

What is Electricity

- Electricity is the energy caused by moving electrons within an atom.
- Electrical energy is the energy of electric charges.

ELECTRIC CHARGE

Electricity is related to charges, and both electrons (-) and protons (+) carry a charge.

An object can have a negative charge, positive charge or no charge.

Atoms have no charge because the charges of the protons and electrons cancel each other out.

Atoms become charged by gaining or losing electrons

TRANSFER OF ELECTRIC CHARGE

Conduction:

Electrons move more easily through conductors, like metals

- Metals conduct well because: atoms in metals have electrons that move easily through the material

Ex: Copper wire

Insulation:

Insulator- a material that doesn't allow electrons to move through it easily

- Occurs because electrons are held tightly to the atoms in insulating materials – like wood, plastic, glass

VOLTAGE

Voltage: difference in energy per unit charge as the charge moves between two points in the path of a circuit

- Also called: potential difference
- Measured as voltage (V)

Higher voltage, the more work the electrons can do.

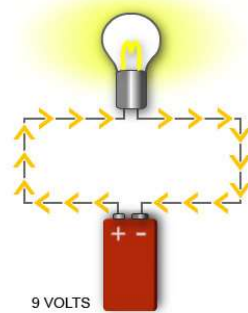
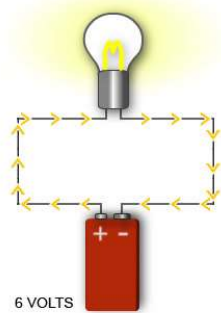


Voltage can vary

VOLTAGE



Example: a AA battery has a potential difference of 1.5 V between the two ends (the positive and negative terminals).



VOLTAGE

There is a Voltage across the terminals of a battery.

The potential difference or voltage across the two ends, or terminals, of a battery ranges from about 1.5 V for a small battery to about 12 V for a car battery.



ELECTRIC CURRENT

Electric current: the flow of electricity/electrons through a wire or any conductor.

- Used to make electrical appliances to work
- Measured in units of Amperes (A)

ELECTRIC CURRENT

- Different from static electricity because it lasts longer

Charges flow from High voltage to Low voltage

For charges to flow, the wire must always be connected in a closed path, or circuit

ELECTRIC CURRENT

There are two main kinds of electric current,

- Direct current (DC)
- Alternating current (AC).

Explains how current gets moved

DIRECT CURRENT (DC)

ALTERNATING CURRENT (AC)

ELECTRIC CURRENT

DIRECT CURRENT

(DC) Direct current is a flow of charge always in one direction.

From batteries

Direct Current:
one way flow
from negative
to positive

Direct current (DC)

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HOW A BATTERY WORK!

Electrolyte solution is inside the battery

- Zinc and manganese dioxide

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ELECTRIC CURRENT

Mainly used today

ALTERNATING CURRENT

(AC) -Alternating current is a flow of charge back and forth, changing its direction many times in one second.

- (Plugs and outlets / household)

Advantages of AC

- Voltage can be raised or lowered
- More efficient over long distances
- From Generators
- Used in your home
- Transformers are used to convert high voltage to low voltage.

Alternating Current

Direct Current (DC)

Alternating Current (AC)

- Is this (AC) Alternating Current, or (DC) Direct Current?

AC

DC

AC

AC

DC

AC

ELECTRICAL RESISTANCE

Resistance- the tendency for a material to oppose the flow of electrons, changing electrical energy into Thermal energy and light

- Opposition to the flow of charge
- All materials have some electrical resistance.
- **Increasing resistance by doing the following.**
 1. Making wires thinner
 2. Making wires longer
 3. Increasing temperature

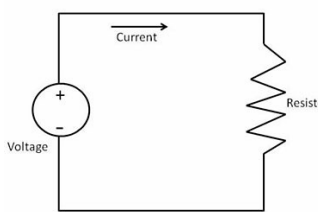
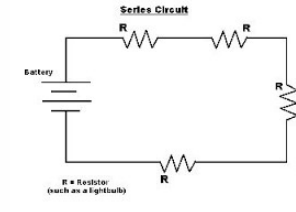
As resistance increases... current **decreases!!!!**

- Measured in ohms: omega Ω

Figure 4


CIRCUITS

- Resistance is supplied by a resistor.
- A **resistor** is a device that uses electric energy to do work.
 - A wire connected from the resistor to the positive terminal completes the circuit.

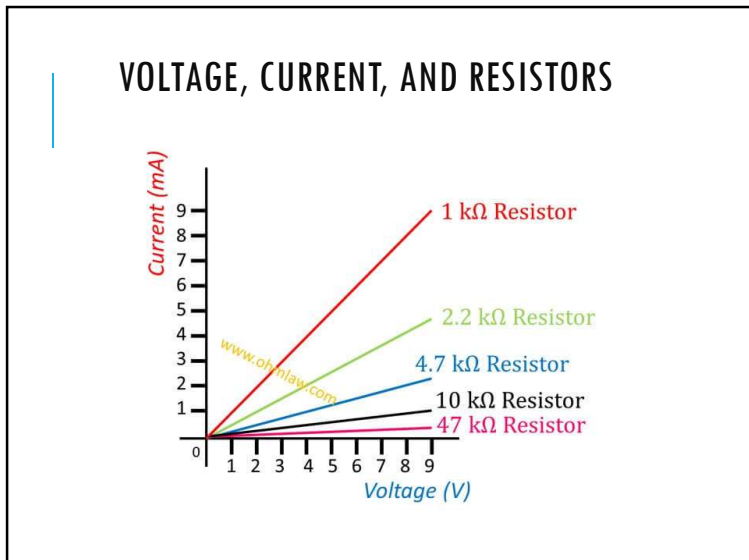



ELECTRICAL RESISTANCE

- **Conductors** have low resistances.
- **Insulators** have high resistances.
- **Semiconductors** conduct under certain conditions.
 - materials that have electrical properties between those of insulators and conductors



[Superconductor clip](#)



VOLTAGE, CURRENT, AND RESISTORS RELATIONSHIP

- As resistance increases
 - Current decreases
- As voltage increases
 - Current increases
 - Resistance stays the same
- As current increases
 - Voltage increases
 - Resistance stays the same

There is a **linear relationship** between current and voltage

OHM'S LAW

Ohm's law states that the current in a circuit is equal to the voltage divided by the resistance

What is the formula if solving for R?

What is the formula if solving for V?

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

The relationship among current, voltage, and resistance.

Units

I = Current → Amperes (A)
 V = Voltage → Volts (V)
 R = Resistance → Ohm (Ω)

PRACTICE PROBLEMS: RESISTANCE

1. A car has a 12 volt system. The headlights are on a 10 amp circuit. How much resistance do they have?

V= 12 volts R= V/I R= 12 volt/10 amp **R= 1.2 Ohm (Ω)**
 I= 10 amps
 R= ?

2. Your house uses 120 volts. What amount of current would flow through a 20 ohm resistor?

V= 120 volts I= V/R I= 120 volts/20 ohm **I= 6 Amps**
 I= ?
 R= 20 ohm

PRACTICE PROBLEMS: RESISTANCE

3. A refrigerator's circuit has a current equal to 0.647 A in it when the voltage across the circuit equals 116 V. What is the resistance of the circuit?

V= 116 volts R= V/I R= 116 volts/0.647 amps
 I= 0.647 amps
 R= ? **R= 179 ohms(Ω)**

4. The resistance of a wire in a hair dryer is 7.7 Ω . If the current through the wire equals 15.6 A, what is the voltage across the terminals of the hair dryer?

V= ? V= I x R V= 15.6 amps x 7.7 Ω **V= 120 Volts**
 I= 15.6 amps
 R= 7.7 Ω

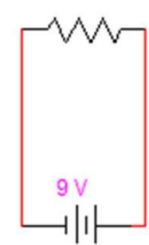
What will happen if the voltage of the battery is increased to 25 volts?

A. The voltage across the resistor will increase

B. The voltage across the resistor will decrease

C. The voltage of the resistor does not change


10 Ohms



9 V

What will happen if the voltage of the battery is increased to 25 volts?

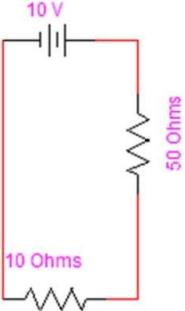
A. The current through the resistor will increase
 B. The current through the resistor will decrease
 C. The current of the resistor does not change



A circuit diagram showing a 9V battery at the bottom and a 10 Ohm resistor at the top, connected in a single loop.

Which resistor will have the greatest current?

A. 50 Ω
 B. 10 Ω
 C. They have the same current



A circuit diagram showing a 10V battery at the top, a 10 Ohm resistor at the bottom, and a 50 Ohm resistor on the right side, all connected in a single loop.

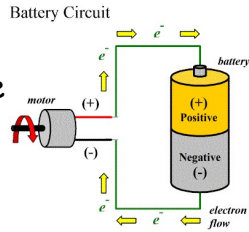
CIRCUITS

For current to flow there must be a complete loop

Electric circuit: complete, a closed path through which electrons travel.

Electrons flow from negative to positive terminal

Work is done if there is a resistance in the wire.

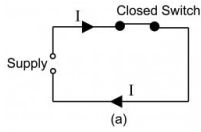
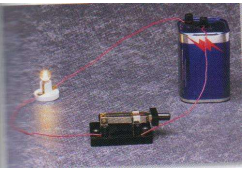


A diagram labeled 'Battery Circuit' showing a battery with a positive (+) terminal and a negative (-) terminal. A motor is connected between the terminals. Arrows indicate the direction of 'electron flow' from the negative terminal, through the motor, and back to the positive terminal.

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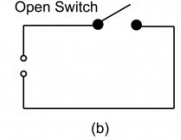
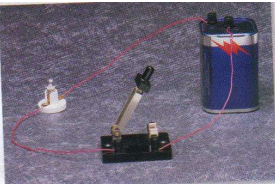
CIRCUITS

Closed Circuit- A closed-loop path for electrons to flow through, creating a current

(a)

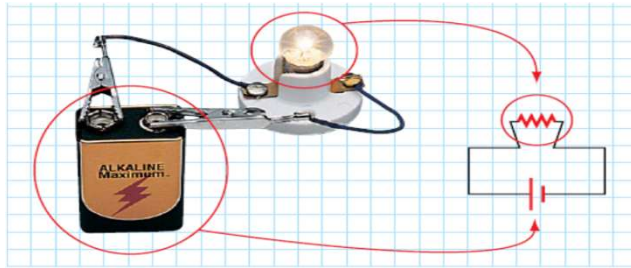
Open Circuit- if any part of the circuit is disconnected, no current flows

(b)

DRAWING A SCHEMATIC DIAGRAM

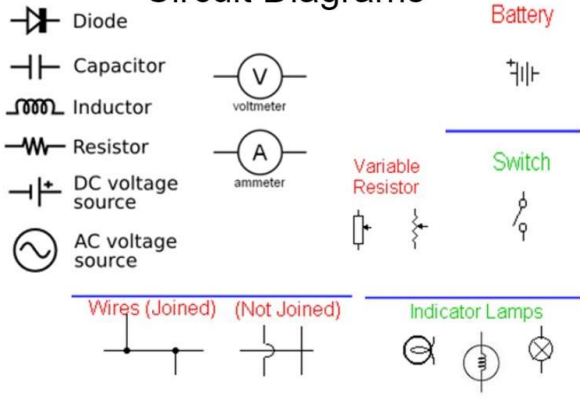
A schematic diagram is a model of an electric circuit with standard symbols for the electrical devices.



SCHEMATIC DIAGRAM SYMBOLS

Wire or conductor 	Battery or other direct current source
Resistor 	Switch
Bulb or lamp 	

Circuit Diagrams



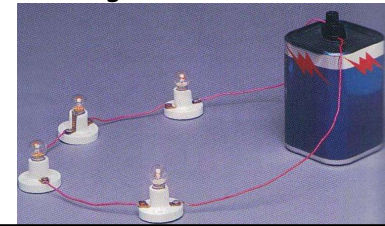
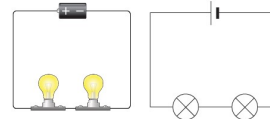
TWO TYPES OF CIRCUITS

Series circuits: A circuit with only one path.

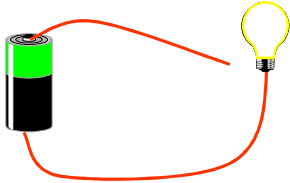
All the resistors in a series circuit lie along a single path.

The amount of current in a series circuit is the same at all parts of the circuit.

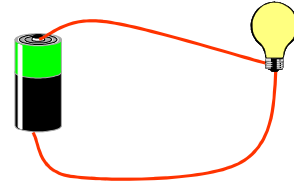
Resistance in the circuit changes if resistors are added or taken away.



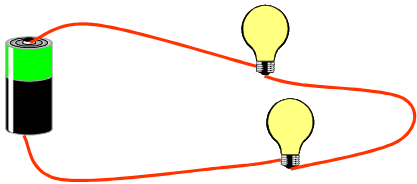
Series Circuits



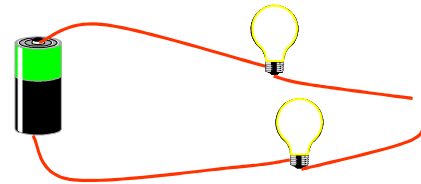
Series Circuits



Series Circuits



Series Circuits



Break in the wire turns off all the lights

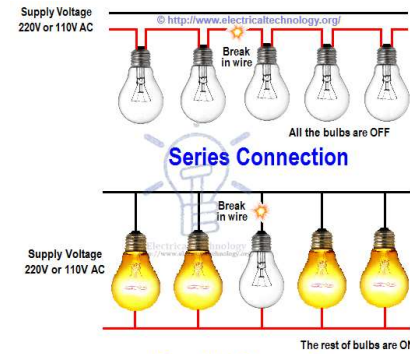
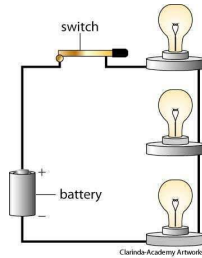
ADVANTAGES & DISADVANTAGES OF SERIES CIRCUIT

Disadvantages

1. If one component in a series circuit fails, then all the components in the circuit fail because the circuit has been broken.
2. The more components there are in a series circuit, the greater the circuit's resistance*.
3. There is less voltage going through each light bulb making them dimmer.

Advantages

1. It costs less to make
2. It is easier to make



Why Parallel Connection is Preferred over Series Connection?

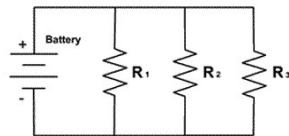
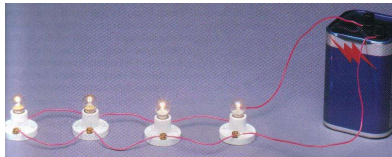
TWO TYPES OF CIRCUITS

Parallel circuits: The electrons in a parallel circuit can travel through more than one path, each path is separate.

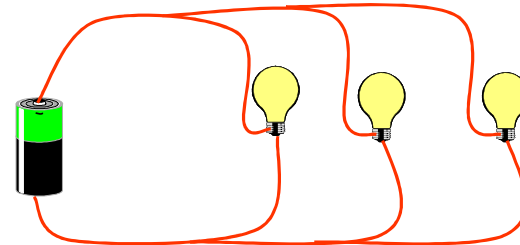
If there's a break in one path in the circuit, electrons can still flow through the other paths and maintain a complete circuit.

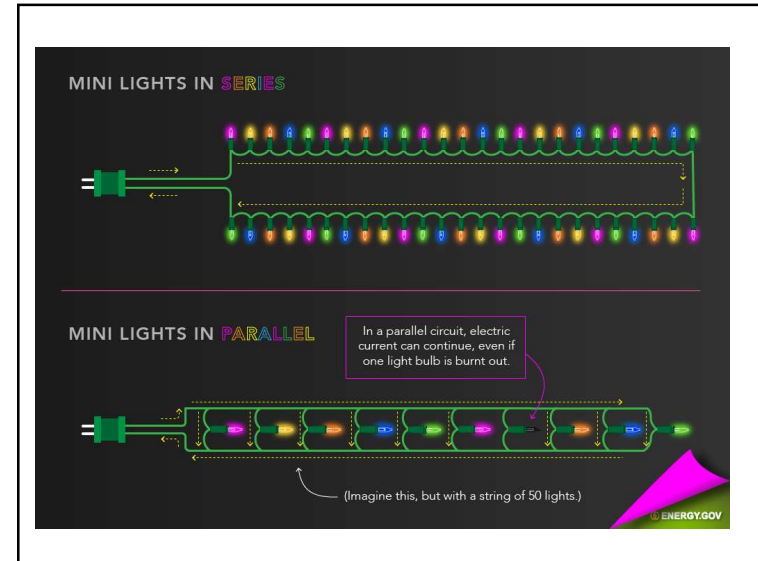
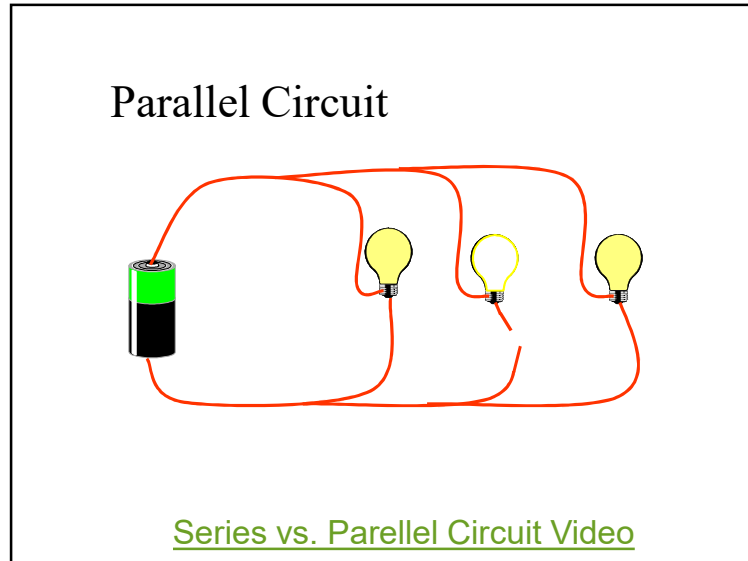
Parallel circuits in your home allow each light or appliance to use the amount of current it needs to work.

A parallel circuit prevents all the lights or appliances from shutting off when one of them stops working.



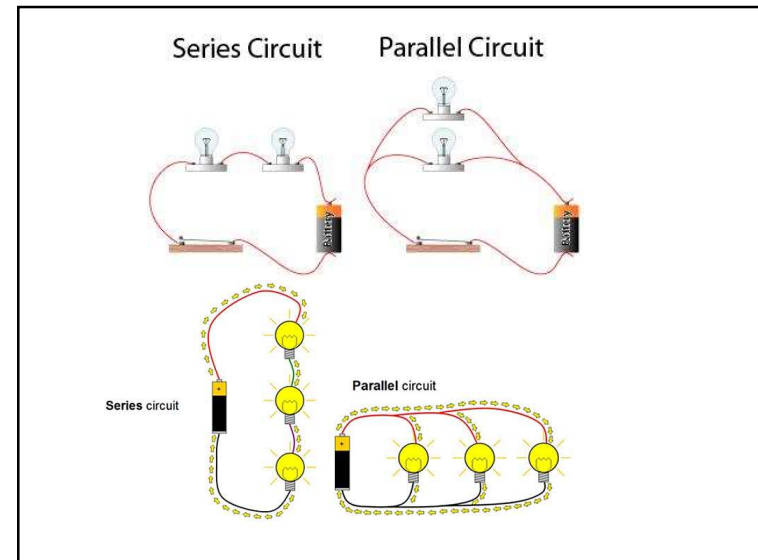
Parallel Circuit





ADVANTAGES & DISADVANTAGES OF PARALLEL CIRCUIT

Disadvantages	Advantages
<ol style="list-style-type: none"> 1. More difficult and complicated to assemble. 2. Splits current 	<ol style="list-style-type: none"> 1. It becomes easy to connect or disconnect a new element without affecting the working of other elements. 2. If there is a break in one branch, charges can still move through other branches. 3. Switches can be added to turn on different part. 4. Resistance decreases and current increases.



Describe the advantages and disadvantages of series and parallel circuits

Series Circuits		Parallel Circuits	
Advantages	Disadvantages	Advantages	Disadvantages

ELECTRIC SAFETY

- Fuses and circuit breakers protect against overloaded circuits.
- **Fuses**- contain a small piece of metal that melts if the current becomes too high, opening the circuit and stopping the flow of current
- **Circuit breakers**- contain a small piece of metal that bends when it gets hot, opening the circuit and stopping the current
- Circuit breakers are often used in place of fuses.



ELECTRIC SAFETY

Short Circuits

Broken wires or water can cause electric appliances to short-circuit.

A short circuit occurs when electricity takes a short path and bypasses the resistors in the circuit.

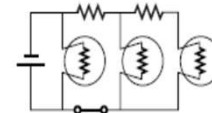
Because of this the resistance of the circuit is less and the circuit wire increases.

The increased current can produce enough heat to melt wires and start a fire, or cause serious electric shock.



CLASSWORK

1. Identify the components, and the number of each in this diagram.



2. Draw a schematic diagram with 4 lights in parallel.
3. Draw a schematic diagram of 2 lights in series.
4. Draw a schematic diagram with 2 lights in parallel, and one in series.