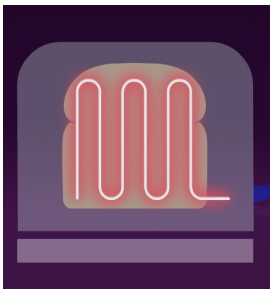
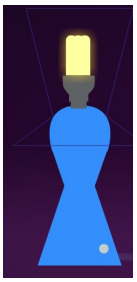
EFFECTS OF ELECTRICITY

HEAT



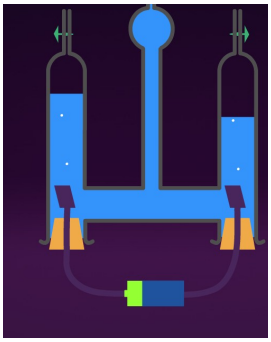
LIGHT



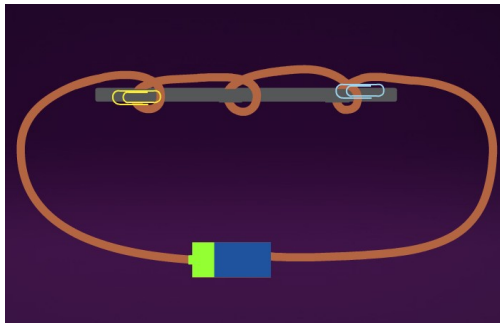
SOUND

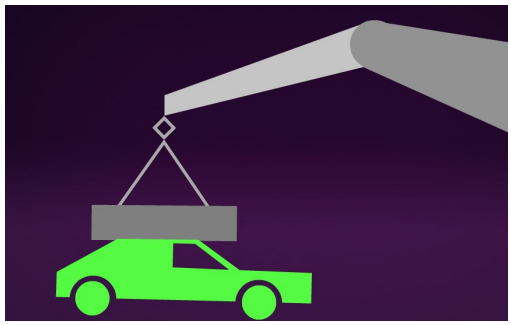
MOTION

ELECTROLISYS



ELECTROMAGNET



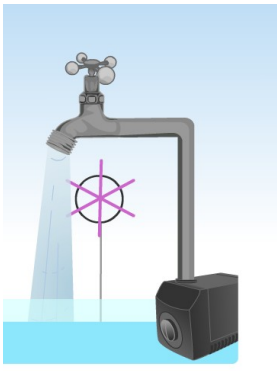


....

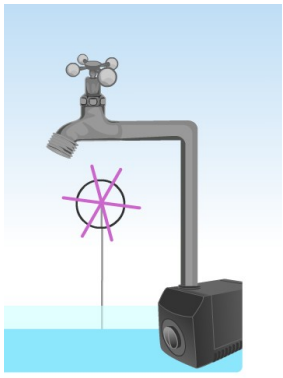
WATER CURRENT AND ELECTRIC CURRENT

Both, the water and electric current follow a path or circuit

Water Circuit: The pump pushes the water up the pipe. It flows out of the pipe onto the water wheel making the wheel spin
The water comes back into the pump and goes around again in a circle.
If you turn the faucet off then you break the circuit



Faucet open



Faucet close

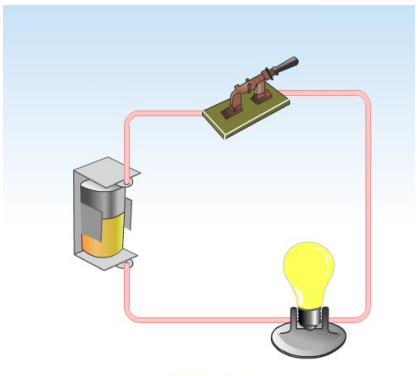
Electric Circuit:

An electric current is a flow of an electric charge. The battery supplies energy to move the charge throught the circuit to the light bulb.
The wire in this circuit is a conductor. A conductor is a material that electricity flows through easily. Metals are good conductors.
When electricity completes the path back to the battery. It completes the circuit and makes the light turns on

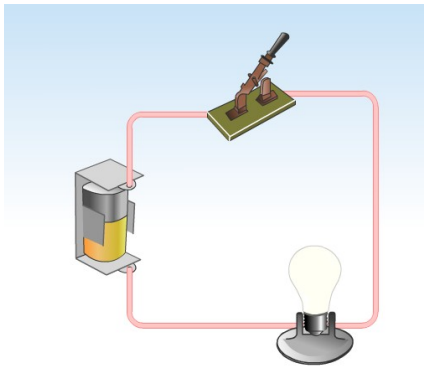
When the switch is off, there is a break between the wires and the circuit is broken (opened). No current can flow and the light turns off.

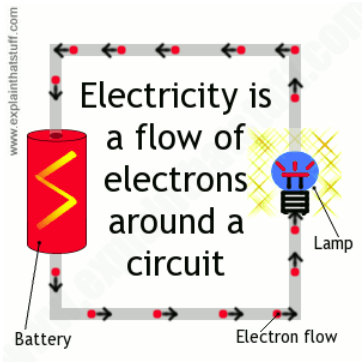
Then

Switch on



Switch off





Complete circuit **Incomplete circuit (with a gap)**

A complete Electrical Circuit is required in order to make electricity practical. Electrons must flow from and return to the power source.

For water analogy:

Water = Charge
Pressure = Voltage
Flow = Current

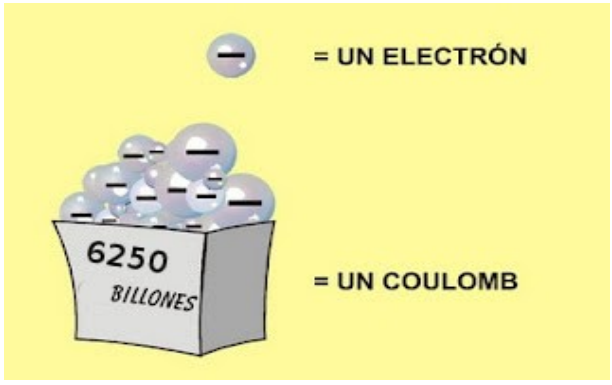
VOLTAGE

The pressure at the end of the hose can represent voltage. The water in the tank represents charge. The more water in the tank, the higher the charge, the more pressure is measured at the end of the hose.

We can think of this tank as a battery, a place where we store a certain amount of energy and then release it. If we drain our tank a certain amount, the pressure created at the end of the hose goes down. We can think of this as decreasing voltage, like when a flashlight gets dimmer as the batteries run down. There is also a decrease in the amount of water that will flow through the hose. Less pressure means less water is flowing, which brings us to current.

CURRENT

We can think of the amount of water flowing through the hose from the tank as current. The higher the pressure, the higher the flow, and viceversa. With water, we would measure the volume of the water flowing through the hose over a certain period of time. With electricity, we measure the amount of charge flowing through the circuit over a period of time. Current is measured in Amperes (usually just referred to as “Amps”). An ampere is defined as



6.241*1018electrons (1 Coulomb) per second passing through a point in a circuit. Amps are represented in equations by the letter “I”.

RESISTANCE

Consider again our two water tanks, one with a narrow pipe and one with a wide pipe.

It stands to reason that we can’t fit as much volume through a narrow pipe than a wider one at the same pressure. This is resistance. The narrow pipe “resists” the flow of water through it even though the water is at the same pressure as the tank with the wider pipe.

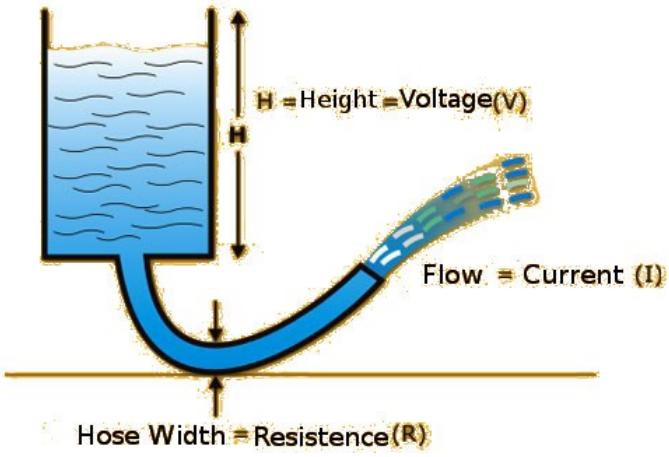
OHM`S LAW

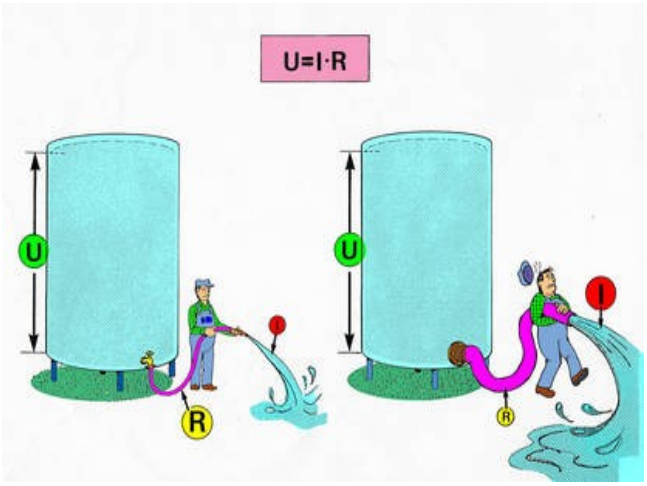
Combining the elements of voltage, current, and resistance,

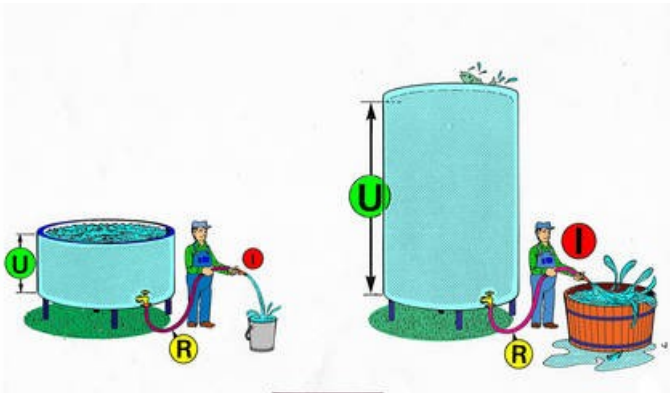
Ohm developed the formula:

Where

V = Voltage in volts
I = Current in amps
R = Resistance in ohms







I = U/R

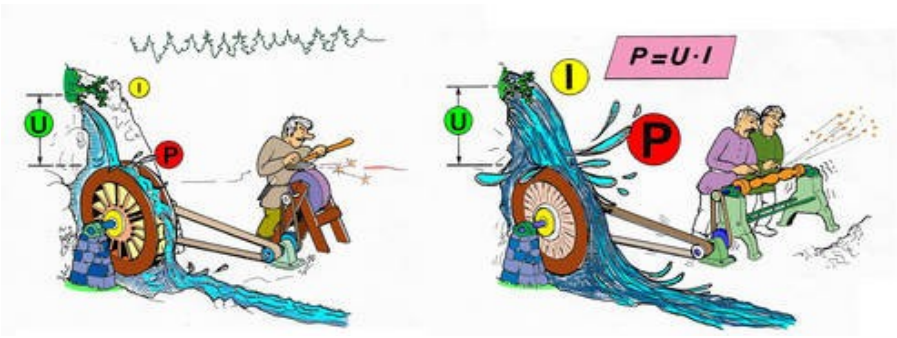
Example 1. If Voltage is 200V and resistance is 20Ω, calculate current

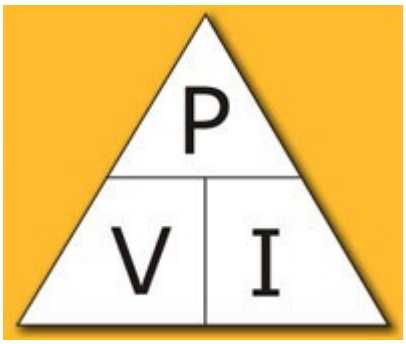
$$I = \frac{V}{R} = \frac{200V}{20\Omega} = 10A$$

Example 2. If Voltage is 6V and current 0,2A, calculate resistance

$$R = \frac{V}{I} = \frac{6V}{0{,}2A} = 30\Omega$$

POWER





Example 3. If V= 230V and I= 200mA then the power is:
P = V I = 230 V 0,2 A = 46 W

Example 4. If the current is 150mA and the power is 0,9W, calculate Voltage

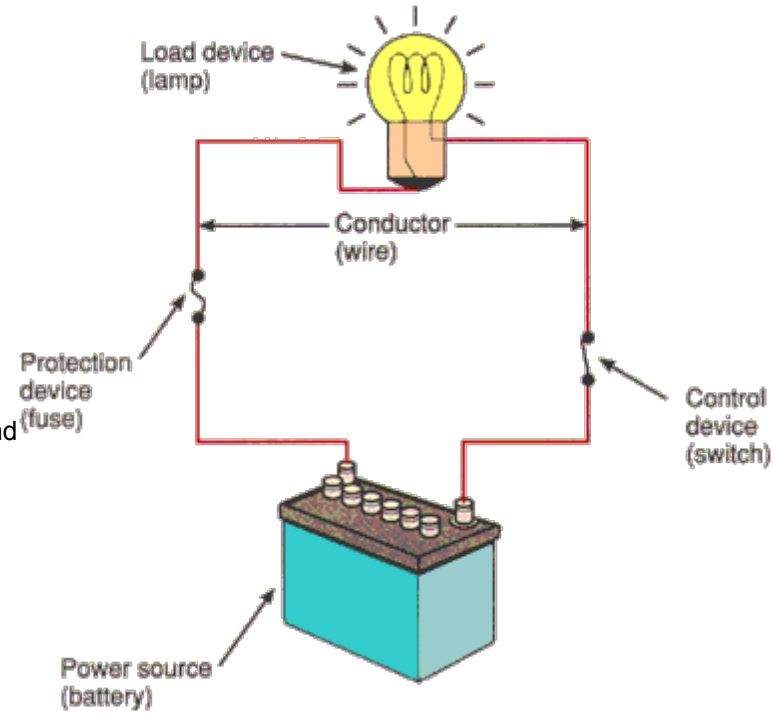
$$V = \frac{P}{V} = \frac{0{,}9\,W}{0{,}15\,A} = 6\text{V}$$

Example 5. If the power is 900W and the voltage is 230V, calculate the current

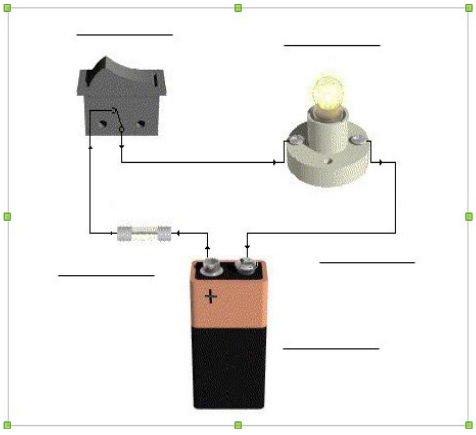
$$I = \frac{P}{V} = \frac{900\,W}{230\,V} = 3{,}9\,A$$

All the circuits require the same <u>BASIC COMPONENTS:</u>

1. **Power Source** is needed to supply the flow of electrons (electricity).-→ Battery, Alternator, Generator, etc
2. **Protection Device** prevents damage to the circuit in the event of a short. → Fuse, Fusible link or Circuit Breaker
3. **Load Device** converts the electricity into work.→ Lamp, Motor, Resistor, Buzzer, ...
4. **Control Device** allows the user control to turn the circuit on or off → Switch, Relay or Transistor
5. **Conductors** provide an electrical path to and from the power source. → wires



Exercise: Identify the type of components in the circuit below

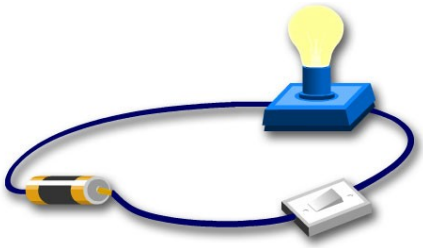


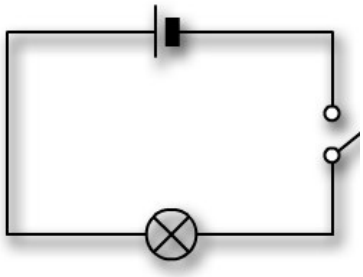
CIRCUIT DIAGRAMS

We don't draw circuit diagrams with colourful pictures of bulbs and buzzers because not everyone can draw well and so, it would start to get difficult working out what's what. Instead, we draw circuit diagrams.

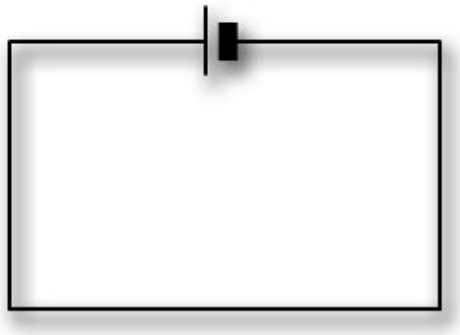
Circuit diagrams use symbols to represent the components in a circuit.

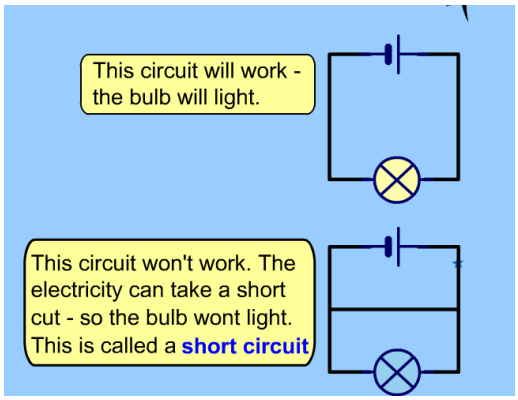
So, instead of drawing a circuit for a torch like this …we draw a circuit diagram like this:





Short circuits





A short circuit happens when electric current can flow round a circuit from one terminal of the battery to the other without passing through any components. In a short circuit, the wire heats up and the battery will go flat.

SERIES AND PARALLEL CIRCUITS

There are two types of circuit we can make, called **series** and **parallel**. (OR a mixed one called COMBINED)

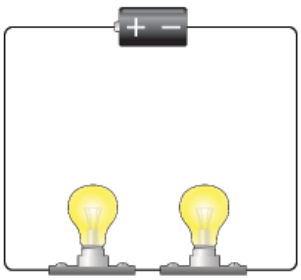
Series circuits

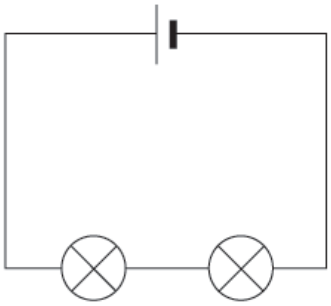
In a television series, you get several episodes, one after the other. A series circuit is similar. You get several components one after the other.

If you follow the circuit diagram from one side of the cell to the other, you should pass through all the different components, one after the other, **without any branches.**

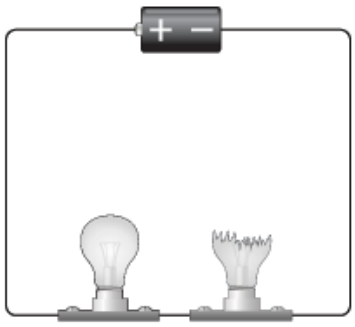
If you put more lamps into a series circuit, the lamps will be dimmer than before.

In a series circuit, if a lamp breaks or a component is disconnected, the circuit is broken and all the components stop working.





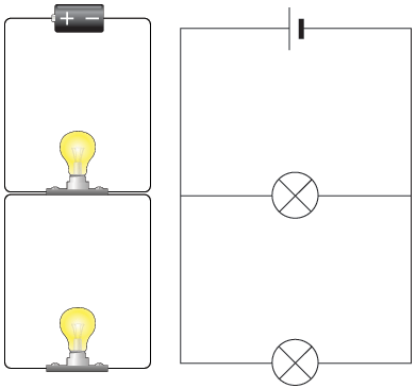
Series circuits are useful if you want a warning that one of the components in the circuit has failed. They also use less wiring than parallel circuits.

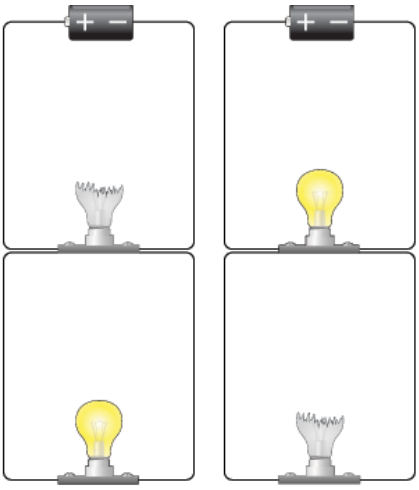


Parallel circuits

In parallel circuits different components are connected on different branches of the wire. If you follow the circuit diagram from one side of the cell to the other, you can only pass through all the different components if you follow all the **branches**.

In a parallel circuit, if a lamp breaks or a component is disconnected from one parallel wire, the components on different branches **keep working**. And, unlike a series circuit, the lamps stay bright if you add more lamps in parallel.



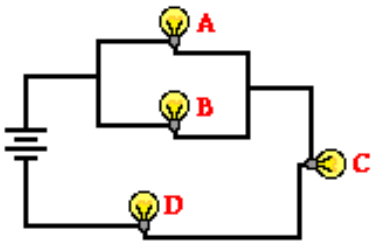


Parallel circuits are useful if you want everything to work, even if one component has failed. This is why our homes are wired up with parallel circuits.

Combined circuits

Nor series nor parallel

Example: ---->



MEASURING AMPS AND VOLTS

You need to know how to measure current and voltage.

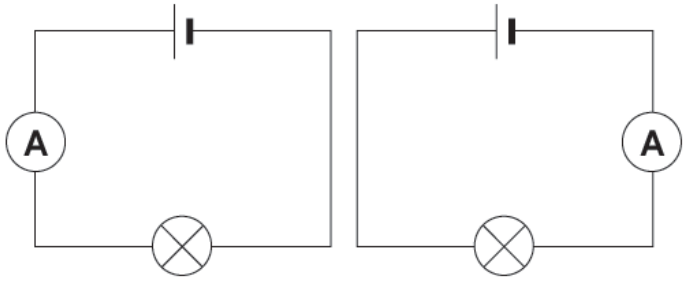
Current

Current is a measure of how much **electric charge** flows through a circuit. The more charge that flows, the bigger the current.

Current is measured in units called **amps**. The symbol for amps is **A**. For example, 20A is a bigger current than 5A.

Measuring current

A device called an ammeter is used to measure current. Some types of ammeter have a pointer on a dial, but most have a digital readout. To measure the current flowing through a component in a circuit, you must connect the ammeter in **series** with it.



Voltage

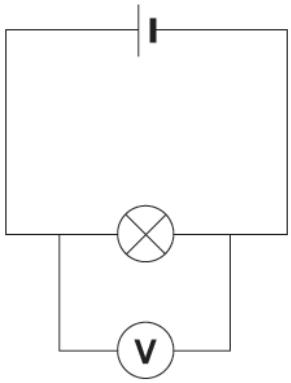
Voltage is a measure of the difference in **electrical energy** between two parts of a circuit. The bigger the difference in energy, the bigger the voltage.

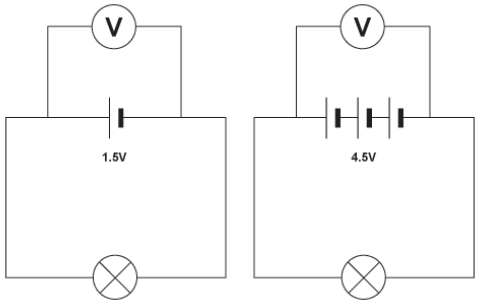
Voltage is measured in **volts**. The symbol for volts is **V**. For example, 230V is a bigger voltage than 12V.

Measuring voltage

Voltage is meaured using a voltmeter. Some types of voltmeter have a pointer on a dial, but most have a digital readout. To measure the voltage across a component in a circuit, you must connect the voltmeter in **parallel** with it.

Using a voltmeter to measure the voltage across a lamp -->





← You can measure the voltage across a cell or battery. The more cells, the bigger the voltage.

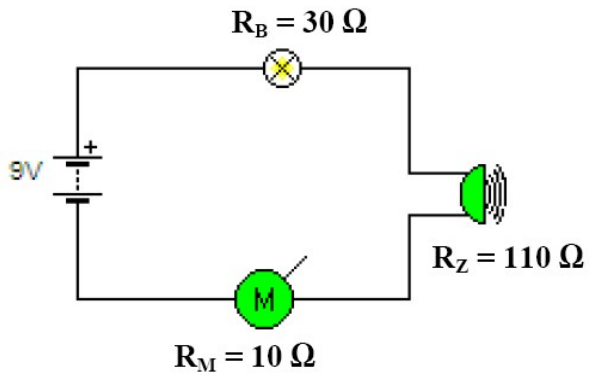
The more cells, the bigger the voltage

Checkpoint

	Current	Voltage
Measured in	amps, A	volts, V
Measured with	ammeter in series	voltmeter in parallel
Circuit symbol of measuring devise		

EXERCISES

1. Say the name of the devices in this circuit. Calculate total resistor of the circuit, the current and the power



We have a conductor, a battery, a bulb, a buzzer and a motor.

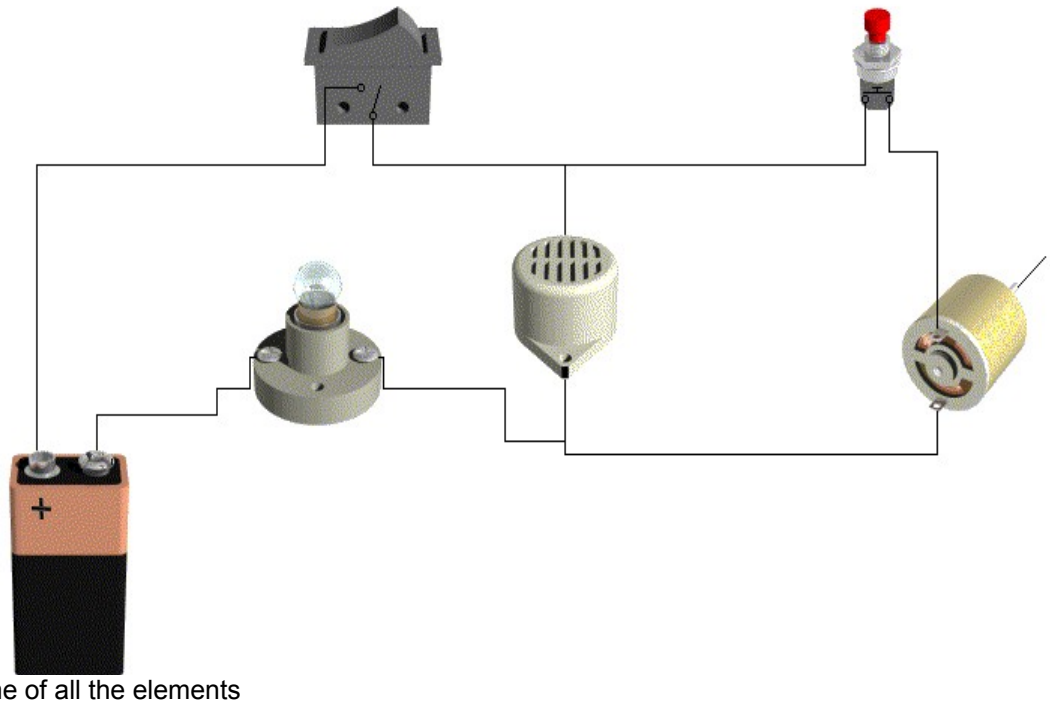
Total resistor (series circuit) is 150 Ω.

Using Ohm´s Law the current is:

I = V/R = 9V / 150 Ω = 0,06A = 60 mA

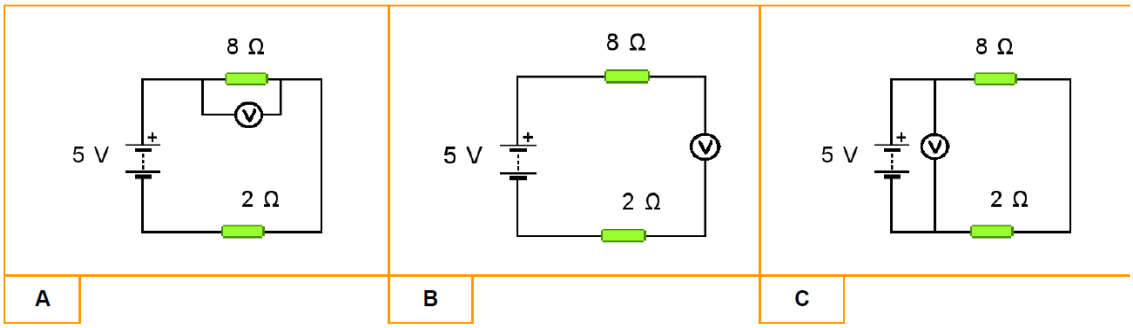
P = VI = 9V 60 mA = 540 mW

2. In the following picture,

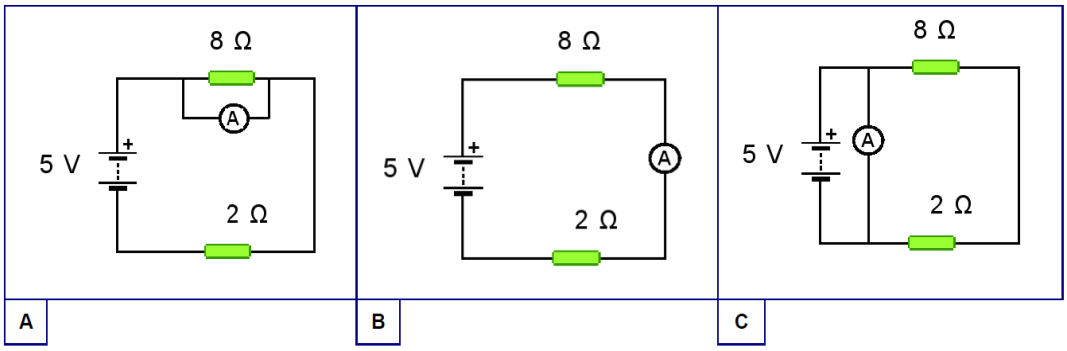


a. Say the name of all the elements
b. Make the electrical circuit (with symbols)
c. What type of circuit is: serial, parallel or combined. Justify your answer.
d. Can the motor spin if the bulb is unscrewed?

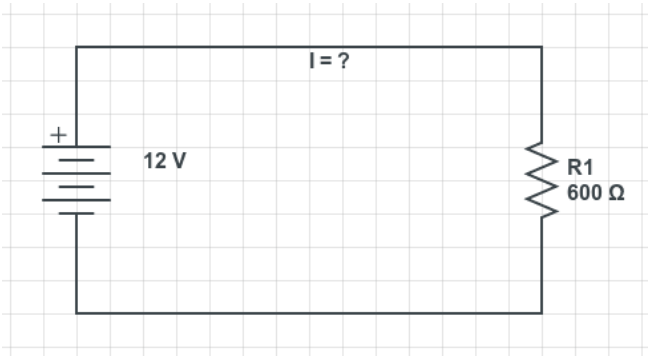
2. What is the right choice if we want to measure the cell voltage? Justify your answer.



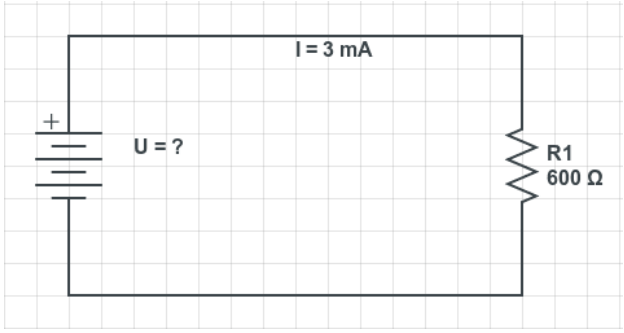
3. What is the right choice if we want to measure the current in the circuit?.Justify your answer



4. How much current flows through the circuit?
Calcalate the power also

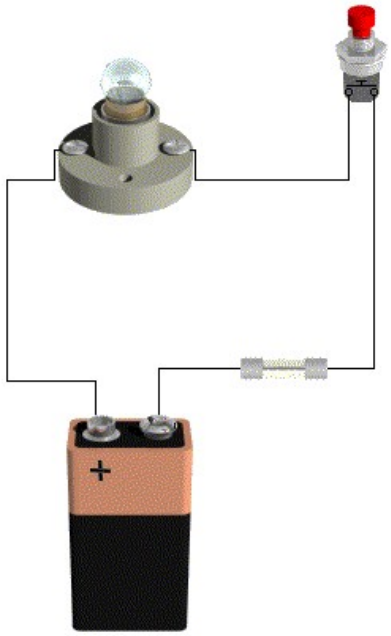


5. Voltage of the battery and power

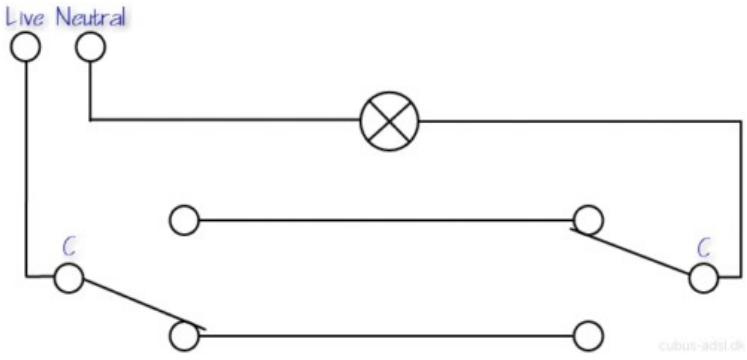


6. What type of electrical connection you want in your home?. Justify your answer

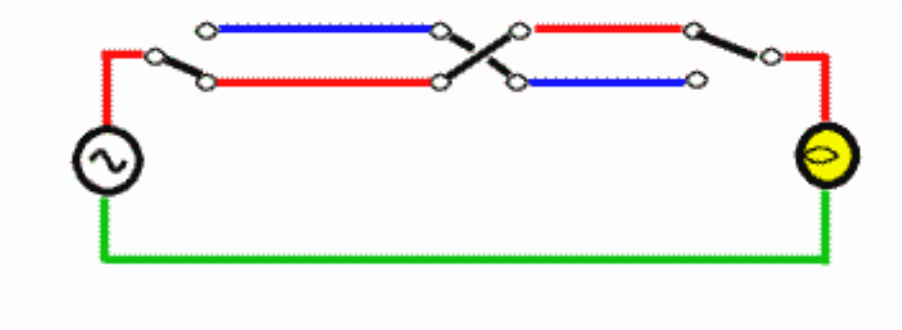
7. In that picture identify →
power source,
load device,
control device,
protection device and
conductor



8. Identify elements and explain how it works

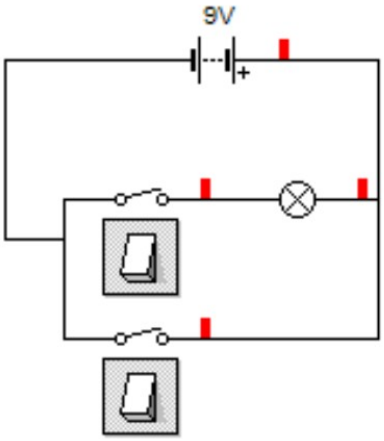


9. Identify and explain →

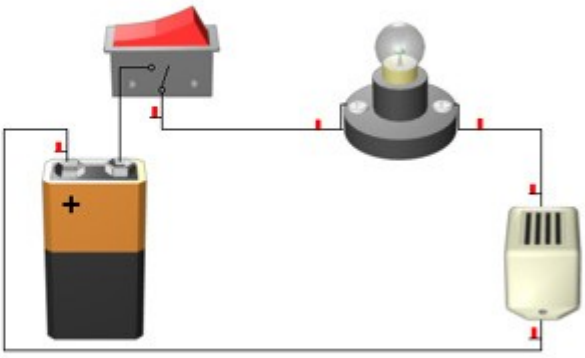


(In exercises 8 and 9 is a home installation using 3 and 4 ways switch)

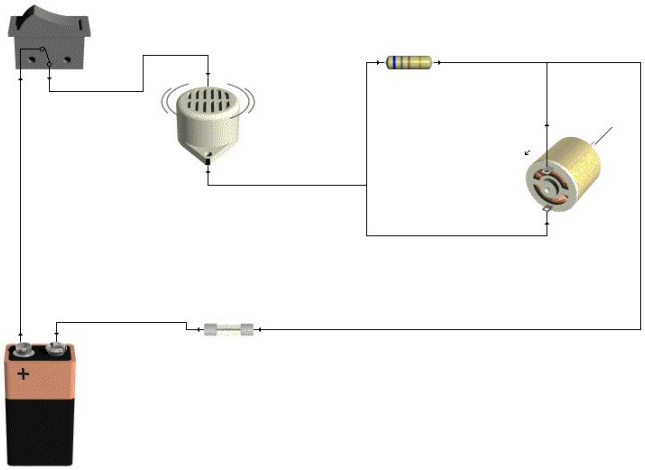
10. What happen if I turn on switch 2? →
(Any short-circuit?)



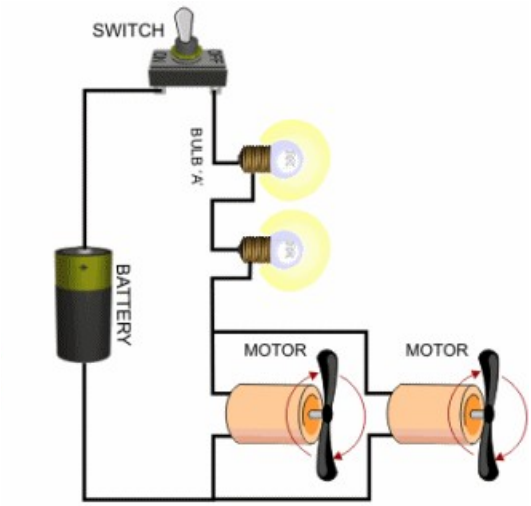
11. Make the diagram



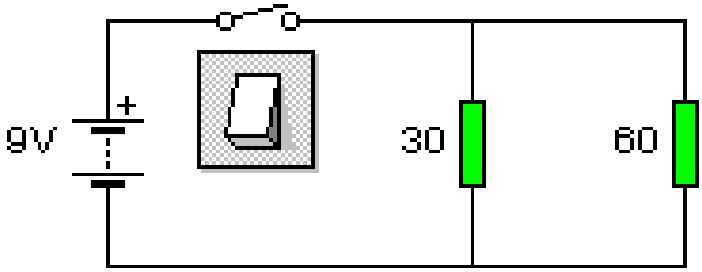
12. Make the diagram



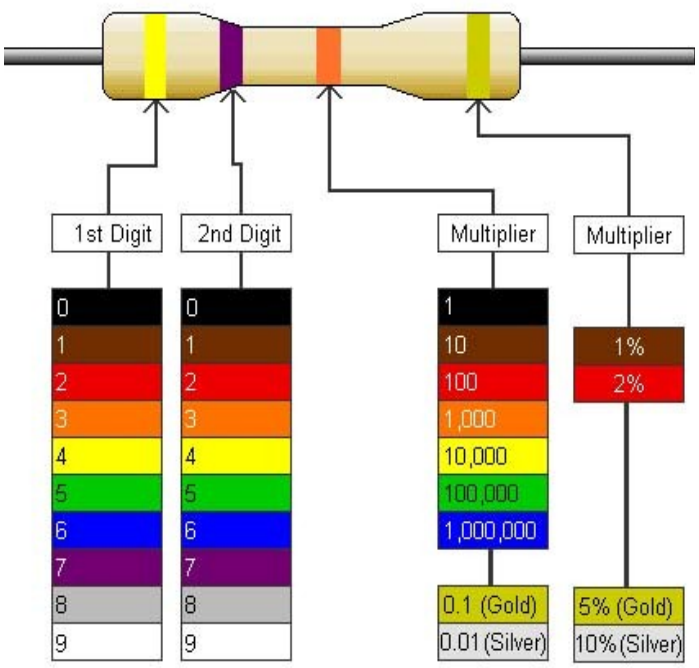
13. Make the diagram



14. Calculate the current in each resistor

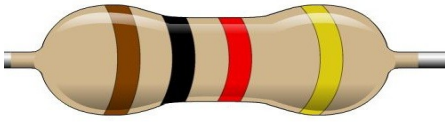


COLOR CODE

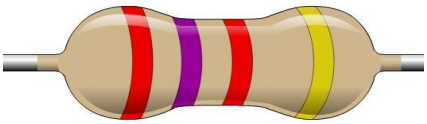


black
brown
red
orange
yellow
green
blue
violet
grey
white

1. Say the value of the resistors

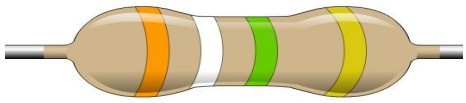


Brown, black, red and gold



Red, violet, red and gold

Brown, grey, orange and gold



Orange, white, green and gold

2. Say the color code

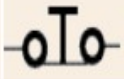
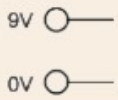
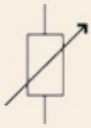
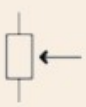
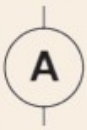
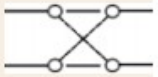
a. 3300 Ω ± 10%

b. 39 Ω ± 20%

c. 120 Ω ± 5%

d. 470 Ω ± 10%

SOME SYMBOLS

					
Cell	Push-to-break switch	Push-to-make switch	Single-pole single-throw switch	Bell	Voltage rails
					
Battery	Resistor	Variable resistor	Single-pole double-throw switch (3 ways switch)	Microphone	Earth
					
Potentiometer	Crossing of conductors	Joined conductors	Loud-speaker	Buzzer	Lamp
					
Motor	Ammeter	Voltmeter	4 ways switch	Ohmmeter	