Electromagnets

2. Current

CONCEPT 1

SERIES CIRCUITS

NOTES

What are electrical circuits

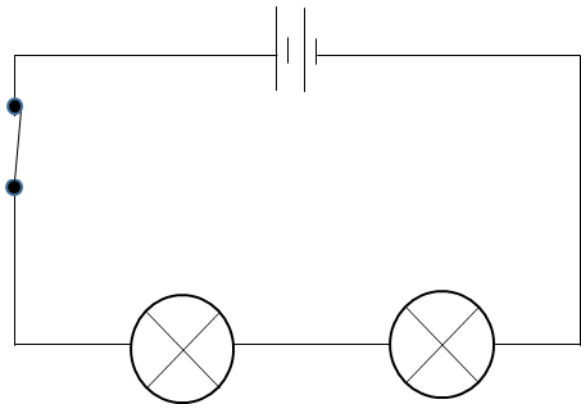
Electrical circuits are used in devices in order to convert electrical energy into something useful, for example heat, light or sound. This energy is transferred by small particles called electrons moving in an electrical conductor. We can measure the flow of these charges in a circuit by counting how many units of charge pass a point in the circuit per second. This is called the current in the circuit. This can be modelled using rope (see topic 2.1). Circuits must be made of complete loops otherwise charge cannot flow and energy cannot be transferred.

Most circuits used in electrical devices have combinations of series and parallel circuits within them.

Series Circuits

In a series circuit:

- All the components are connected, one after the other, in a complete loop of conducting wire
- There is only one path the current can take



This diagram shows a series circuit.

Start with your finger on the battery and follow the wires around the circuit. If you don't need to make any decisions about which way to go before returning back to the battery then it must be a series circuit.

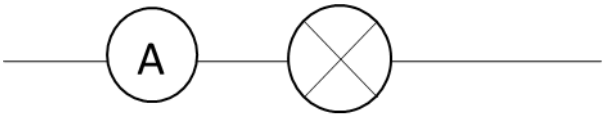
Changing components in series circuits

In the series circuit above, components can be changed with the following effects:

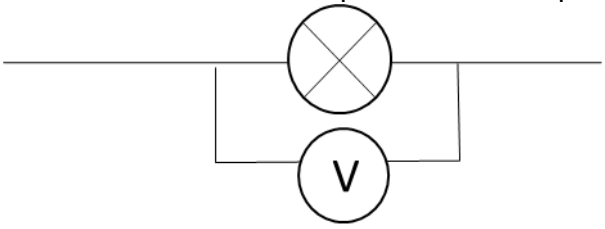
Component changed	Effect	Why?
Adding another cell	The brightness of the bulbs increase	The potential difference of the circuit has been increased so there is more energy being transferred by the current. Each bulb will now get a greater amount of energy for every unit of charge so the brightness increases.
Adding another bulb	The brightness of the bulbs decreases	The resistance of the circuit is increased. This opposes the flow of current so fewer electrons pass per second transferring less energy. The bulbs are therefore not as bright.
Opening the switch	When the switch is open the bulbs do not light	Current has only one path to follow in a series circuit. If the circuit is broken then the current cannot jump the gap so it does not flow. This means that no energy is transferred to the bulbs so they both go out.

Analysing Current and Potential Difference in Series Circuits

An ammeter measures the current at any point in a circuit i.e. the number of charges passing a point in one second. Think of it like a frictionless revolving door in one of the wires in the circuit counting each unit of charge that passes. It therefore must be connected in series with components in a circuit as shown:



A Voltmeter measures the potential difference between two points in a circuit. It compares the energy that each unit of charge carries between two points in a circuit. In the same way that if you are comparing the height of two people you need to stand back from them, a voltmeter has to stand back from the circuit to make the comparison. It therefore must be connected in parallel with components in a circuit as shown:



In a series circuit the current is the same everywhere in the circuit. However, the potential difference is divided across the components. In the diagram below you can see how the potential difference across each of the components adds up to the total potential difference supplied by the battery and how current is the same everywhere in the circuit.