AQA Combined Science: **Physics Topic 2 Electricity – Foundation and Higher**

Required Practical

Investigating Resistance in a Wire

Independent variable: length of the wire.

Dependent variable: resistance.

Control variables: type of metal, diameter of the wire.

Conclusion: As the length of the wire increases, the resistance of the wire also increases.

Investigating Series and Parallel Circuits with Resistors

Independent variable: circuit type (series, parallel).

Dependent variable: resistance.

Control variables: number of resistors, type of power source.

Conclusion: Adding resistors in series increases the total resistance of the circuit. In a parallel circuit, the more resistors you add, the smaller the resistance.

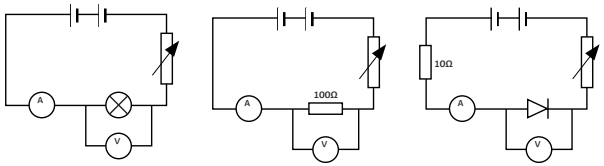
Investigating I-V Relationships in Circuits (Using a filament bulb, ohmic conductor, diode.)

Independent variable: potential difference/volts (V).

Dependent variable: current (A).

Control variable: number of components (e.g. 1 filament bulb, 1 resistor), type of power source.

Set up the circuits as shown below and measure the current and the potential difference.



Draw graphs of the results once collected.

Equations and Maths

Equations

Charge:	$Q = It$
Potential difference:	$V = IR$
Energy transferred:	$E = Pt$
Energy transferred:	$E = QV$
Power:	$P = VI$
Power:	$P = I^2R$

Maths

1kW = 1000W

0.5kW = 500W

Charge

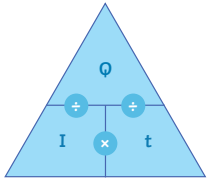
Electric current is the flow of electric charge. It only flows when the circuit is complete.

The **charge** is the current flowing past a point in a given time. Charge is measured in **coulombs (C)**.

Calculating Charge

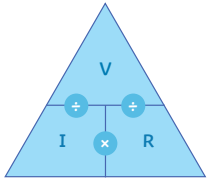
charge flow (C) = current (A) × time (s)

$Q = It$



potential difference = current x resistance

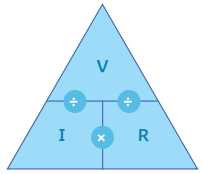
V (V) = I (A) × R (Ω)



Resistance

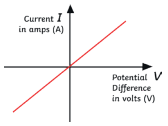
voltage (V) = current (A) × resistance (Ω)

V = IR

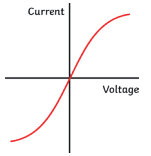


Graphs of I-V Characteristics for Components in a Circuit

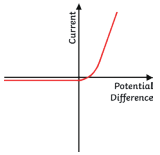
1. **Ohmic conductor**: the current is directly proportional to the potential difference - it is a straight line (at a constant temperature).



2. **Filament lamp**: as the current increases, so does the temperature. This makes it harder for the current to flow. The graph becomes less steep.



3. **Diode**: current only flows in one direction. The resistance is very high in the other direction which means no current can flow.

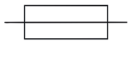
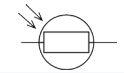
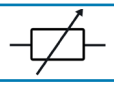
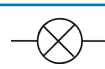
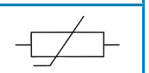
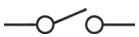
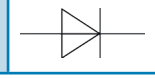


Current and Circuit Symbols

Current: the flow of electrical charge.

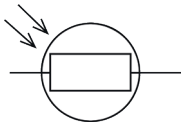
Potential difference (voltage): the push of electrical charge.

Resistance: slows down the flow of electricity.

cell		closed switch		fuse	
resistor		ammeter		LDR	
battery		voltmeter		LED	
variable resistor		bulb		thermistor	
open switch		diode			

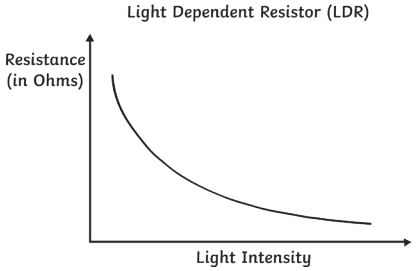
Circuit Devices

LDR – Light Dependent Resistor

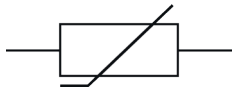


An LDR is dependent on light intensity. In bright light the resistance falls and at night the resistance is higher.

Uses of LDRs: outdoor night lights, burglar detectors.

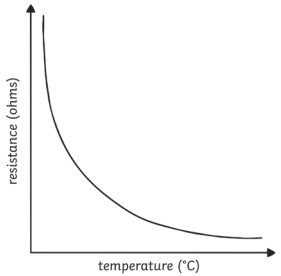


Thermistor



A thermistor is a temperature dependent resistor. If it is hot, then the resistance is less. If it becomes cold, then the resistance increases.

Uses of thermistors: temperature detectors.



Series and Parallel Circuits

Series Circuits

Once one of the components is broken then all the components will stop working.

Potential difference – the total p.d. of the supply is shared between all the components.

$V_{total} = V_1 + V_2$

Current – wherever the ammeter is placed in a series circuit the reading is the same.

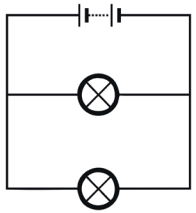
$I_1 = I_2 = I_3$

Resistance – In a series circuit, the resistance will add up to make the total resistance.

$R_{total} = R_1 + R_2$

Parallel Circuits

They are much more common - if one component stops working, it will not affect the others. This means they are more useful.



Potential Difference – this is the same for all components.

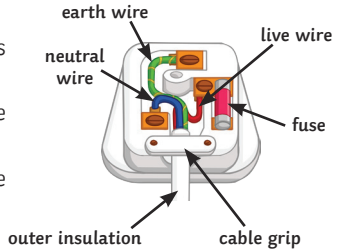
$V_1 = V_2$

Current – the total current is the total of all the currents through all the components.

$I_{total} = I_1 + I_2 + I_3$

Resistance – adding resistance reduces the total resistance.

Electricity in the Home



AC – alternating current. Constantly changing direction - UK mains supply is 230V and has a frequency of 50 hertz (Hz).

DC – direct current. Supplied by batteries and only flows in one direction.

Cables – most have three wires: live, neutral and earth. They are covered in plastic insulation for safety.

Live wire – provides the potential difference from the mains.

Neutral wire – completes the circuit.

Earth wire – protection. Stops the appliance from becoming live. Carries a current if there is a fault. Touching the live wire can cause the current to flow through your body. This causes an electric shock.

Energy Transferred – this depends on how long the appliance is on for and its power.

energy transferred (J) = power (W) × time (s) **E = Pt**

Energy is transferred around a circuit when the charge moves.

energy transferred (J) = charge flow (C) × potential difference (V) **E = QV**

power (W) = potential difference (V) × current (A) **P = VI**

power (W) = current^2 (A) × resistance (Ω) **P = I^2R**

The National Grid

The National Grid is a system of cables and transformers. They transfer electrical power from the power station to where it is needed. Power stations are able to change the amount of electricity that is produced to meet the demands. For example, more energy may be needed in the evenings when people come home from work or school. Electricity is transferred at a low current, but a high voltage so less energy is being lost as it travels through the cables.

Step-up transformers – increase the voltage as the electricity flows through the cables.

Step-down transformers – decrease the potential difference to make it safe.