

7.1 Electric circuits

You use electricity to turn on the lights, charge your phone, and play video games on your computer at home.

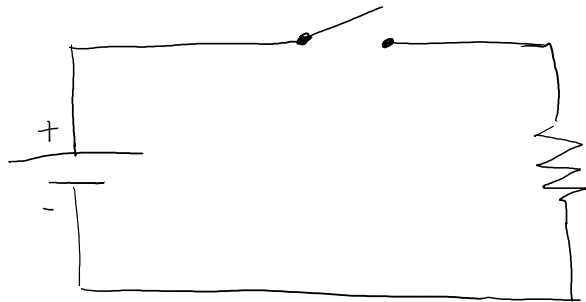
When charges move, a **current** is generated. **Current (I)** is the amount of charge flow per unit of time, measured in **amperes** or **amps (A)**.

$$I = \frac{Q}{t} \left(\frac{C}{s} \right) \text{ or } (A)$$

For current to flow, you'll need:

- 1) power source (voltage source such as a battery or an electric outlet)
- 2) closed circuit

Below is an example of a circuit diagram:



Which direction is the current flow?

In reality, **electrons flow** from the negative terminal of the battery to the positive terminal of the battery.

However, we use the **conventional current** which describes the flow of positive charges from the positive terminal to the negative terminal of the battery.

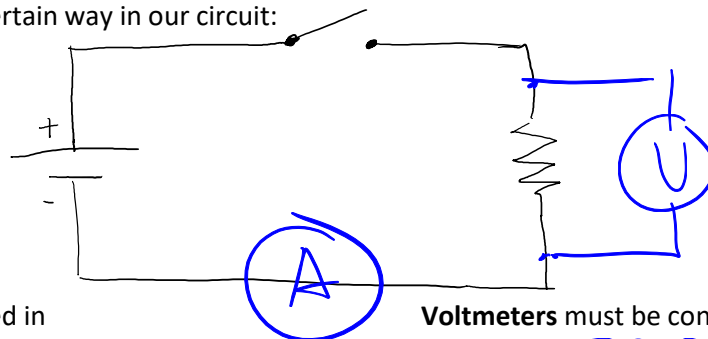
Component	Schematic
Battery	
Resistor (ex. Light bulb)	
Switch	
Wire	
Ammeter	
Voltmeter	
Capacitor	

We will mostly use direct current (DC) in this unit, but the current that we receive from our outlets provide **alternating current** (AC). Alternating current means that the current alternates direction. Our home electric circuits alternative 60 times a second (60 Hz).

We can measure the **current** at any part of the circuit using an **ammeter**.

To measure the **voltage** drop across a resistor or a battery in a circuit, we use a **voltmeter** that measures in **volts**.

They must be connected a certain way in our circuit:



Ammeters must be connected in series.

Voltmeters must be connected in parallel.

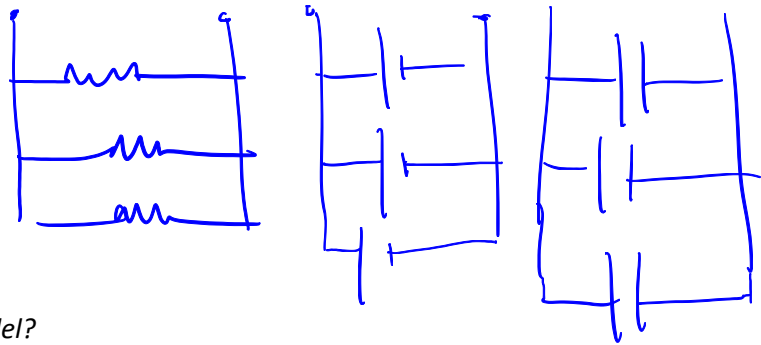
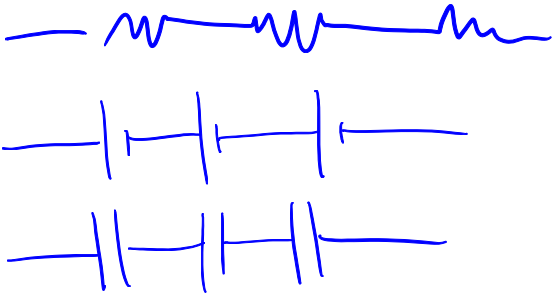
Why must they be connected in this way?

Name: _____
Series: one path for current flow

Phys 12
Parallel: multiple paths for current flow

Resistor, battery, and capacitor examples:

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When is it beneficial to attach your batteries in series? In parallel?

If we can measure the current and the voltage drop across a resistor, we can find its **resistance**.

Ohm's Law: The current across a conductor is directly proportional to the voltage drop.

$$V = IR$$

Voltage: Energy per coulomb of charge (**volts**).

Resistance: How difficult it is for current to flow through a conductor, measured in **ohms (Ω)**.

When you buy light bulbs at the store, you see a wattage reading. Watts are units of power.

We can express Power using current (I), voltage (V), and resistance (R).

$$P = VI \quad P = I^2 R \quad P = \frac{V^2}{R}$$

Notice that these are all variations using Ohm's Law.

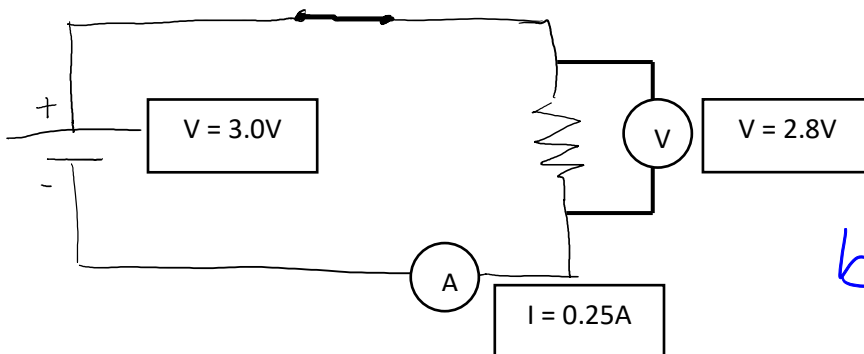
We can derive this from voltage = Energy/charge

$$P = \frac{\Delta E}{t} = \frac{Vq}{t} = VI$$

Ex. 1: Using the diagram below, calculate the following:

- The light bulb's resistance. (ANS: 11Ω)
- The power consumed by the light bulb. (ANS: $0.70W$)

$$a) \frac{V}{I} = \frac{2.8V}{0.25A} = 11\Omega$$



$$b) P = VI = 2.8V(0.25A) = 0.70W$$