FACTFILE:
GCSE
SINGLE AWARD PHYSICS
Practical Booklet

Experiments

Experiment 3.1.8:

Using electrical circuits to measure the voltage and current passing through a wire.

PART ONE

Current is the flow of electrons (charge) around a circuit. It is measured in AMPERES (A). The higher the current, the greater the flow of charge – in other words, the more electrons passes round the circuit every second.

Small currents can be measured in milliamperes (mA)

1000mA = 1A

for example, a current of 0.4A is 400mA

Current is measured using an ammeter connected **between** (in series with) the component you are measuring.

Current in a simple series circuit

Set up the following circuit drawn in black (ignore the dotted line for now) with your ammeter in position 1 – **please ask to have this circuit checked by your teacher before you switch on**.

Before you switch the supply on, how do you think the ammeter readings will relate to each other?

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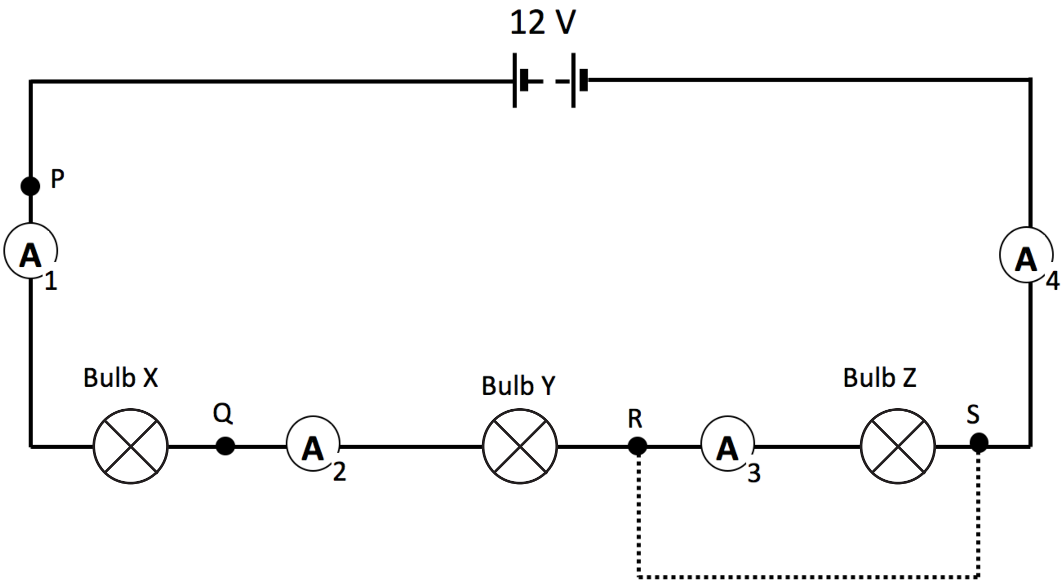

You only have one ammeter so you will need to disconnect the ammeter from position 1 and reconnect it into position 2, then 3, then 4 and record the readings below.

A_1 = ____________ A_2 = ____________ A_3 = ____________ A_4 = ____________

What conclusion can you make about the ammeter readings? What do you think could be said about current in any series circuit?

____

Keeping the power supply on, break (or open) the circuit at point P and then Q. What do you notice and what conclusion can you draw from this?

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Before adding an extra lead joining points R and S (the dotted line), predict what you think will happen to bulbs X, Y, Z and each of the ammeters.

____

Then record what actually does happen. Can you explain why you see this pattern? (Try to use the term *resistance*)

____

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Electric current – parallel circuits

Set up the following circuit drawn in black (ignore the dotted line for now) with your ammeter in position 1 – **please ask to have this circuit checked by your teacher before you switch on**.

Before switching the supply on, explain how do you think the ammeter readings will relate to each other.

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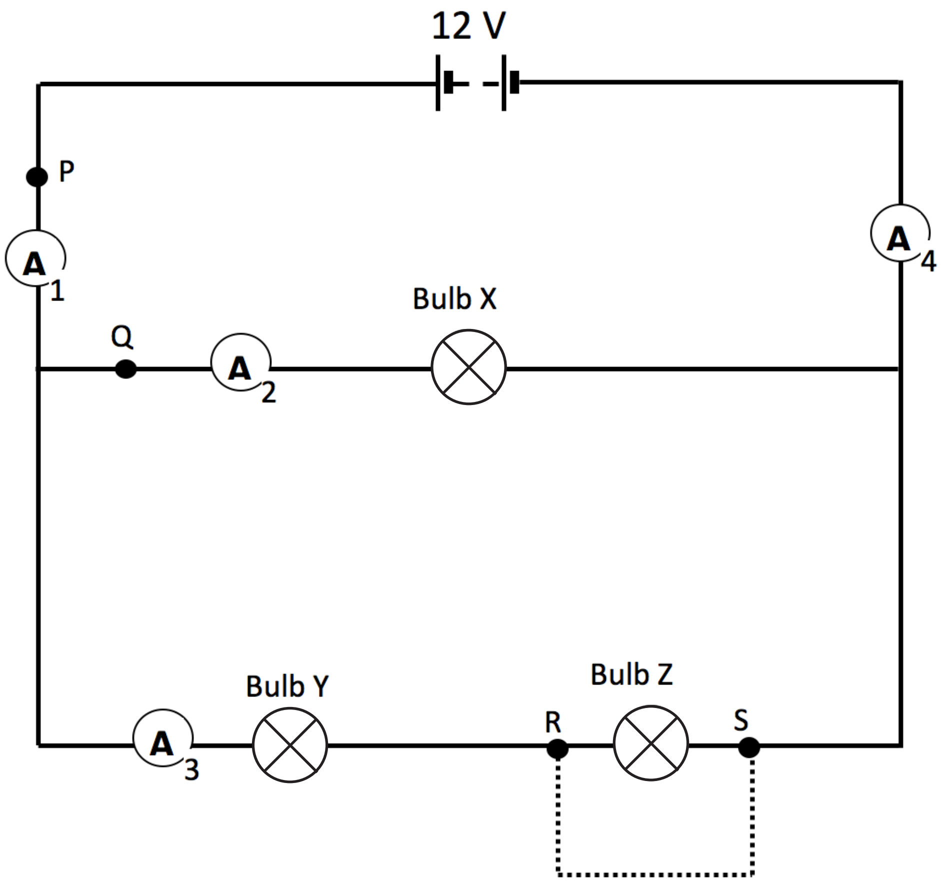

You only have one ammeter so you will need to disconnect the ammeter from position 1 and reconnect it into position 2, then 3, then 4 and record the readings below.

A_1 = ____________ A_2 = ____________ A_3 = ____________ A_4 = ____________

What conclusion can you make about the ammeter readings? What do you think could be said about current in any parallel circuit?

____

____

Keeping the power supply on, break (or open) the circuit at point P, then Q, and then R. What do you notice and what conclusion can you draw from this?

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____

Before you add an extra lead joining points R and S (the dotted line), predict what you think will happen to bulbs X, Y, Z and each of the ammeters.

____

Then record what actually does happen. Can you explain why you see this pattern? (Try to use the term *resistance* in your response)

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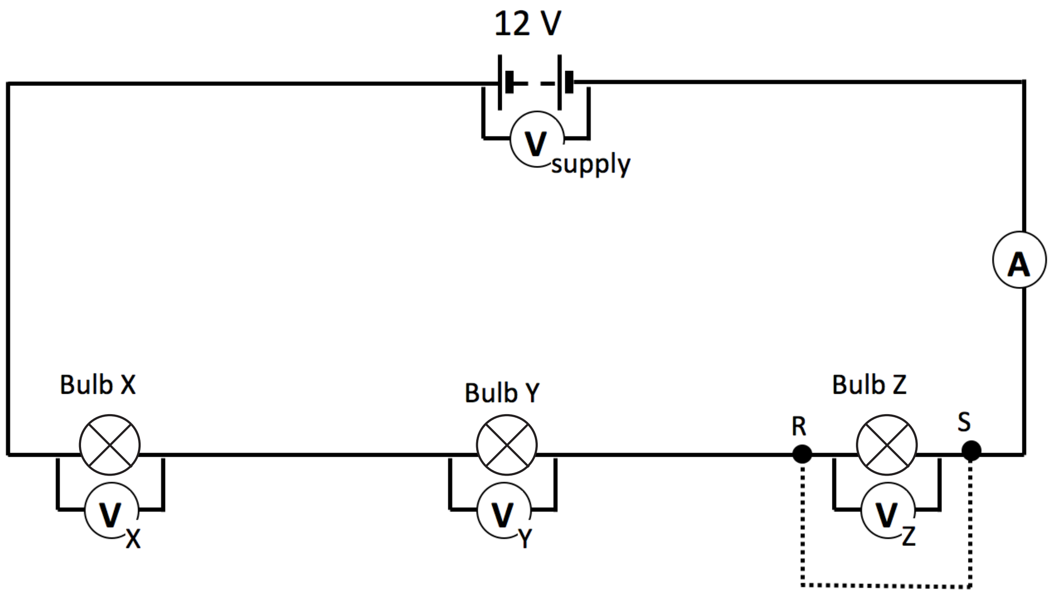
Potential Difference in series and parallel

Series:



Connect the circuit as shown (ignoring the dotted wire) with the ammeter as labelled and your one voltmeter positioned across the supply as shown. Then move the voltmeter to each of the positions X, Y and Z as shown and record your results.

A = ____________ V_{supply} = ____________ V_X = ____________ V_Y = ____________ V_Z = ____________

What pattern do you notice here?

……………………………………………………………………………………………………..

If the dotted lead were to be connected, what do you predict will happen to each bulb and to the five meter readings? Why?

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Now connect that lead between points R and S and then move the voltmeter as necessary.

Bulb X = ____________ Bulb Y = ____________ Bulb Z = ____________ A = ____________

V_{supply} = ____________ V_X = ____________ V_Y = ____________ V_Z = ____________

Now can you explain why you see these changes?

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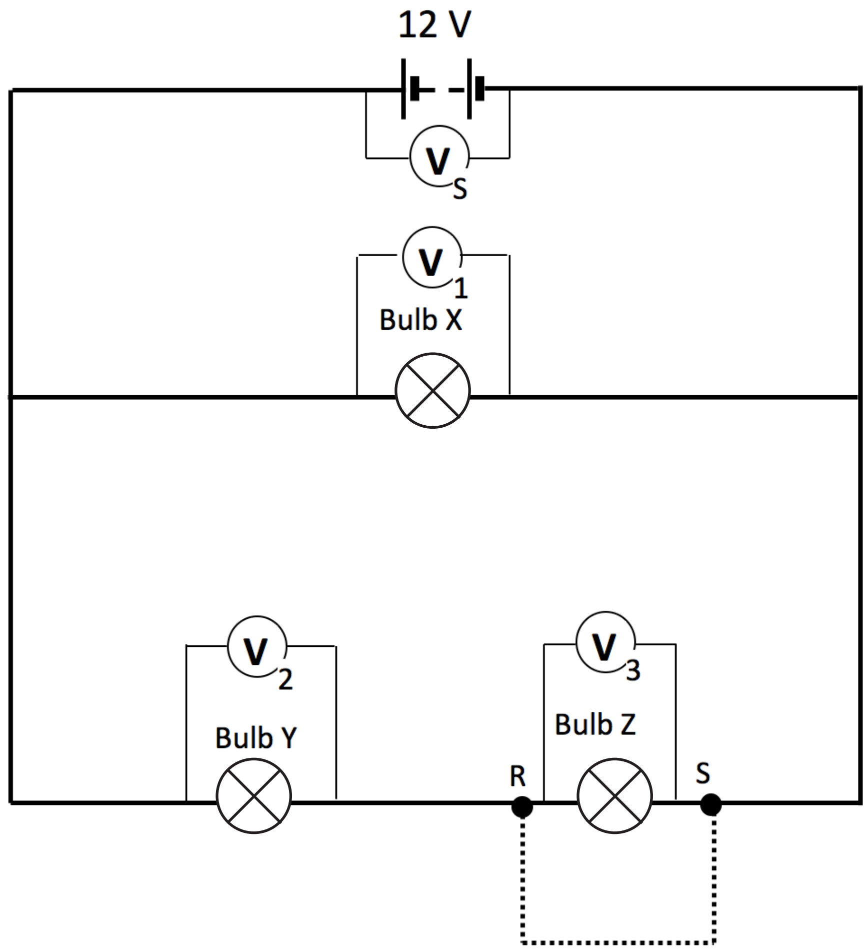
Potential difference in series and parallel

Parallel:



Once again, connect the circuit as shown. Move your one voltmeter around the circuit to the different positions. Do not yet add the wire between R and S.

V_S ____________ V_1 ____________ V_2 ____________ V_3 ____________ V_4 ____________

What pattern do you notice between these results?

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Before you add a wire between R and S, predict what do you think will happen to the meter readings.

____

Now add the wire between R and S and record the results.

V_S ____________ V_1 ____________ V_2 ____________ V_3 ____________ V_4 ____________

Did the pattern turn out as you expected?

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Risk Assessment:

Make sure there are no broken wires or loose connections or terminals in your set up and equipment.

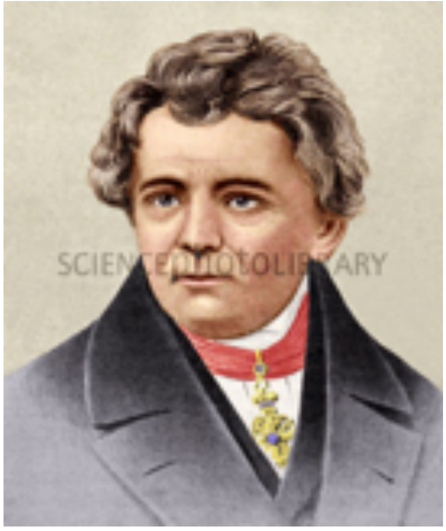
Do not remove, insert or touch any wires while the power supply is switched on.

Ensure you keep the power supply turned to a low value to prevent the bulb from blowing.

Experiment 3.1.10:

Using Electrical Circuits to demonstrate Ohm's Law

Ohm's Law states that:



The potential difference (voltage) across an ideal conductor is proportional to the current through it.
The constant of proportionality is called the "resistance", R.

Resistance can be calculated using V = I x R (R = V / I)

where V is the potential difference (Volts) between two points which include a resistance R (Ohms). I is the current (Amps).

Apparatus and materials

Ammeter (1 amp), DC

Voltmeter (5 volt), DC

Eureka wire (34 SWG), 10-cm length

Power supply, low voltage, DC

Leads, 4 mm, 6

Crocodile clips, 2

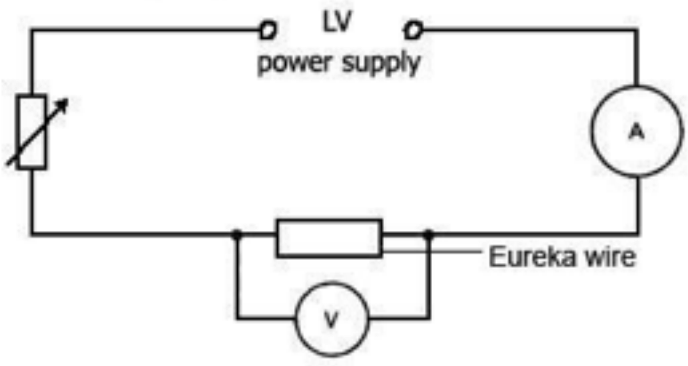
Rheostat (10 ohms, at least 1A)

(A Rheostat is a variable resistor)

Procedure

1. Set up the circuit shown. The length of Eureka wire acts as the resistance in the circuit.

2. By adjusting the power supply, you can vary the potential difference (p.d.) across the Eureka wire. The ammeter will show corresponding values of the current through the wire. Keep the current small so that the temperature of the wire does not increase. (Adjust the rheostat at the beginning and then keep it constant.) Record a series of values of p.d. and current.

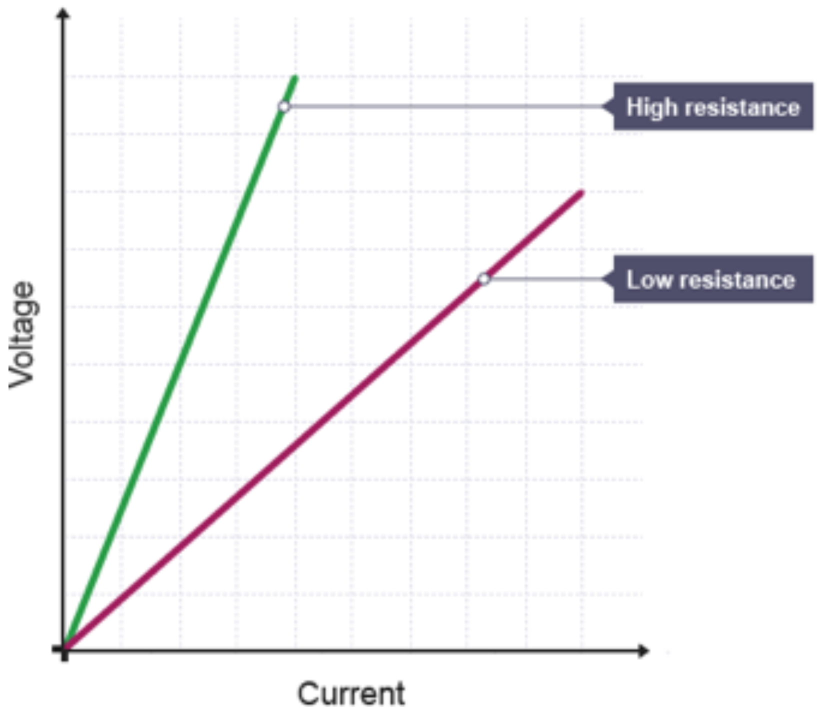


3. Calculate the ratio of p.d./current for each pair of values. Record in the table.

4. Draw a graph to represent the same data. Calculate (and check) the value for resistance from the graph.

Potential Difference (V)	Current (I)	Resistance (R)

Graph



The independent variable is normally the potential difference and so it could be plotted along the x-axis. The resultant current, the dependent variable, would be plotted on the y-axis.

This would show how the current varies with potential difference. However, the ratio p.d./current is important to us, and so the axes would have to be reversed if the ratio were needed from the slope of the graph.

The straight-line graph through the origin indicates that the current is proportional to the potential difference driving it. It is this proportionality which is Ohm's law.

Conclusion:

Risk Assessment:

Make sure there are no broken wires or loose connections or terminals in your set up and equipment.

Do not remove or insert any wires while the power supply is switched on.

Ensure you keep the power supply turned to a low value to prevent the bulb from blowing.

Experiment 3.5.1:

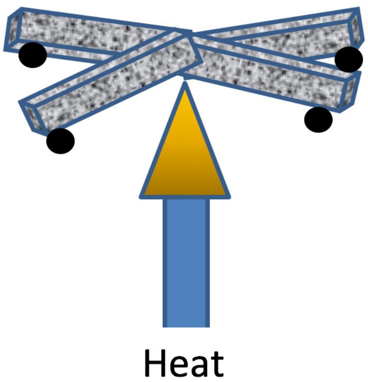
Investigating the heat conductivity of different materials

Conduction is when thermal energy is passed on from particle to particle. The particles at the hot end of an object have more kinetic energy and vibrate more strongly and this is passed on to neighbouring particles along the length of the object. In non-metals (e.g. plastic, wood, rubber etc.) which are poor thermal conductors (i.e. good insulators), this conduction process is very slow.

In metals which are good thermal conductors however, the increased vibration of the atoms at the hot end of the rod is transferred to the cold end by two separate mechanisms:

- Inter-particle vibrations as for non-metals, and
- Free electrons which collide with strongly vibrating atoms at the hot end and then move through the rod, transferring their energy by collision with atoms and other electrons. This heat transfer mechanism is much faster than that due to vibrations from particle to particle and accounts for the fact that metals are excellent thermal conductors.

The apparatus shown below can be used to compare the thermal conductivity of four different metals. All the bars have identical dimensions and each has a small paperclip stuck to its end with petroleum jelly. The Bunsen Burner flame is positioned in the centre and the heat is conducted along the bars and eventually melts the petroleum jelly, causing the ball bearings to drop in a certain order. Record this order in the table.



Order in which the pins fell	Metal
1st	
2nd	
3rd	
4th	

Conclusion:

Risk Assessment:

Care should be taken when near the open flame. Safety goggles should be worn. Do not touch the metal during or after the heating process, Do not allow hot petroleum jelly to drip onto clothing or skin.

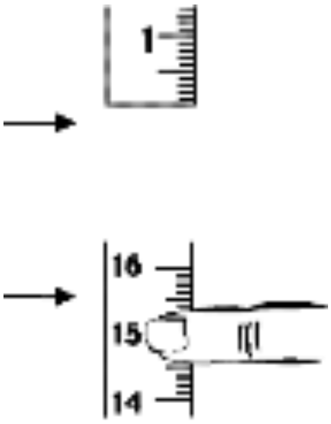
Experiment 3.7.5

Investigating reaction times.

A reaction time is defined as the time our body takes to respond to a stimulus.

You can test your reaction time with a partner and a ruler.

One of you holds a ruler while the other holds their thumb and finger either side just below the 0cm mark.



The first person lets go of the ruler *without warning.* The other person must close their thumb and finger as soon as they see the ruler drop.

Record the distance in **centimetres** and use the table below to find your reaction time in **milliseconds**. Milliseconds are thousandths of a second.

Use the table to convert your distance to a time.

You could compare the reactions of your right and your left hand.

Drop	Length (centimetres)	Time (milliseconds)
1st		
2nd		
3rd		
4th		
5th		
6th		
7th		
8th		

Left Hand	**Average:**	

Drop	Length (centimetres)	Time (milliseconds)
1st		
2nd		
3rd		
4th		
5th		
6th		
7th		
8th		

Right Hand	**Average:**	

The table calculates the time taken in terms of the distance the ruler has travelled. You should know that Speed, Distance and Time are all related, ***but you do not need to be able to do this calculation.***

Your results will vary depending on technique and which pupils you used, but you should expect that many of you will show a slight improvement with practise.

Why?

When we begin to acquire a new physical skill through repetition, our nervous system creates new neural pathways. Here's an example: when we practise something like catching a ruler over and over again, all the members of that neural pathway (eye, brain, muscles) become more well-connected and efficient. This phenomenon is often referred to as **Muscle memory**. However, no matter how good your muscle memory for this task becomes, it will always take some time for the falling ruler to travel as a message from your eyes to your brain and from your brain to your fingers!

Reaction Time Chart	
Distance on Ruler	**Reaction Time**
5 centimetres	.10 seconds
10 centimetres	.14 seconds
15 centimetres	.18 seconds
20 centimetres	.20 seconds
25 centimetres	.23 seconds
30 centimetres	.25 seconds

http://pbskids.org/zoom/activities/sci/images/reactiontime1_c.gif

How did you do? (Conclusion)

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How could you improve the method of this experiment?

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Risk Assessment:

- ensure there are no trip hazards as concentration will be on the task;
- ensure no splinters in wooden metre rule.