PHYSICS LECTURE 2

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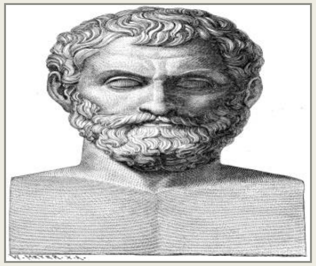
Great People who Contributed in the Development of Electronics



624 -547 BC

THALES -. Wrote about the attraction of straw and dust to fossilized tree sap called amber (amber is the greek word for electron)

1736-1806

CHARLES COULOMB-. Discovered the force between electrically charged objects. The unit of electric charge is coulomb.

History of Electronics

1745- 1827

ALLESANDRO VOLTA – Discovered that electricity is produced when two different metals are in contact with moistened cloth. The Volt is the unit of potential difference

1777 - 1851

HANS OERSTED - Determined that magnetic field is present when current flows in a wire. Oersted is one unit of magnetism.

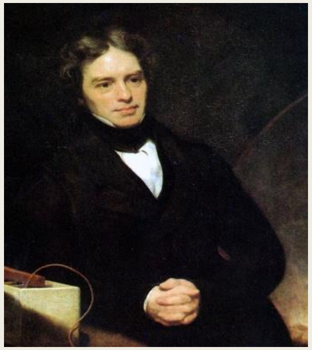
$$H(\mathrm{Oe}) = \frac{1000}{4\pi}\frac{I(\mathrm{A})}{l(\mathrm{m})}$$

History of Electronics

1775 - 1836

ANDREW AMPERE - Discovered the correct theory of electromagnetic force.

AMPERE is the unit of current.



1791 - 1867

MICHAEL FARADAY- Discovered the principle of electromagnetic induction
Invented the electric motor.

FARAD is the unit of capacitance.

History of Electronics

1789- 1854

GEORGE OHM – Determined the relationship between current and voltage in an electric circuit .

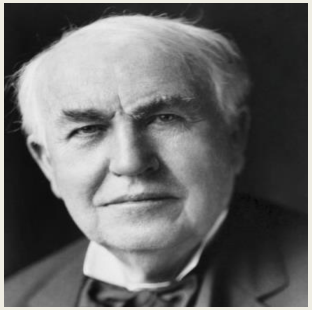
OHM is the unit of resistance.

1856 - 1940

J.J. THOMPSON – Discovered the electron. The study of the flow of electrons and its uses is called electronics.

He won the nobel prize for Physics in 1906

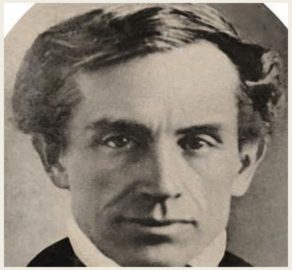
History of Electronics



1847 - 1931

THOMAS ALVA EDISON – Invented the incandescent lamp , phonograph and early film projector

Patented 1093 inventions.



1791 - 1872

SAMUEL MORSE – Invented the telegraph and the code that bears his name.

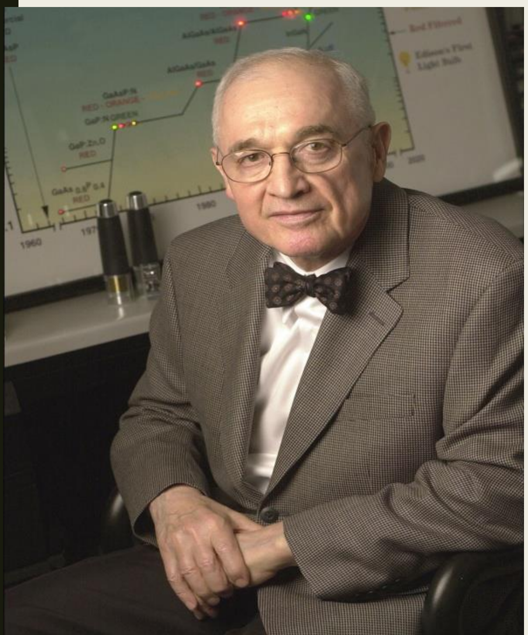
Sent the first telegraph message in 1844

History of Electronics

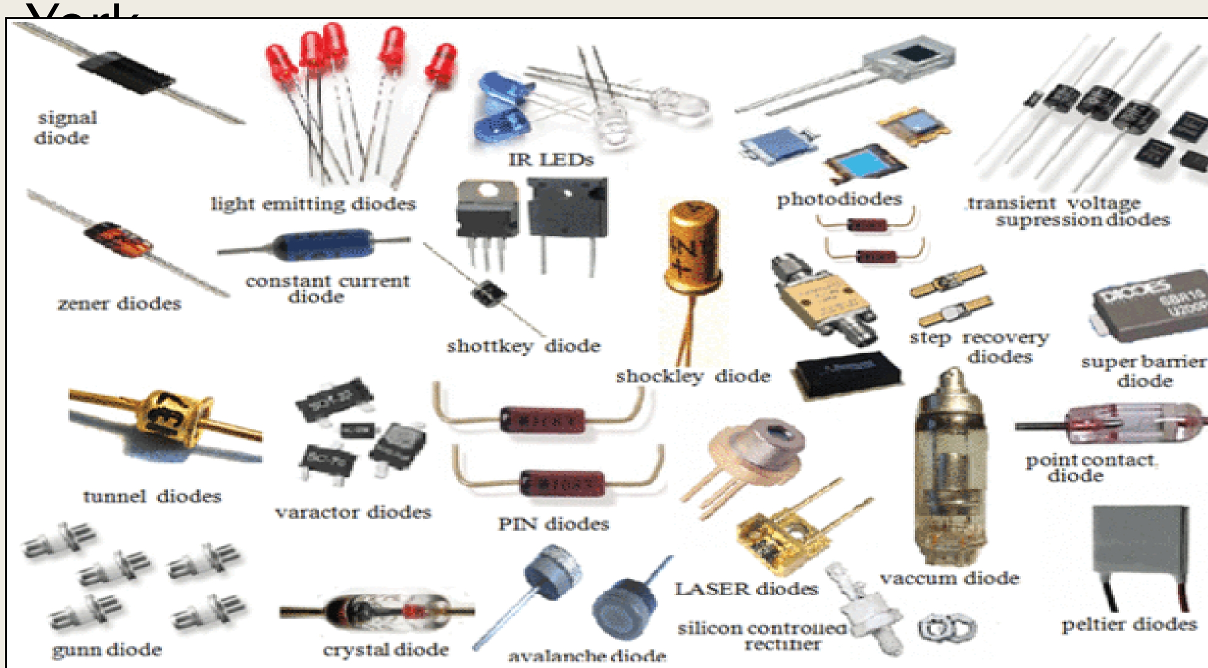
GUGLIELMO MARCONI – Developed the first practical inventions in radio telegraphy over long distances.
Received the first trans-atlantic radio signal in 1901.
Received the nobel prize for Physics in 1908

AMBROISE FLEMING AND LEE DE FOREST- Invented the vacuum tube In 1902 . Lee de Forest developed the vacuum tube amplifier in 1906.

History of Electronics



Nick Holonyak, Jr. - invented the first visible-spectrum LED in 1962 while working as a consulting scientist at a General Electric Company laboratory in Syracuse, New York



Types of Diode

Basic Electronics I

Objectives

- Define basic components of electricity
- Recognize the 3 electrical classifications of materials
- Compare and contrast AC vs. DC
- Explain the concept of grounding
- Use Ohm's law and Watt's law to express the relationship between current, voltage, and resistance

Electricity can be broken down into:

- Electric Charge
- Voltage
- Current
- Resistance

Negative & Positive Charges

- What do the effects of electricity in TV, radio, a battery, and lightening all have in common?
- Basic particles of electric charge with opposite polarities.

Electrons

- The smallest amount of electrical charge having the quality called negative polarity.
- Electrons orbit the center of atoms.

Protons

- The proton is a basic particle with positive polarity.
- Protons are located in the nucleus of atoms along with neutrons, particles which have neutral polarity.

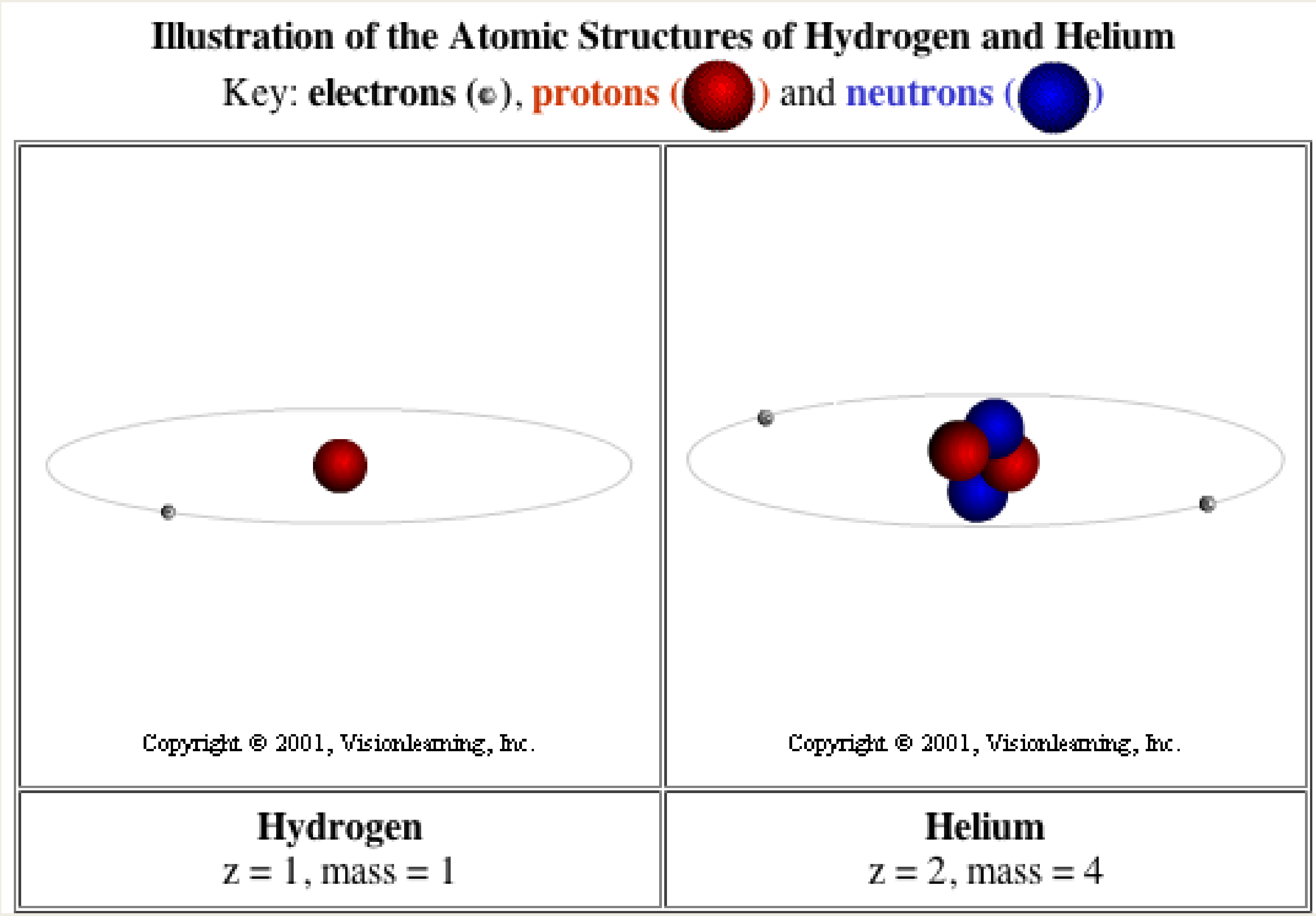


Illustration of the Atomic Structures of Hydrogen and Helium
Key: electrons ( ), protons ( ) and neutrons ( )
Copyright © 2001, Visionlearning, Inc.
Copyright © 2001, Visionlearning, Inc.
Hydrogen
z = 1, mass = 1
Helium
z = 2, mass = 4

Electrically, all materials fall into 1 of 3 classifications:

- Conductors
- Insulators
- Semi-Conductors

Conductors

- Have 1 valence electron
- Materials in which electrons can move freely from atom to atom are called conductors.
- In general all metals are good conductors.
- The purpose of conductors is to allow electrical current to flow with minimum resistance.

Insulators

- Have 8 valence electrons
- Materials in which electrons tend to stay put and do not flow easily from atom to atom are termed insulators.
- Insulators are used to prevent the flow of electricity.
- Insulating materials such as glass, rubber, or plastic are also called **dielectrics**, meaning they can store charges.
- Dielectric materials are used in components like capacitors which must store electric charges.

Semi-Conductors

- Have 4 valence electrons
- Materials which are neither conductors nor insulators
- Common semi conductor materials are carbon, germanium and silicone.
- Used in components like transistors

The Symbol for Charge

- The symbol for charge is Q which stands for quantity.
- The practical unit of charge is called the coulomb (C).
- One coulomb is equal to the amount of charge of $6.25 X 10^{18}$ electrons or protons stored in a dielectric.

Voltage

- Potential refers to the the possibility of doing work.
- Any charge has the potential to do the work of attracting a similar charge or repulsing an opposite charge.
- The symbol for potential difference is E (for electromotive force)
- The practical unit of potential difference is the volt (V)
- 1 volt is a measure of the amount of work required to move 1C of charge

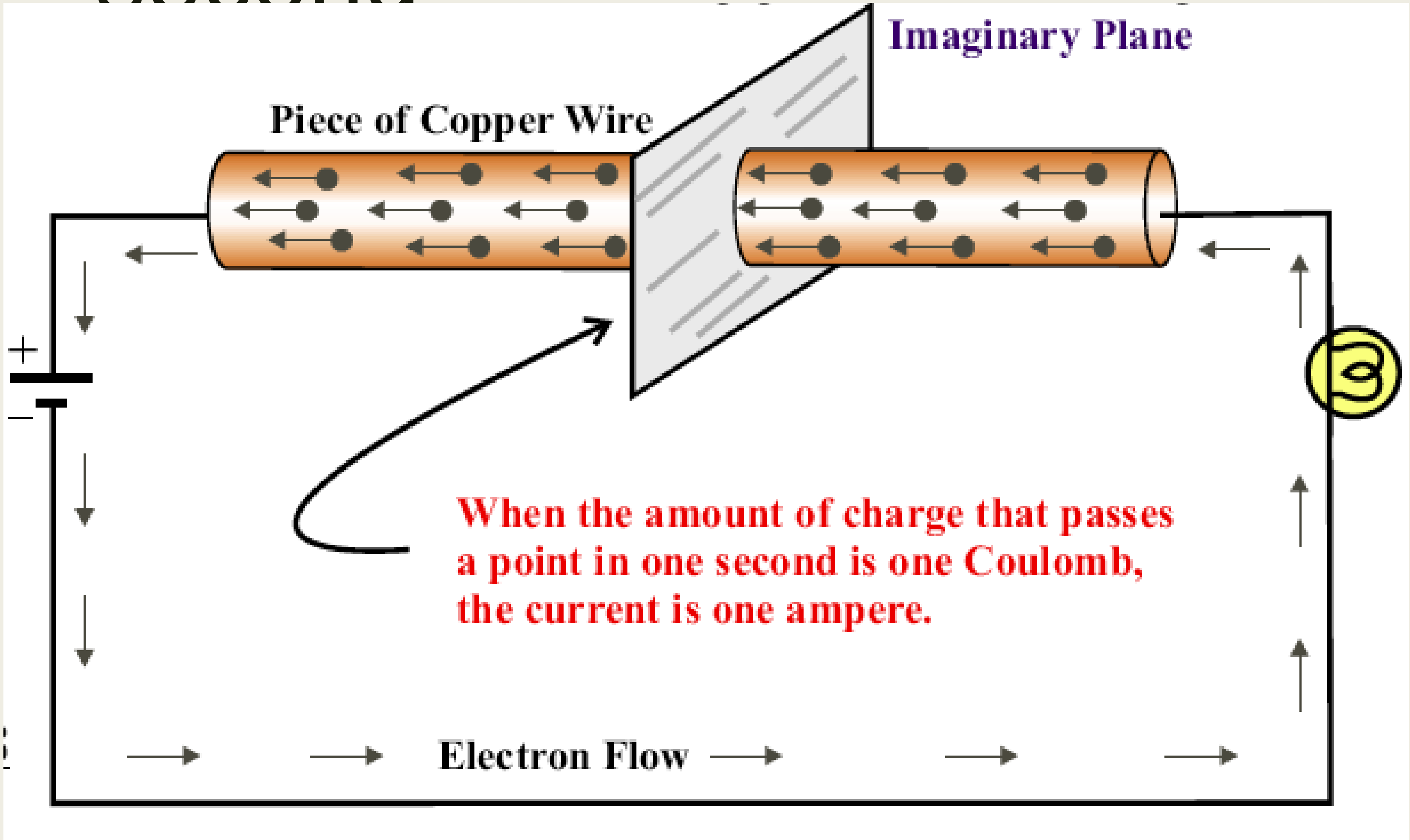
Current

- When a charge is forced to move because of a potential difference (voltage) current is produced.
- In conductors - free electrons can be forced to move with relative ease, since they require little work to be moved.
- So current is charge in motion.
- The more electrons in motion the greater the current.

Amperes

- Current indicates the intensity of the electricity in motion. The symbol for current is I (for intensity) and is measured in **amperes.**
- The definition of current is: $I = Q/T$
- Where I is current in amperes, Q is charge in coulombs, and T is time in seconds.

1 ampere = 1 coulomb per second



Resistance

- Opposition to the flow of current is termed **resistance.**
- The fact that a wire can become hot from the flow of current is evidence of resistance.
- Conductors have very little resistance.
- Insulators have large amounts of resistance.

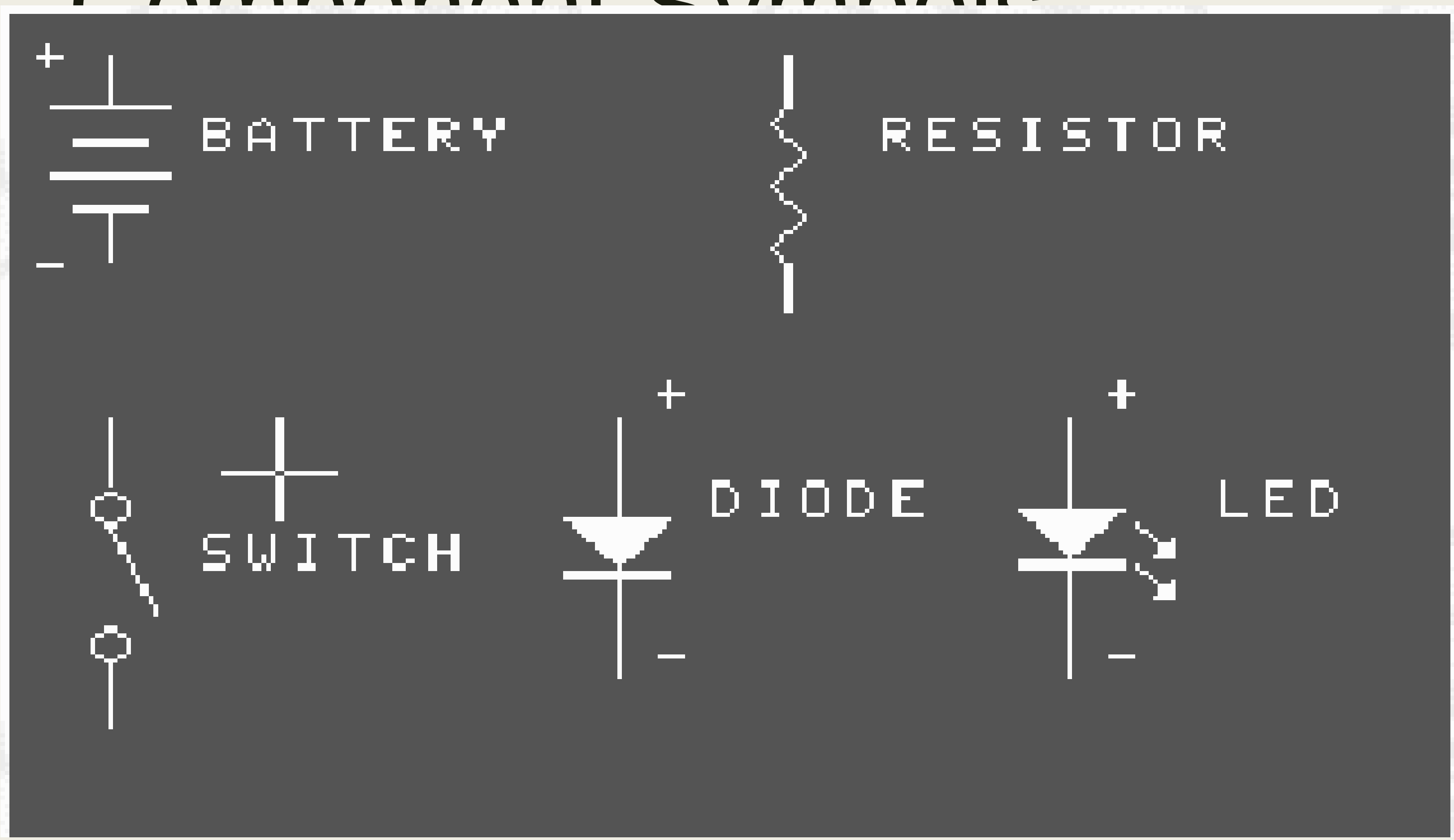
Ohms

- The practical unit of resistance is the **ohm** designated by the Greek letter omega: Ω
- A resistor is an electronic component designed specifically to provide resistance.

Closed Circuits

- In applications requiring the use of current, electrical components are arranged in the form of a circuit.
- A circuit is defined as a path for current flow.

Common Electronic Component Symbols



Open Circuits

An Open Circuit

Current can only exist where there is a conductive path (e.g. A length of wire). In the circuit shown in Figure 4- 6, I= 0 since there is no conductor between points a & b. We referred to this is an ***open circuit***.

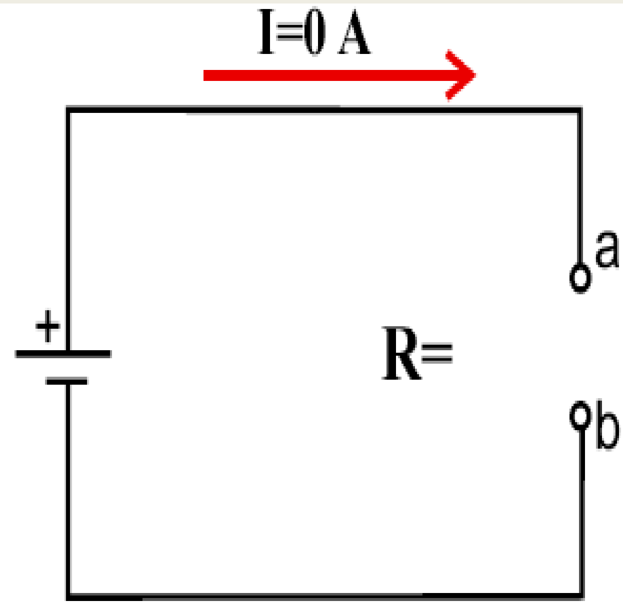


Fig 4-6 An open circuit has infinite resistance

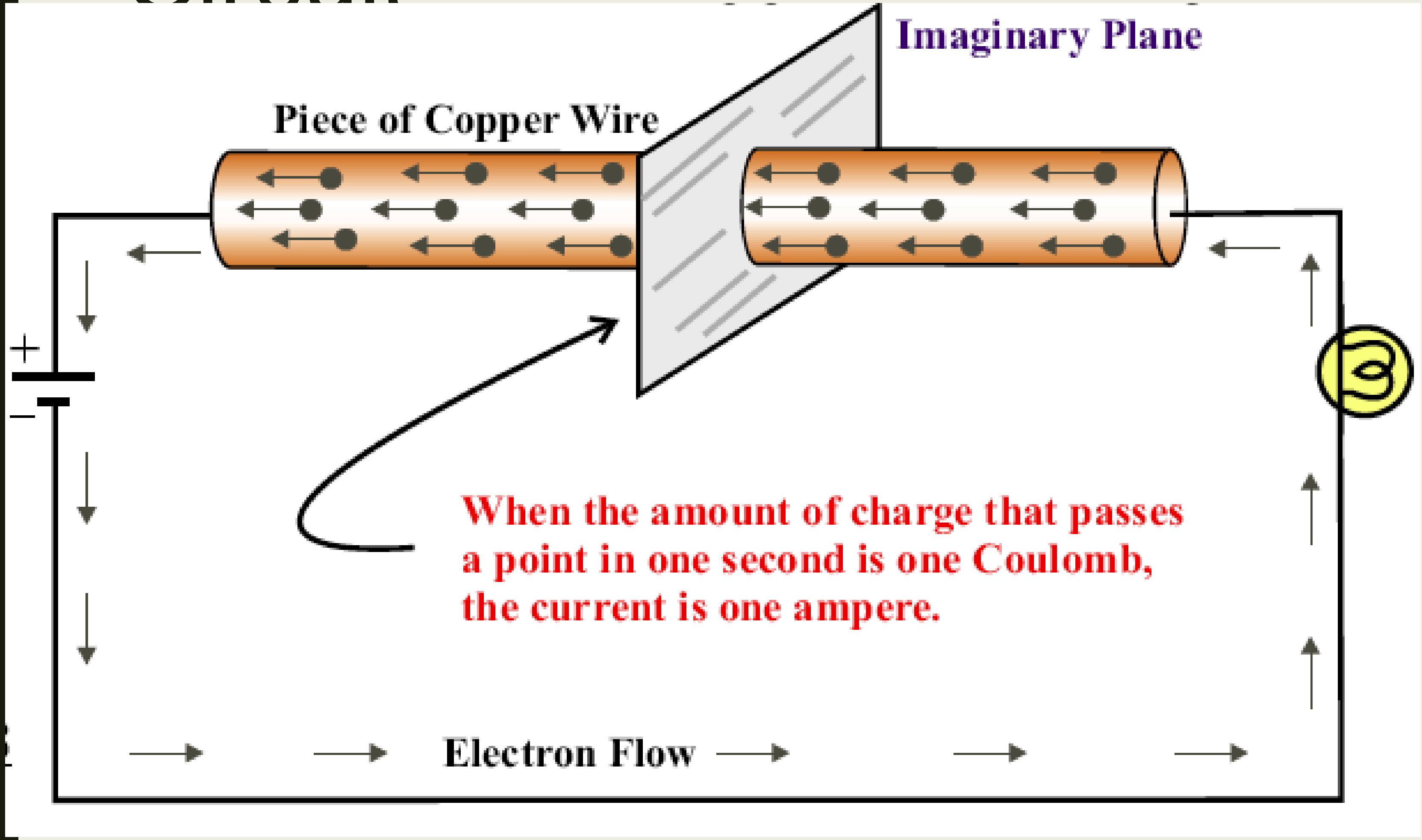
The Circuit is a Load on the Voltage Source

- The circuit is where the energy of the source (battery) is carried by means of the current through the the various components.
- The battery is the **source**, since it provides the potential energy to be used.
- The circuit components are the **load resistance** - they determines how much current the source will produce.

Direction of Electron Flow

- The direction of electron flow in our circuit is from the negative side of the battery, through the load resistance, back to the positive side of the battery.
- Inside the battery, electrons move to the negative terminal due to chemical action, maintaining the potential across the leads.

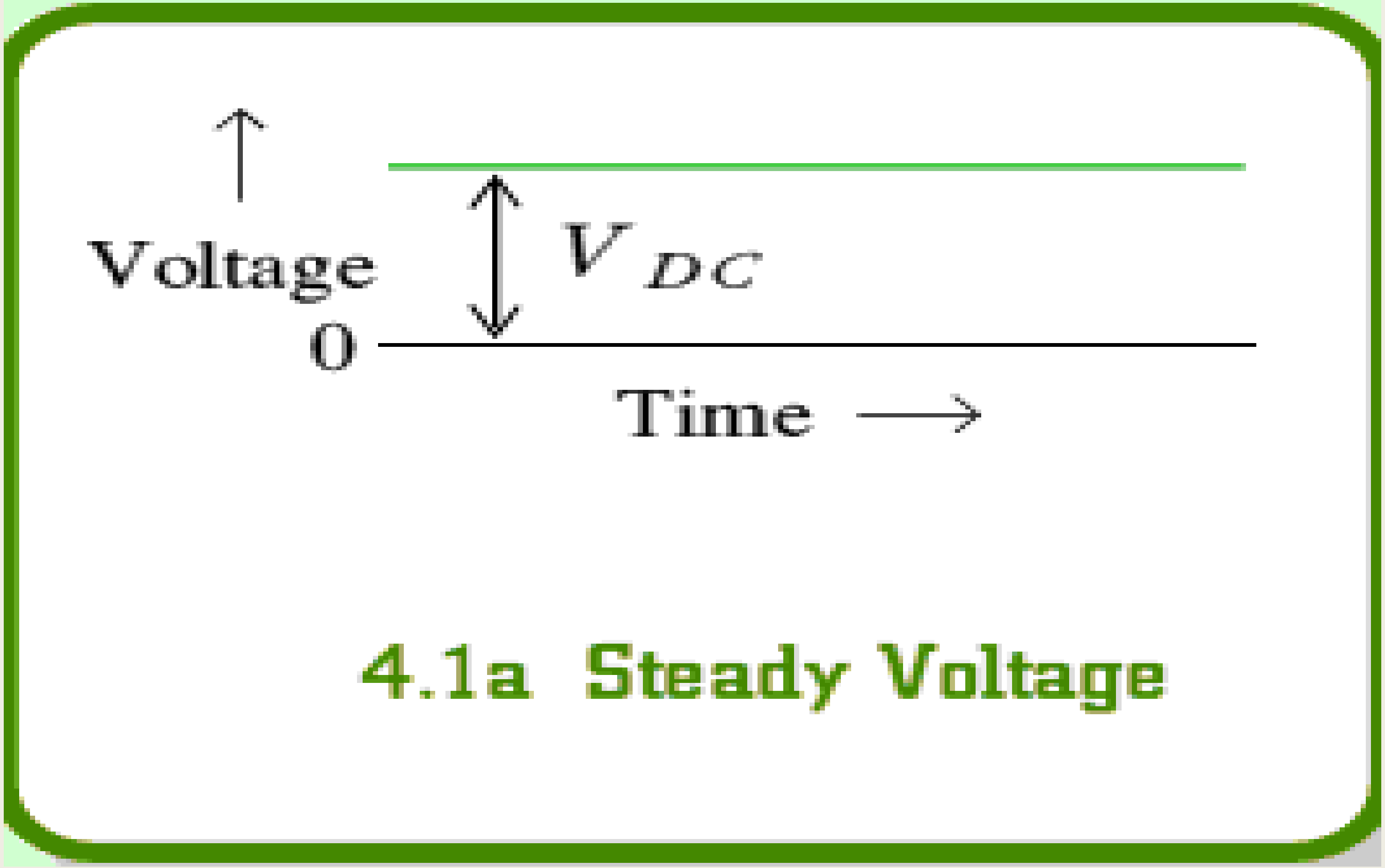
Electron Flow in a Simple Circuit



DC

- Circuits that are powered by battery sources are termed **direct current** circuits.
- This is because the battery maintains the same polarity of output voltage. The plus and minus sides remain constant.

Waveform of DC Voltage



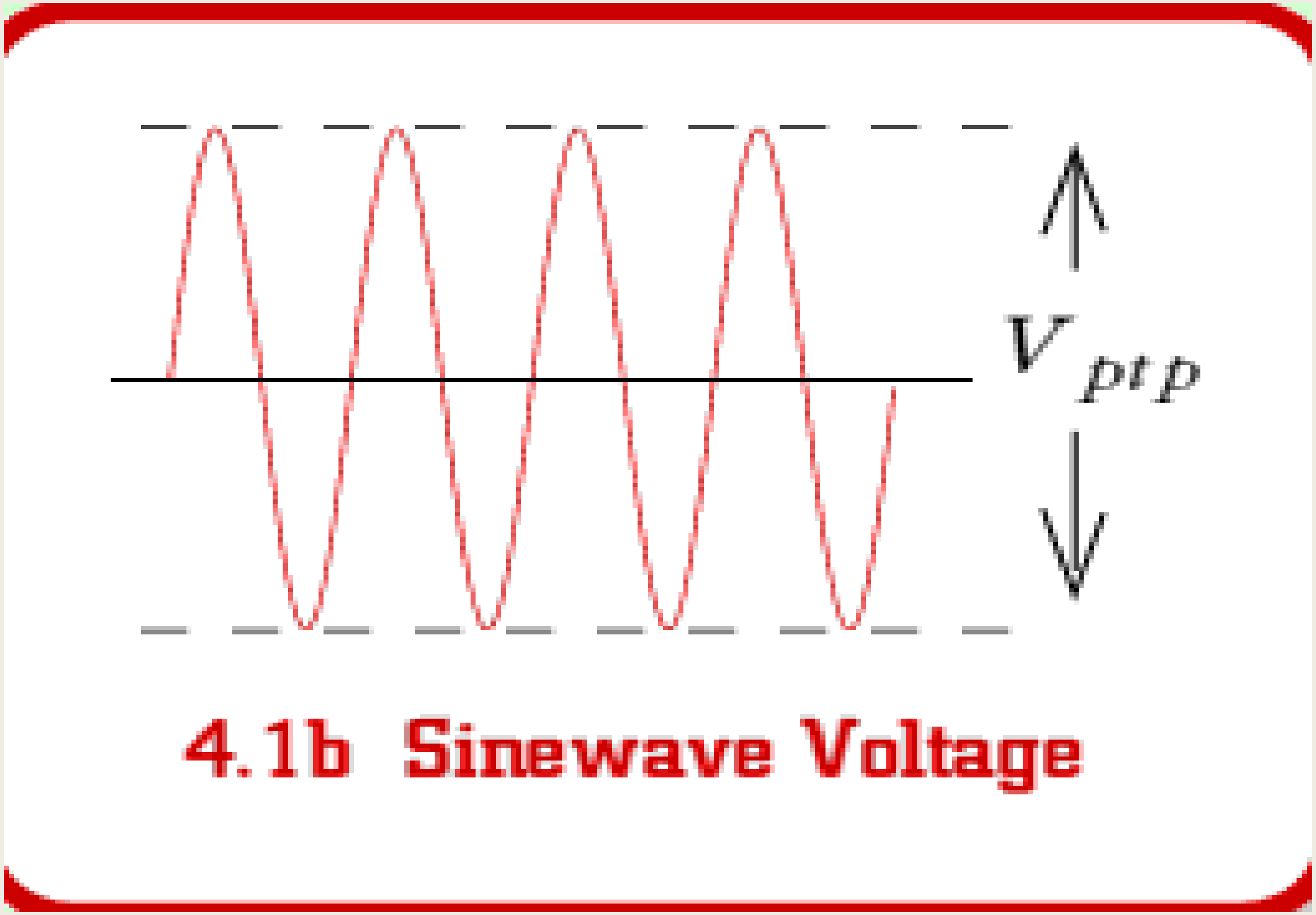
Characteristics of DC

- It is the flow of charges in just one direction and...
- The fixed polarity of the applied voltage which are characteristics of DC circuits

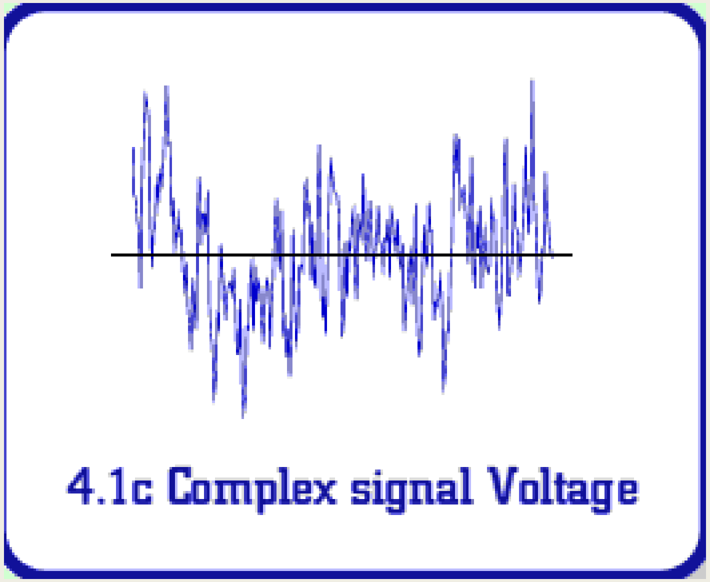
AC

- An alternating voltage source periodically alternates or reverses in polarity.
- The resulting current, therefore, periodically reverses in direction.
- The power outlet in your home is 60 cycle ac - meaning the voltage polarity and current direction go through 60 cycles of reversal per second.
- All audio signals are AC also.

Waveform of AC Voltage



Complex Voltage



This is a more realistic view of what

an audio signal's voltage would look like

Comparison of DC & AC

DC Voltage	**AC Voltage**
Fixed polarity	Reverses polarity
Can be steady or vary in magnitude	Varies in magnitude between reversals in polarity
Steady value cannot be stepped up or down by a transformer	Used for electrical power distribution
Electrode voltage for tube and transistor amps	I/O signal for tube and transistor amps
Easier to measure	Easier to amplify

Heating Effects the same for both AC and DC current

Many Circuits Include both AC & DC Voltages

- DC circuits are usually simpler than AC circuits.
- However, the principles of DC circuits also apply to AC circuits.

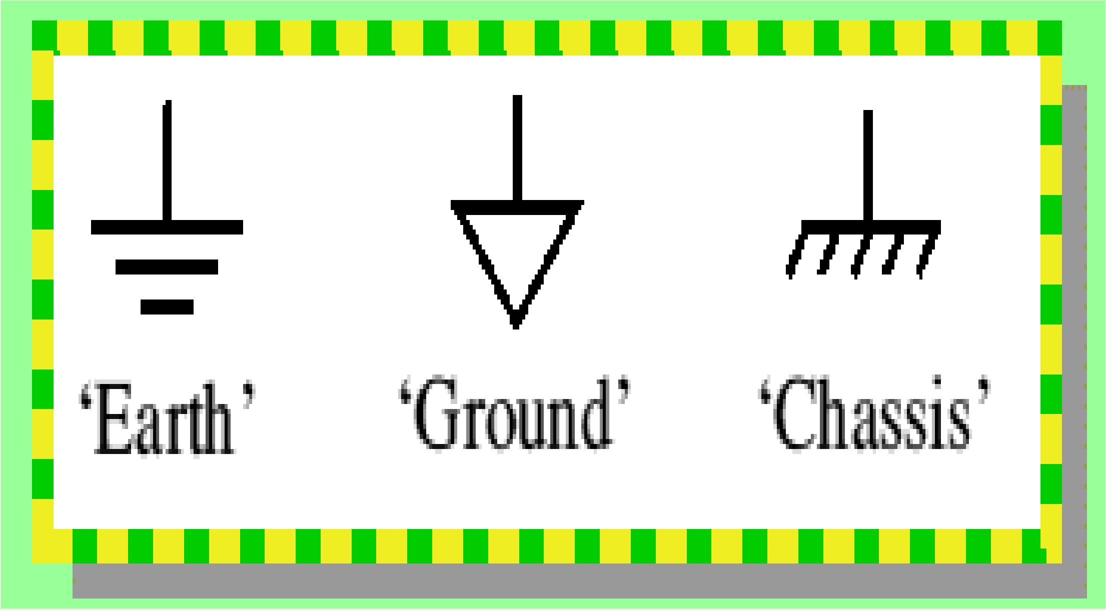
Impedance

- Impedance is resistance to current flow in AC circuits and its symbol is Z.
- Impedance is also measured in ohms.

Grounding

- In the wiring of practical circuits one side of the voltage source is usually grounded for safety.
- For 120 V - ac power lines in homes this means one side of the voltage source is connected to a metal cold water pipe.
- For electronic equipment, the ground just indicates a metal chassis, which is used as a common return for connections to the source.

Common Symbols/ Names for Ground in Electric Circuits

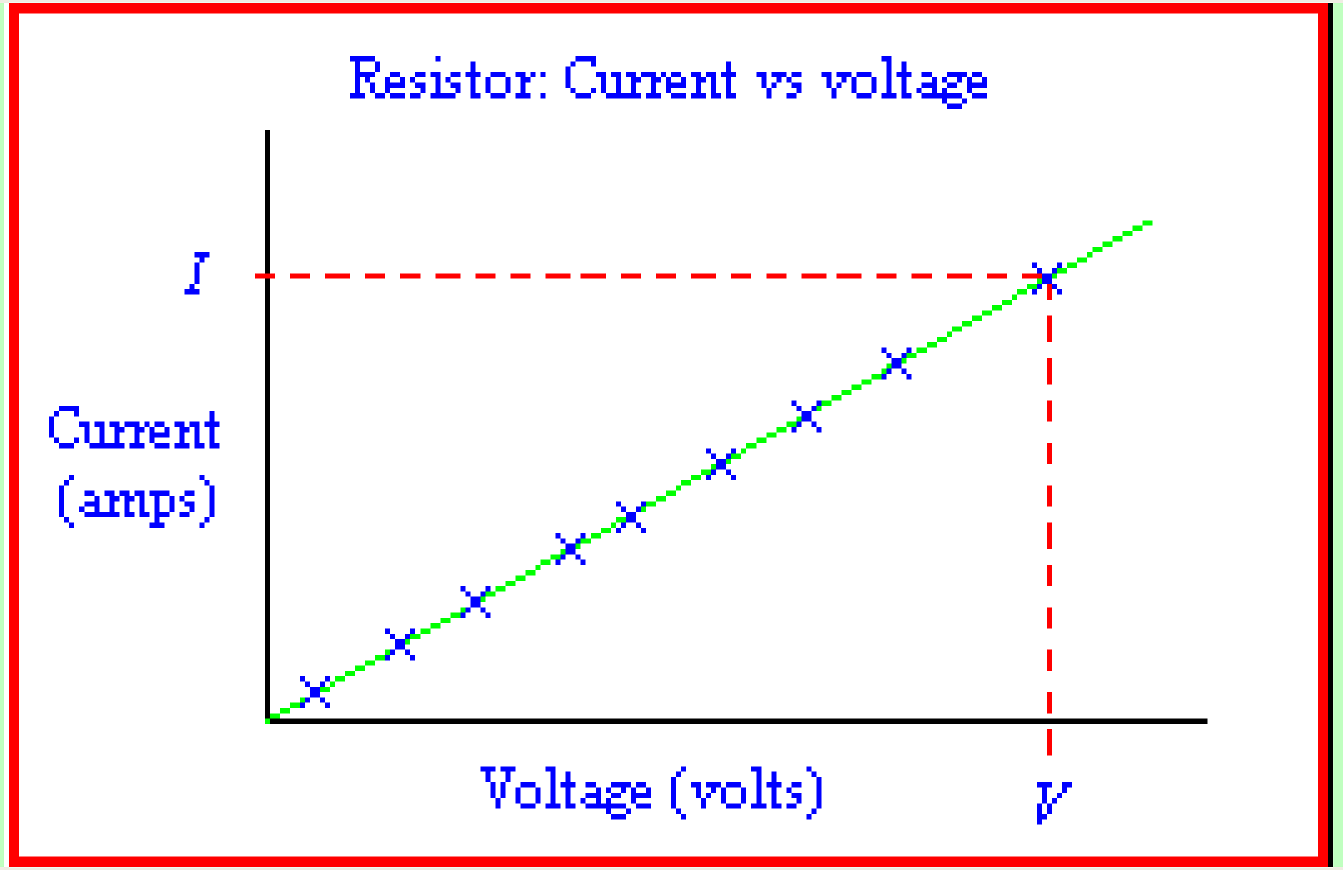


Ohm's Law

- The amount of current in a circuit is dependent on its resistance and the applied voltage. Specifically $I = E/R$
- If you know any two of the factors E, I, and R you can calculate the third.
- Current $I = E/R$
- Voltage $E = IR$
- Resistance $R = E/I$

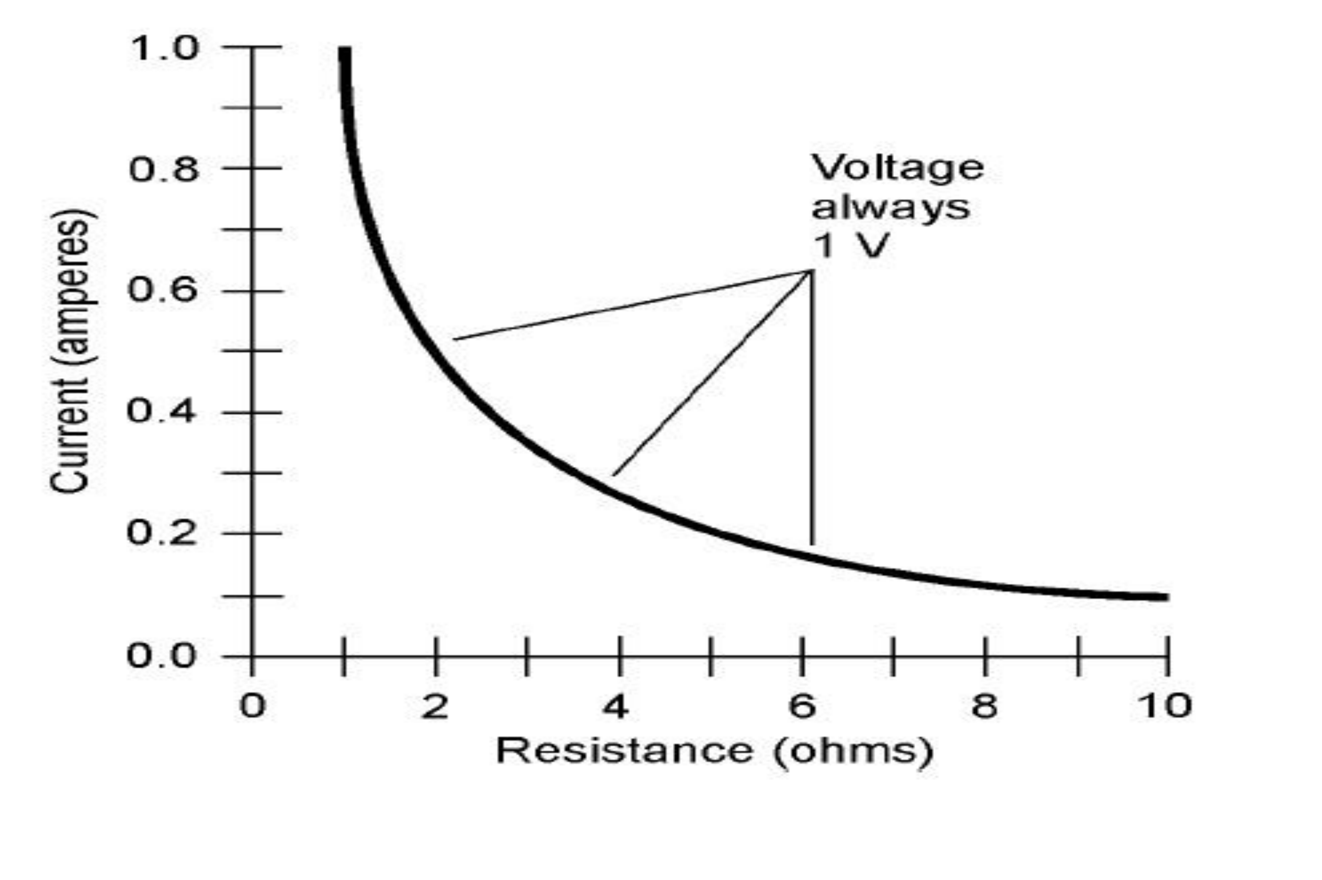
Current is Directly Proportional to Voltage for a Constant Resistance

OHM's LAW



Current is Inversely Proportional to Resistance for a Constant Voltage

OHM's LAW



Power

- The unit of electrical power is the watt.
- Power is how much work is done over time.
- One watt of power is equal to the work done in one second by one volt moving one coulomb of charge. Since one coulomb a second is an ampere:
- Power in watts = volts x amperes
- P = E x I

3 Power Formulas

- $P = E \times I$
- $P = I^2 \times R$
- $P = E^2 / R$

Conversion Factors

Prefix	Symbol	Relation to basic unit	Examples
Mega	M	1,000,000 or $1x10^6$	5MΩ = $5x10^6$ Ω
Kilo	k	1,000 or $1x10^3$	18kV = $18x10^3$ V
Milli	m	.001 or $1x10^{-3}$	48 mA = $48x10^{-3}$A
Micro	μ	.000001 or $1x10^{-6}$	15μV = $15x10^{-6}$V