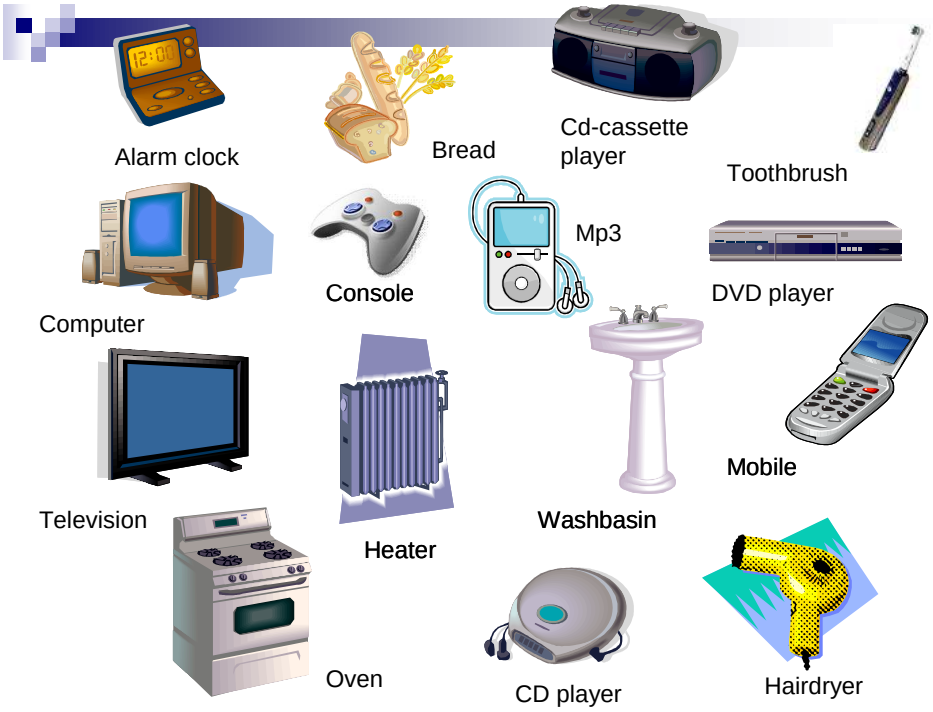
UNIT 1: ELECTRIC CIRCUITS

Belén Gallego

WORKSHEET 1: What is electricity?

INTRODUCTION

1.- Work in groups of three or four. Look at these pictures and discuss:



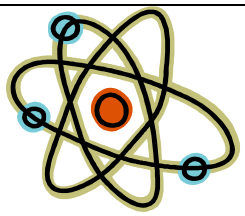
- which of these objects do you use every day? Write down the names.

- which of them need electricity to work?

- why is electricity important in our lives?

WHAT IS ELECTRICITY?

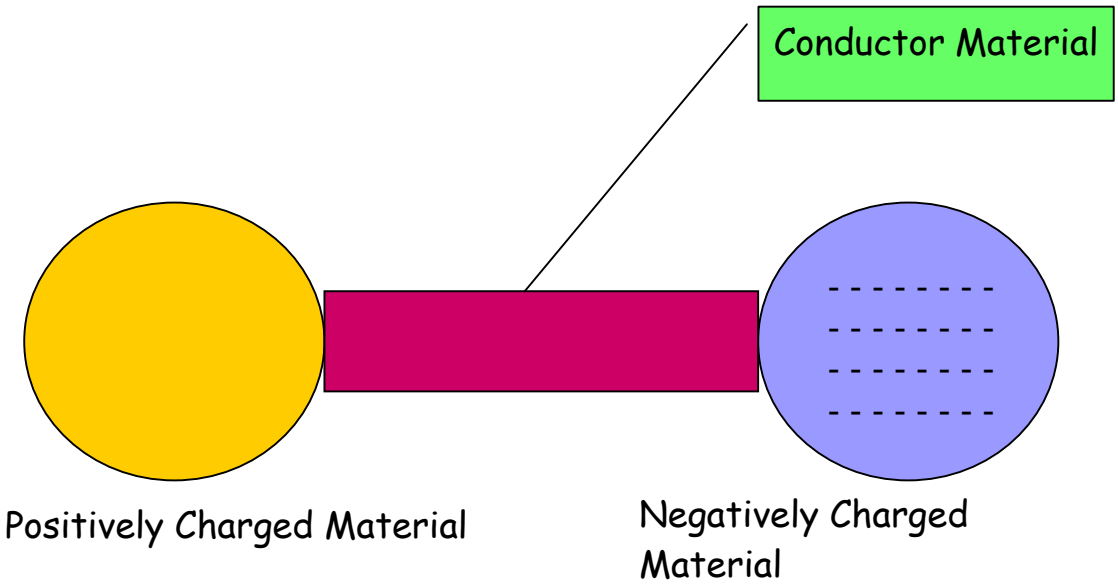
2.- Look at the picture. Make 5 sentences that explain the behaviour of the particles of the atom.

	Electrons	move	around the	nucleus
		don't move		
	Protons	are	together in the	
	Neutrons	aren't		

3.- Complete these sentences with the most suitable word. Work in pairs.

- _____ (electrons/protons) have negative charge and protons have _____ (positive/negative) charge.
- A _____ (stable/charged) atom has the same number of electrons and protons.
- If an atom has a higher number of electrons than of protons it is _____ (positively/negatively) charged.
- If an atom has a lower number of electrons than of protons it is _____ (positively/negatively) charged.
- If an atom is stable it _____ (has/does not have) charge.

4.- Look at this picture. Where do you think there are more electrons?



Now try to imagine what will happen. Choose the sentence you think is true.

- Electrons will move from negatively charged material to positively charged material
- Nothing.
- Electrons will move from positively charged material to negatively charged material.

5.- Now you know what electricity is. Write the definition.
Your classmate has half of the words you need to complete the definition.

Electricity…

Words: a, flow, electrons, in
(Words of the other student: is, substance, a, of)

What have you learnt?

6.- Is it true? Is it false? Put a ✓

	True	False
Electrons move around the nucleus		
A negatively charged atom has positive charge		
A positively charged atom has more electrons than protons		
Stable atoms have the same number of electrons and protons		
Atoms are made of molecules		
Electrons move from negatively charged material to positively charged material		

Correct the false sentence. Write down the correction.

HOW IS ELECTRICITY PRODUCED?

7.- Look at the picture of the exercise 1.

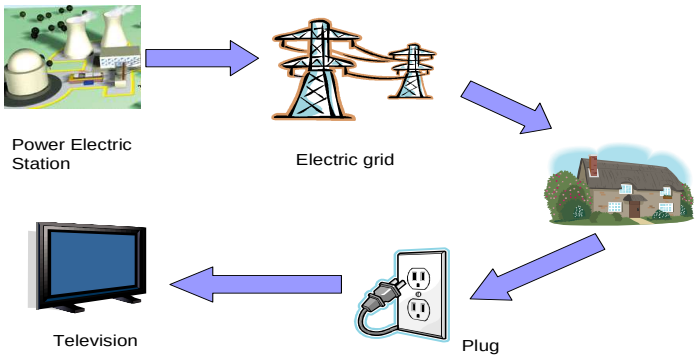
Which of those electric devices need to be plugged in  to work?

Which of them need a cell  or a battery  to work?

To be plugged in	Cell/Battery

8.- What is the *way of electricity*?

Look at the picture.



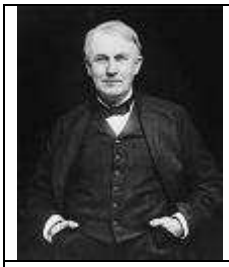
Now, work in pairs. Put the following sentences in order.

a. Plugs are connected to an electric grid
b. An electric grid carries the electricity produced in Power Electric stations.
c. Electricity is produced in Power Electric Stations.
d. Televisions must be plugged in to work
e. Televisions need electricity to work.

Write the sentences in the correct order.

9.-Do you know who invented the first bulb? Read the text below.

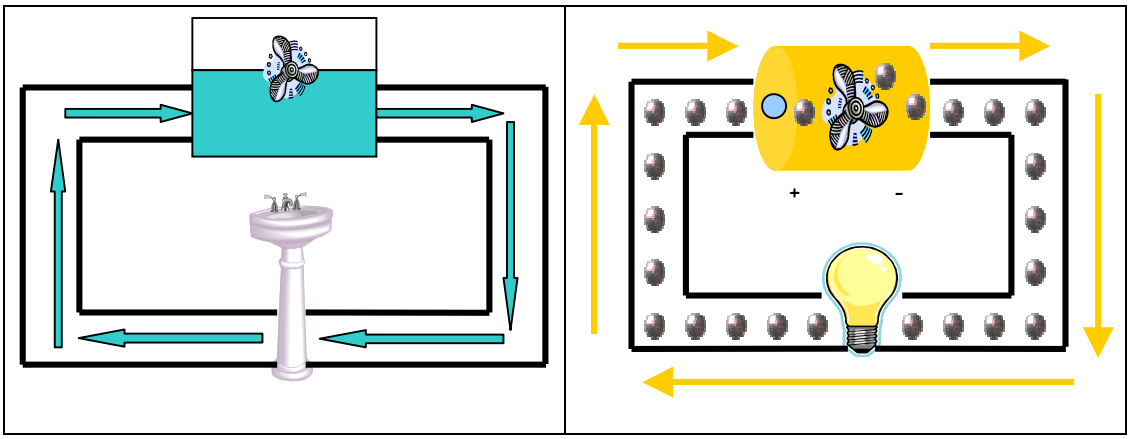
Thomas Alva Edison was born in Ohio (United States) in 1847. He worked in business but he was also an inventor. He enjoyed doing experiments with electricity. In 1879 he invented the bulb. He used a carbonized bamboo filament. That bulb worked for 48 hours. He died in 1931.

	Where and when was he born?	What was his job?	What did he invent?	Which materials did he use?
Thomas Alva Edison and his bulb				

WORKSHEET 2: Introduction to electric circuits

ELECTRIC CIRCUITS

1.- Look at these pictures.



What do these circuits have in common? Discuss in pairs and choose the most suitable sentence.

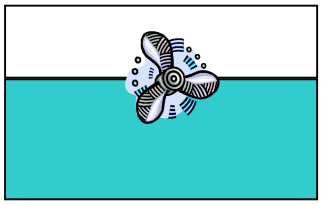
- These circuits are all open.
- These circuits are all closed.

- There are some elements running in the circuit (e.g: water, electrons).
- There are no elements running in the circuit.

- The circuit is interrupted.
- The circuit is not interrupted

Now, write the sentences you have chosen.

2.- Which elements from both pictures do you think have the same function?
Match pairs.



3.- Below are parts of the definition of an electric circuit. Can you put them in the correct order?

An Electric Circuit…

of electrons.	is a group of	to give way	
elements	inter-connected		

4.- Discuss with your partner and answer:

Which of the electric elements of exercise 2 do you think give electrons energy to move?

Which of the electric elements above do you think allows electrons to travel through it?

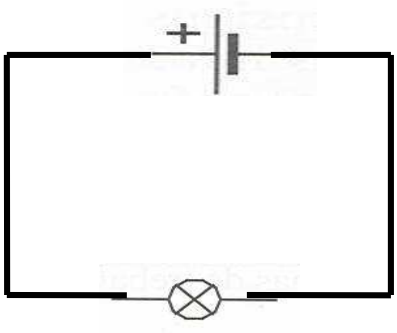
Which of the electric elements above do you think transform electrical energy into another kind of energy?

DOING EXPERIMENTS

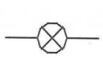
- We will do some experiments with electric circuits. We will start with the simplest.
- Before you start, you need to know:

1) Scientists and electricians draw electric circuits using international special **symbols**.

2) Electric circuit diagram: is a schematic drawing that represents an electric circuit. For example:



3) **Basic elements**:

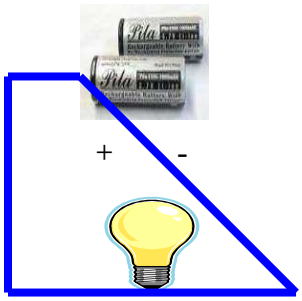
Electric Components		
Picture	Name	Symbol
	Cell	
	Wire	
	Bulb	

EXPERIMENT 1

Material:

- 1 cell 1,5 V
- wires
- 1 bulb 1,5 V

Picture



What's happened?

The bulb	does not	light up.
	-	lights up.

Electric diagram

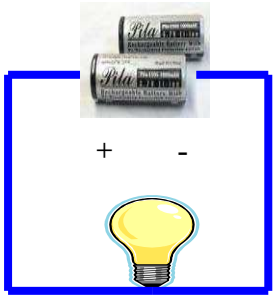
You must **change** the **picture** for the **symbol**.

EXPERIMENT 2

Material:

- 1 cell 1,5 V
- wires
- 1 bulb 1,5 V

Picture



What's happened?

The bulb	does not	light up.
	-	lights up.

Electric diagram

You must **change** the **picture** for the **symbol**.

Conclusions:

In	the first experiment	if I connect the wire in	the same terminal	of the cell	the bulb	-	lights up.
	the second experiment		different terminals			doesn't	light up.

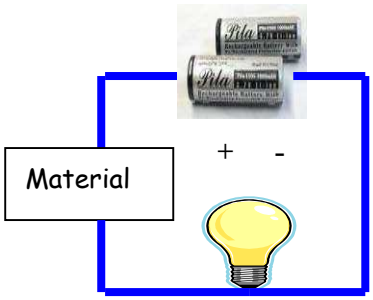
Write the correct sentence for every experiment.

EXPERIMENT 3

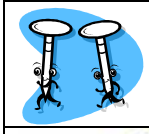
Material:

- 1 cell 1,5 V
- wires
- 1 bulb 1,5 V
- Materials: paper, nail, rubber, pen.

Picture



What's happened? Put a ✓

	It lights up	It does not light up
		
		
		
		

Conclusions:

<table>
<tr><td rowspan="4">When I connect the wires with</td><td>paper</td><td rowspan="4">the bulb</td><td rowspan="2">doesn't</td><td rowspan="2">lights up</td></tr>
<tr><td>a rubber</td></tr>
<tr><td>a nail</td><td rowspan="2">-</td><td rowspan="2">light up.</td></tr>
<tr><td>a pen</td></tr>
</table>

Write the sentences for every experiment.

WORKSHEET 3: Electric Components

Conductors & Insulators

1.- Remember the results of experiments in lesson 2. Complete the chart.

Materials that make a bulb light up	Materials that do not make a bulb light up

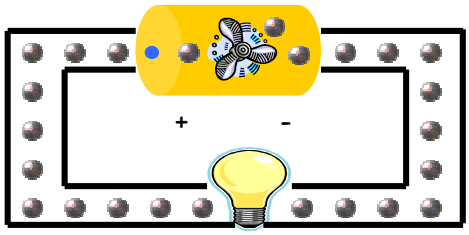
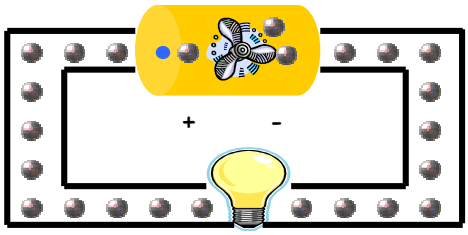
2.- Re-order the letters of these words and complete the next sentences.

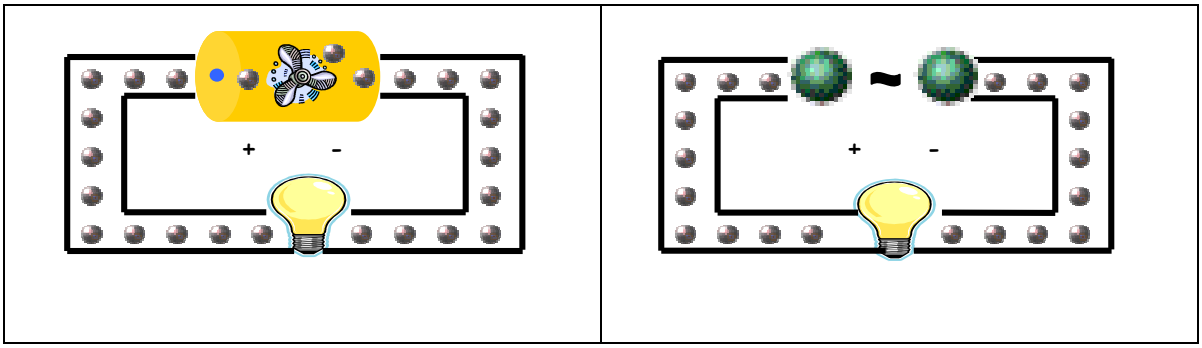
RDONUCTOC= NAULTISRO=

- _____ is a material that allows electrons to pass through it.
- _____is a material that does not allow electrons to pass through it.

Real/Conventional & DC/AC

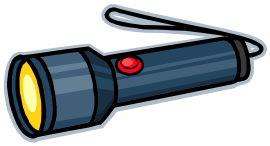
3.- Draw arrows ( ) to show the direction of electrons in every case.

Real way	Conventional way
	
Direct Current	Alternating Current



ELECTRIC COMPONENTS

4.- Look at these pictures.



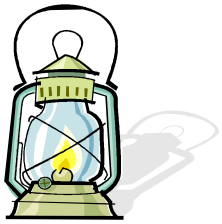
Torch

Lamp

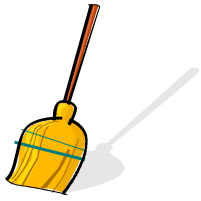
Vacuum Cleaner

Hand Mixer

Mixer



Oil lamp



Brush

Whisk

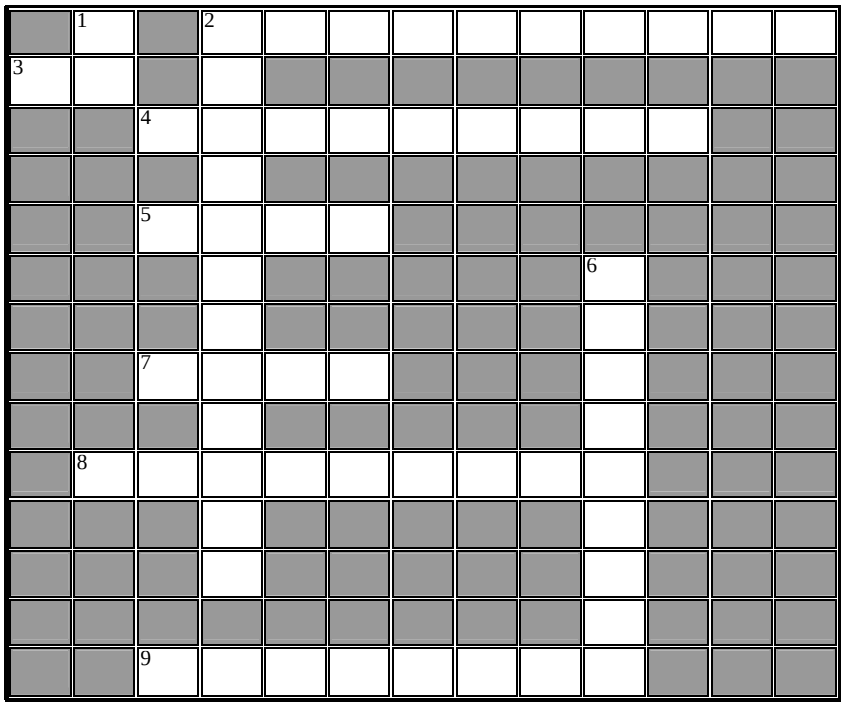
Answer the questions below:

- Which of these devices have the same function?

- Which of these devices have an electric circuit?

- Is there an element to switch on and switch off the electric devices?

5.- Electric Crossword.



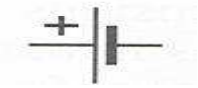
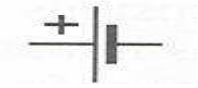
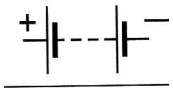
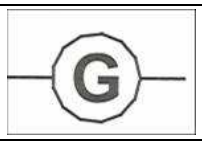
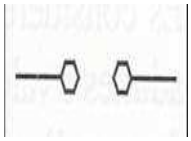
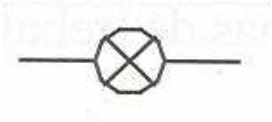
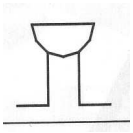
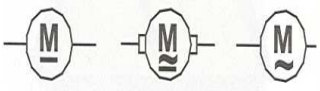
ACROSS

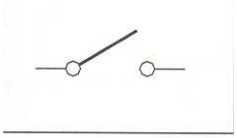
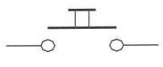
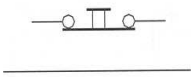
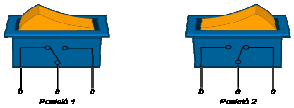
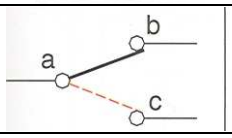
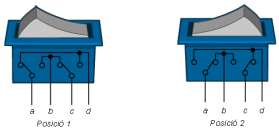
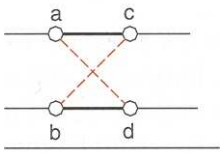
2. It allows us to open or close an electric circuit
3. Direction of electric current is constant
4. Material that does not allow electrons to pass through it.
5. Name of electron's path from negative terminal to positive terminal
7. Plastic outside, copper inside
8. Material that allows electrons to pass through it.
9. It transforms electrical energy in another kind of energy that we need.

DOWN

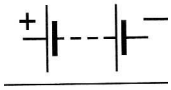
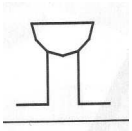
1. Direction of electric current is not constant
2. Name of electron's path from positive terminal to negative terminal
6. It gives electrons energy to flow through a circuit

Useful Information

Picture	Name	Symbol
	Cell	
	Accumulator	
	Battery	
	Dynamo	
	Alternator	
	Bulb	
	Buzzer	
	Bell	
	Engine	
	Wire/Cable	

	One-way switch	
	Push switch NO Push switch NC	 
	Two/way switch	
	Double-Pole switch	

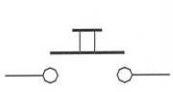
6.- Complete the chart below.

Electric Component	Name	Symbol	Energy Transformation
Generator	Accumulator		
			
			DC. Mechanical-Electrical
			AC. Mechanical-Electrical
			

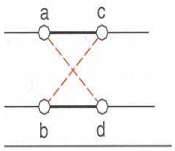
			Electrical- Sound
	Bulb		
	Engine		

7.- Match the names with the right symbol.

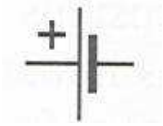
Battery



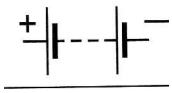
Push switch NC



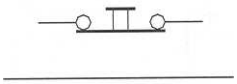
Two-way switch



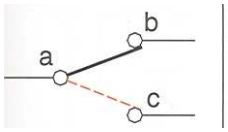
Double pole switch



Accumulator



Push switch NO



8.- Put the names of the components of this wire:

WORKSHEET 4: Experiments with Electric Components Game...

1.- In order to revise what we did in the previous lesson we will play a game.

- You will have some cards (pictures, names or symbols).
- Everyone must complete one column (you must put the card in the corresponding place).
- Ask your classmates for the cards you need to complete the column.
- The questions can be, for example:

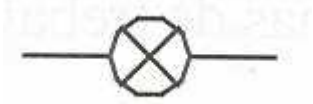
Do you have the bulb picture?
or
Do you have the bulb name?
or
Do you have the bulb symbol?

- The answers can be:

No, I don't
or
Yes, I do. Here it is!
or
Yes, I do. Take it!

- The first person who completes the column wins the game.

EXAMPLE:

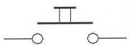
Picture	Name	Symbol
	Bulb	

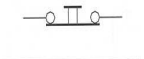
DOING EXPERIMENTS

EXPERIMENT 1	
Material: • 1 cell 1,5 V • wires • 1 buzzer • 1 push switch NO	**Picture** 

What's happened?

Underline the most suitable word in these sentences:

When the push switch is in the OFF position  the circuit is open/closed. Electricity flows/does not flow.

When the push switch is in the ON position  the circuit is open/closed. Electricity flows/does not flow.

When the push switch is in the OFF position the buzzer rings/does not ring.

When the push switch is in the ON position the buzzer rings/does not ring.

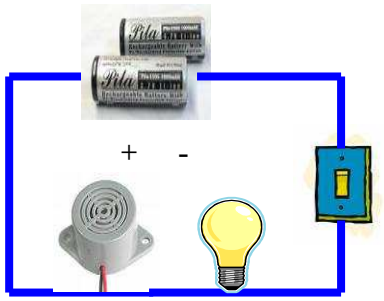
Circuit Diagram
Draw the diagram of the circuit.

EXPERIMENT 2

Material:

- 1 cell 4,5 V
- wires
- 1 buzzer
- 1 bulb 1,5 V
- 1 one-way switch

Picture



What's happened?

Complete these sentences:

When the one-way switch is in the OFF  position the buzzer _____ and the bulb _____.

When the one-way switch is in the ON position the buzzer _____ and the bulb _____.

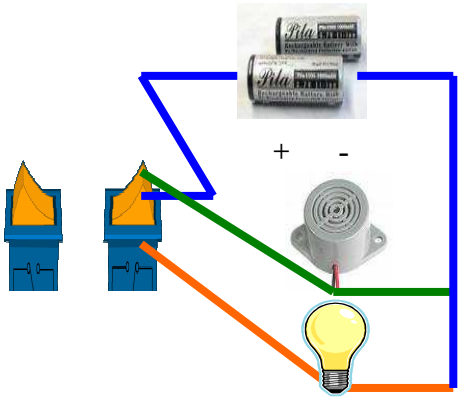
Circuit Diagram
Draw the diagram of the circuit

EXPERIMENT 3

Material:

- 1 cell 1,5 V
- wires
- 1 buzzer
- 1 bulb 1,5 V
- 1 two-way switch

Picture



What's happened?

Complete these sentences:

When the two-way switch is in the OFF position  the buzzer _____ and the bulb _____.

When the two-way switch is in the ON position the buzzer _____ and the bulb _____.

Why do you think this happens?

Because when the two-way switch is in the ____ position it is connected with _____ and is not connected with _____

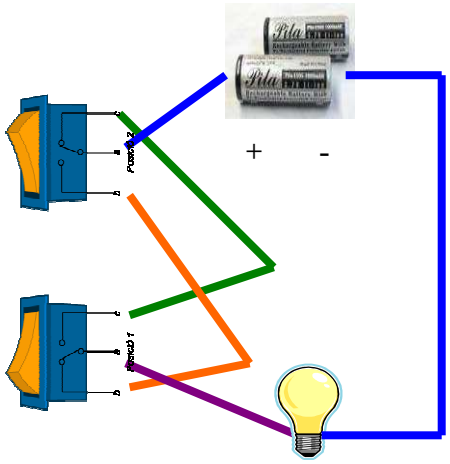
Circuit Diagram
Draw the diagram of the circuit.

EXPERIMENT 4

Material:

- 1 cell 1,5 V
- wires
- 1 bulb 1,5 V
- 2 two-way switch

Picture



What's happened?

Complete these sentences:

When both two-way switch № 1 and switch № 2 are in the OFF position  the bulb _____.

When both two-way switch № 1 and switch № 2 are in the ON position the bulb _____.

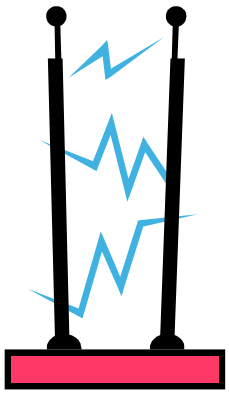
When switch № 1 is in OFF and switch № 2 is ON the bulb _____.

When switch № 1 is On and switch № 2 is OFF the bulb _____.

Circuit Diagram

Draw the diagram of the circuit.

UNIT 2: ELECTRICAL MAGNITUDES



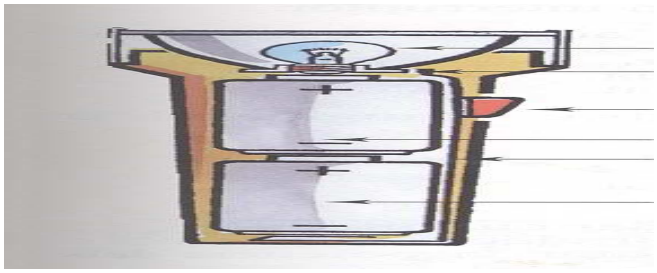
Technology

Belén Gallego

Worksheet 5: Electrical Magnitudes

Revising...

1.- What are they? Label the electric components (generator, receiver, conductor or controller) and what type it is (cell, motor,…)



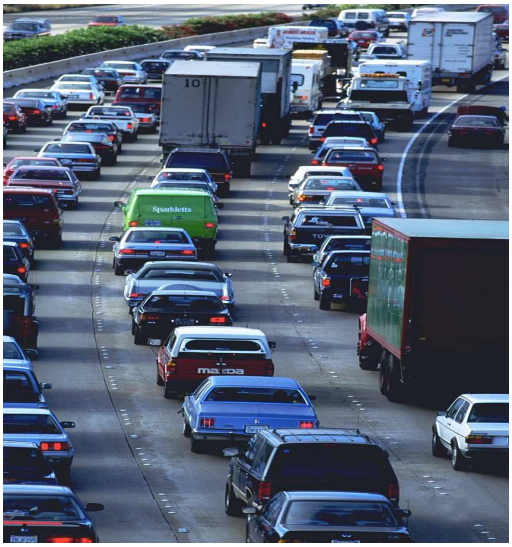
Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

Match the **electric components** with the **types** and their **function**:

Electric Component	Type	Function
generator		elements that transform electrical energy in another kind of energy that we need
receiver		transports electrons from generator to receiver and from receiver to generator
conductor		allows to open or close an electric circuit
controller		gives electrons energy to flow through a circuit

ELECTRICAL MAGNITUDES

2.- Look at these pictures:



Discuss with your partner the following questions. You can answer using:

I think that…because
In my opinion…because
From my point of view…because

- In which picture do you think cars are faster? Why do you think so?

- Where do you think more cars pass in one minute?

- Look at the picture on the left, do you think cars would go faster if the road was broader (⟷) or narrower (→ ←)?

- Now imagine an electric circuit and relate electric components to the main components of the pictures:

Cars	Generator
Engine	Wires
Roads	Electrons

- Make a similar sentence to the first one using the words in brackets:

  - The **more** powerful an engine is the **more** energy the car has.
  - The **more** powerful a _____ is the **more** energy the _____ has .(electron, generator)

  - Traffic current is the number of cars that pass on a road every second.
  - _____ current is the number of _____that pass through an electric circuit every second. (electrical, electrons)

  - The **broader** a road is the **faster** cars go.
  - The **broader** a _____is the **faster** _____ go. (electrons, wire)

- The **narrower** a road is the **slower** cars go.
- The **narrower** a _____ is the **slower** _____ go. (electrons, cable).

3.- Fill the gaps with the words given:

Voltage, Current, Resistance

- _____ is the number of electrons that pass through an electric circuit every second.
- The opposition that some materials offer to the movement of electrical current is called _____.
- _____ is the energy given to electrons to pass through a circuit.

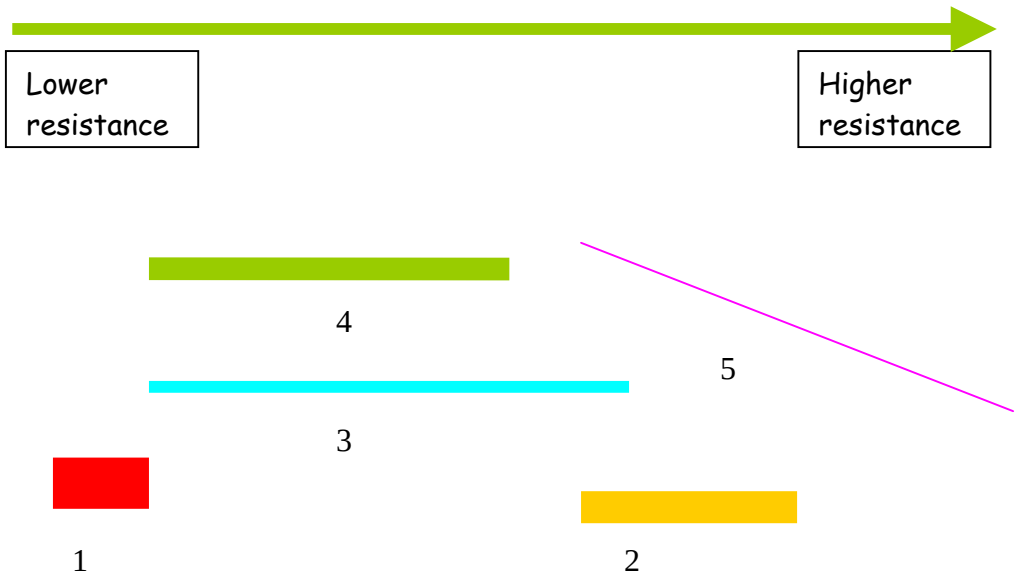
4.- Complete this chart.

Magnitude	**Unit**	**Symbol**
Voltage		
	Ampere	
		Ω

5.- Work in pairs. Underline what you think is the most suitable word:

- The **thicker** and **shorter** a wire is the more/less resistance it has.
- The **thinner** and **longer** a wire is the more/less resistance it has.

6.- Work in pairs. Put the wires in order from lower to higher:



7.- Discuss this dilemma with a classmate:

You have two wires. The first one is 1 mm wide and the second one 5 mm wide. You have a mixer that spends 15 A and a lamp that spends 3 A.

Which wire would you use in each case?

I would use the …

1 mm wide wire	with	the mixer	because this wire is	thinner	so	more	electrons can pass through it.
5 mm wide wire		the lamp		thicker		less	

Now, you have two more wires. The first one is 2,5 mm wide and the second one 4,5 mm wide. You have the same mixer and the lamp as in the example above.

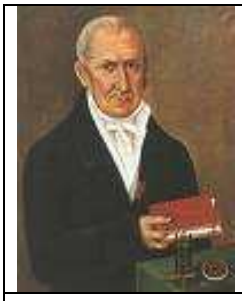
Which wire would you use in each case?

Write the sentences:

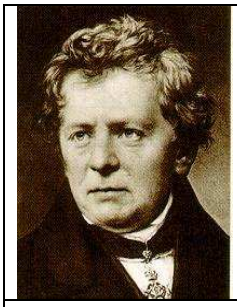
Worksheet 6: Instruments to measure

A little research...

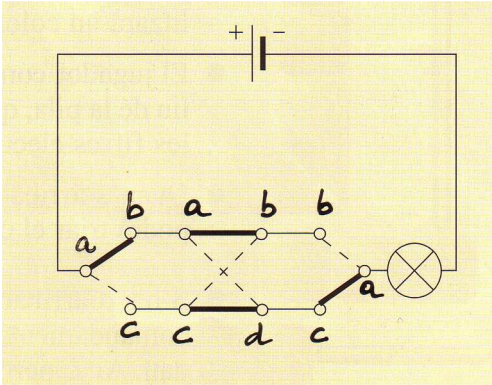
1.- Do you know who Alessandro Volta, André-Marie Ampère and George Simon Ohm were? You have some information of one of them.
Ask your classmates for the missing information. You can use the questions in the chart.

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
Alessandro Volta	Birth: 18th February of 1745 in Como Death: 5th March of 1827	Physicist and teacher	Voltage	Volt (V)

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
André-Marie Ampère				

	Where was he born? When was he born When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
George Simon Ohm				

DOING EXPERIMENTS

EXPERIMENT 1	
Material: Look at the diagram. **Identify** what components are there?. Write them down below.	**Circuit Diagram**  Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

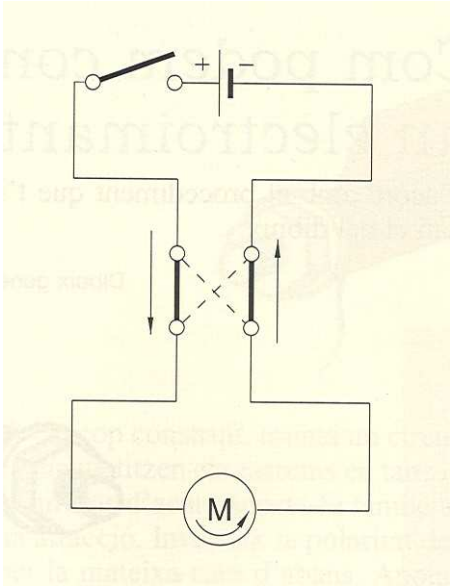
If I connect the components as shown in the diagram, the bulb _____.

If I change the position of only one of the switches, the bulb _____.

EXPERIMENT 2

Material: Look at the diagram. Identify what components there are. Write them down below.

Circuit Diagram



Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

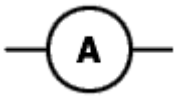
If I connect the components as shown in the diagram, the engine spins to the _____(left/right).

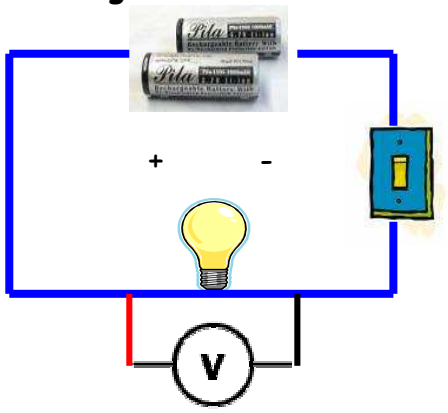
If I change the position of the switch, the engine spins to the _____ (left/right).

Why do you think this happens?

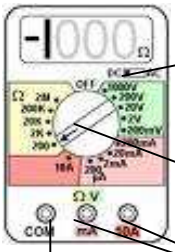
Because the engine….

INSTRUMENTS TO MEASURE ELECTRICAL MAGNITUDES

Device	Symbol	Connection
Voltmeter: it measures voltage across a component in a circuit.		In parallel
Ammeter: it measures the current flowing through a component in a circuit.		In series
Ohmmeter: it measures the resistance of a resistor.		In parallel and without voltage.
Multimeter: it measures voltage, current and resistance just as other magnitudes	It depends on the magnitude measured.	It depends on the magnitude measured.

EXPERIMENT 3	
Material: • Multimeter • 1 bulb 1,5 V • 1 cell 1,5 V • wires • 1 one-way switch	**Circuit Diagram** 

Procedure



1.- Select DC or AC
2.- Select VOLTAGE and the right scale
3.- Connect the black wire in the COM connection (as in the picture)
4.- Connect the red wire in the Ω-V connection (behind COM)
5.- Put the ON position of the multimeter
6.- Connect the wires in **parallel** as in the picture. Notice the red wire is connected in the positive side and the black one in the negative side.

Read the meter, how many volts does the multimeter show?

Is it approximately the same voltage as the cell?

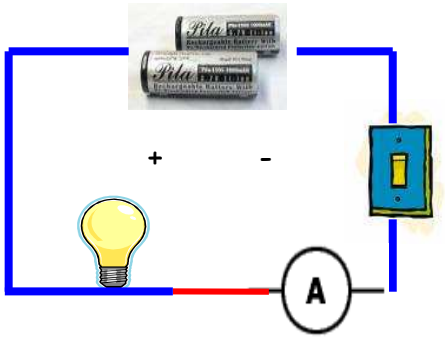
Circuit Diagram
Draw the diagram.

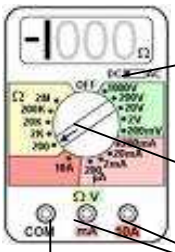
EXPERIMENT 4

Material:

- Multimeter
- 1 bulb 1,5 V
- 1 cell 1,5 V
- wires
- 1 one-way switch

Electric Circuit Diagram





To select DC or AC

To select a magnitude and scale

To connect the red wire

To connect the black wire

1.- Select DC or AC
2.- Select CURRENT and the right scale
3.- Connect the black wire in the COM connection (as in the picture)
4.- Connect the red wire in the mA or A, the most suitable
5.- Put the ON position of the multimeter
6.- Connect the wires in **series** as in the picture. Notice the red wire is connected in the positive side and the black one in the negative side.

Read the meter, how many amperes does the multimeter show?

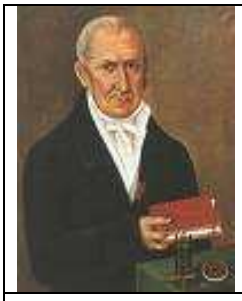
Circuit Diagram

Draw the diagram.

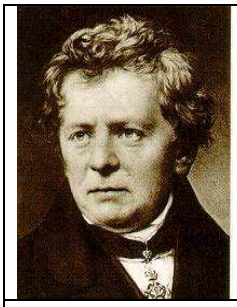
Worksheet 6: Instruments to measure

A little research...

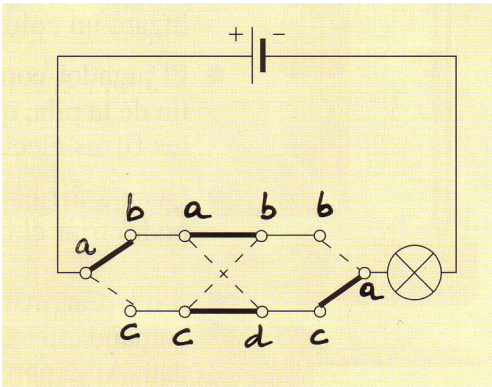
1.- Do you know who Alessandro Volta, André-Marie Ampère and George Simon Ohm were? You have some information of one of them.
Ask your classmates if they have the information you do not have. You must ask them the same questions you have in the chart.

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
Alessandro Volta				

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
André-Marie Ampère	Birth: 20th January 1775 in Lyon Death: 10th June 1836	Physicist and teacher	Current	Ampere (A)

	Where was he born? When was he born? When did he die?	Which was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
George Simon Ohm				

DOING EXPERIMENTS

EXPERIMENT 1	
Material: Look at the diagram. **Identify** what components are there?. Write them down below.	**Circuit Diagram**  Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

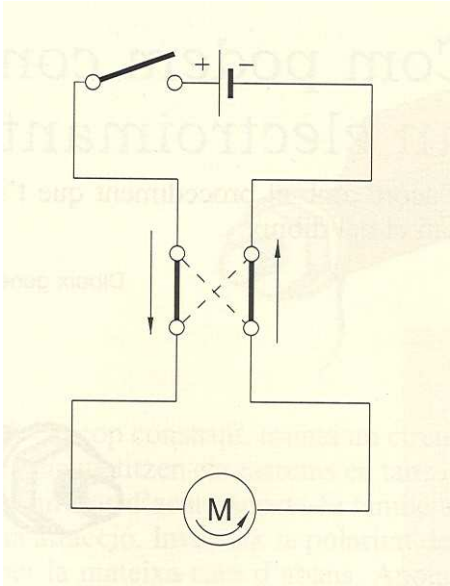
If I connect the components as shown in the diagram, the bulb _____.

If I change the position of only one of the switches, the bulb _____.

EXPERIMENT 2

Material: Look at the diagram. Identify what components there are. Write them down below.

Circuit Diagram



Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

If I connect the components as shown in the diagram, the engine spins to the _____(left/right).

If I change the position of the switch, the engine spins to the _____ (left/right).

Why do you think this happens?

Because the engine….

INSTRUMENTS TO MEASURE ELECTRICAL MAGNITUDES

Device	Symbol	Connection
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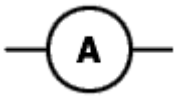
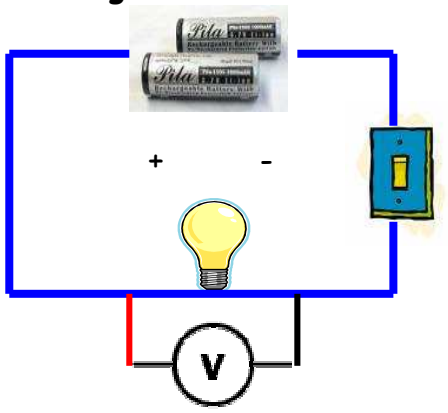
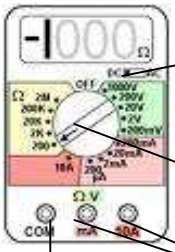
Ammeter: it measures the current flowing through a component in a circuit.		In series
Ohmmeter: it measures the resistance of a resistor.		In parallel and without voltage.
Multimeter: it measures voltage, current and resistance just as other magnitudes	It depends on the magnitude measured.	It depends on the magnitude measured.

EXPERIMENT 3	
Material: • Multimeter • 1 bulb 1,5 V • 1 cell 1,5 V • wires • 1 one-way switch	**Circuit Diagram** 

Procedure



1.- Select DC or AC
2.- Select VOLTAGE and the right scale
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Read the meter, how many volts does the multimeter show?

Is it approximately the same voltage as the cell?

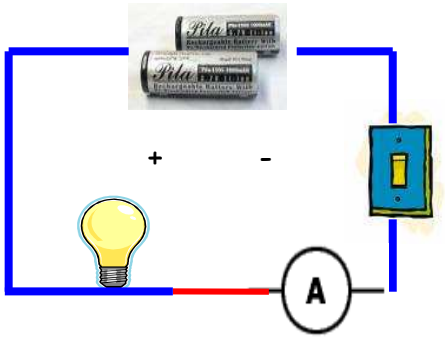
Circuit Diagram
Draw the diagram.

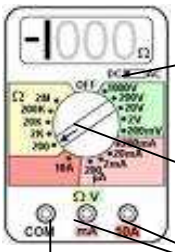
EXPERIMENT 4

Material:

- Multimeter
- 1 bulb 1,5 V
- 1 cell 1,5 V
- wires
- 1 one-way switch

Electric Circuit Diagram





To select DC or AC

To select a magnitude and scale

To connect the red wire

To connect the black wire

1.- Select DC or AC
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Read the meter, how many amperes does the multimeter show?

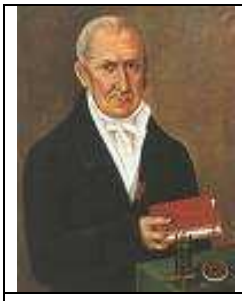
Circuit Diagram

Draw the diagram.

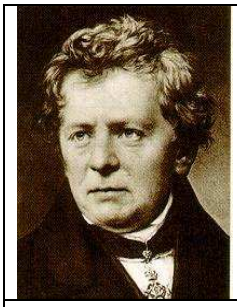
Worksheet 6: Instruments to measure

A little research...

1.- Do you know who Alessandro Volta, André-Marie Ampère and George Simon Ohm were? You have some information of one of them.
Fill in the missing information by asking your classmates. You can use the questions provided in the chart

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
Alessandro Volta				

	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
André-Marie Ampère				

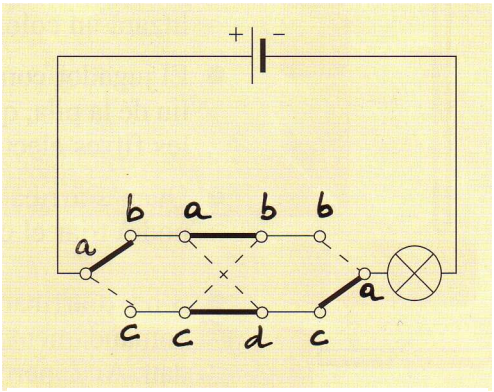
	Where was he born? When was he born? When did he die?	What was his job?	What electrical magnitude did he discover?	What electrical unit is named after his surname?
George Simon Ohm	Birth: 16th March 1789 in Erlangen Death: 6th July 1854	Teacher and Physicist	Resistance	Ohm (Ω)

DOING EXPERIMENTS

EXPERIMENT 1

Material: Look at the diagram. **Identify** what components are there?. Write them down below.

Circuit Diagram



Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

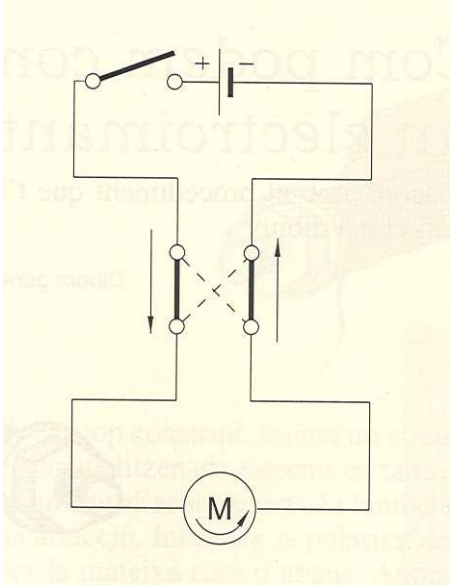
If I connect the components as shown in the diagram, the bulb _____.

If I change the position of only one of the switches, the bulb _____.

EXPERIMENT 2

Material: Look at the diagram. Identify what components there are. Write them down below.

Circuit Diagram



Espurnes, fils i bombetes. El motor elèctric. Ed McGrawhill.

What's happened?

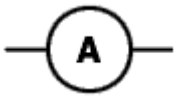
If I connect the components as shown in the diagram, the engine spins to the _____(left/right).

If I change the position of the switch, the engine spins to the _____ (left/right).

Why do you think this happens?

Because the engine….

INSTRUMENTS TO MEASURE ELECTRICAL MAGNITUDES

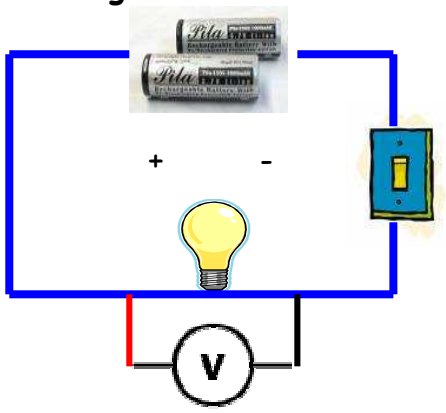
Device	Symbol	Connection
Voltmeter: it measures voltage across a component in a circuit.		In parallel
Ammeter: it measures the current flowing through a component in a circuit.		In series
Ohmmeter: it measures the resistance of a resistor.		In parallel and without voltage.
Multimeter: it measures voltage, current and resistance just as other magnitudes	It depends on the magnitude measured.	It depends on the magnitude measured.

EXPERIMENT 3

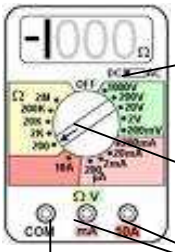
Material:

- Multimeter
- 1 bulb 1,5 V
- 1 cell 1,5 V
- wires
- 1 one-way switch

Circuit Diagram



Procedure



1.- Select DC or AC
2.- Select VOLTAGE and the right scale
3.- Connect the black wire in the COM connection (as in the picture)
4.- Connect the red wire in the Ω-V connection (behind COM)
5.- Put the ON position of the multimeter
6.- Connect the wires in **parallel** as in the picture. Notice the red wire is connected in the positive side and the black one in the negative side.

Read the meter, how many volts does the multimeter show?

Is it approximately the same voltage as the cell?

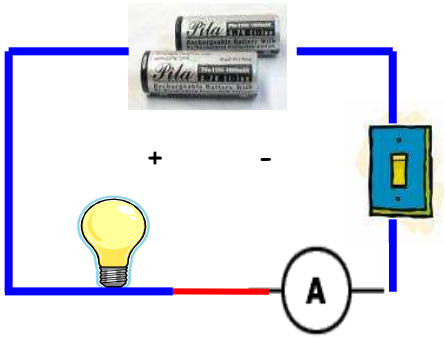
Circuit Diagram
Draw the diagram.

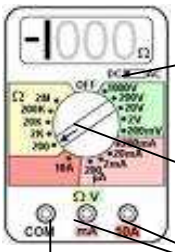
EXPERIMENT 4

Material:

- Multimeter
- 1 bulb 1,5 V
- 1 cell 1,5 V
- wires
- 1 one-way switch

Electric Circuit Diagram





To select DC or AC

To select a magnitude and scale

To connect the red wire

To connect the black wire

1.- Select DC or AC
2.- Select CURRENT and the right scale
3.- Connect the black wire in the COM connection (as in the picture)
4.- Connect the red wire in the mA or A, the most suitable
5.- Put the ON position of the multimeter
6.- Connect the wires in **series** as in the picture. Notice the red wire is connected in the positive side and the black one in the negative side.

Read the meter, how many amperes does the multimeter show?

Circuit Diagram

Draw the diagram.

Worksheet 7: Ohm's Law

Ohm's Law

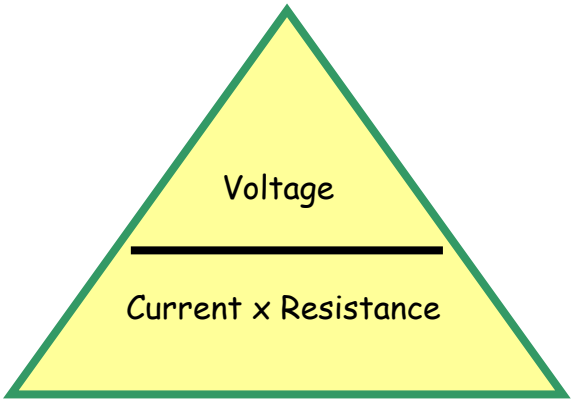
In an electric circuit VOLTAGE, CURRENT and RESISTANCE are closely related with each other.

This relationship is known as OHM'S LAW:

Voltage = Current x Resistance

You need a new lamp for your bicycle so you buy one. The filament of the bulb has a 4 Ω resistance and it takes a current of 0,8 A. The shop assistant did not give you a battery so now you must buy one. What voltage should the battery have?

Solve this problem with the help of this triangle.



Resistance = 4 Ω

Current = 0,8 A

Voltage = ?

(Cover with your finger the magnitude you are looking for. Operation: multiplication)

V = 0,8 A x 4 Ω V = 3,2 volts (V)

Answer **you must buy a 3,2 v battery.**

Some Exercises

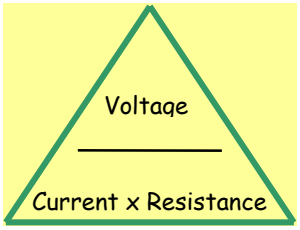
1.- What operation must you do in every case?

If I do not know……

- the current I must_____ (multiply / divide) _____ (voltage /current /resistance) by _____ (voltage / current / resistance)
- the voltage I must _____ (multiply / divide) _____ (voltage /current /resistance) by _____ (voltage / current / resistance)
- the resistance I must _____ (multiply / divide) _____ (voltage /current /resistance) by _____ (voltage / current / resistance)

Now practise this new concept:

2.- The circuit of a little torch  has 3 Ω of resistance. It has a 4,5 v battery. What is the current through the circuit?



Voltage =

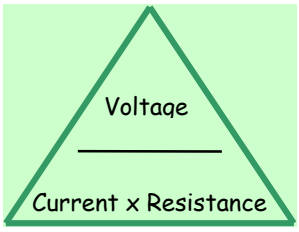
Resistance =

Current =

Operations:

Answer =

3.- A friend of yours has given you a lamp  that has 625 Ω and the current flowing through it is 0,2 A. What is the voltage?



Voltage =

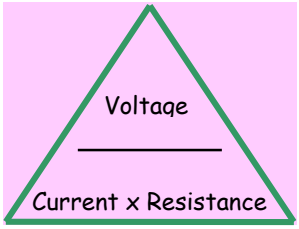
Resistance =

Current =

Operations:

Answer =

4.- Your stereo player  needs **four** 4,5 v batteries to work and it takes a current of 2 A . What is the resistance of the circuit?



Voltage =

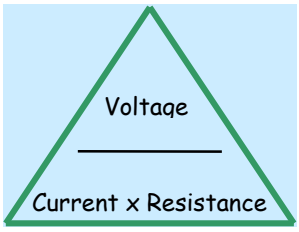
Resistance =

Current =

Operations:

Answer =

5.- The battery of your mobile  is 3,7 v and has a 5 Ω resistance. What is the current through the battery if the switch is open?



Voltage =

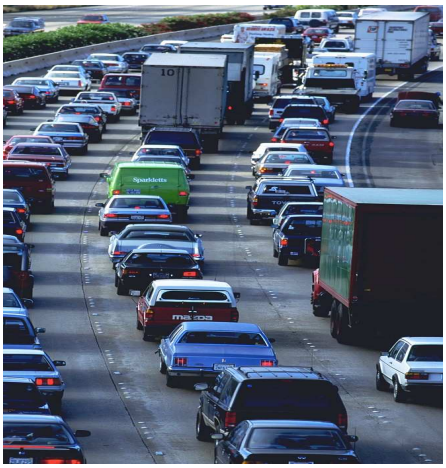
Resistance =

Current =

Operations:

Answer =

6.- Do you remember this picture? Work in pairs and answer the questions below.



- How can you **increase** the **current** (number of cars per minute) **without** modifying the engine of the cars? Choose the most suitable answer:

  - making the road broader
  - making the road narrower

So, in the case of an electric circuit we must:

- use a _____(thicker/thinner) wire.
- _____(increase/decrease) the resistance.

- How can you **decrease** the **current** without modifying the engine of the cars? Choose the most suitable answer:

  - making the road broader
  - making the road narrower

  So, in the case of an electric circuit we must:

  - use a _____(thicker/thinner) wire.
  - _____(increase/decrease) the resistance.

- How can you **increase** the **current** without modifying the size of the road?

  - making an engine that gives more energy
  - making an engine that gives less energy

  So, in the case of an electric circuit we must:

  - use a generator with _____(higher/lower) voltage
  - _____(increase/decrease) the voltage.

- How can you **decrease** the **current** without modifying size of the road?
  - making an engine that gives more energy
  - making an engine that gives less energy

  So, in the case of an electric circuit we must:

  - use a generator with _____(higher/lower) voltage
  - _____(increase/decrease) the voltage.

Write 4 conclusions:

To	increase	the current without modifying	the voltage	we must	increase	the voltage
	decrease		the resistance		decrease	the resistance

Worksheet 8: Introduction to series & parallel circuits Game...

1.- GAME: Instructions:

- The teacher will give one of your classmates a piece of paper where a name of something related to electricity is written.
- The rest of the students will guess what it is
- You must ask questions until somebody makes the right guess

QUESTIONS you can use:

1st questions: Is it an electric component? Is it an electrical magnitude? Is it an electrical magnitude's unit? Is it an electrical measuring device?
2nd questions: **For electric components:** Does it give electrons energy? Is it an element that transforms electrical energy into another one? Does it transport electrons? Does it allow to complete or to break a circuit? **For electrical magnitudes:** Is it the energy given to electrons to pass through a circuit? Is it the number of electrons every second? Is it the opposition to the passing of electrons? **For electrical magnitude's units:** Is it the unit of voltage? Is it the unit of current? Is it the unit of resistance? **For electrical measure devices:** Does it measure voltage? Does it measure current? Does it measure resistance? Does it measure all magnitudes?

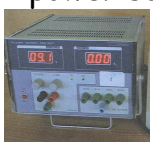
DOING EXPERIMENTS

EXPERIMENT 1

FIRST PART

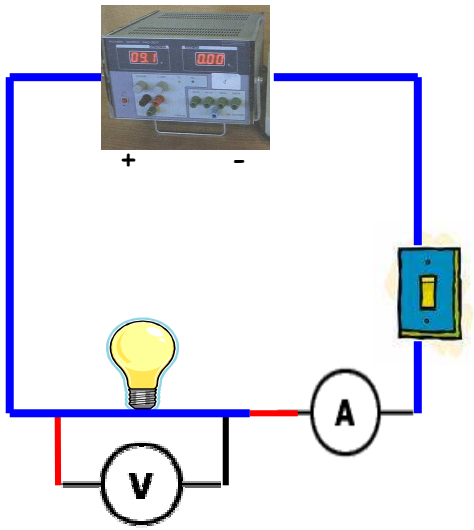
Material:

- 1 power source



- 2 multimeters
- 1 bulb 6V
- 1 one-way switch
- wires

Picture



Instructions:

- Adjust the power source to 6V
- Put the multimeter 1 in the voltage position as shown in the picture
- Select DC
- Select 20 V in the scale
- Put the multimeter 2 in the current position as shown in the picture
- Select DC
- Select 20 A in the scale

Questions:

Volts multimeter 1	Volts power source	Amperes multimeter 2

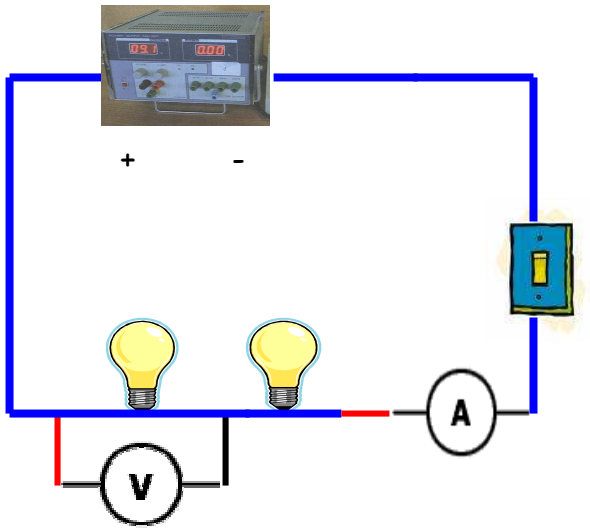
Circuit Diagram

SECOND PART

Material:

- All components of the first part
- 1 bulb 6 V more

Picture



Instructions:

- Adjust the power source to 12V
- Put the multimeter 1 in the voltage position as shown the picture
- Select DC
- Select 20 V in the scale
- Put the multimeter 2 in the current position as shown the picture
- Select DC
- Select 20 A in the scale

Questions:

Volts multimeter 1 for every bulb	Volts power source	Amperes multimeter 2
Bulb 1: Bulb 2:		

- Is the mark of the multimeter 1 the double (x 2) or half (: 2) of the mark of the power source?

- What happens when you adjust the power source to 6V? Underline the most suitable option:

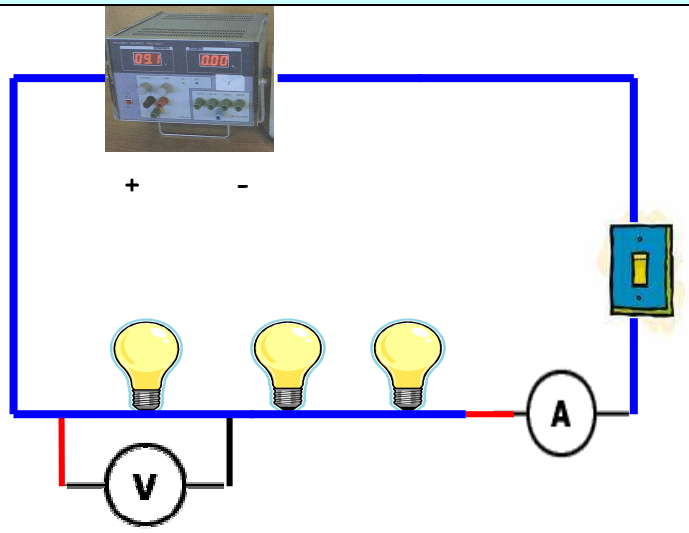
Bulbs have more/less light

Circuit Diagram

THIRD PART

Material:

- All components of the second part
- 1 bulb 6 V more



Instructions:

- Adjust the power source at 18V
- Put the multimeter 1 in the voltage position as shown the picture
- Select DC
- Select 20 V in the scale
- Put the multimeter 2 in the current position as shown the picture
- Select DC
- Select 20 A in the scale

Questions:

Volts multimeter 1 for every bulb	Volts power source	Amperes multimeter 2
Bulb 1: Bulb 2: Bulb 3:		

- Is the mark of the multimeter 1 triple (x 3) or the third part (: 3) of the mark of the power source?

- What happens when you unscrew one of the bulbs?

  - All bulbs do not light up
  - All bulbs light up

  - Multimeter 2 marks 0,25 A
  - Multimeter 2 marks 0 A

Circuit Diagram

EXPERIMENT 2

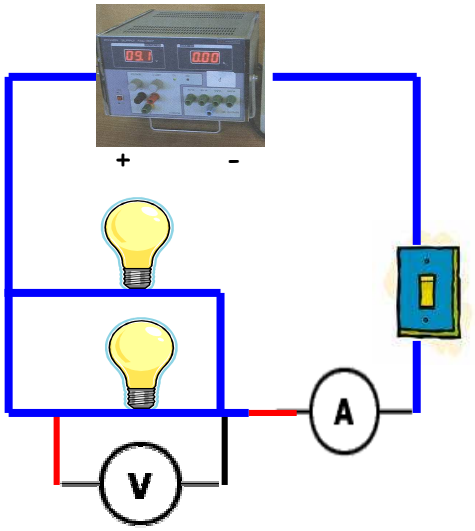
FIRST PART

Material:

- 1 power source

- 2 multimeters
- 2 bulb 6V
- 1 one-way switch
- wires

Picture



Instructions:

- Adjust the power source at 6V
- Put the multimeter 1 in the voltage position as shown the picture
- Select DC
- Select 20 V in the scale
- Put the multimeter 2 in the current position as shown the picture
- Select DC
- Select 20 A in the scale

Questions:

Volts multimeter 1 for every bulb	Volts power source	Amperes multimeter 2
Bulb 1: Bulb 2:		

- Is the voltage of both bulbs the same as the power source voltage?

- The current of every bulb is 0,25 A, as in experiment 1. Is the mark of multimeter 2 double or half?

- What happens if you unscrew a bulb?

  - the other ones light up
  - the other ones do not light up

- How many amperes does multimeter 2 mark?

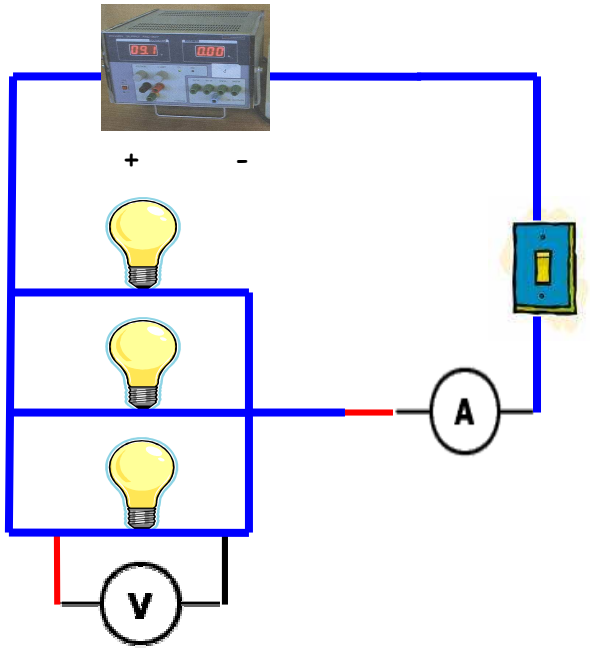
Circuit Diagram

SECOND PART

Material:

- All components of the first part
- 1 bulb 6 V more

Picture



Instructions:

- Adjust the power source to 12V
- Put the multimeter 1 in the voltage position as shown the picture
- Select DC
- Select 20 V in the scale
- Put the multimeter 2 in the current position as shown the picture
- Select DC
- Select 20 A in the scale

Questions:

Volts multimeter 1 for every bulb	Volts power source	Amperes multimeter 2
Bulb 1: Bulb 2: Bulb 3:		

- Is the voltage of both bulbs the same as the power source voltage?

- How many amperes does the multimeter 2 mark?

- Is it triple or the third part?

- What happens if you unscrew one bulb?

- How many amperes does the multimeter 2 mark?

  - 0,25 A
  - 0,5 A
  - 0,75 A
  -

- What happens if you unscrew two bulbs?

- How many amperes does the multimeter 2 mark?

  - 0,25 A
  - 0,5 A
  - 0,75 A

Circuit Diagram

Worksheet 9: Series & Parallel circuits

CONNECTIONS OF CIRCUITS

When you connect bulbs this way

you produce a **SERIES CIRCUIT**

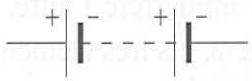
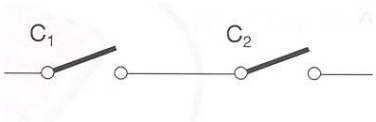
Characteristics
Remember the experiments you did in the workshop. Work in groups. Choose the most suitable option: - The current through a receiver is the same in every one - The current through a receiver is half, a third ,…of the voltage of every receiver - - The voltage crossing every receiver is the same as the voltage at the power source - The voltage crossing every receiver is half, a third ,…of the voltage of every receiver - If a bulb is disconnected the other ones do not light up - If a bulb is disconnected the other ones light up

- The total voltage of the circuit is the sum (+) of the voltage crossing every receiver
- The total voltage of the circuit is the same as the voltage crossing every receiver

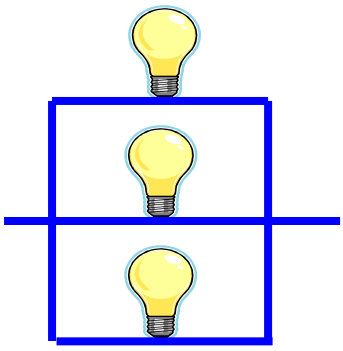
- The total current of the circuit is the sum of the current through every receiver
- The total current of the circuit is the same as the current through every receiver

Write correct sentences:

More things….

BATTERIES	CONTROLLERS
	
The total voltage is the SUM of voltage of every cell. It is useful if we want to increase the TOTAL voltage of a circuit.	A circuit is complete when ALL controllers are in the ON position.

When you connect bulbs this way



you produce a PARALLEL CIRCUIT

Characteristics

Remember the experiments you did in the workshop.

Work in groups. Choose the most suitable option:

- The current through a receiver is the same in every one
- The current through a receiver is half, a third ,…of the voltage of every receiver

- The voltage crossing every receiver is the same as the voltage at the power source
- The voltage crossing every receiver is half, a third ,…of the voltage of every receiver

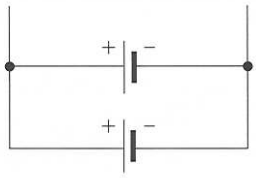
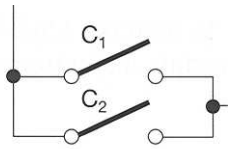
- If a bulb is disconnected the other ones do not light up
- If a bulb is disconnected the other ones light up

- The total voltage of the circuit is the sum (+) of the voltage crossing every receiver
- The total voltage of the circuit is the same as the voltage crossing every receiver

- The total current of the circuit is the sum of the current through every receiver
- The total current of the circuit is the same as the current through every receiver

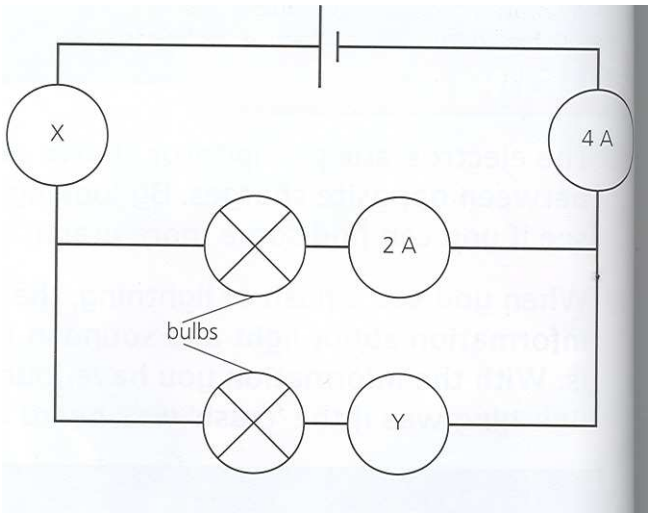
Write correct sentences:

More things...

BATTERIES	CONTROLLERS
	
The total voltage is the SAME as voltage of every battery. It is useful if we want to increase the DURATION of the batteries.	A circuit is complete when at least ONE controller is in ON position.

Some Exercises

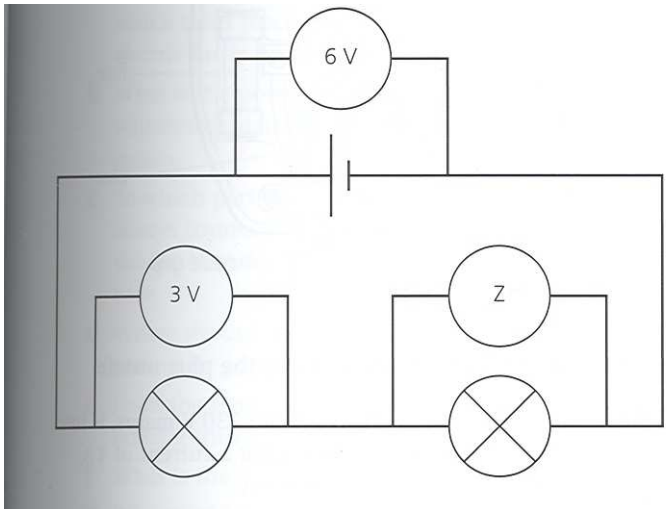
1.- Look at the diagram:



Target Science *Physics Foundation Tier*. Ed Oxford

- How are the bulbs connected to the cell?
- How many amperes does the ammeter X mark?
- How many amperes does the ammeter Y mark?

2.- Look at the diagram:



Target Science *Physics Foundation Tier*. Ed Oxford

- How are the bulbs connected to the cell?

- How many volts does voltmeter Z mark?

3.-. You have three 10 V bulbs connected to each other in series. Draw an electric diagram circuit

- What will happen if a bulb is blown  ?

  Other bulbs….

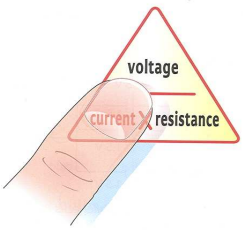
- Why?

  Because the circuit is open/closed.

4.- We want to connect 40 6 V bulbs to light up a Christmas tree  . The resistance of every bulb is 24 Ω.

	Series	**Parallel**
Voltage		
Current		
Resistance		

Do the operations below:



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5.- We have a plug that is connected a to a 220 V and two 110 V bulbs. How must we connect it to make it work?

Why?

Because in a _____(series/parallel) circuit the total voltage is _____(the sum/the same as) the voltage crossing all receivers.

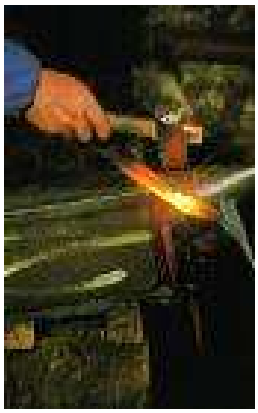
UNIT 3: DOMESTIC ELECTRICITY

Belén Gallego

Worksheet 10: Joule Effect, Short Circuit & Fuses

JOULE EFFECT

Look at these pictures.



- Is the iron cold or hot?

- Is the filament of the bulb cold or hot?

- Does this happen when the bulb is lit up or when the bulb isn't lit up?

- When an electric device has been working for a long time, is it cold or hot?

That is because electrons pass through an electric circuit

1.- Put a ☑ in the most suitable answer:

This TV  will be …	**Hotter**	**Colder**
…if it is connected to a **high current**		
…if it is connected to a **low current**		
…if its wires have **high resistance**		
…if its wires have **low resistance**		
…if it has been working for a **long time**		
…if it has been working for a **short time**		

Write sentences to summarize the chart above:

This TV will be hotter…

This TV will be colder…

That is called JOULE EFFECT

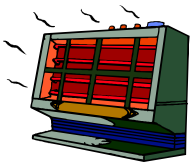
it depends on the square of current, resistance and time working.

2.- Choose what electric devices are based on in Joule effect.

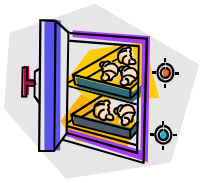
Iron

Tap

Toilet



Fan



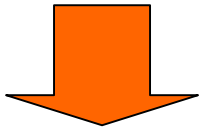
Oven

3.-Classify the devices based on Joules effect according to the kind of energy they produce:

Heat Energy	Light Energy

DANGER ELECTRICITY

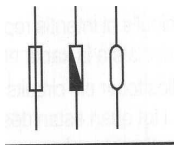
- ***A SHORT CIRCUIT***: is an electric circuit accident. When current increases too much, heat increases, too. It can damage the circuit and the circuit can catch fire.



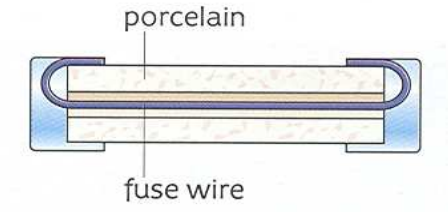
- ***FUSE*** 

It is a thin piece of wire that is not made of copper.

It is made of a material that melts easily with heat (like chocolate under the sun) ).

Its symbols are 

Parts of a fuse:



The **current** that a fuse need to blow is **written on the top**.

If an electric toaster  takes current of 4 A it needs a 5 A fuse.

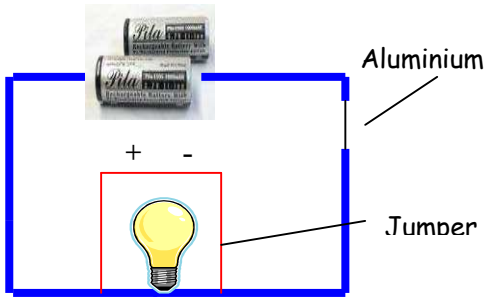
DOING EXPERIMENTS

EXPERIMENT 1

Material:

- 1 cell 1,5 V
- wires
- 1 bulb 1,5 V
- 1 fuse
- aluminium wire
- a piece of wood or something to protect the table

Picture



Instructions

- Build the circuit as in the picture but without the jumper
- Connect the jumper in both extremes of the bulb

Questions

What's happened to the bulb?

What's happened to the aluminium wire?

The aluminium wire has melted/stays the same

You have produced a **SHORT CIRCUIT**!

Why? Underline the most suitable word:

1.- Resistance in the jumper circuit is very **low/high**
2.- Voltage in the jumper circuit is **the same as/different** from the bulb circuit
3.- Current in the jumper circuit is very **high/low**
4.- Wires **do/do not** overheat because of Joules effect
5.- Electrons **have/have not** passed through the jumper circuit
6.- The aluminium's wire has **melted/stays the same**

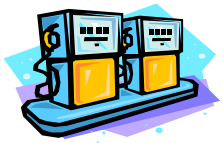
Write down the correct sentences: Now, replace the aluminium wire for the fuse. See what happens. Is it the same result?
Circuit Diagram Draw the diagram of the circuit with the fuse.

Worksheet 11: Electrical Power

Electrical Power

Look at these pictures.

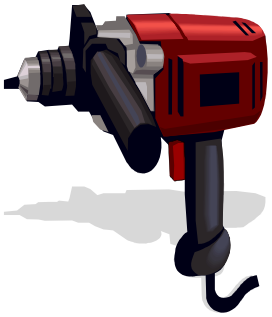
- Which motorbike do you think is faster?

- Why is it? Is it because of the fuel  type, because of the wheels  or because of the engine  ?

- Which engine do you think is more powerful?

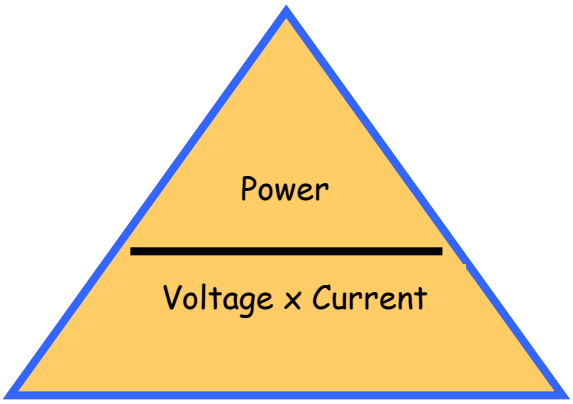
The POWER of an electric device depends on the VOLTAGE and the CURRENT of its circuits. Its unit is called Watt and the symbol is **W**.

Power = Voltage x Current



This drill has a power of 460 W. You plug it in 230 V voltage. What current does it take?

Solve this problem with the help of this triangle.



Power = 460 W

Voltage = 230 V

Current = ?

(Cover with your finger the magnitude you are looking for. Operation: division)

C = 460 W : 230 V C = 2 amperes (A)

Answer **it takes 2 amperes.**

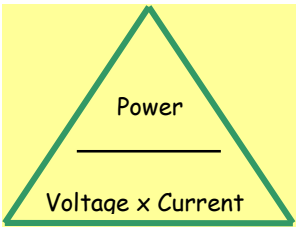
1.- What operation must you do in every case?

If I do not know……

- the current I must_____ (multiply / divide) _____ (power/voltage/current) by _____ (power/voltage/current)
- the voltage I must _____ (multiply / divide) _____ (power/voltage/current) by _____ (power/voltage/current)

- the resistance I must _____ (multiply / divide) _____ (power/voltage/current) by _____ (power/voltage/current)

2.- A kettle  has a power of 2300 W. If the voltage is 230 V, what current does it take?



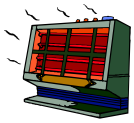
Power =

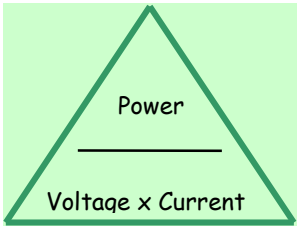
Voltage =

Current =

Operations:

Answer =

3.- A heater  is connected to 220 V of voltage. There is 5 A of current flowing through the circuit. What power does the heater have?



Power =

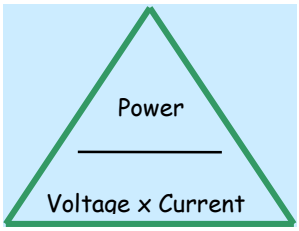
Voltage =

Current =

Operations:

Answer =

4.- A refrigerator has a power of 240 W. There is 2 A of current flowing through the circuit. What is the voltage?



Power =

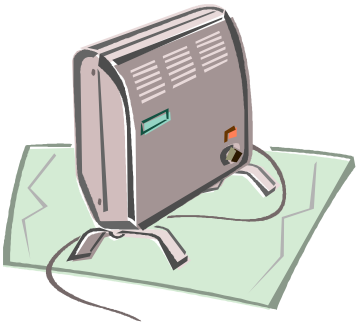
Voltage =

Current =

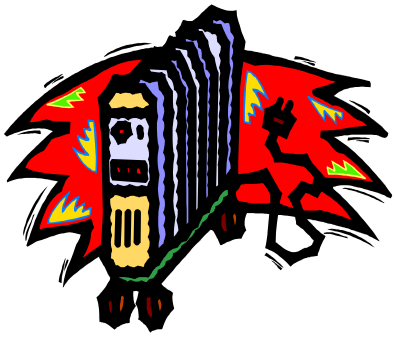
Operations:

Answer =

5.- Which of these two heaters do you think heats ( )more?



1000 W

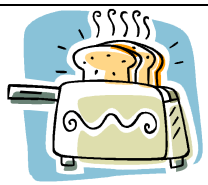
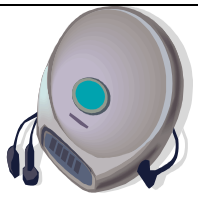
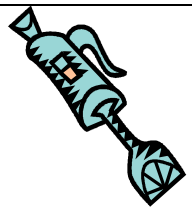


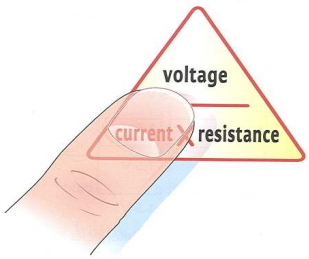
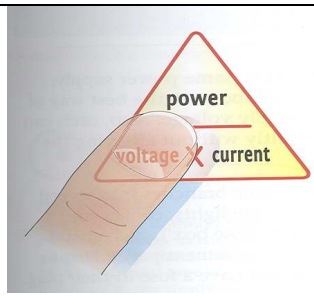
1500 W

Why do you think so?

Because the heater _____(on the left/on the right) has_____.

6.- Complete the chart below:

				
C (A)		0,08	4	5
V (V)	125	125		
R (Ω)				20
P (W)	1000		920	

Be careful! Remember!	
	
Target Science *Physics Foundation Tier*. Ed Oxford	Target Science *Physics Foundation Tier*. Ed Oxford

Make the mathematical operations here: