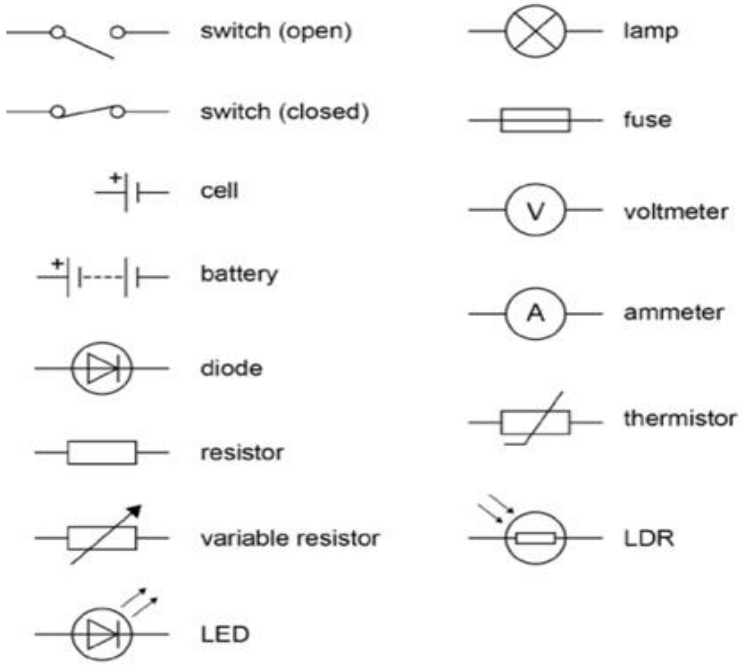
science physics

GCSE P2 – Electricity

1. Circuit symbols



2. Circuit rules

Electrons are negatively charged particles which transfer energy through wires as electricity.

- ***Current*** - the **flow of electrons** through a circuit, measured in **Amps** (A) using an **ammeter** placed in **series** with the components.
- ***Potential Difference (Voltage)*** - a measure of how much **energy** is transferred between two points in a circuit (the push provided to the electrons). Measured in **Volts** (V) using a **voltmeter** placed in **parallel** with the component.
- ***Resistance*** - **opposes** the flow of current. Measured in **Ohms** (Ω). Electrons flowing through any wire or component will experience resistance

	Series	Parallel
Current	Same	Shared
Voltage (P.d)	Shared	Same
Total Resistance =	sum of all resistors	Reduced as current follows multiple paths

3. Equations, symbols and units

$$Q = I\,t$$
charge (C) = current (A) x time (s)

$$V = I\,R$$
voltage (V) = current (A) x resistance (Ω)

$$R_T = R_1 + R_2$$
total resistance (Ω) = sum of all resistors

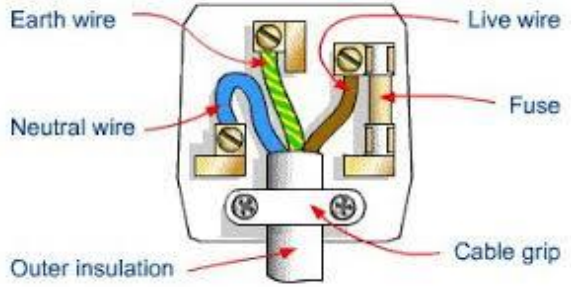
$$P = I\,V$$
power (W) = current (A) x voltage (V)

$$P = I^2R$$
power (W) = current² (A) x resistance (Ω)

$$E = Pt$$
energy transferred (J) = power (W) x time (s)

$$E = QV$$
energy transferred (J) = charge (C) x voltage (V)

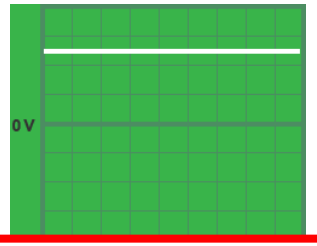
4. Plugs



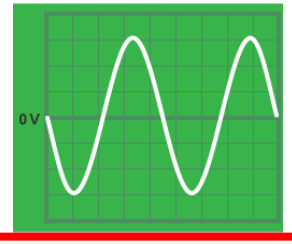
BROWN Live wire = Alternating potential difference (230V)
BLUE Neutral wire = completes the circuit (0V)
YELLOW/GREEN Earth Wire = Safety wire stops the metal appliance becoming live (0V). It carries away dangerous currents.
Fuse = prevents overheating will blow if current surges

5. AC and DC

Direct current (DC) flows only in one direction eg batteries and p.d. is constant



Alternating current (AC) constantly changes direction eg mains electricity 50Hz 230V and p.d. flips from positive to negative



6. National Grid

A network of transformers and wires to transmit electricity from the power station to homes and buildings.

- Electricity is produced in power stations
- It is transported along wires on pylons at very high voltage
- Step-Up transformers increase the p.d. (to 400,000V)
  - The higher the voltage, the lower the current
  - The lower the current the smaller the heat (energy) loss
- Step Down transformers decrease the p.d. to a safe level (230V) to be used in homes and workplaces

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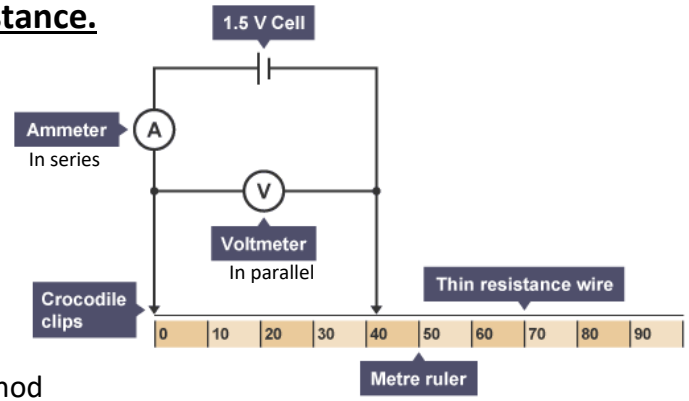
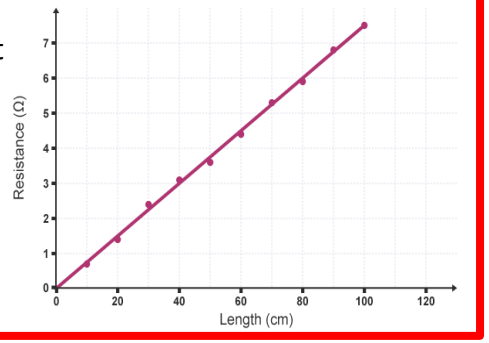
7. Required Practical – investigating how changing the length of the wire affects its resistance.

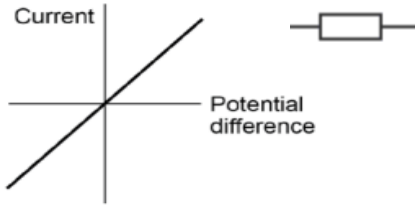


Method

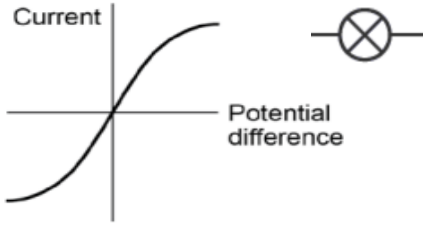
1. Connect the circuit as shown in the diagram.
2. Connect the crocodile clips to the resistance wire, 100 centimetres (cm) apart.
3. Record the reading on the ammeter and on the voltmeter.
4. Move one of the crocodile clips closer until they are 90 cm apart.
5. Record the new readings on the ammeter and the voltmeter.
6. Repeat the previous steps reducing the length of the wire by 10 cm each time down to a minimum length of 10 cm.
7. Use the results to calculate the resistance of each length of wire by using R = V/I.
8. Plot a graph of resistance against length of the resistance wire.



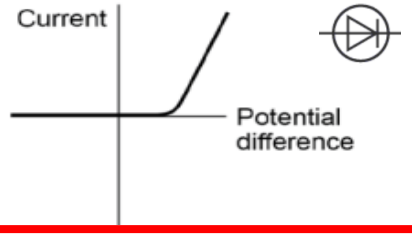
8. Required Practical – investigating the relationship between current and potential difference for a resistor, bulb and diode.



The current through a **fixed resistor** (ohmic conductor at constant temperature) is **directly proportional** to the voltage.

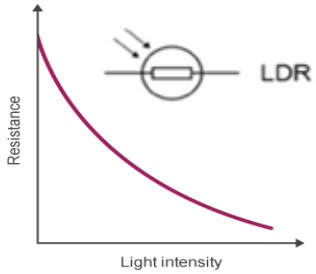


The current through a **filament lamp** is **not** directly proportional because as the **temperature increases, the resistance increases**.

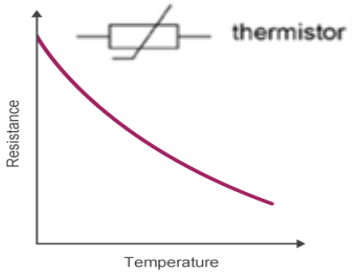


The current through a **diode** can **only go one way** it has a very high resistance in the other direction.

9. LDRs and Thermistors



Resistance decreases as light intensity increases



Resistance decreases as temperature increases

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10. Static electricity

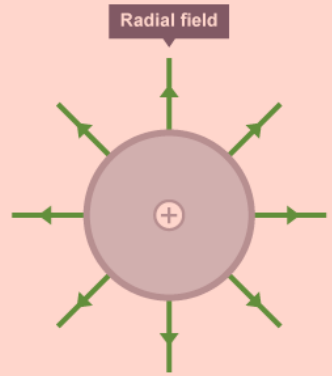
When insulating materials rub against each other, they may become electrically **charged**. **Electrons (e-)** may be 'rubbed off' one material and on to the other.

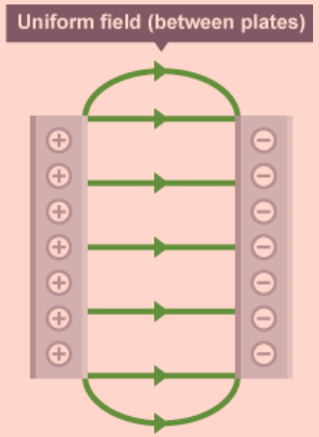
- The material that gains electrons becomes negatively charged.
- The material that loses electrons is left with a positive charge.

Insulators prevent electrons from moving and the charge remains **static**.
Conductors cannot hold the charge, as the electrons can move through them.

11. Electric fields

- An electric field is a region where **charges** experience a **force**.
- All charged objects have an **electric field** around them.
- Field lines point away from positive charges and towards negative charges.





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