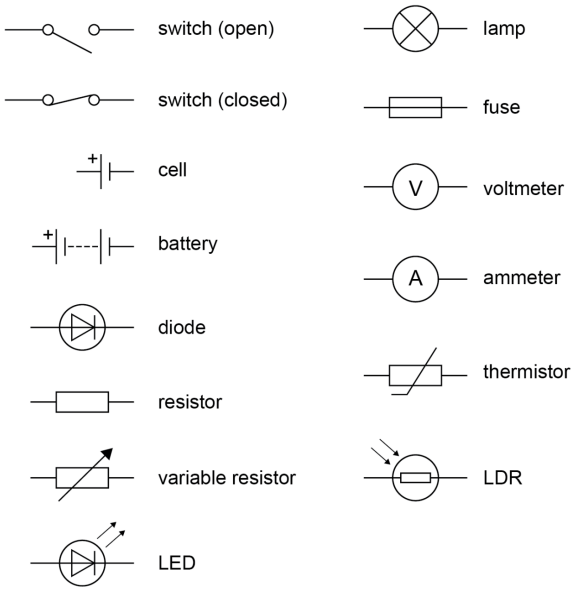
AQA Electricity Revision Notes

These notes can be incorporated into your revision of electricity. After each section I have included the relevant Free Science Lessons videos that can be found on YouTube.

Circuit Symbols

You need to be able to draw and recogise these symbols



Electrical charge and current

A source of potential difference is necessary for electrical charge to flow in a circuit.

Definition of Electric Current: It's the movement of electrical charge.

How to Measure Current:

Determined by how fast the electrical charge flows.

Calculated using the formula:

Charge flow (Q) = Current (I) × Time (s)

$Q = I \times t$

Q: Charge flow in coulombs (C).

I: Current in amperes (A), "amp" is also used.

t: Time in seconds (s).

In a closed loop: The current remains samet throughout a single closed loop i.e. has the same value.

Revision Videos on this topic

https://youtu.be/CEBfn4ndQWI?si=wZ9W01kzqtfzGysv

https://youtu.be/ts7WumFAaSg?si=fb06pSJoYTgzj3i7

Current, resistance and potential difference

The current (I) flowing through a component is influenced by two factors: the component's resistance (R) and the potential difference (V) across it.

If a component has higher resistance, it will have a smaller current when a for a specific potential difference.

In questions, both "potential difference" and "voltage" are terms that can be used, and using either correctly will be accepted.

To calculate the current, potential difference, or resistance, you can use the equation

$V=I\times R$

where:

V is the potential difference in volts (V),
I is the current in amperes (A), and "amp" is also used,
R is the resistance in ohms (Ω).

Revision Videos on this topic

https://youtu.be/cx9xLwa7Gco?si=1zsrL43JnZRdV0Kh

The following required practicals are needed

Required practical activity 3: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include:

- the length of a wire at constant temperature
- combinations of resistors in series and parallel.

Revision video to help with these below

https://youtu.be/YsZeZotYVag?si=JE-PsgL_1FiI8XLg

Resistors

In some resistors, the resistance (R) stays the same, but in others, it changes as the current varies.

For ohmic conductors, at a constant temperature, the current is directly proportional to the potential difference, keeping the resistance constant even if the current changes.

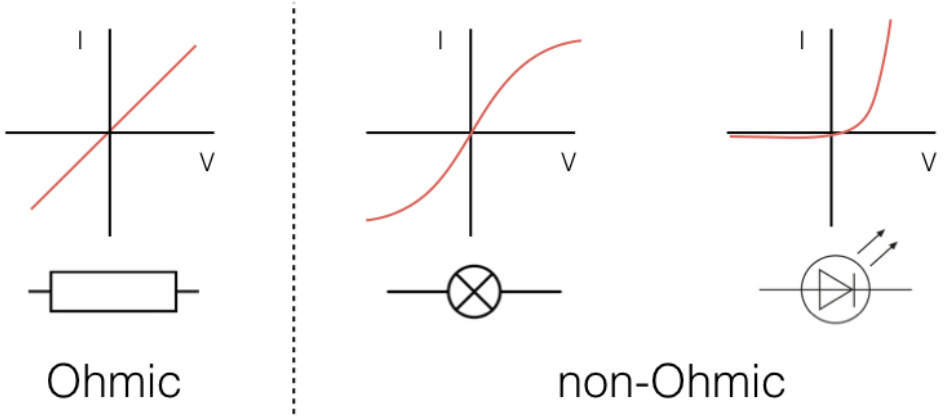
Components like lamps, diodes, thermistors, and Light-Dependent Resistors (LDRs) have varying resistances depending on the current.

The resistance of a filament lamp increases when its filament gets hotter.

Diodes allow current to flow in only one direction and have high resistance in the reverse direction.

The resistance of a thermistor decreases as its temperature increases, making them useful in temperature-sensitive circuits like thermostats and digital thermometers.

An LDR's resistance decreases with increasing light intensity, ideal for circuits that activate in darker conditions, like automatic lights.



Revision videos on this topic

https://youtu.be/2CA1mcYw3IQ?si=47QYspQodR3IV2z2

https://youtu.be/WzSh6ykqn9I?si=uQV5MIrhjvXGnIFM

https://youtu.be/Tk_OltwtxZE?si=KYAy6bCz_4_Ity0V

https://youtu.be/bb7sRiLKCvg?si=qt1NbunXMYaZQ9Zk

https://youtu.be/bjt4CrRL8yM?si=BOvRq3kfyXWF3oSf

This required practical is needed for this topic

Required practical activity 4: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.

This video will help with this

https://youtu.be/A1SyKvdHoqY?si=XFvxuSzyuqa7KBNL

Series and Parallel Circuits

Electrical components can be connected in two ways: in series and in parallel, and some circuits have a combination of both.

In series circuits:

- Every component has the same current flowing through it.
- The total potential difference from the power supply is divided among the components.
- The total resistance is the sum of each component's resistance, calculated as R(total) = R1 +R 2 Resistance is measured in Ohms (Ω).

In parallel circuits:

- Each component has the same potential difference across it.
- The total current in the circuit is the sum of the currents through each component.
- The total resistance of two resistors is less than the resistance of the smallest resistor.This means that in parallel the resistance is less than in series.

Revision videos to help with this

https://youtu.be/CEBfn4ndQWI?si=CCGlkmXQiuncSour
https://youtu.be/JhBrAmQYr2g?si=6t9o8qHDuzPRSEY0
https://youtu.be/YAzyHRusOS0?si=-7W3rhKAG89OXfBi
https://youtu.be/UM1jyQVdGD8?si=9FVx-zdorsTPOtAD

Direct and alternating potential difference

Mains electricity is a type of alternating current (AC) supply.

In the United Kingdom, the standard for domestic electricity is set at a frequency of 50 Hertz (Hz) and a voltage of about 230 volts (V).

Direct current (DC) means the electric charge flows in one constant direction.

Alternating current (AC), like mains electricity, means the direction of the electric charge changes 50 times a second in the UK.

Revision video to help with this.

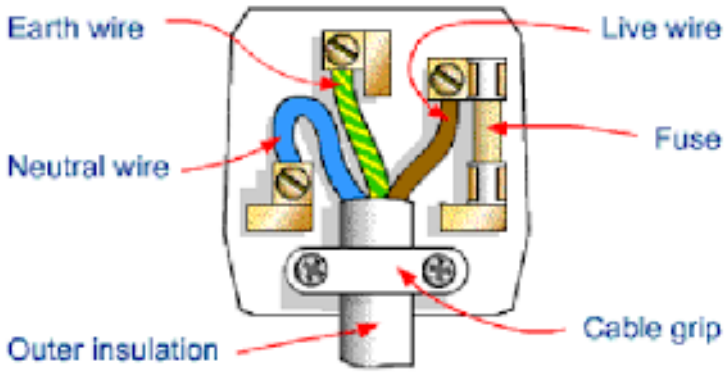
https://youtu.be/MEvO2rQFIWk?si=z4Gw7UZOSJmrqWu1

Mains Electricity

Most electrical appliances connect to the mains power using a three-core cable.

Each wire in the cable is covered with insulation in different colors for easy identification:

- The live wire is brown.
- The neutral wire is blue.
- The earth wire has green and yellow stripes.



The live wire carries the alternating potential difference from the power supply.

The neutral wire completes the electrical circuit.

The earth wire is a safety feature that prevents the appliance from becoming dangerously live.

The potential difference between the live wire and the earth (which is at 0 V) is about 230 V.

The neutral wire is at or near earth potential (0 V).

The earth wire, also at 0 V, only carries current in the case of a fault. Students should understand:

A live wire can be dangerous even if a switch in the mains circuit is off.

There are significant dangers in creating any connection between the live wire and earth.

Revision Video to help with this

https://youtu.be/fbu3o9wavHk?si=31auISESWMqCZblf

Power

Power in a circuit is related to the potential difference across the device and the current flowing through it.

It is the amount of energy transferred by a component per second.

The formula for power is

$P=V \times I$, where:

- P is power in watts (W),
- V is potential difference in volts (V),
- I is current in amperes (A), and "amp" can be used for ampere.

Power can also be calculated using the formula

$P=I^2R$

R is the resistance in ohms (Ω).

Revision video to help with this

https://youtu.be/LOyJdI41aCU?si=c5F1KhhISHk7Mami

Energy transfers in everyday appliances

Everyday electrical appliances such as dishwashers are designed to transfer energy.

The amount of energy transferred by an appliance depends on its power and how long it's turned on for.

When charge flows in a circuit, work is done, resulting in energy transfer.

The energy transferred by electrical work can be calculated in two ways:

Using the equation

$$E=P\times t$$

where E is energy in joules (J), P is power in watts (W), and t is time in seconds (s).

Alternatively, by

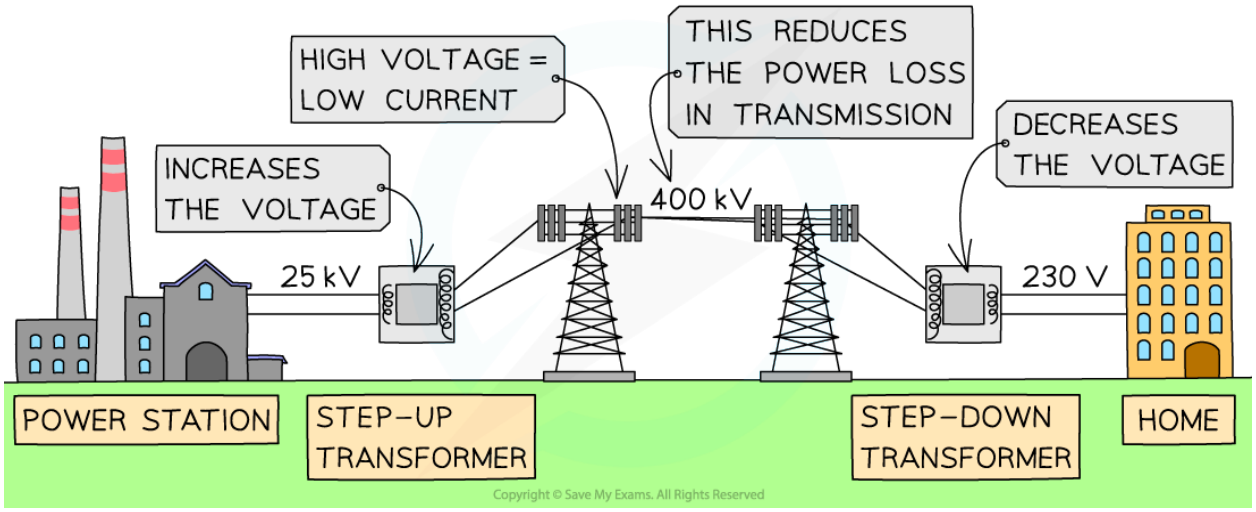
$$E=Q\times V$$

where E is energy in joules (J), Q is charge flow in coulombs (C), and V is potential difference in volts (V).

Useful revision videos on this topic

https://youtu.be/gj1tu8bTKjI?si=jZpI9f1c1imC2_Fk
https://youtu.be/gj1tu8bTKjI?si=eL1ZJBViXImoGqzH

The National Grid



The National Grid is a network of cables and transformers that connects power stations to consumers.

It transfers electrical power from power stations to homes and businesses. Step-up transformers are used at power stations to increase the potential difference for transmission over long distances.

Step-down transformers then reduce this potential difference to a lower, safer level for domestic use.

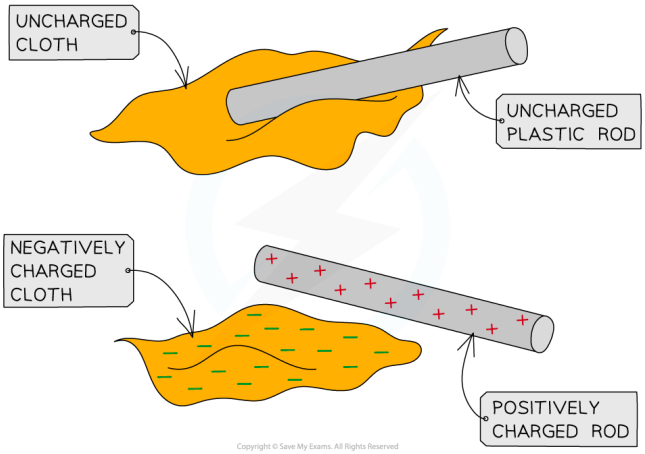
You need to be able to explain why the National Grid is an efficient method for energy transfer - see bullet point below

- High Voltage, Low Current: By using step-up transformers to increase the potential difference (voltage), the current in the transmission cables is reduced. Lower current means less energy is lost as heat due to the resistance in the cables.

Revision Video to help with this

https://youtu.be/iNvGiTn64fQ?si=kuHWrj99IjN9mcbT

Static Electricity (Physics Only)



Rubbing certain insulating materials together can cause them to become electrically charged.

This happens because negatively charged electrons are transferred from one material to another.

The material that gains electrons becomes negatively charged, while the material that loses electrons gets a positive charge.

When two charged objects are near each other, they exert forces on each other without touching, known as non-contact forces.

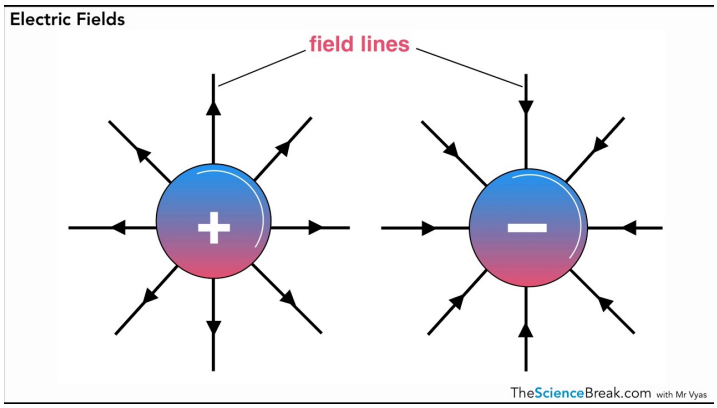
Objects with the same type of charge (either positive or negative) repel each other.
Objects with opposite charges (one positive, one negative) attract each other.

Static electricity, and sometimes sparking, is produced by the rubbing of surfaces.

Revision video to help with this

https://youtu.be/5obbfXg_MH4?si=Cz37iU5nGFp9FurA

Electric Fields (Physics Only)



A charged object generates an electric field around itself.

This electric field is strongest near the charged object and becomes weaker with distance.

When a second charged object is placed in this field, it experiences a force.

The force between the two charged objects increases as they get closer to each other.

Students should learn to draw the electric field pattern for an isolated charged sphere.

Understanding electric fields helps explain the non-contact force between charged objects and other electrostatic phenomena like sparking.

Sparking occurs when a strong electric field causes the air particles between two objects to ionise, creating a path for electrons to jump across the gap.

Revision video to help with this

https://youtu.be/rPbx_XrrKLQ?si=7OliHTuHqNk-GOmx

References to Images used

Physics Words: Plug @ GCSE Science Dictionary
Transformers (6.6.6) | OCR A Level Physics Revision Notes 2017 | Save My Exams
Electric Fields for AQA 9-1 GCSE Physics (Separate) - YouTube
Static Electricity (2.4.2) | AQA GCSE Physics Revision Notes 2018 | Save My Exams
Electricity – St Roberts GCSE Physics (wordpress.com)