Physic's Coursework
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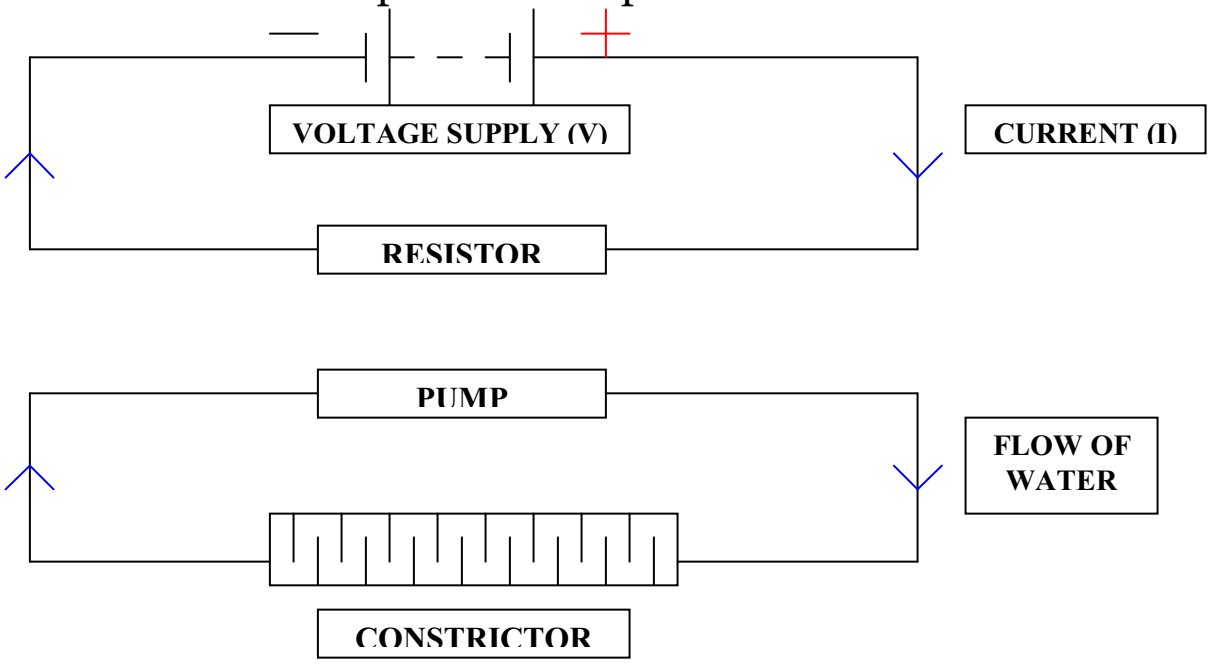
RESISTANCE

AIM: To Investigate how the thickness of a wire affects its Resistance.

Background Knowledge.

The electrical supply can be quite easily compared to the water supply we all have in our homes for our heating. The battery can be easily compared to a water pump as they both have to push a flow around a circuit. A resistor can also easily be compared to a water flow constrictor, both slowing down the flow and power of the push.



If the voltage is increased the current is increased.
If you increase the resistance the current is decreased.

CHARGE = CURRENT x TIME

Q = I x T

The current **I** with a value ampere, **1A** is the number of charges flowing past a point every second. Charge **Q** is measured in Coulombs, **C**.

Short Circuit:

A short circuit happens when the current in a circuit travels along the easiest path it can find. The easiest path is always the one with the least resistance.

Measuring Current & Voltage:

When you have an analogue meter you have to make sure you look at it correctly, you do this by making sure you look at it at exact right angles. You know this when you cannot see the needle reflecting in the mirror of the ammeter. This is to make sure your readings are accurate.

If you are using a digital meter you have to connect the red wire to the red terminal and the black wire to the black terminal.

An ammeter is always connected in series with the test component where a voltmeter is connected in parallel.

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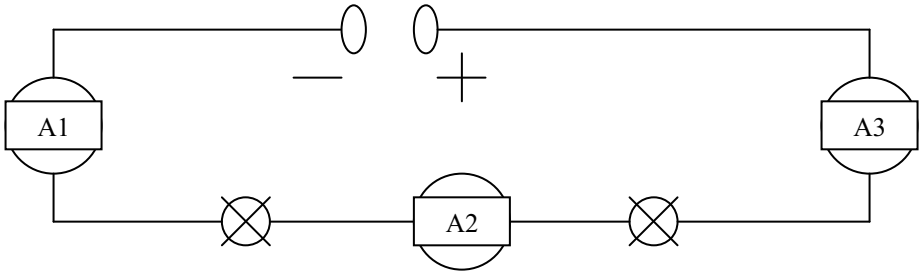
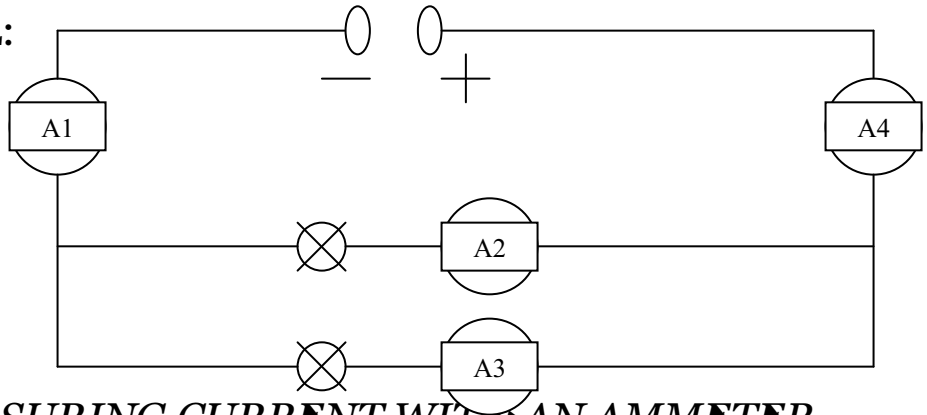


PARALLEL:



MEASURING CURRENT WITH AN AMMETER

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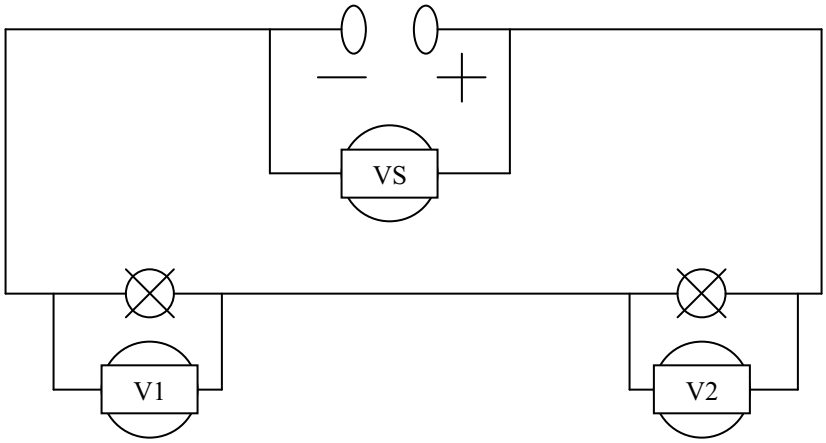


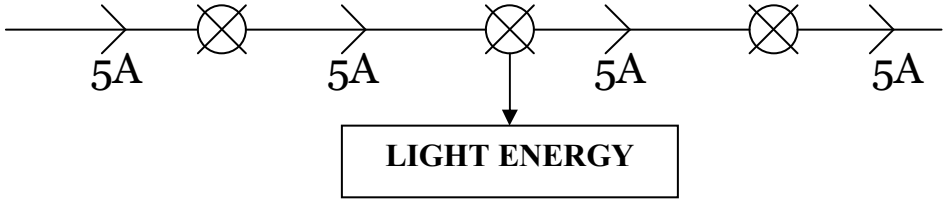
MEASURING VOLTAGE WITH A VOLTMETER

Electrical Energy:

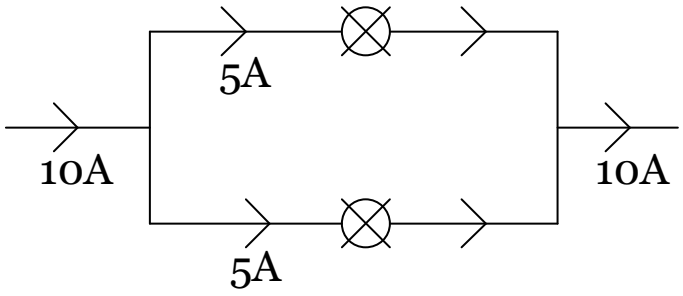
Electrical energy changes in a circuit but it is not used up or destroyed. Electrons have less electrical energy returning to a battery.

CURRENT IS NOT USED UP

SERIES:



PARALLEL:



$$Q = IT$$

The sum of voltages across components in series equal the total voltage supplied by the circuit.

SERIES: $V_s = V_1+V_2+V_3 \ldots\ldots + V_n$

FORMULAS:

Resistors in parallel:

$$R_{Total} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Ohms Law:

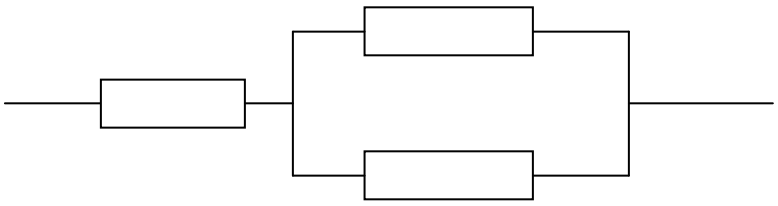
$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}} \qquad R = \frac{V}{I}$$

Multimeters can measure resistance but normally it is calculated after measuring voltage and current.

Resistors in series and Parallel:

$$R_{Total} = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$R_{Total} = R_1 + R_2$$



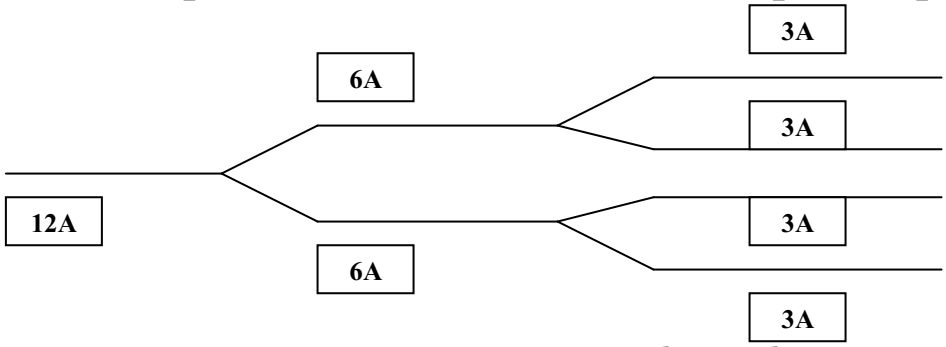
Variables

1. Voltage - Measure
2. Current - Current
3. Resistance - Calculating
4. Length of wire (resistance) - Keep the same
5. Thickness of wire - Change
6. Material {conductor\insulator} - Keep the same
7. Temperature\Thermo Energy - Keep the same
8. Parallel Circuits *
9. Series Circuits *

I will measure the voltage with a voltmeter.
I will measure the current with an ammeter.
I will change the thickness by putting the wires in parallel.
I will keep the material the same by using constantan wire.
I will keep the temperature the same by only turning the circuit on for a few seconds so the current will not heat up the wire.
I will keep the length of resistance wires the same by measuring the length of a wire using a meter stick.
The ammeter will be in series to measure the current.
The voltmeter will be in parallel to measure the voltage.

Prediction

I predict the more wires in parallel will create less resistance. Comparing the electrical system to a traffic system whenever six cars are in one lane the traffic moves slowly but when that lane is split into more lanes the traffic speeds up.



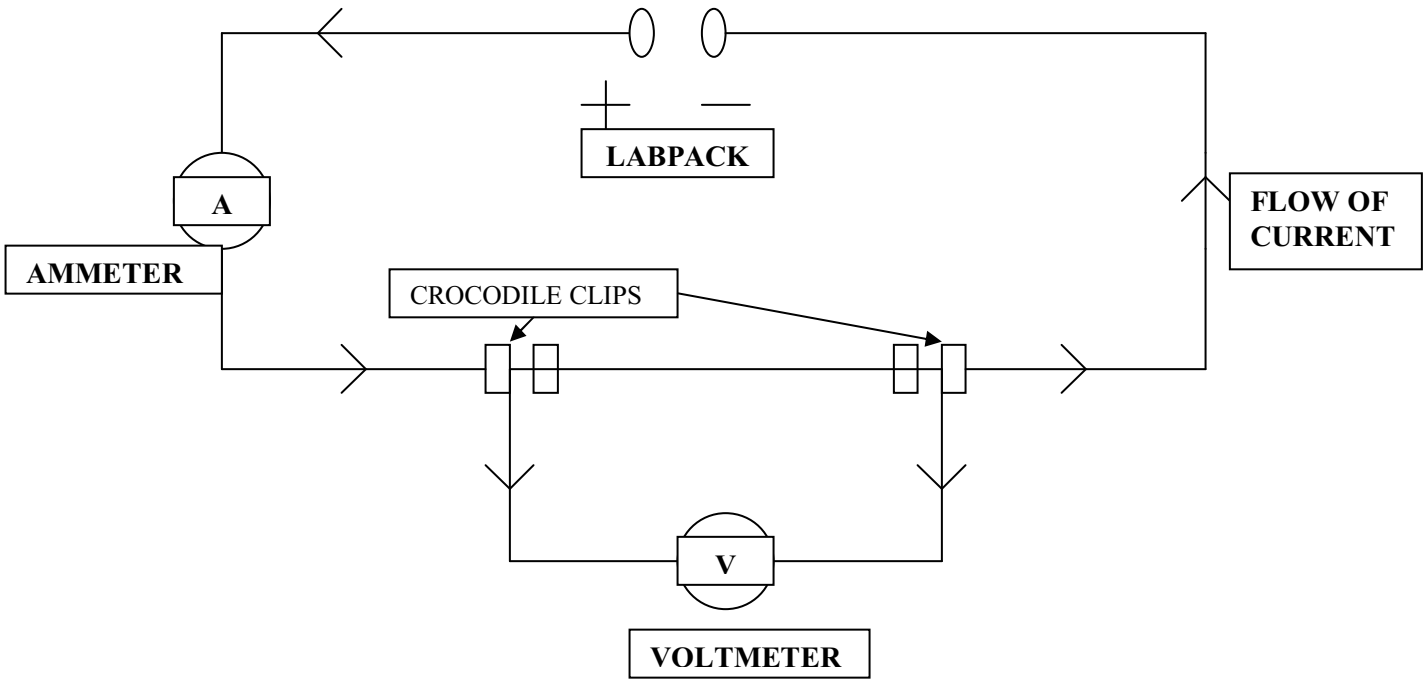
The current starts at 12A in one wire but when we introduce another wire the current is split between the two wires. The more wires that are introduced in parallel the more the current will be split therefore increasing the overall current.

This means that there will be a higher current so the more wires in parallel the bigger the electrical current. Putting the wires in parallel is the same as decreasing the thickness of a wire by the same value.

Apparatus

1. Power supply
2. Ammeter
3. Crocodile clips
4. Constantan resistance wire
5. Meter stick
6. Voltmeter

Diagram


LABPACK
A
AMMETER
FLOW OF CURRENT
CROCODILE CLIPS
V
VOLTMETER

Method

1. Collect apparatus.
2. Connect positive power supply to negative ammeter terminal.
3. From positive ammeter terminal connect voltmeter and constantan wire(s) in parallel.
4. From negative of voltmeter and constantan connect the wire to the negative terminal on the power supply.
5. Set power supply to minimal setting and turn on.
6. Record reading at ammeter and voltmeter.
7. Repeat steps 5 and 6 but put voltage up from 2volts though to 12volts.
8. Add another length of constantan in parallel and repeat steps 5 to 7.
9. Add another length of constantan in parallel and repeat steps 5 to 7.
10. Repeat all measurements twice.

Safety

We have to keep the voltage below 12 volts at all times.
We have to turn the power supply on for the shortest time possible so the constantan wires will not overheat.
We have to make sure the ammeter and voltmeter are connected the right way round.

Results plan

VS	V1	V2	Avr V	I1	I2	Avr I	Avr R
2V							
4V							
6V							
8V							
12V							

RESULTS TABLE FOR ONE WIRE IN PARALLEL.

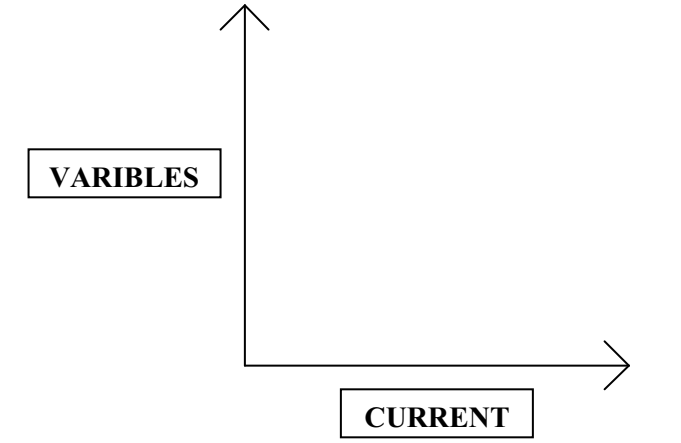
VS	V1	V2	Avr V	I1	I2	Avr I	Avr R
2V							
4V							
6V							
8V							
12V							

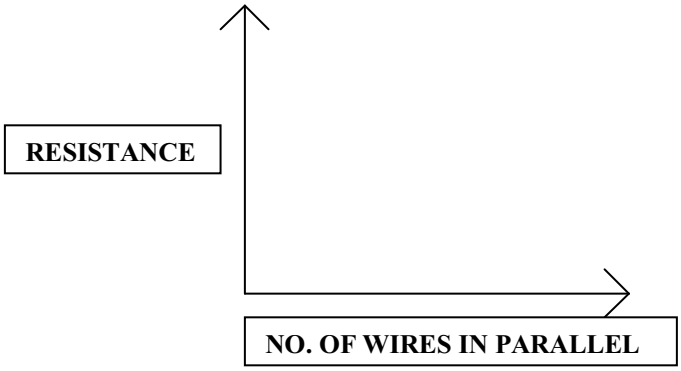
RESULTS TABLE FOR TWO WIRES IN PARALLEL

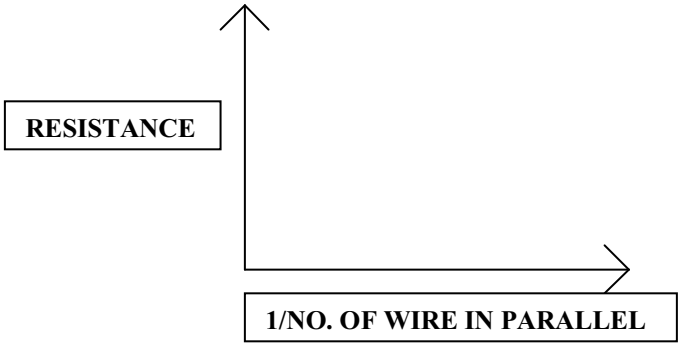
VS	V1	V2	Avr V	I1	I2	Avr I	Avr R
2V							
4V							
6V							
8V							
12V							

RESULTS TABLE FOR THREE WIRES IN PARALLEL.

Graphs


VARIBLES
CURRENT


RESISTANCE
NO. OF WIRES IN PARALLEL


RESISTANCE
1/NO. OF WIRE IN PARALLEL

Conclusion

By looking at my results I can conclude that the more wires there is in parallel the more the resistance in the wires will decrease and there will be more current flowing though the circuit. This is because the added wires in parallel are the same as decreasing the thickness of the constantan wire. The higher we put the voltage the more current we push though the circuit.

This is exactly as I predicted and it shows that comparing the electrical system to a traffic system actually proves that the more wires there is the more the resistance will decrease. This shows that there is a higher current so the more wires we put in parallel the more we increase the electrical current.

Evaluation

If I were doing the experiment again I would change the length of the wires as well as change the thickness. I would do this so I could get a better overall picture of how resistance is affected in a circuit. I would make the electricity wasn't on for as long so the wires would not heat up much – as this can affect my readings. I would measure the wires more accurately so no two wires were different.