3. ELECTRICITY, COMPONENTS and CIRCUITS

Chapter 3 Part 1 of 3

Electricity

Fundamentals of Electricity

Radios are powered by electricity

Radio signals are a form of electrical energy

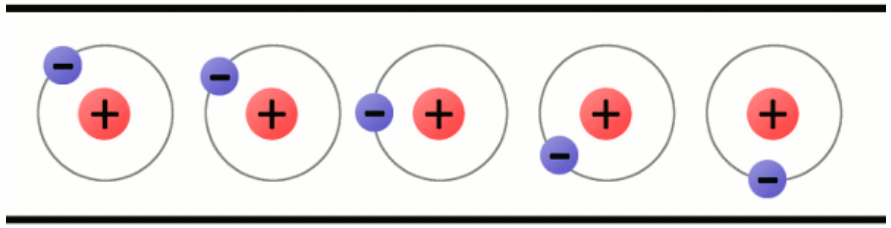
A basic understanding of how we control electrical energy allows you to better operate your radio

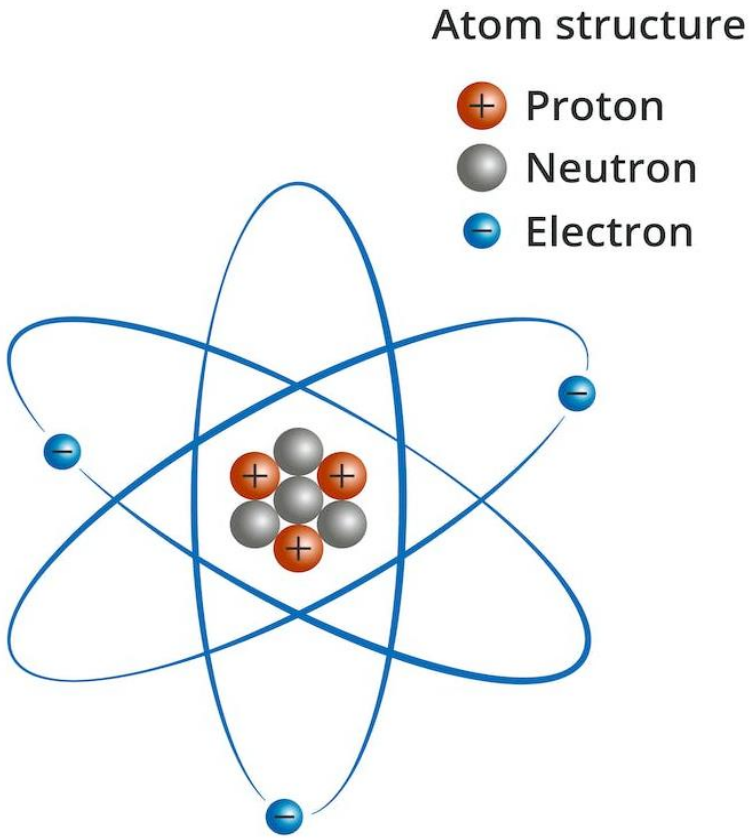
Fundamentals of Electricity

Electrons are negatively charged atomic particles, usually surrounding an atom's positively charged nucleus

Depending on the material, electrons may move in response to an **electromotive force**

In some materials, electrons can move from atom to atom, or even completely free from the atoms.





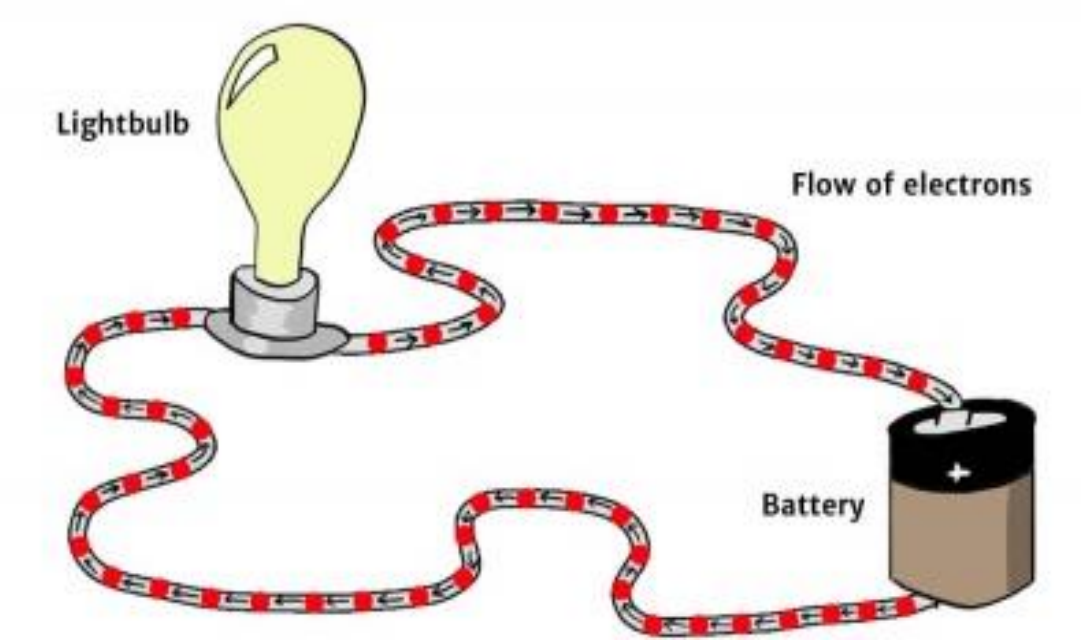
Electron flow

Electrical charge can be positive or negative

Opposites attract

Electrons ‘want’ to move towards a positive charge and/or away from a negative charge

The flow of electrons is called a **current** and they flow in a **circuit**



Basic electrical Concepts

Current

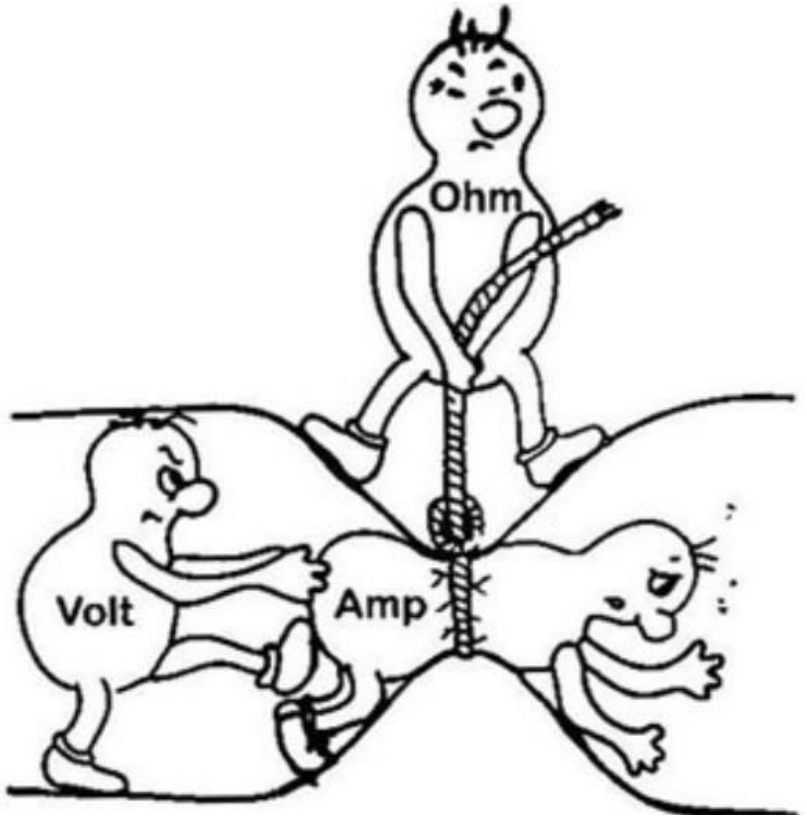
- The *movement* of electrons
- Measured in Ampere (**A**)
- In formulas, represented by **I** (capital i)

Voltage

- The electromotive *force* affecting the electrons
- Measured in Volt (**V**)
- In formulas, represented by **E** or **V**

Resistance

- The *opposition* to the movement of electrons
- Measured in Ohm (**Ω**)
- In formulas, represented by **R**



Ohm’s law

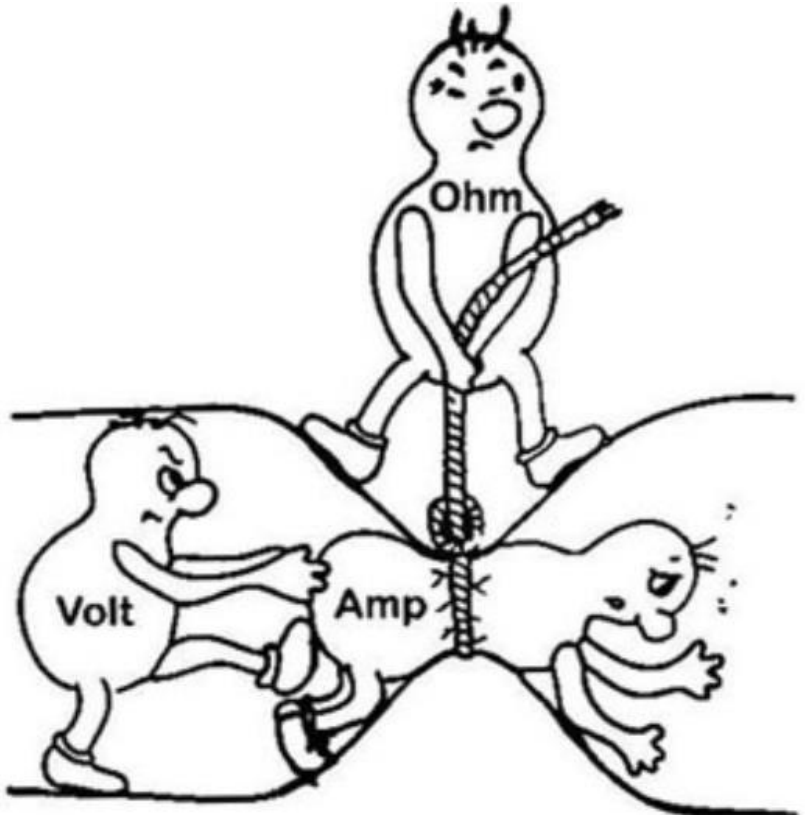
Current, Voltage and Resistance affect each other

Example:

Assuming opposition (Ω) doesn’t change:
more push (V) results in more flow (A)

$$Current = \frac{Voltage}{Resistance}$$

$$I = \frac{E}{R}$$



Ohm’s law

To find Current

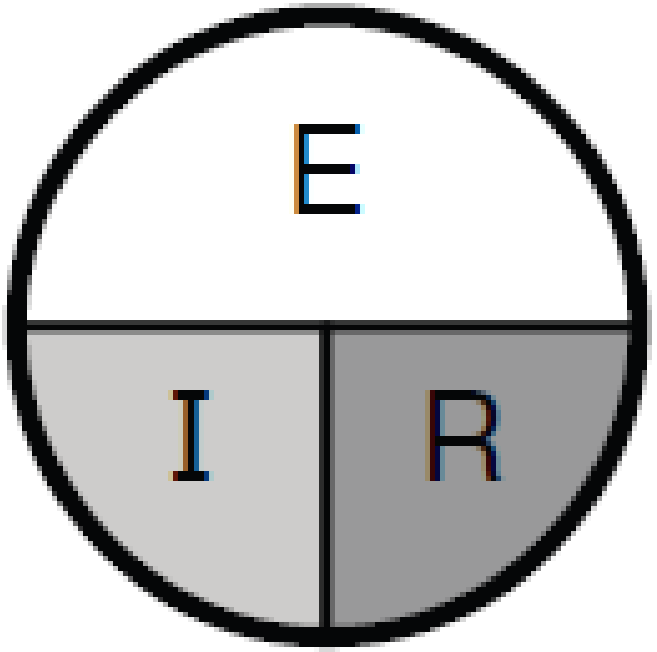
$$I = \frac{E}{R}$$

To find Resistance

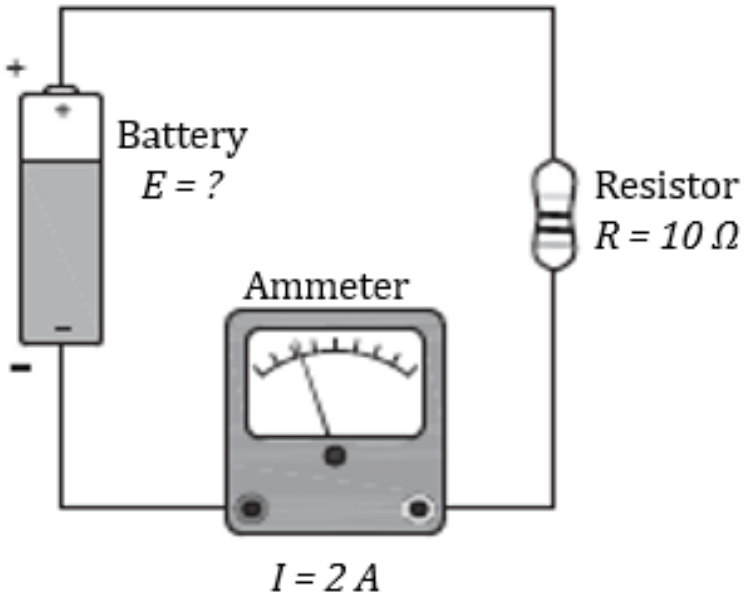
$$R = \frac{E}{I}$$

To find Voltage

$$E = I \cdot \mathrm{R}$$



Ohm’s law example



$$I = \frac{E}{R} \qquad R = \frac{E}{I} \qquad E = I \cdot \mathrm{R}$$

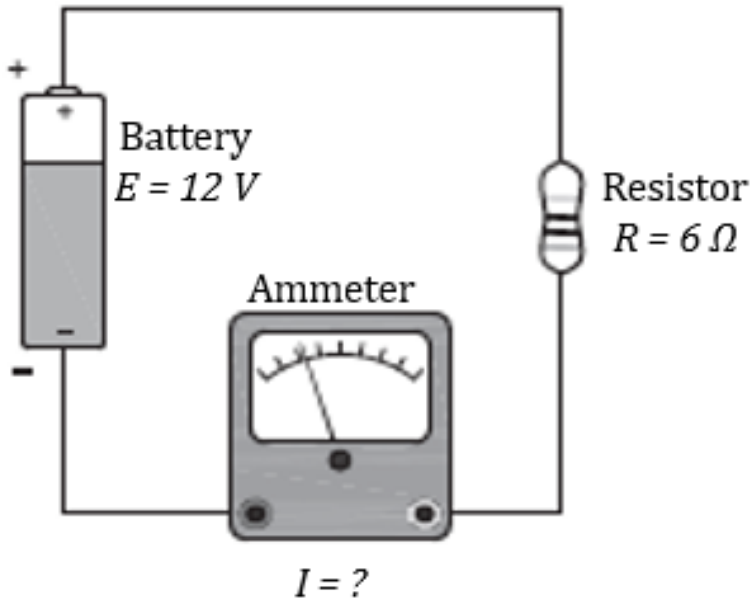
Given : R = 10 Ω, I = 2 A

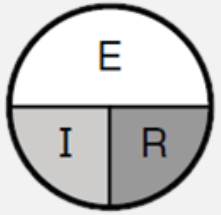
Want to find Volt (E)

$$E = I \cdot \mathrm{R}$$

$$E = 2 \cdot 10 = 20 \text{ Volt}$$

Ohm’s law example





Given : R = 6 Ω, E = 12 V

Want to find Current (I)

$$I = \frac{E}{R}$$

$$I = \frac{12}{6} = 2\,A$$

Enough math !

..for now

..but this is about as hard as it gets

..you are allowed to use a calculator on the test

..but you won’t need it

Current flow

A **circuit** is any path though which current can flow

Electrical circuits are made from components and connections between them

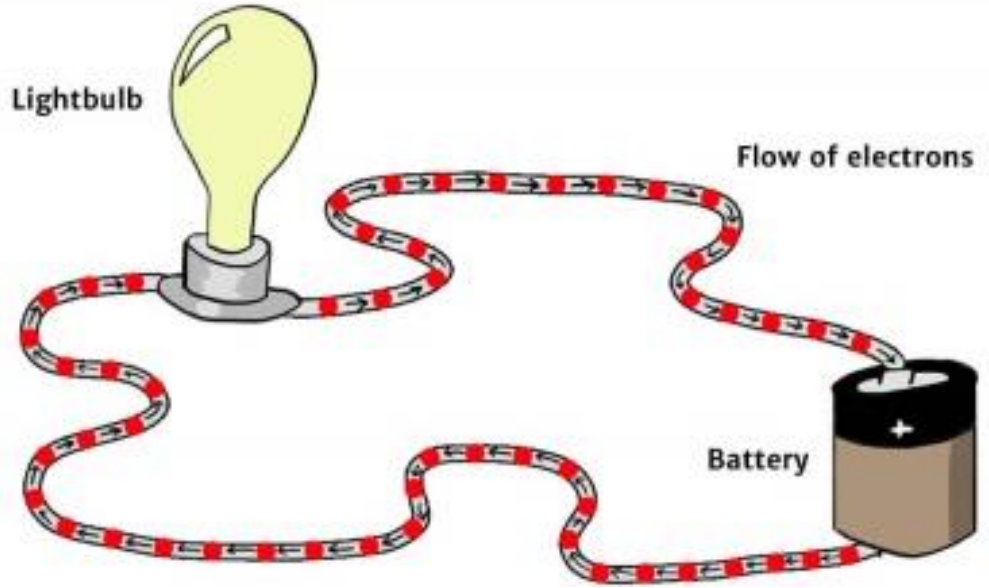
If two or more components are connected in a circuit so that the same current must flow through them, that's a **series circuit**

A **short circuit** is a direct connection between two points in a circuit

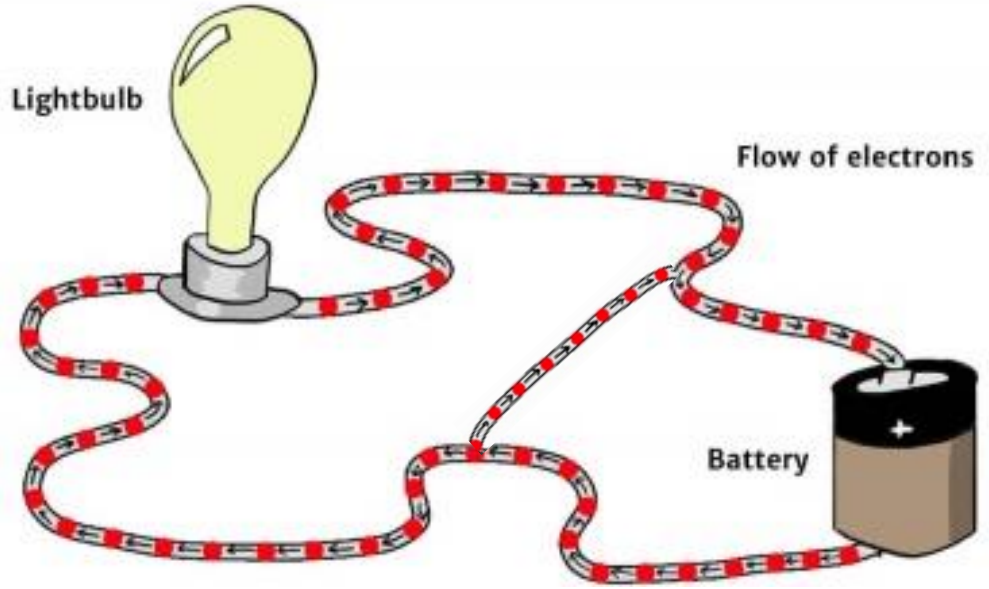
An **open circuit** is made by breaking the current path in a circuit

A **parallel circuit** allows the current to take more than one path

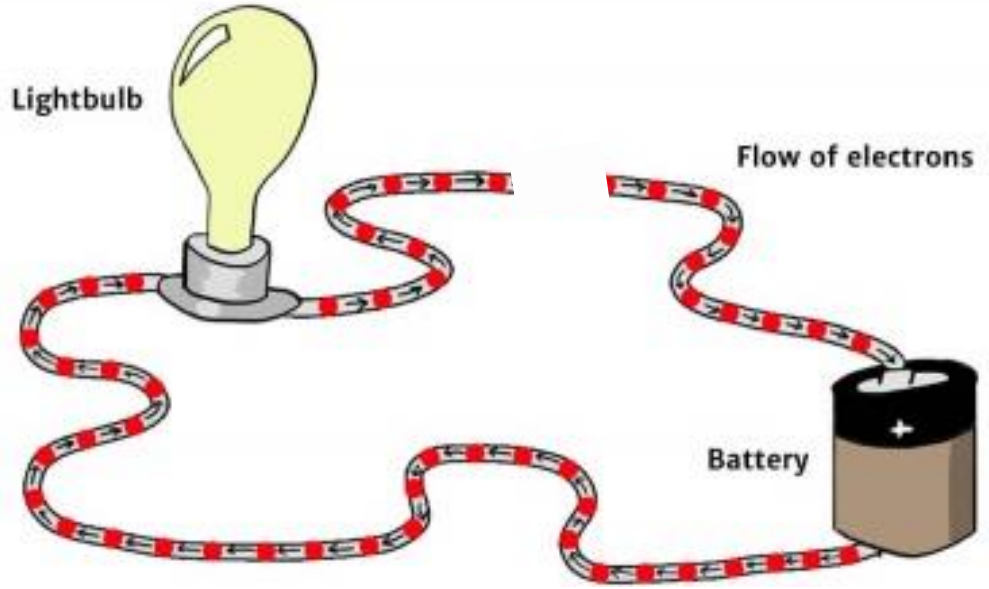
Circuit



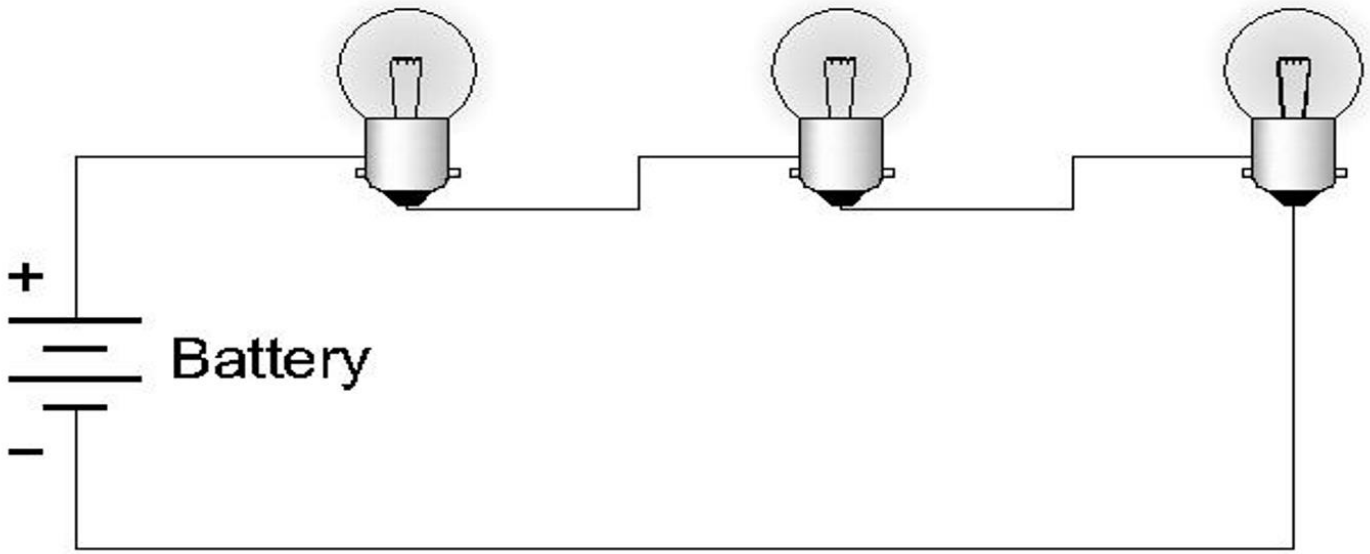
Short Circuit



Open Circuit

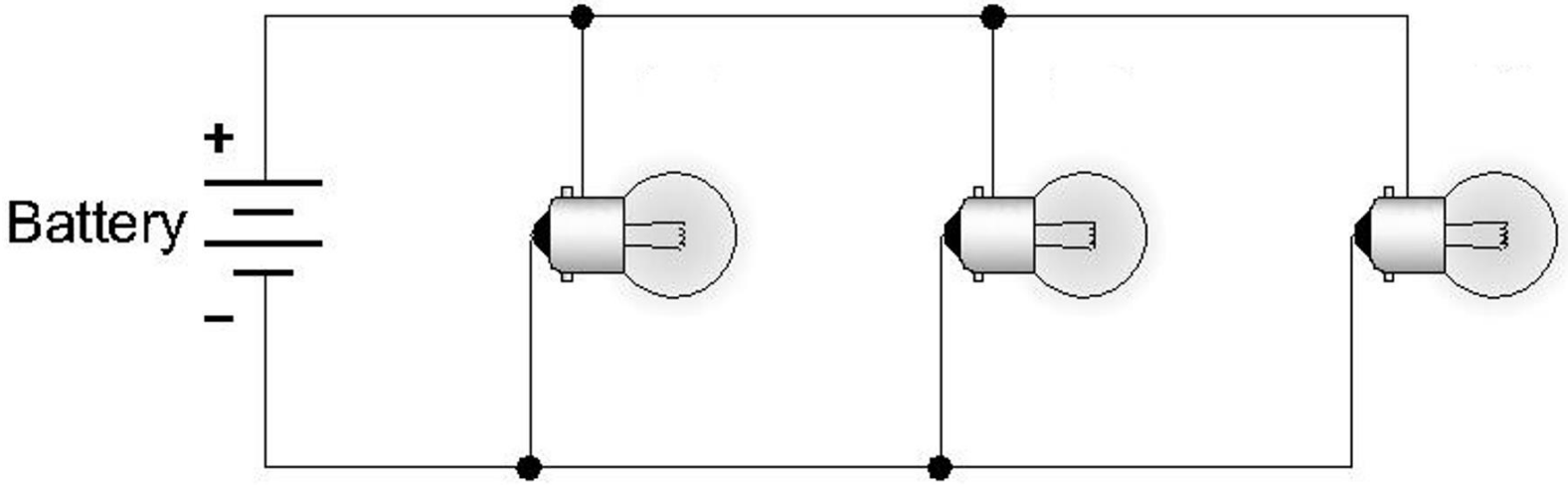


Series Circuit



Current is the same through each bulb

Parallel Circuit

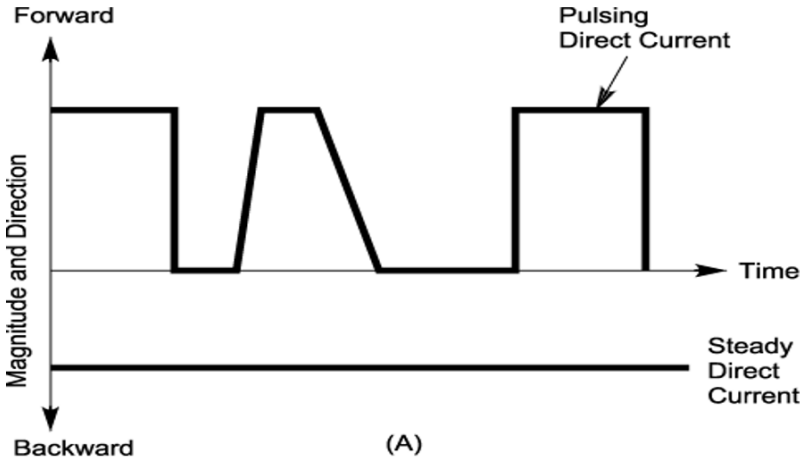


Voltage is the same across each bulb

There are two kinds of current

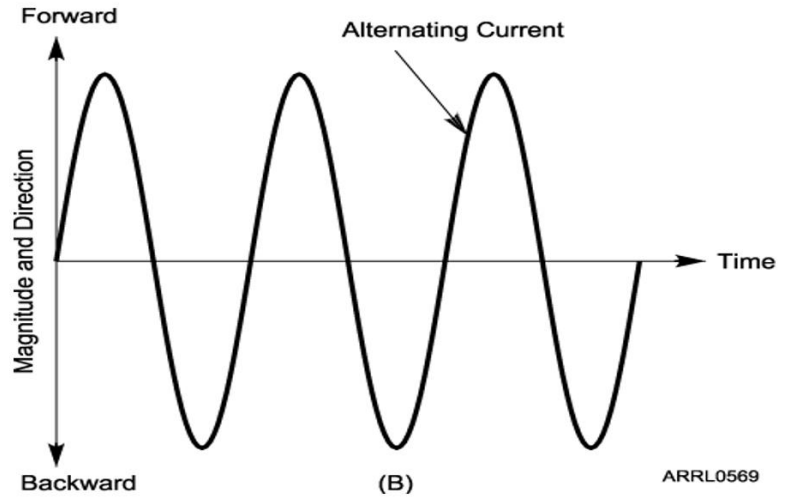
Current that flows in the same direction all the time

- Direct Current (DC)
- Batteries supply DC



Current that changes direction at some interval

- Alternating Current (AC)
- Household current is AC

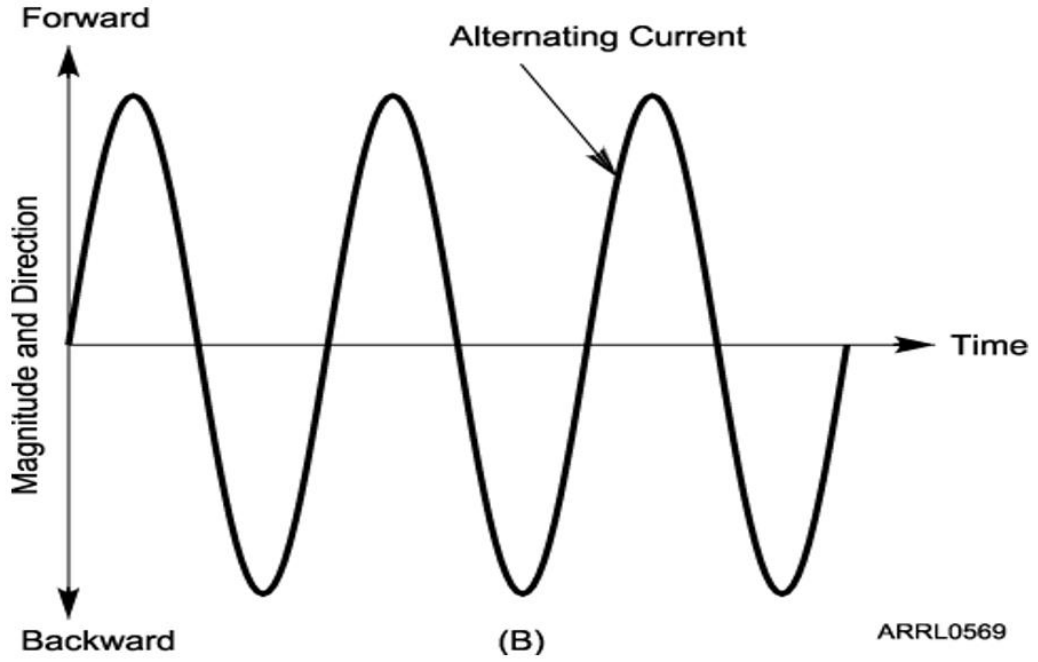


AC frequency

Each time the current changes direction and back is called a cycle

Household AC is 60 cycles per second

The **frequency** is 60 **Hertz** (Hz)



I lied.

..a little more math

Rate of Work

Higher Voltage will cause more Current to flow

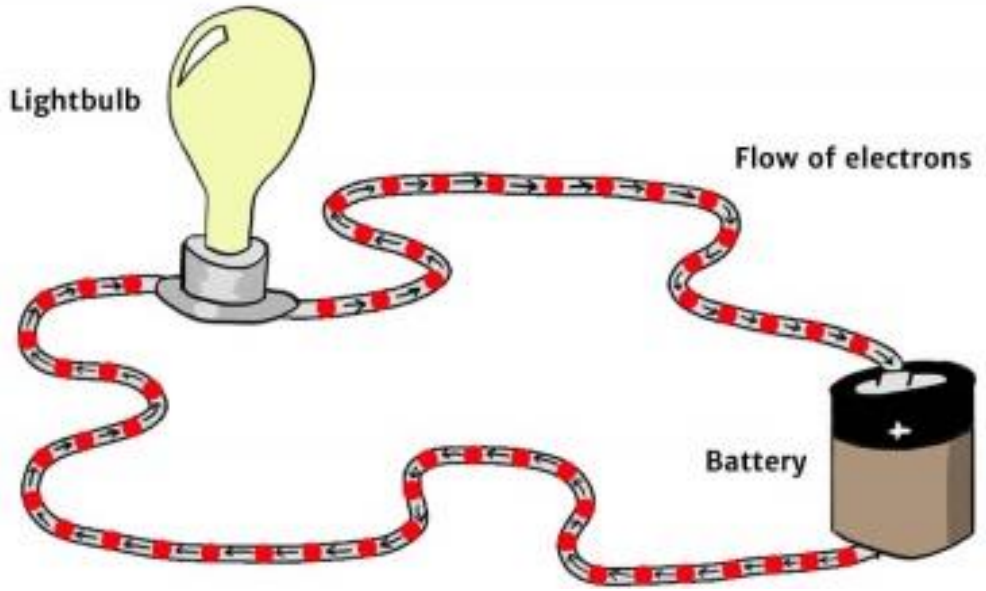
The lightbulb will shine brighter and produce more heat

The Voltage and Current produces work

Rate of work is measured in Watt (W)

..and in formulas written as P

$$P = \mathrm{E} \cdot \mathrm{I}$$



Ohm’s law - Power

To find Power

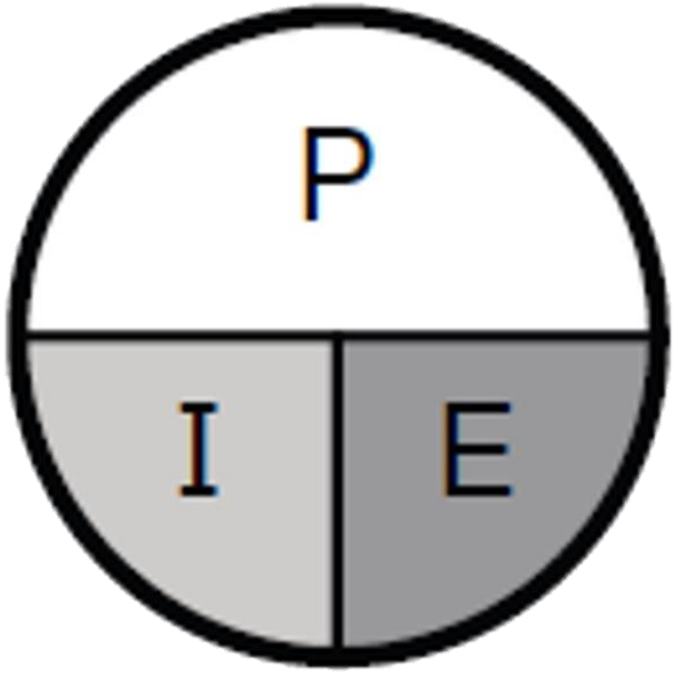
$$P = \mathrm{E} \cdot \mathrm{I}$$

To find Current

$$I = \frac{P}{E}$$

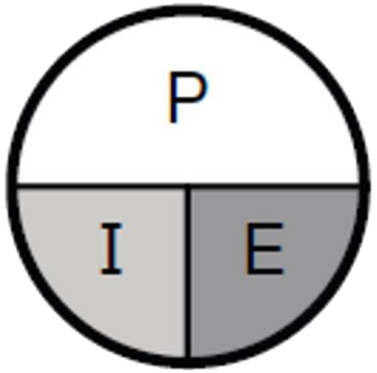
To find Voltage

$$E = \frac{P}{I}$$



Power practice

How much power is delivered by a voltage of 12 volts DC and a current of 2.5 amperes?



$$P = \mathrm{E} \cdot \mathrm{I}$$

$$P = 12 \cdot 2.5 = 30\ \mathrm{W}$$

Questions!