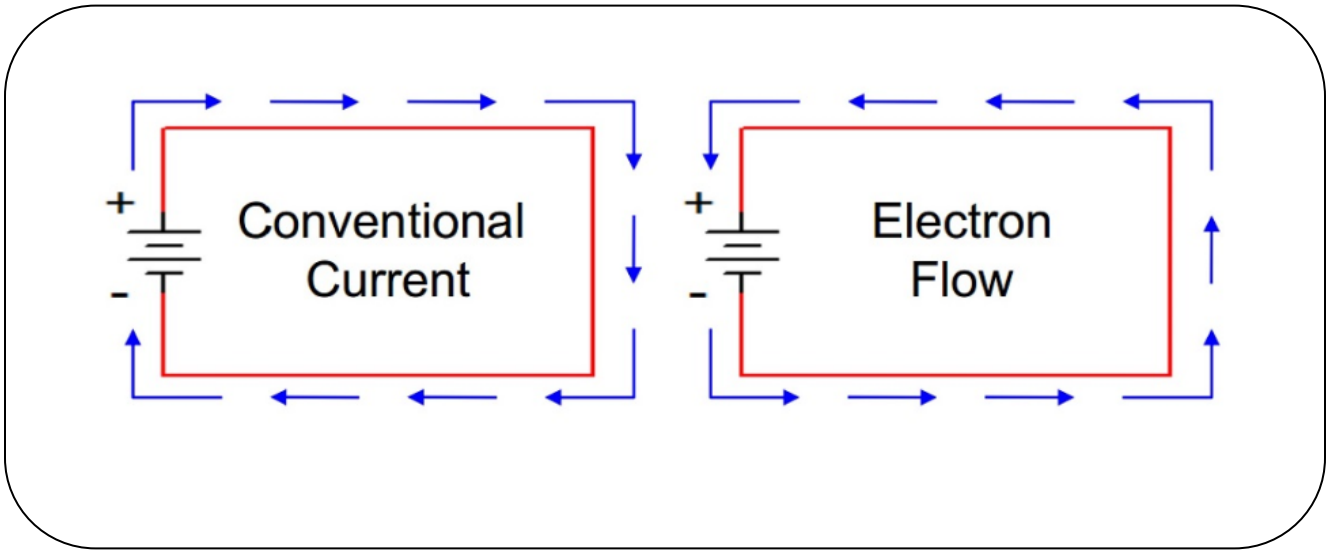
1 Amp = a flow of 6.24 x 10^{18} electrons/second.
(1 A = 6.24 x 10^{18} electrons/s)



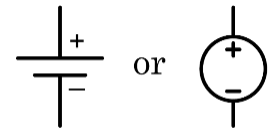
Conventional Current

In a circuit, electrons flow through the wires. Electrons are *negatively-charged* and therefore flow from negative to positive.

But, the arrows on a circuit diagram *always* point in the direction that positive particles would flow (from positive to negative) this is called **Conventional Current.** **It's a *nasty* convention that we have to use – see last page of note.**



Voltage



Symbols of DC Voltage Source

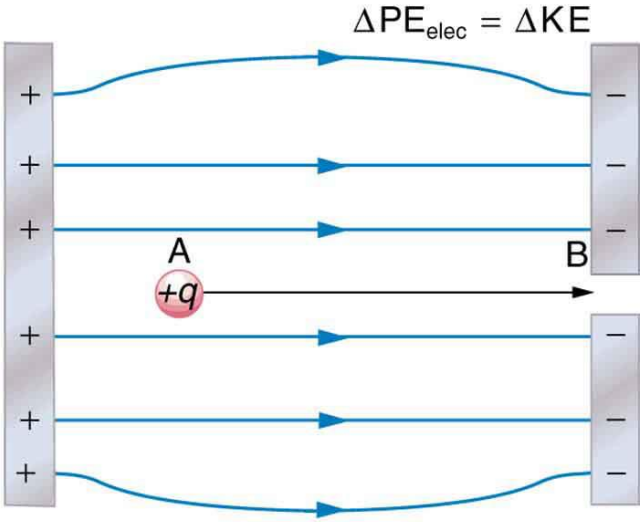
What causes the electrons to flow in a wire? **Energy!**...provided by a **power source** like a battery or a generator. A power source provides **energy** to electrons (so the electrons will move).

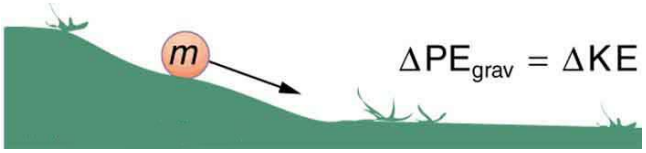
Voltage is, in fact, **Potential Energy** (see diagram below).

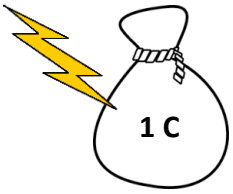
You can see that the positive particle **+q** in diagram below will want to move to the right. (*opposites attract – like charges repel*)....we could push electrons the opposite way...current.

Batteries or generators create a ***potential difference*** that can be used to move the electrons.

Voltage is measured in **Volts (V)**







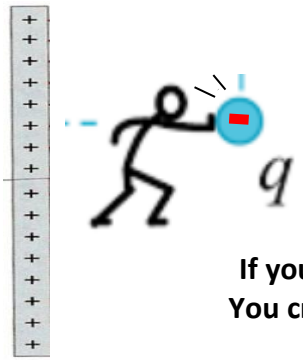
1 Volt = 1 Joule of energy *per* Coulomb

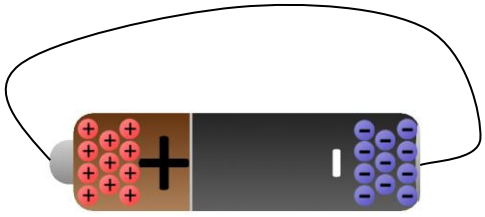
Volts = Joules/Coulomb

1 V = 1 J/C

Volts?...think **ENERGY!** J/C

Circuit diagram symbol - **V**





If you can create Electrical Potential Energy,
You create voltage...That's what batteries do.

Resistance

As electrons flow through the wires of an electrical circuit they do not flow freely. The flow of electrons is affected by how much space they have to move, and other factors.

How much a wire or (conductor) resists the flow of electrons is call its resistance.

Resistance is measured in **Ohms Ω.**

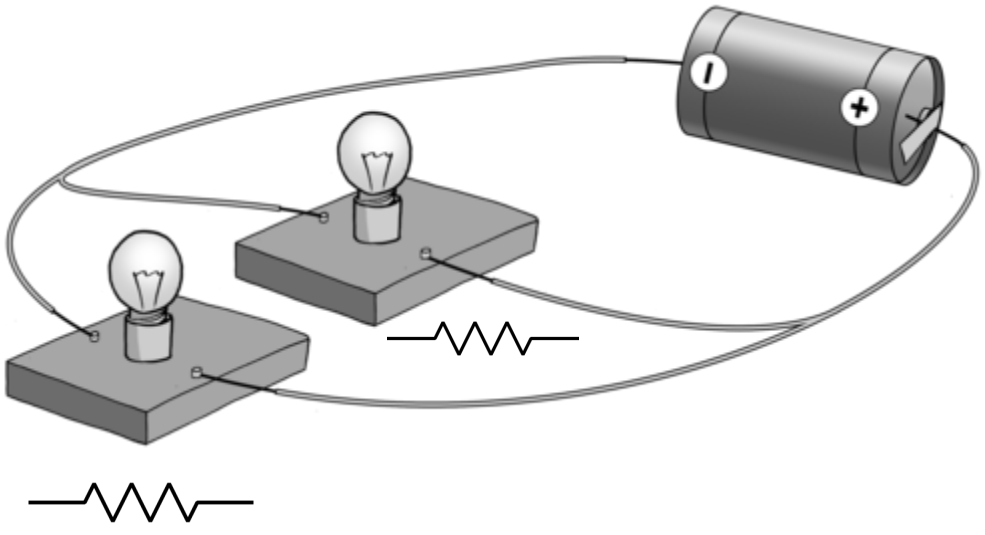
Circuit diagram symbol -

Wires are not the only component in a circuit that has resistance. **Any element** in a circuit will have resistance and will **take energy away from electrons.**

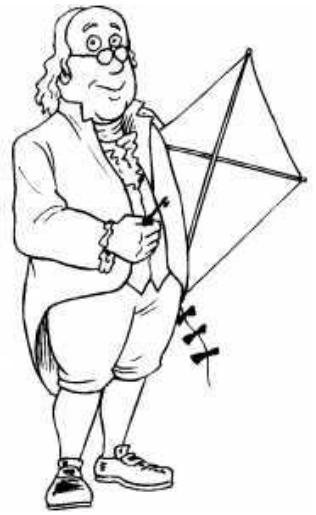
Lights bulbs, electrical appliances, and all component in a circuit have a **resistance.**

It is important to note that when we see the symbol - this means **energy** (joules) or Joules/per coulomb is being **lost.**

We call the energy lost across a component in a circuit **a Voltage Drop or Potential Difference Drop**



Electron Current vs. Conventional Current



In 1752, prior to electricity being identified with the electron, Ben Franklin chose a convention regarding the direction of current flow.

Franklin assumed that electrons (being assumed **positive**) flow from positive to negative terminals. We now know this is incorrect. The charge on an electron is negative by definition (note negative sign): (-1.6×10^{-19} C)

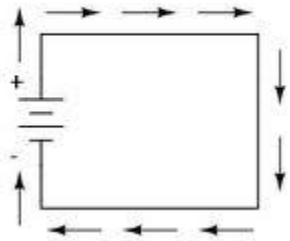
The flow of electrons is termed *electron current*. Electrons flow from the negative terminal to the positive.

Conventional current or simply *current*, behaves as if positive charge carriers cause current flow.

Conventional current flows from the positive terminal to the negative. Perhaps the clearest way to think about this is to pretend as if movement of positive charge carriers constituted current flow.

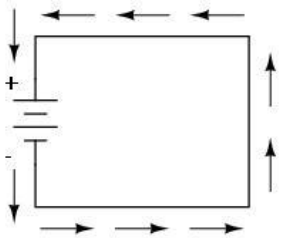
It is important to realize that the difference between conventional current flow and electron flow in no way effects any real-world behavior or computational results. In general, analyzing an electrical circuit yields results that are independent of the assumed direction of current flow. Conventional current flow is the standard that most all of the world follows.

Conventional flow notation



Electric charge moves from the positive (surplus) side of the battery to the negative (deficiency) side.

Electron flow notation



Electric charge moves from the negative (surplus) side of the battery to the positive (deficiency) side.

Introduction to Circuit Electricity Questions:

1. What is the unit of measure for the amount of *Joules per coulomb* added to a circuit

    a) amps
    b) ohms
    c) volts
    d) watts

2. What symbol represents the *unit* of measurement for current?

    a) V
    b) A
    c) R
    d) Ω
    e) I

3. What is the rate of flow of electric charge?

    a) Resistance
    b) Power
    c) Voltage
    d) Current
    e) Energy

4. What quantity do we use to represent how components in a circuit reduce the flow of charge?

    a. Current
    b. Voltage
    c. Power
    d. Resistance

5. What is the *Unit* of Measurement of RESISTANCE ?

    a. Amp
    b. Volt
    c. Watt
    d. Ohm

6. A circuit has 2.7A of current flowing through it. How many electrons are flowing through this circuit it 1.5s?

    A) 1.6×10^{19} B) 4.05 C) 6.48×10^{-19} D) 2.53×10^{19}

7. A coulomb is

    a) Standard measure of current
    b) The amount of charge on an electron
    c) The voltage on a group of electrons
    d) The amount of charge that is on 6.24×10^{18} electrons

8. Voltage is

    a) The amount of joules in a circuit
    b) The force on a charged particle
    c) The amount of energy per coulomb of charge (J/C)
    d) The amount of force per amp of current.

9. Electrons can flow in a wire when:

    a) They are given electrical potential energy
    b) All Joules are forced from the electron's coulomb
    c) Are given ohms
    d) When the wire has two equally positive terminals

10. The name of electron flow is:

    a) Voltage
    b) Resistance
    c) Current
    d) Coulombs

11. The unit for electrical potential difference is

    a) Voltage
    b) C/J
    c) Current
    d) Amps
    e) A and B

12. What symbol represents the *unit* of measurement for Resistance?

    a) V
    b) A
    c) R
    d) Ω
    e) I

13. Conventional current refers to

    a) The direction that actually (real) electrons will flow in a circuit.
    b) The direction that positive particle would flow in a circuit
    c) The convention used for Amps/time
    d) The convention used for Joules/coulombs

14. An Amp represents:

    a) 1 coulomb per second
    b) 1.6×10^{14} coulombs per second
    c) I volt per coulomb
    d) Both A and B

Answers:

1. C
2. B
3. D
4. D
5. D
6. D
7. D
8. C
9. A
10. C
11. A
12. D
13. B
14. A