Electricity and Magnetism

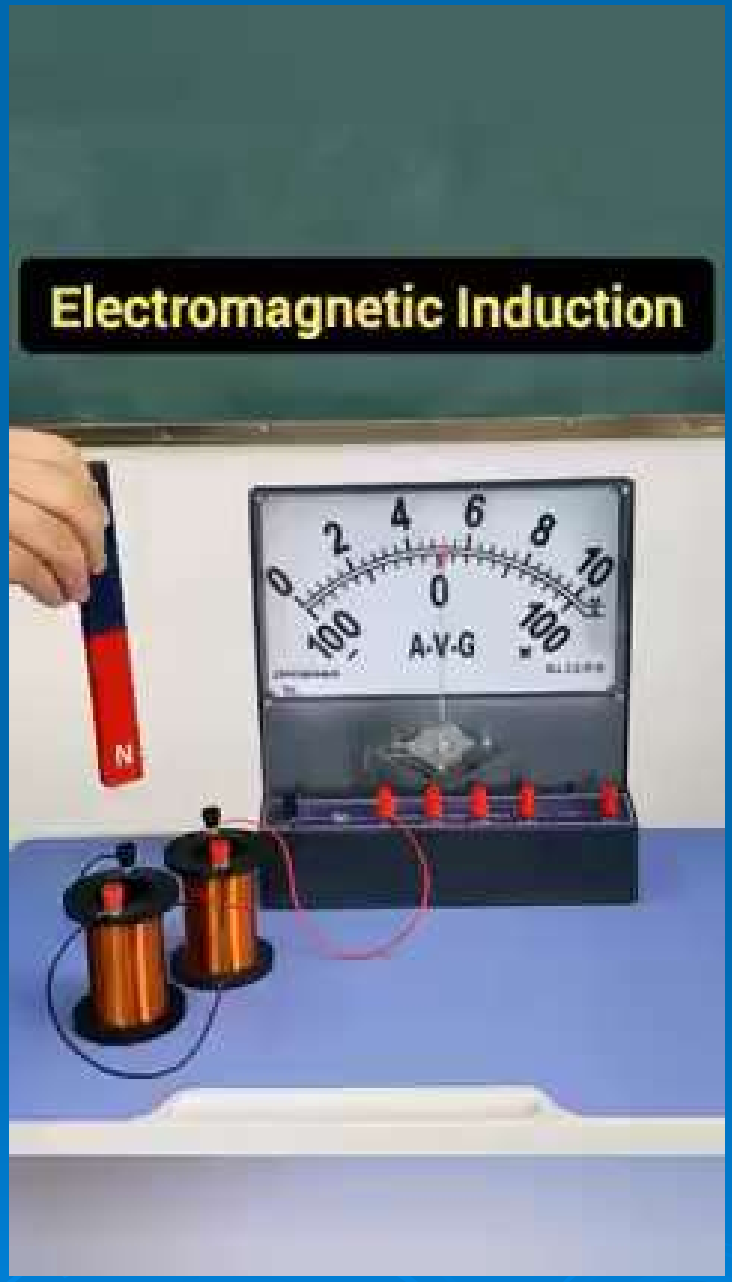
15-1

Magnetics

- Naturally created – Loadstone
- North and South poles
- Opposites attract and Like repel
- Magnetic Field is produced

Electromagnetics

- To produce electricity wrap wires around a magnet. Move magnet back in forth through the coil of wires.
- Magnetics produced when you coil wire around metal and then add electricity.

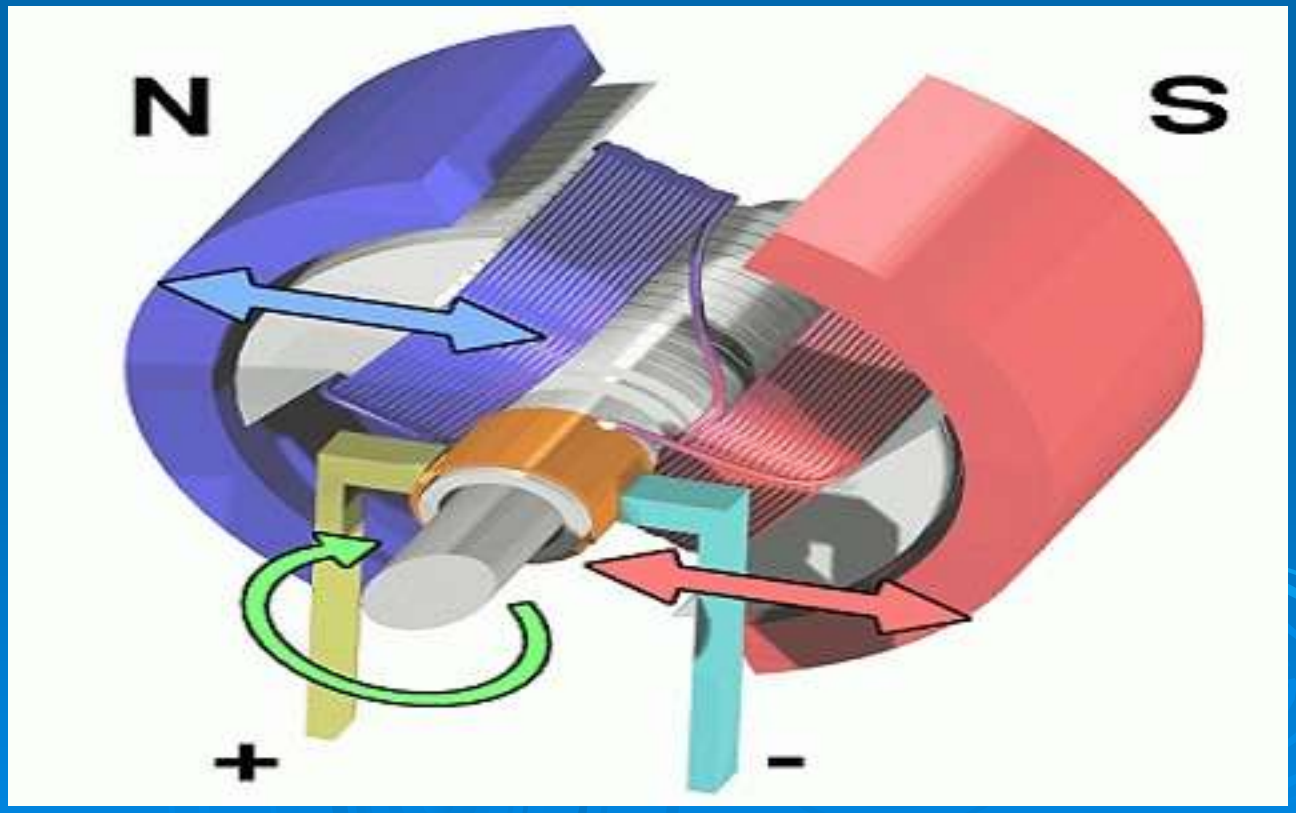

Electromagnetic Induction
0
2
4
6
8
10
100
0
100
A-V-G
N

Demos

- - Hand turn light
- - Shake Flashlight
- - Turn Generator

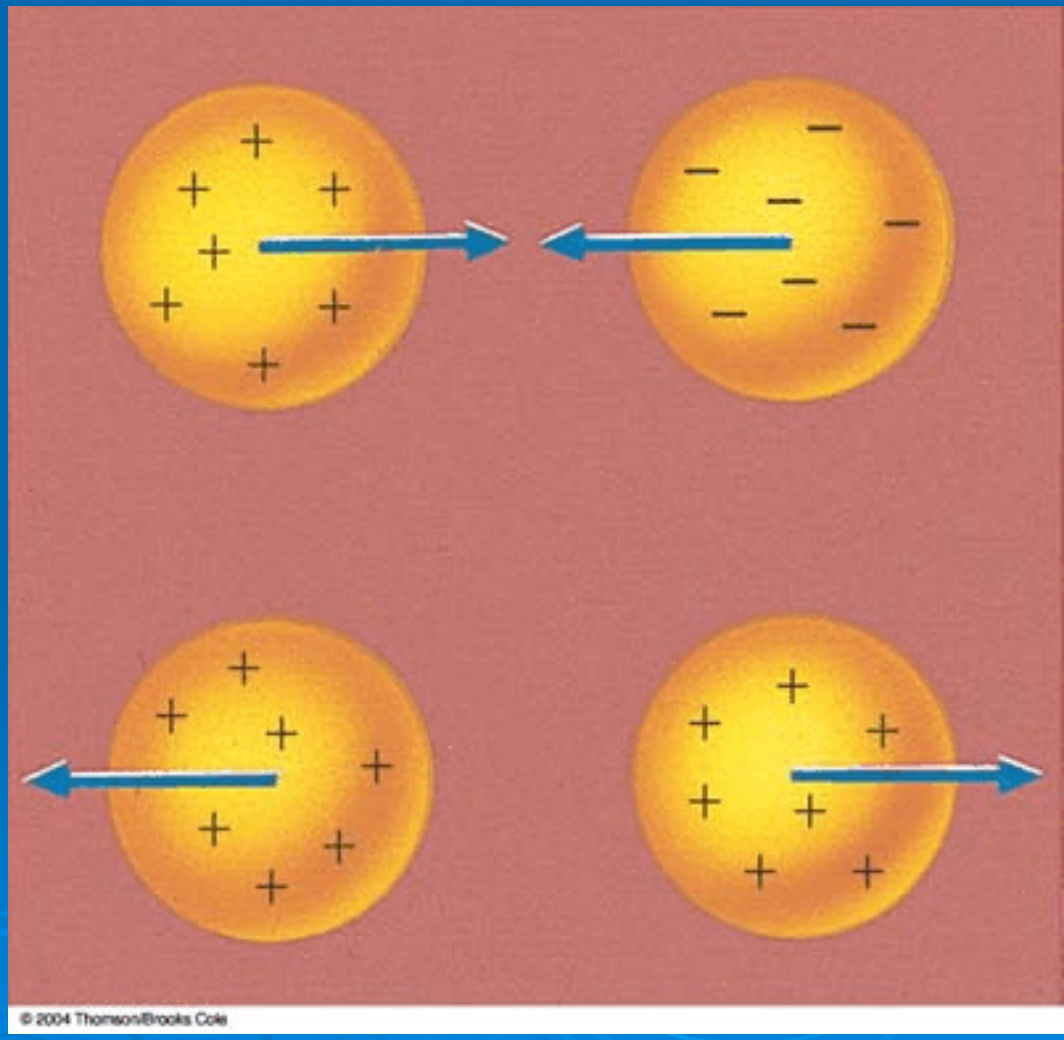
Motors

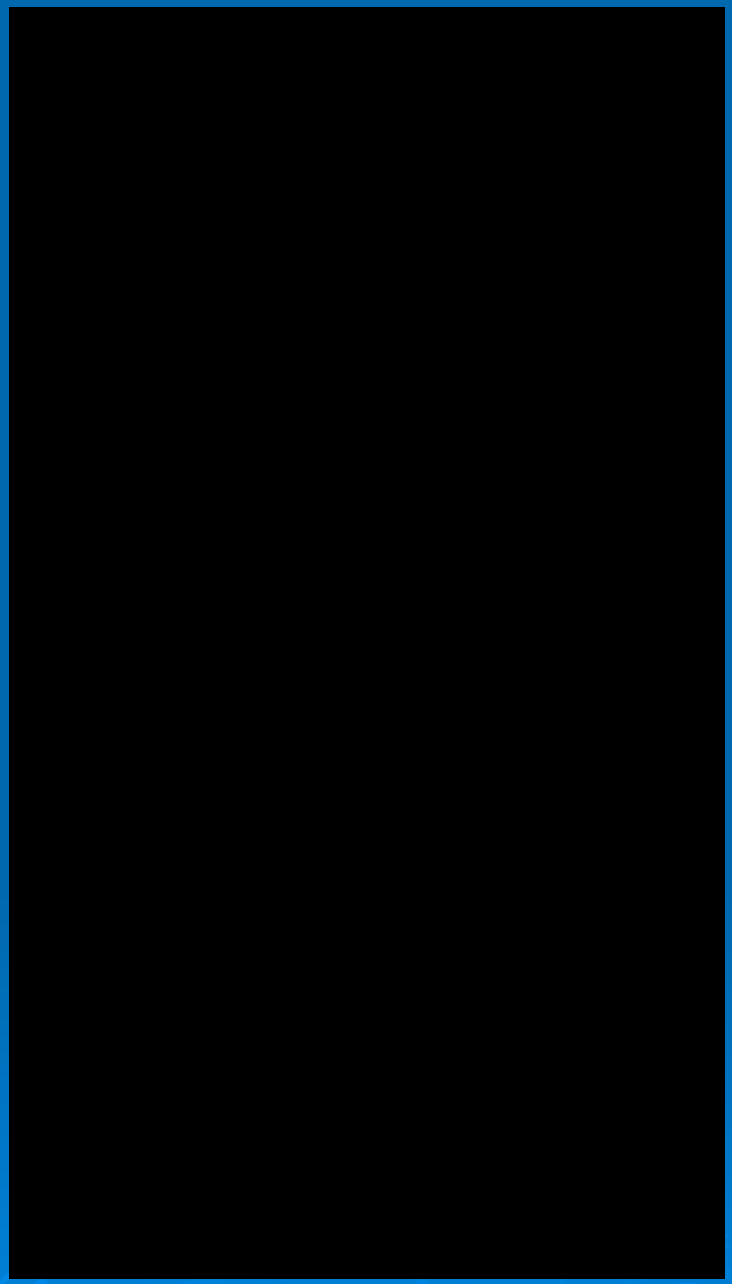
- Electric motors work by electricity moving a charge through a loop in a magnetic field, causing the loop to rotate.



Electric Charges

- Like charges repel
- Opposite charges attract
- Charges Jump from an object to another

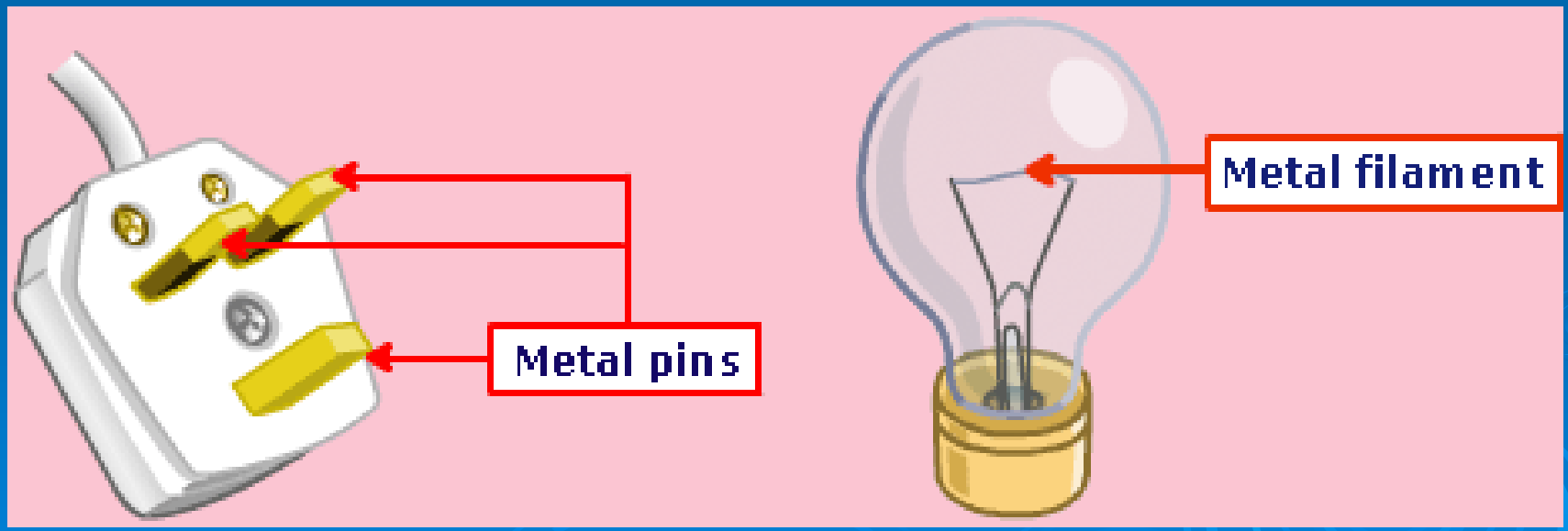




Van De Graff Demos

- Wilmhurst Machine

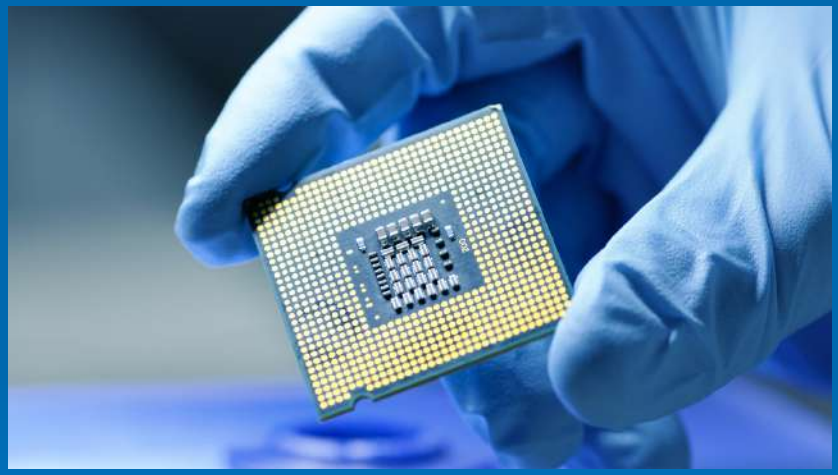
- Conductors allow electric charges to move freely
- Examples include copper, aluminum, and gold.



- Insulators do no allow electric charges to move freely
- Examples include rubber, plastic, and glass.

Semiconductors

- Under certain circumstances, materials that allow electricity to flow.
- Example – silicon chips in computers

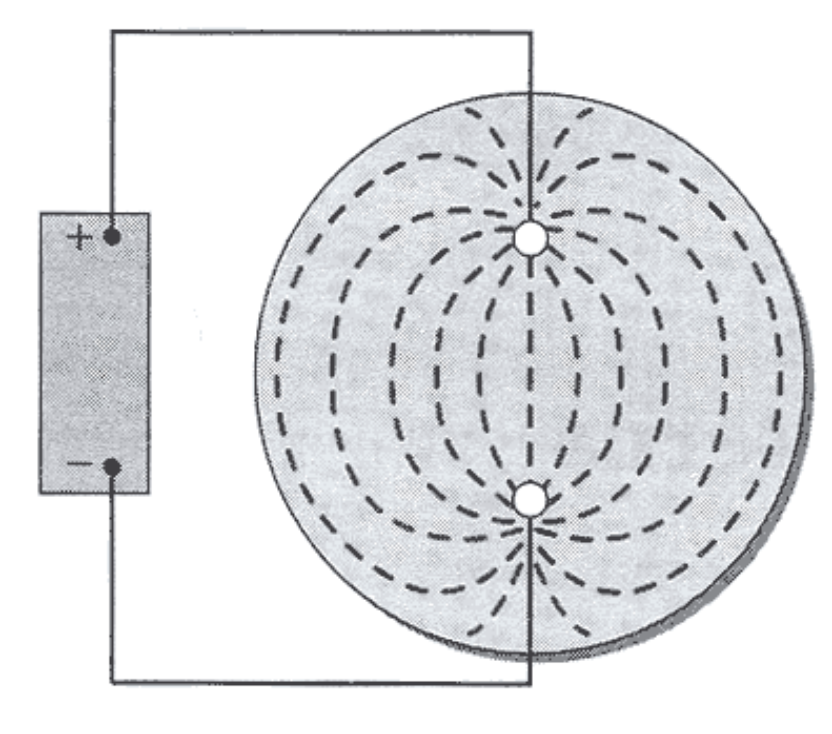


Conductors / Insulator

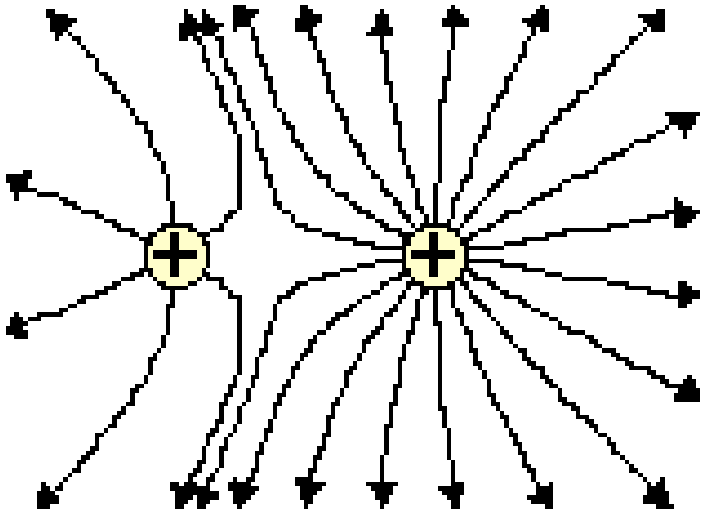
- Energy Stick / Ball
- Plasma Ball and Pickle
- Pickle and high current

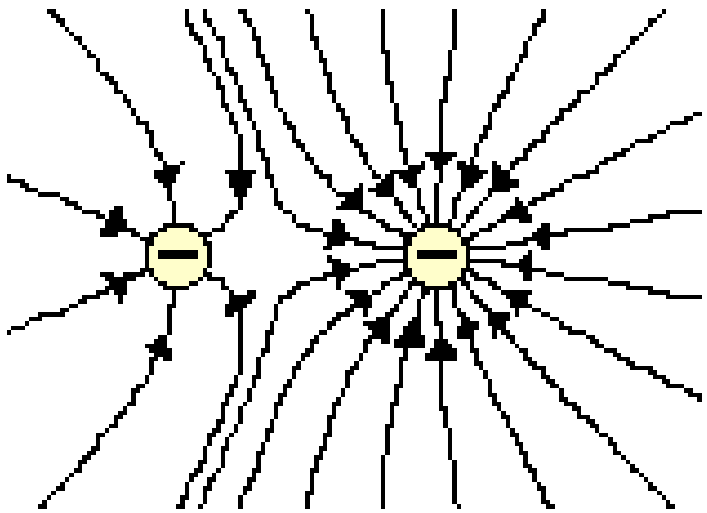
Electric Field

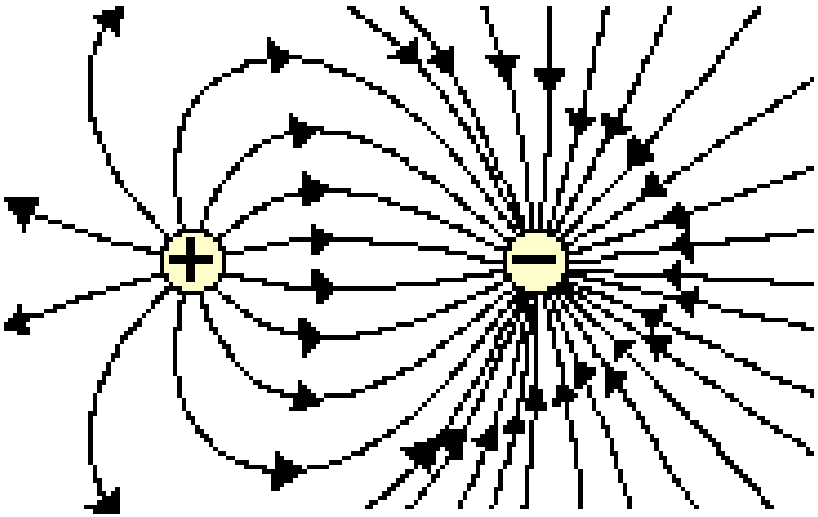
- A charged object has a charged field around it called the Electric Field.
- The amount of electric field lines is proportional to the electric field strength.
- Stronger = more lines

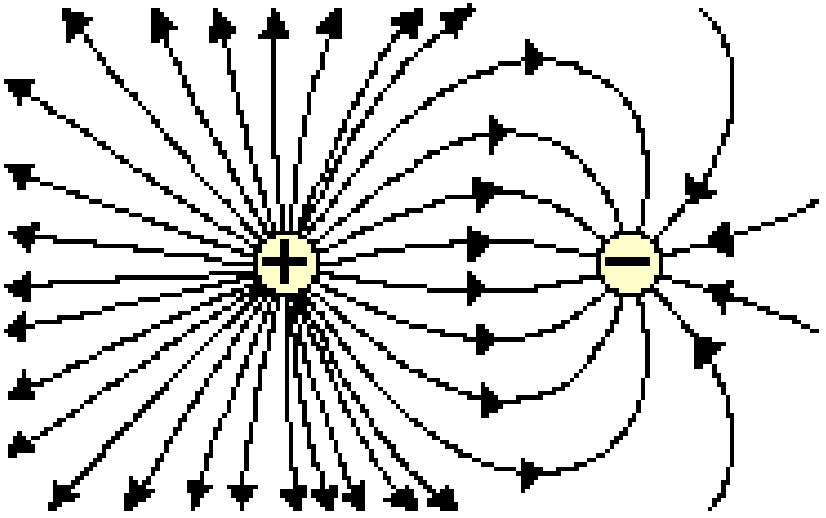


Electric Field Line Patterns for Objects with Unequal Amounts of Charge



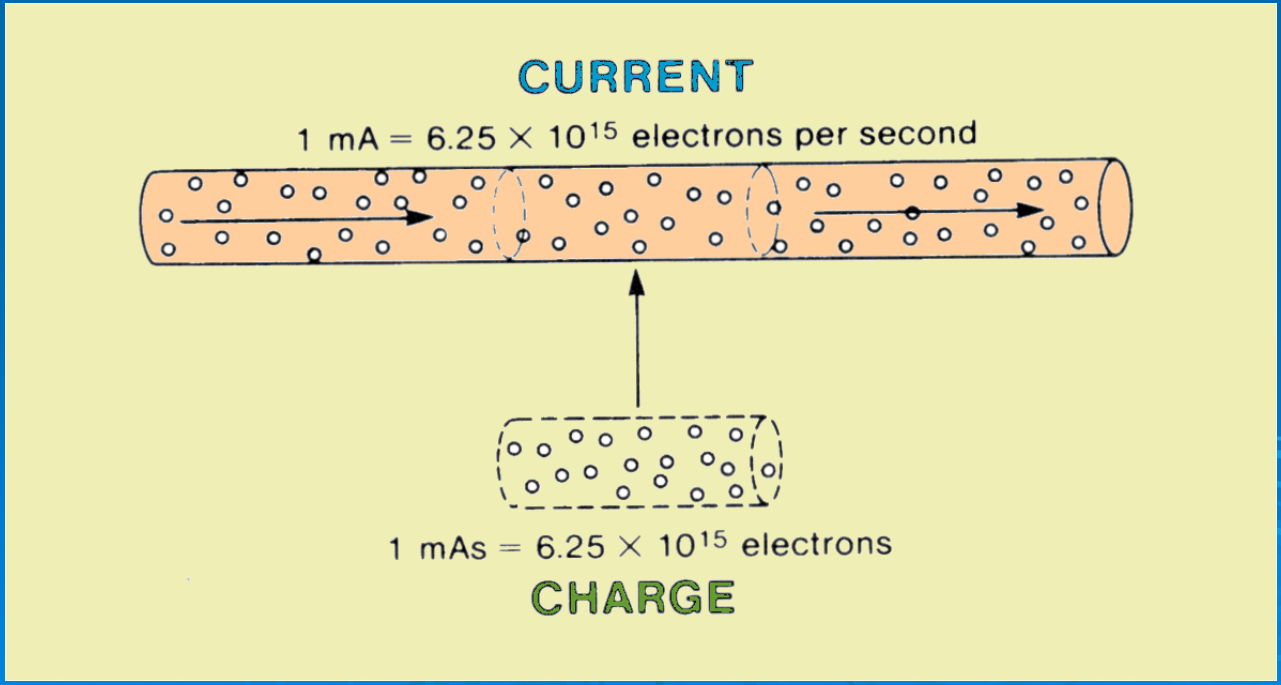






Current

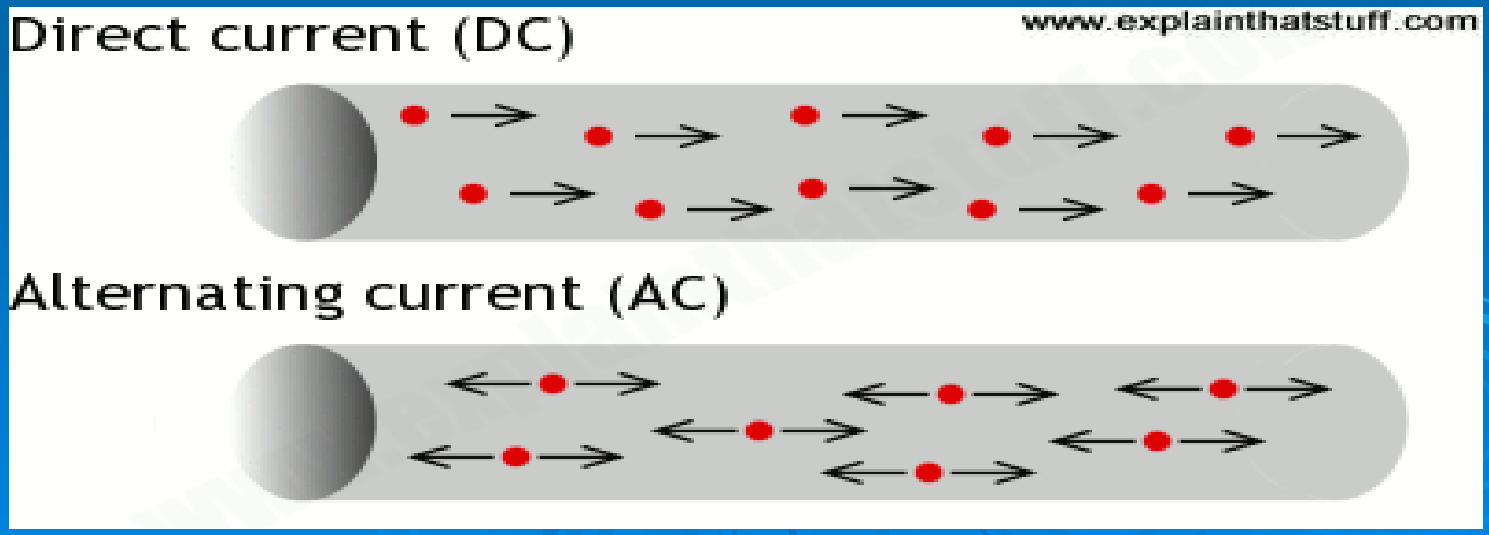
- How fast charges move is called Current.
- Current is measured in Amps (A).



Tesla Coil

AC versus DC

- AC – alternating current (electricity flows back and forth)
- DC – direct current (electricity flows only one direction)



DC – Direct Current

AC – Alternating Current

What type of electrical energy do batteries produce?

- Pulsating current
- Digital current
- Direct current
- Alternating current

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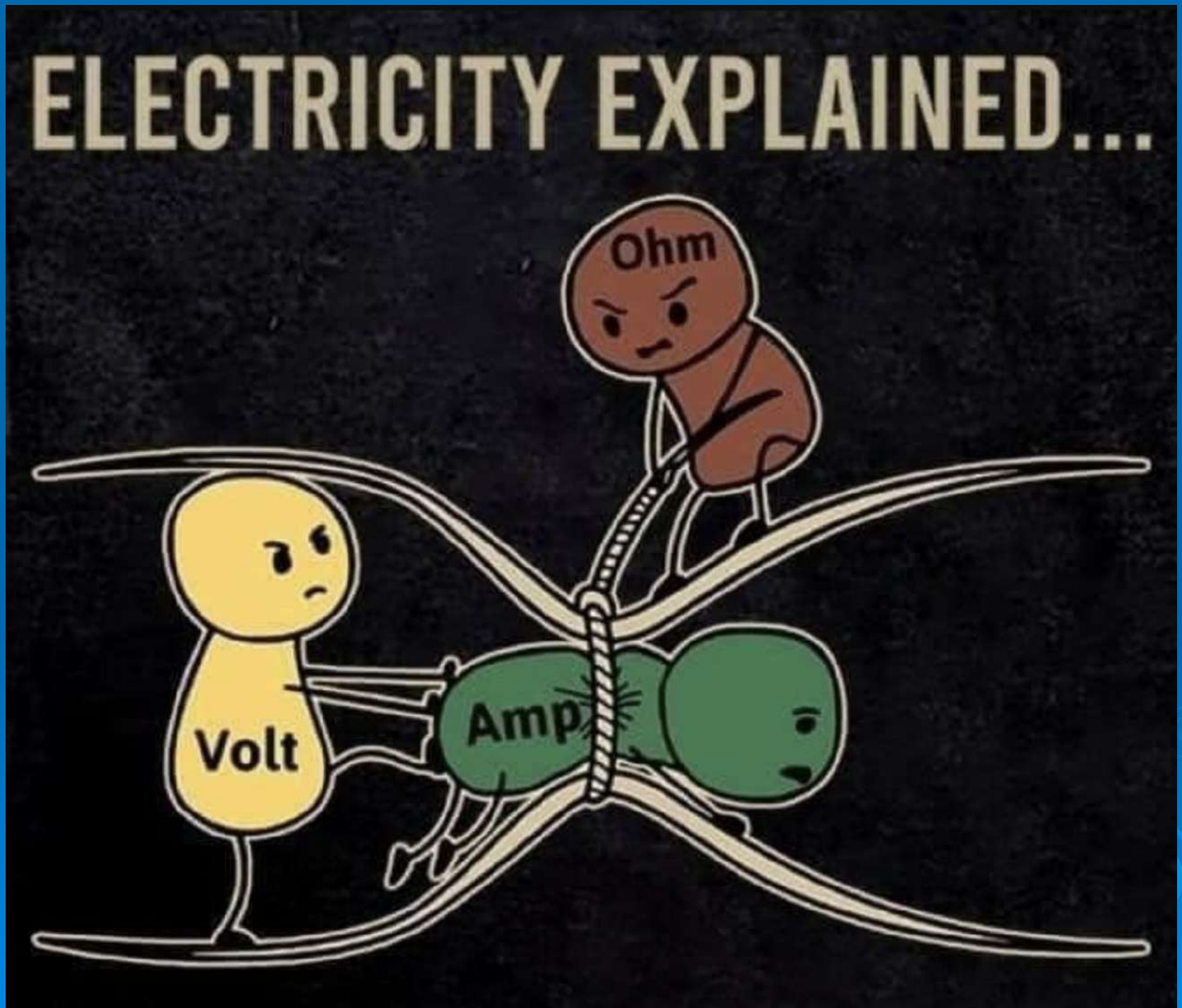

ELECTRICITY EXPLAINED...
Ohm
Volt
Amp

Ohm's Law

- Voltage = current * resistance
- Ohm's Law is not true for all materials. However, most common materials do follow Ohm's Law so when working problems we assume the materials follow this law.

How much current will flow through a 470-Ohm resistor if a 9-volt battery is used?

- ○ 19 mA
- ○ 8 mA
- ○ 27 mA
- ○ 36 mA

How much current will flow through a 470-Ohm resistor if a 9-volt battery is used?

- [x] 19 mA
- [ ] 8 mA
- [ ] 27 mA
- [ ] 36 mA

Voltage = Current * Resistance

9 = current * 470

.019 Amps = 19 mA

What is the voltage drop if there is 5 mA flowing through an 18,000 Ω resistor?

- ○ 120 volts
- ○ 60 volts
- ○ 90 volts
- ○ 30 volts

What is the voltage drop if there is 5 mA flowing through an 18,000 Ω resistor?

- ○ 120 volts
- ○ 60 volts
- ● 90 volts
- ○ 30 volts

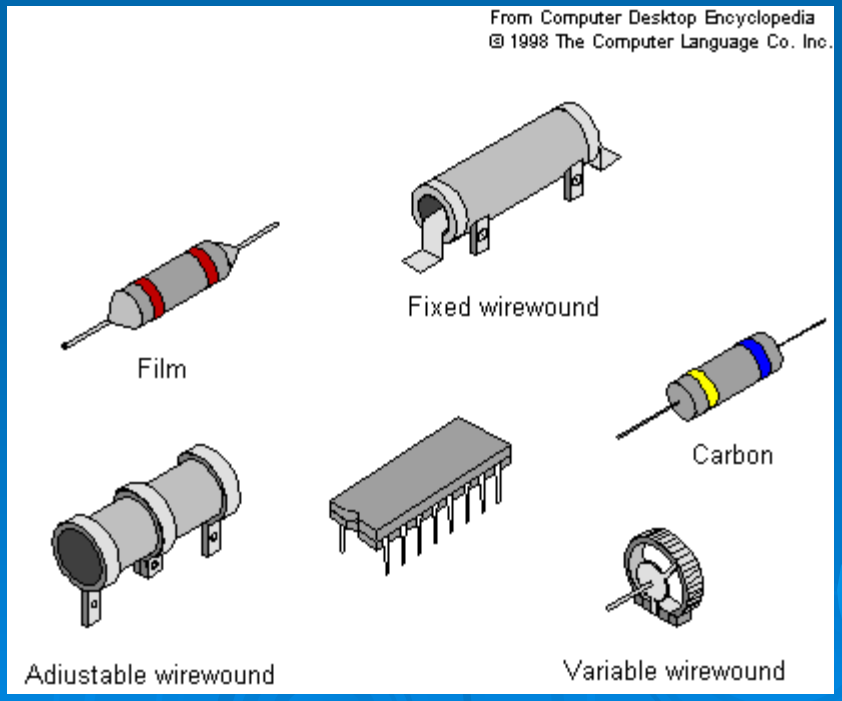
Voltage = Current * Resistance

Voltage = 5 * 18,000

Voltage = 90,000 / 1000 = 90

Resistors

- The opposition to the flow of charges (current) is called resistance.
- Resistance is measured in Ohms (Ω)



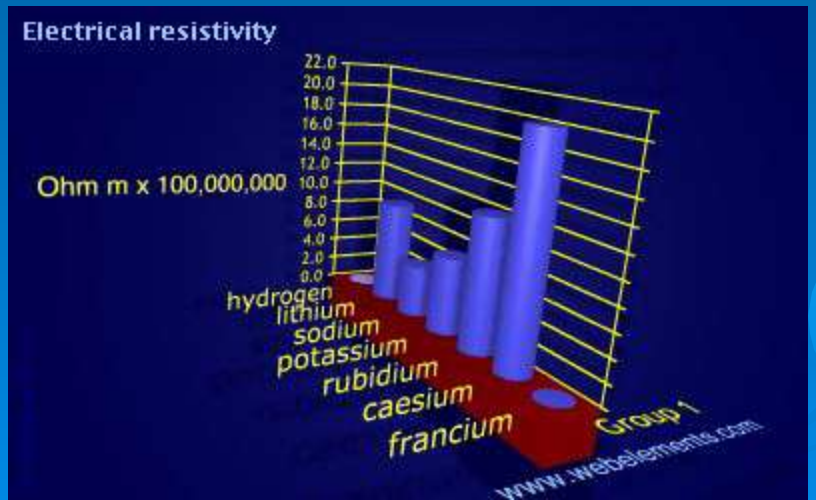

JOIN THE RESISTANCE
OHMMMMM...
VIA 9GAG.COM
VIA 9GAG.COM

Resistance

- Resistance depends on length, area, material, and temperature.
- Longer wires have more resistance.
- Thinner (less radius) wires have more resistance.

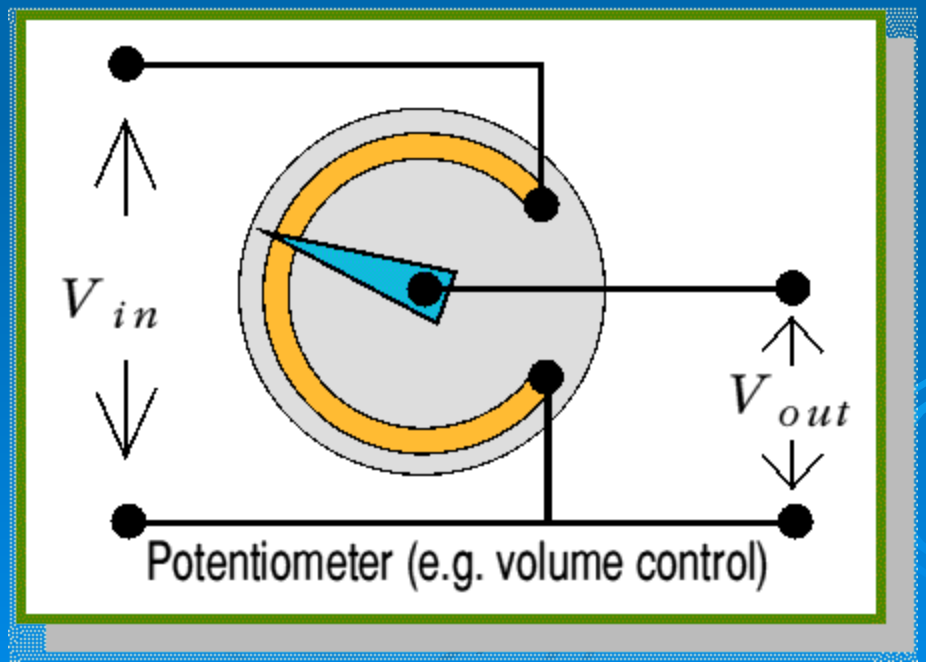
Resistance

- Certain materials, such as gold, have less resistance than others. This depends on the structure of the atom.
- As temperature increases, for most materials the resistance increases. When a material is hot, it's atoms vibrate faster and interfere with the flow of electrons.



Variable Resistors

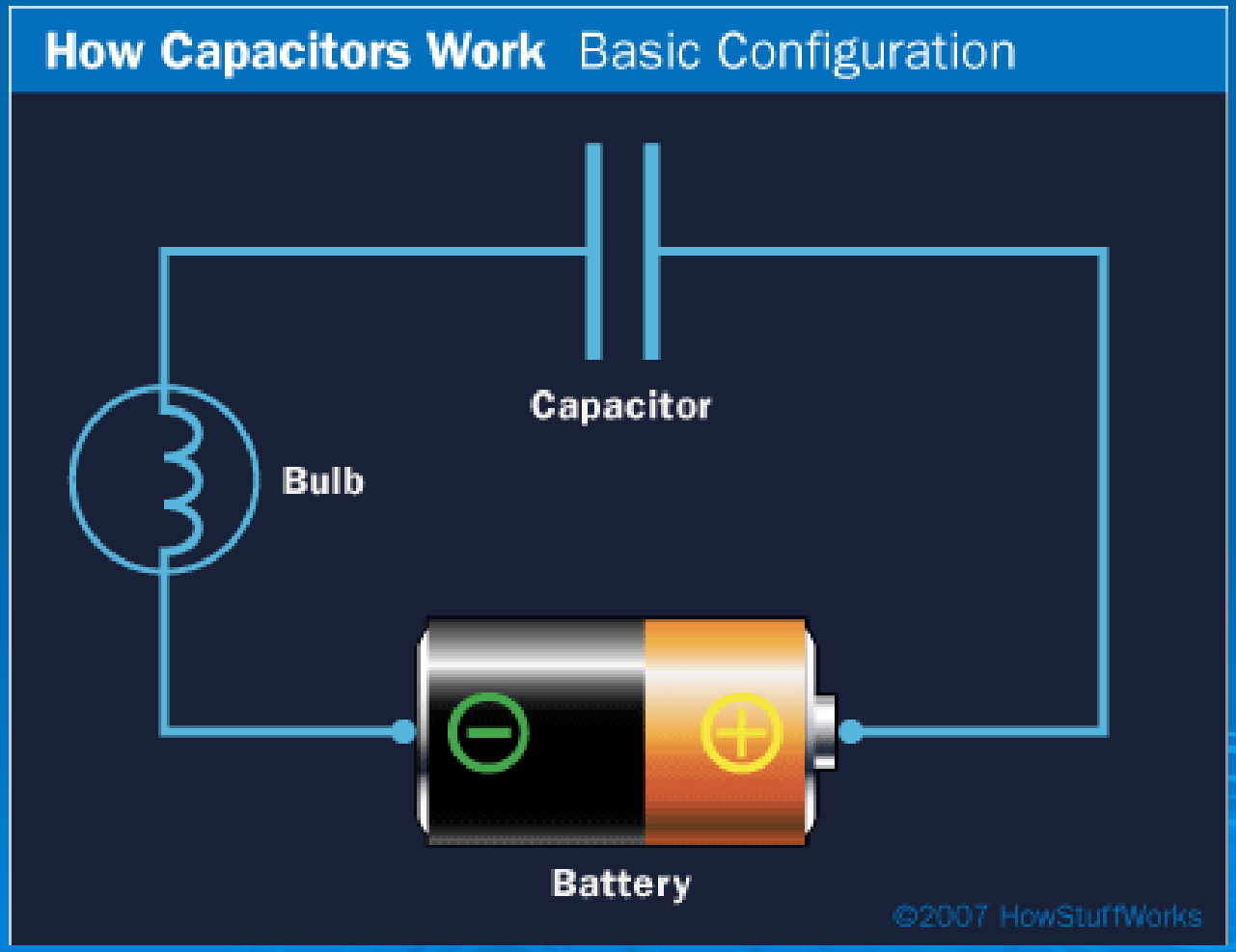
- Resistors that can change their resistance are called Potentiometers.
- They have one fixed end and the other end slides to change the resistance.



Electric Potential Energy

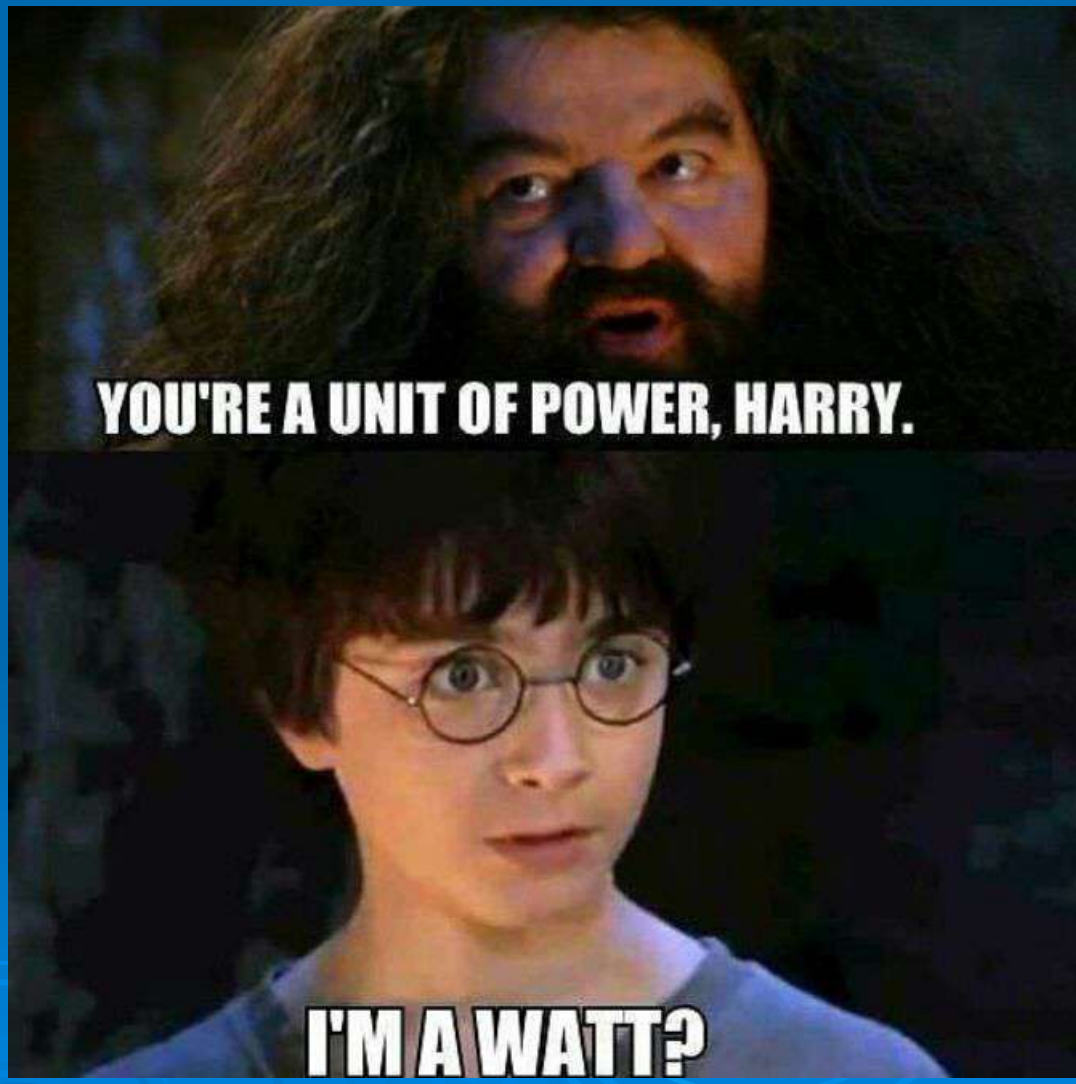
- Electric Potential Energy is energy that is stored.
- Capacitors are the most common ways to store energy.
- Measured by the capacitance.
- Capacitance has units of the Farad (F)

Capacitor


How Capacitors Work Basic Configuration
Capacitor
Bulb
Battery
©2007 HowStuffWorks

Power

- Electrical power is how fast a charges do work.
- Electrical Power has Watts as units.



Hand Crank

Electric Circuit

- Together, the bulb, battery, switch, and wire form the electric circuit.
- This is a path through which charges can flow.

Operation Game

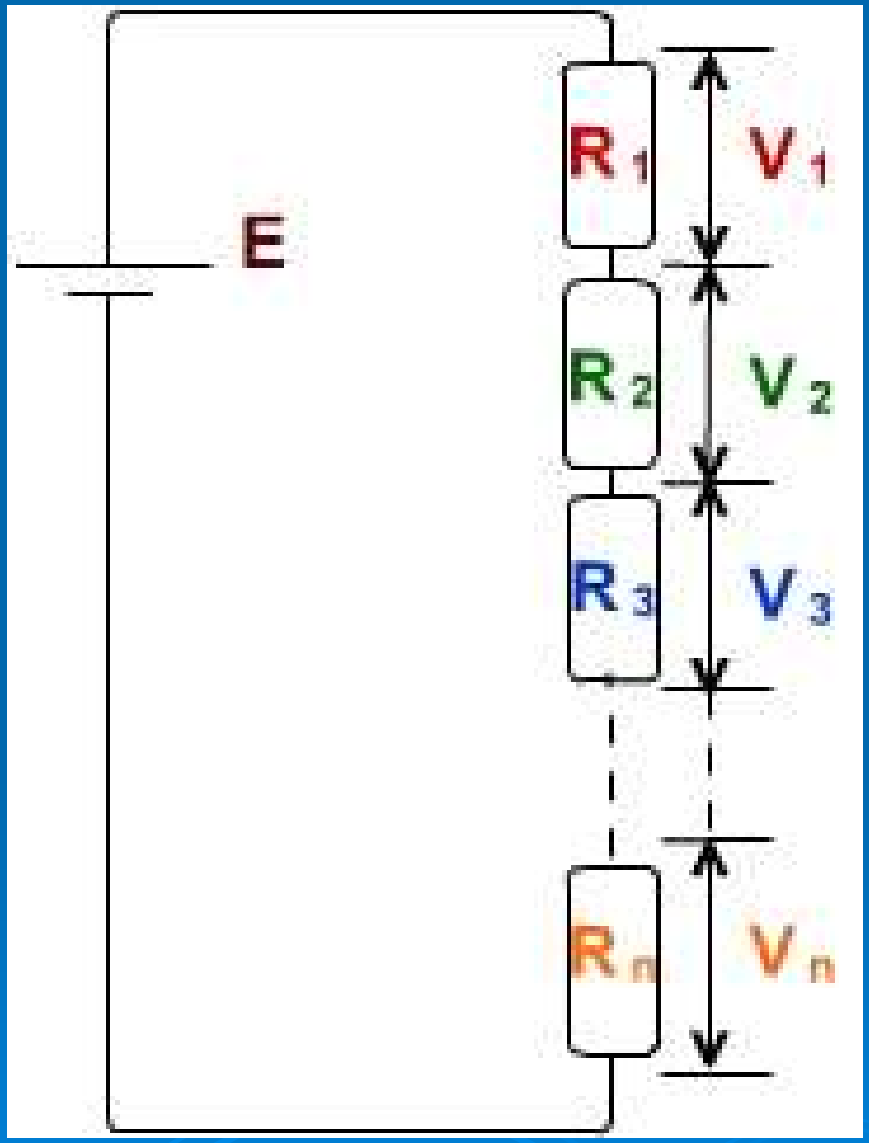
Short Circuits

- In a short circuit, the current can increase and become unsafe.
- The wires can’t withstand the increased current, and begin to overheat.

Short Circuit Demo

Series

- **In series, there is only one path for the current to flow.**
- When many resistors are connected in series, the current in each resistor is the same.
- $R_1 + R_2 \ldots\ldots = R_{total}$


E
R 1
V 1
R 2
V 2
R 3
V 3
R n
V n

What type of circuit has a single path of electrical flow?

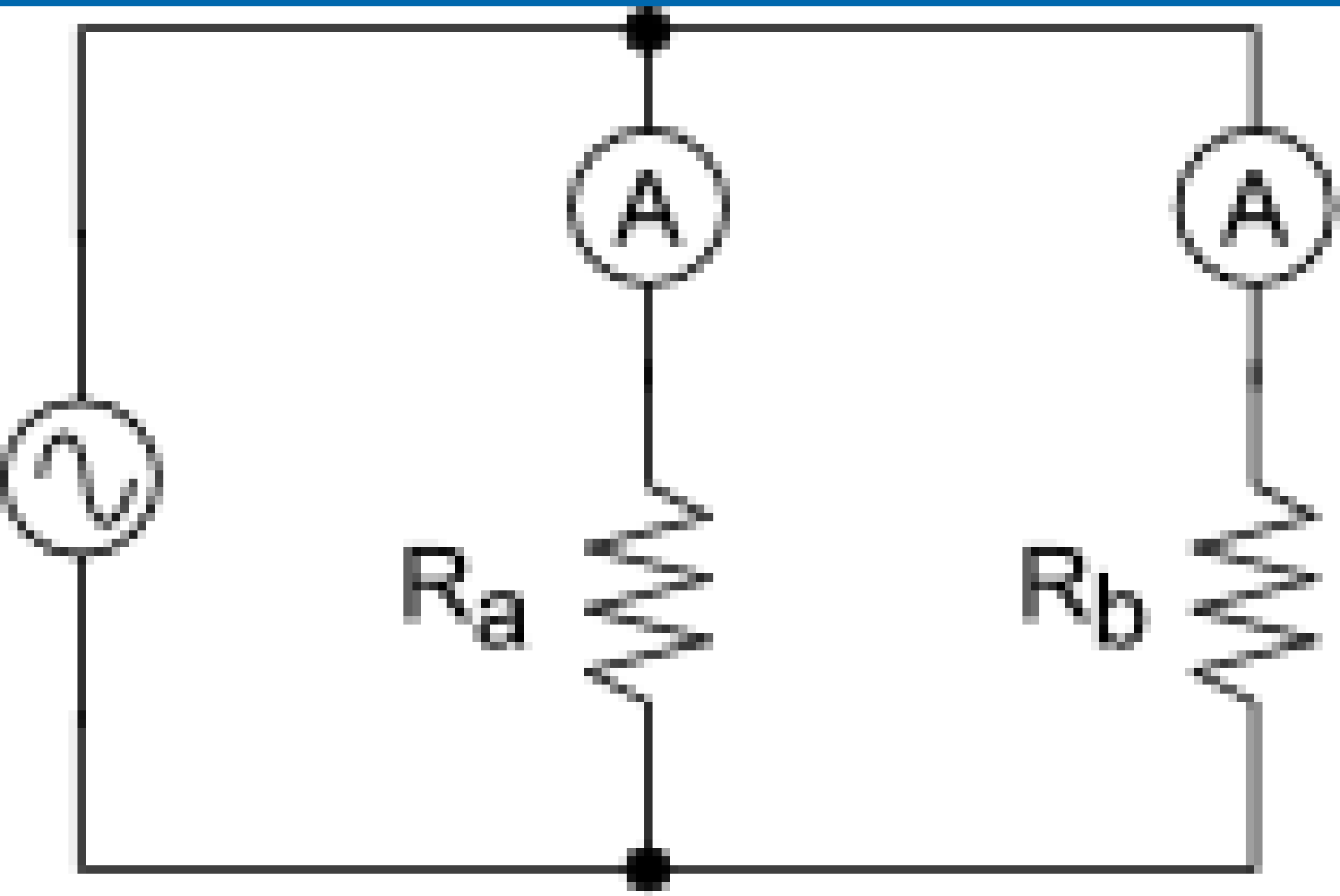
- Parallel circuit
- Open circuit
- Short circuit
- Series circuit

What type of circuit has a single path of electrical flow?

- ○ Parallel circuit
- ○ Open circuit
- ○ Short circuit
- ● Series circuit

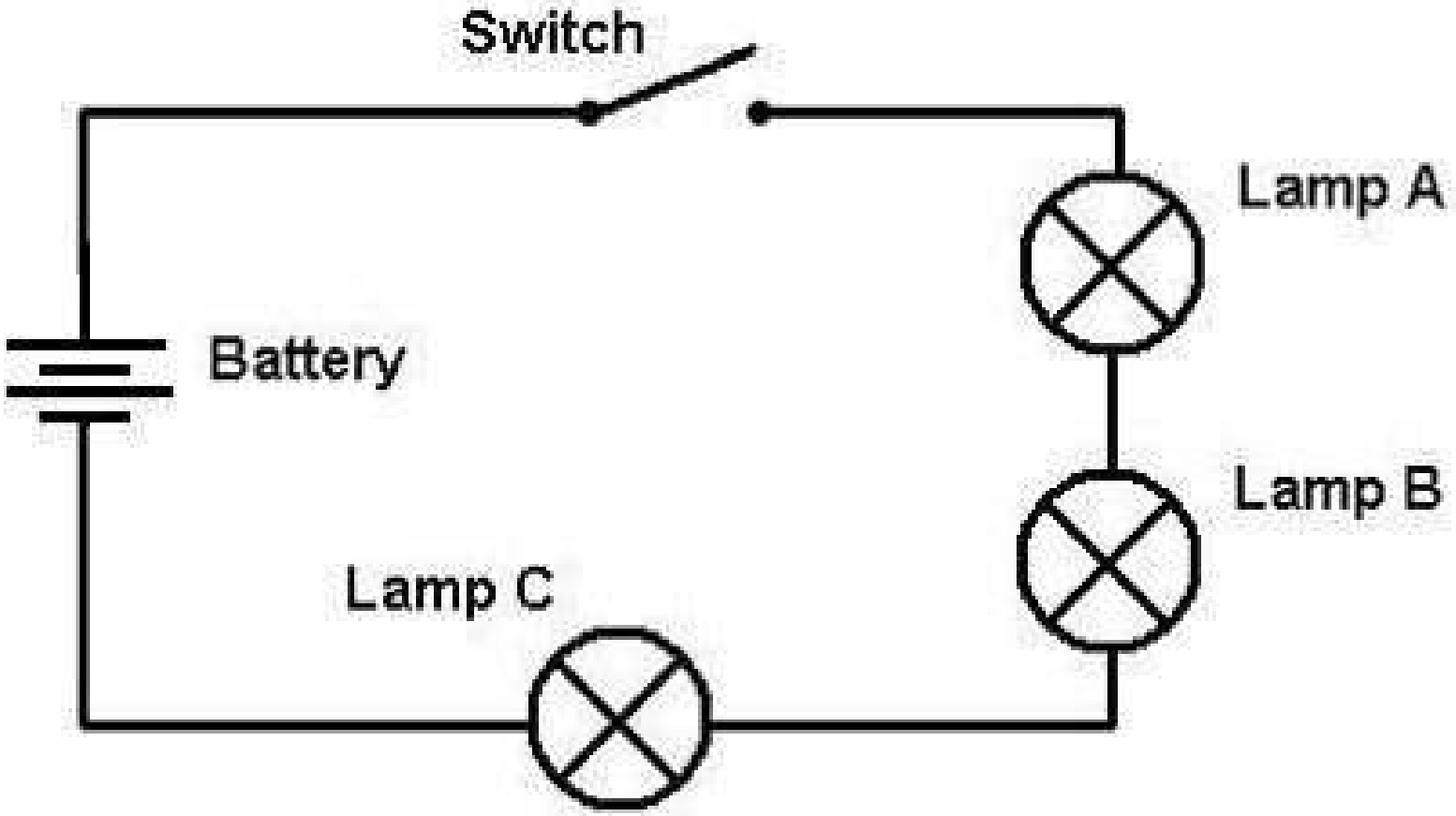
Resistance in Parallel

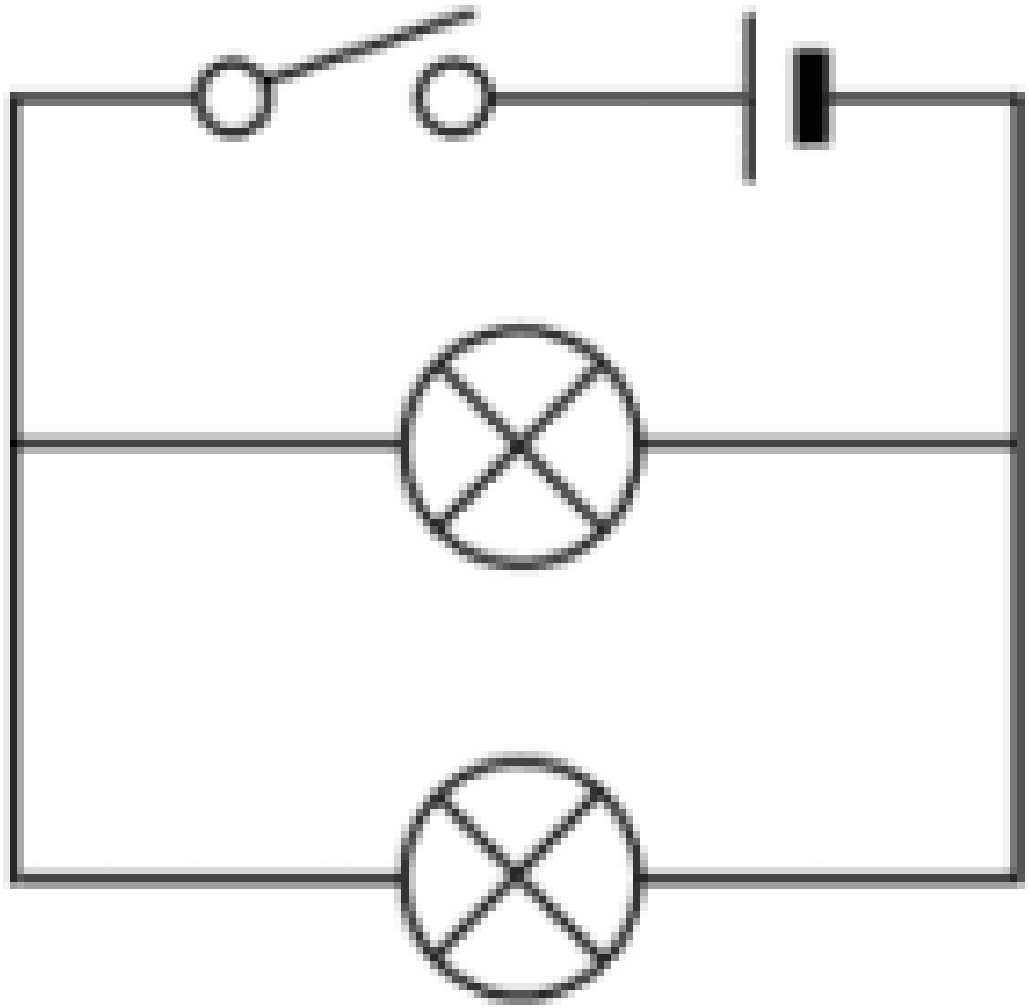
- Parallel means there are more than 1 path for a current to flow.
- $1/R_{total} = 1/R_1 + 1/R_2 \ldots..$


A
A
Ra
Rb

Schematic Diagram

- A diagram that depicts the construction of an electrical apparatus is called a schematic diagram.
- Diagrams use symbols to represent bulbs, batteries, and wires.


Switch
Lamp A
Battery
Lamp B
Lamp C



How do we measure Voltage, Amps, Resistance?

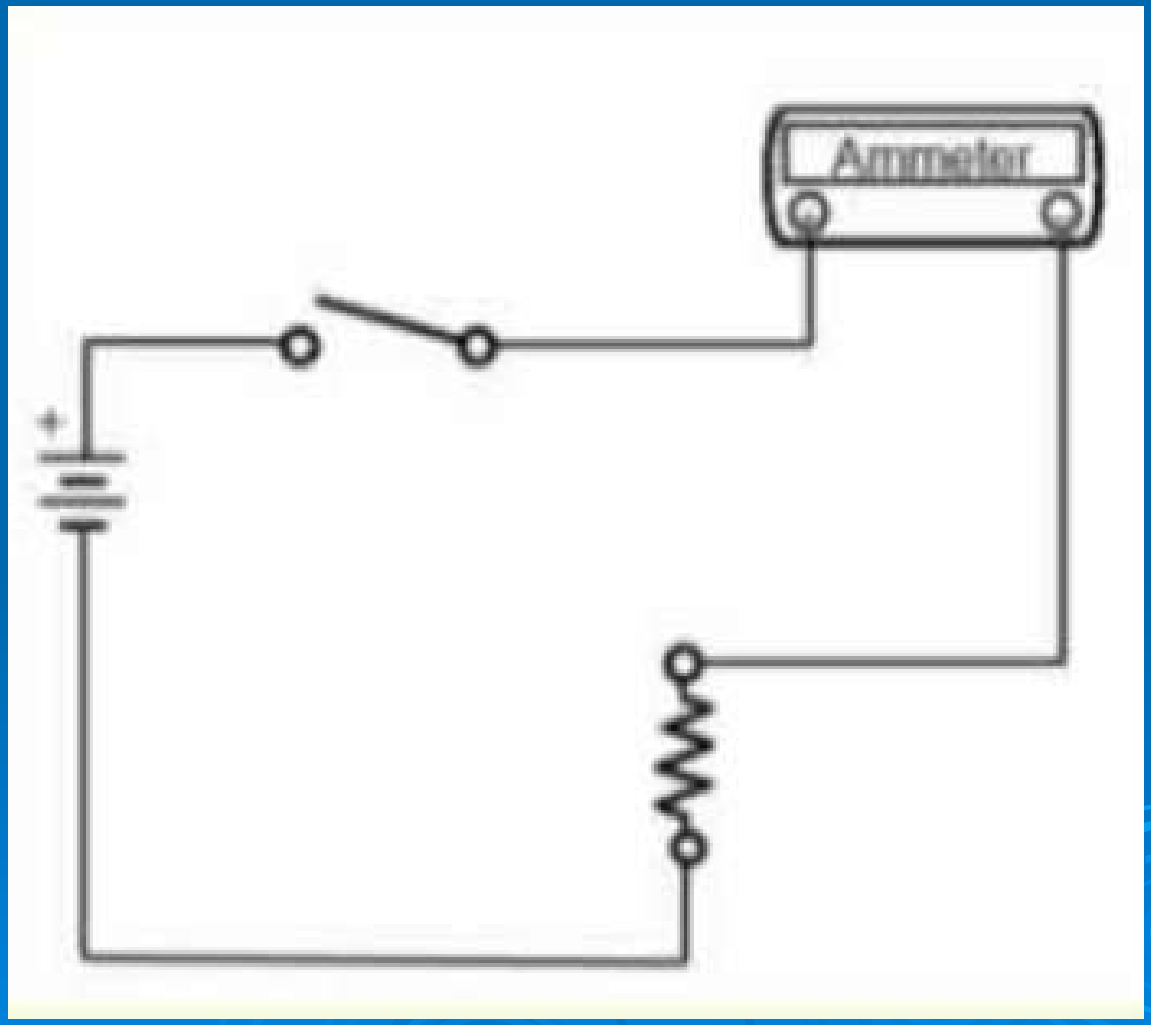
What is the reading on the digital multi-meter?

- 100 A
- 1,000 mV
- 1,000 A
- 100 mV

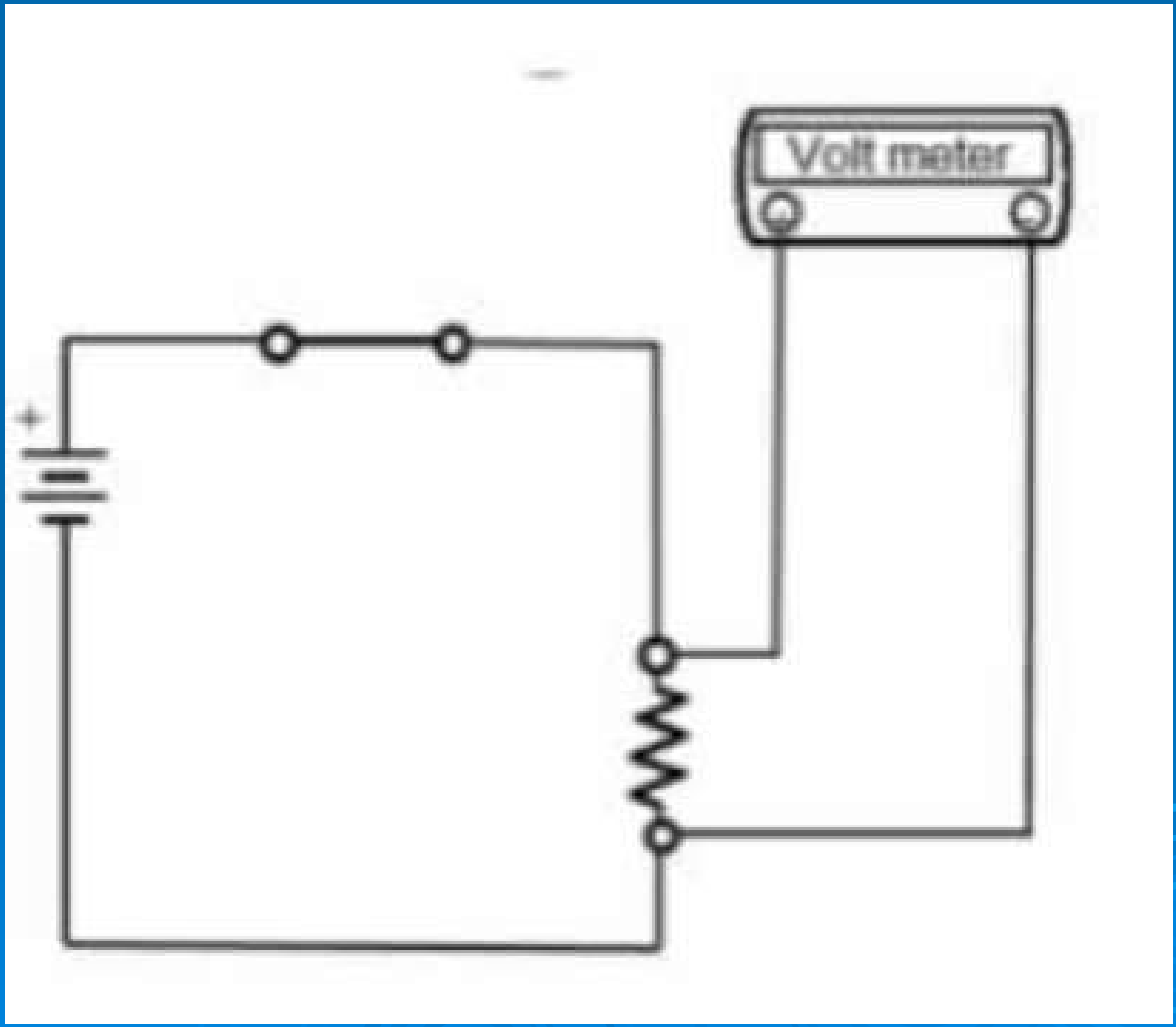
What is the reading on the digital multi-meter?

- ○ 100 A
- ○ 1,000 mV
- ○ 1,000 A
- ● 100 mV

Ammeter – Amps (current)



Voltmeter – Volts



Oscilloscope

Voltage = Amplitude