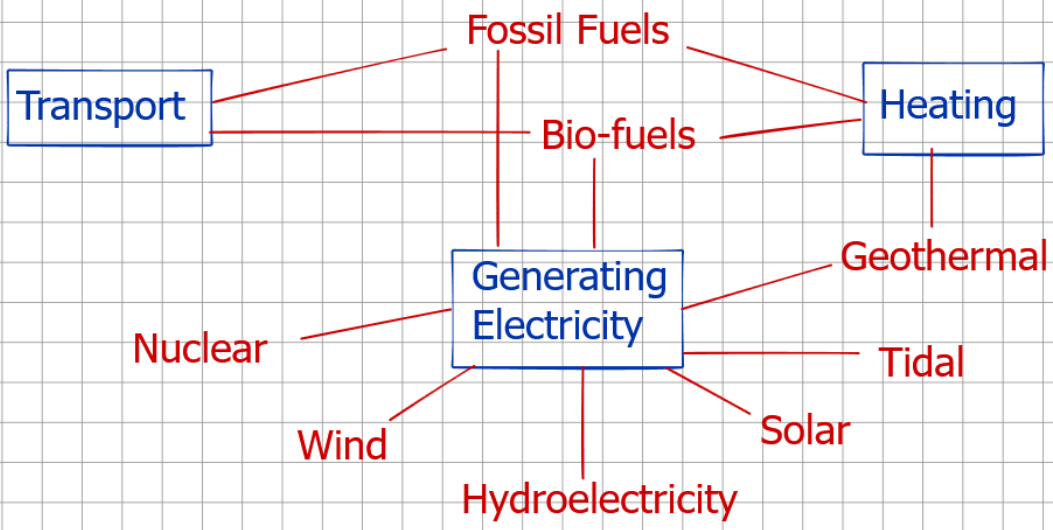
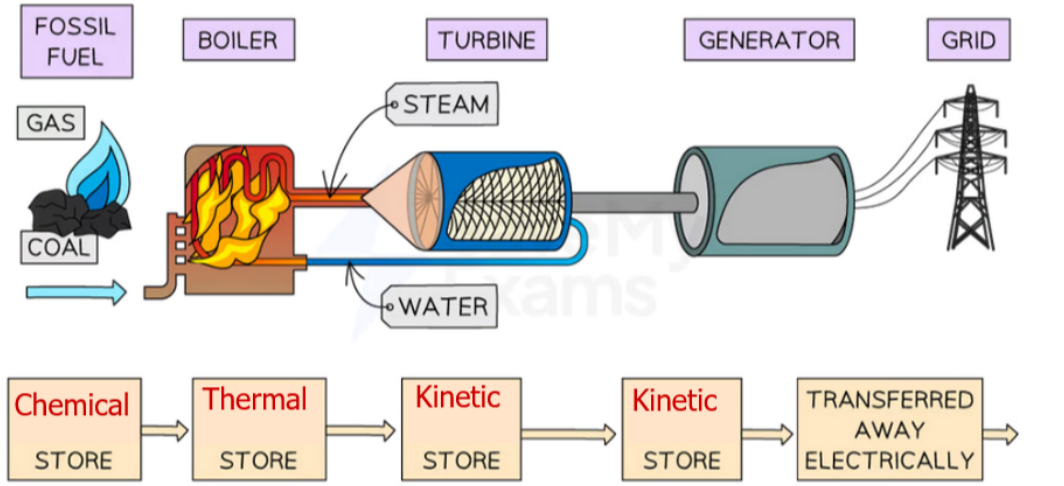
Energy Resources

3rd July

We use energy resources to generate electricity, to power transport and to heat homes and businesses.



Energy Resources	Description
Fossil fuels	Fossil fuels are combusted to heat water to produce steam to turn turbines to generate electricity
Nuclear	Nuclear fuels are reacted to heat water to produce steam to turn turbines to generate electricity
Bio-fuels	Plant matter, ethanol or methane can be produced and used as a fuel in place of fossil fuels
Wind	Wind turns turbines directly to generate electricity
Hydroelectric	Water is stored at a height, and when released, rushing water turns turbines directly to generate electricity
Tidal	The movement of water due to tides turn turbines directly to generate electricity
Geothermal	Hot rocks underground are used to heat water to produce steam to turn turbines which generate electricity
Solar	Solar cells use light to generate electricity, solar panels use thermal radiation to heat water to produce warm water for household use
Water waves	Moving water due to waves turn turbines directly to generate electricity



Some energy resources are NON-RENEWABLE; they will RUN OUT eventually.

We use them at a greater rate than they can be replaced.

Others are RENEWABLE; they WILL NOT RUN OUT

This can be because we replace them at the same/greater rate than we use them.

A RELIABLE resource can produce energy at any time, and a NON-RELIABLE resource only produces energy some of the time.

Energy Resource	Renewable?	Advantages	Disadvantages
Fossil Fuels (Coal, Oil Gas)	N	Reliable. Can produce a lot of energy at short notice.	Produces greenhouse gases (carbon dioxide), which can lead to climate change. Global dimming due to carbon particulates.
Nuclear (Fission)	N	Reliable. No greenhouse gas emissions. High energy density.	Produces radioactive waste which can take thousands of years to decay.
Bio-Fuels	Y	Reliable. 'Carbon-neutral'.	Can take up land and resources that are needed for food production.
Wind	Y	Produces no greenhouse gases.	Unreliable - needs wind to work.
Hydroelectric (falling water)	Y	Reliable and can produce energy at short notice. No greenhouse gases produced.	Can involve flooding a large area, which can destroy wildlife habitats.
Tidal	Y	Predictable. No greenhouse gases.	Very few suitable locations. Can cause damage to habitats and disrupt shipping
Geothermal	Y	Reliable. No greenhouse gases.	Not many places are suitable. Can release polluting gases from the ground e.g. sulfur dioxide.
Solar	Y	No greenhouse gases or pollution.	Not reliable.

AC/DC and Electrical Power

11th Sep

DC (direct current) always flows in the same direction.

This is produced by a DIRECT POTENTIAL DIFFERENCE (polarity of the terminals in the power source does not change i.e. positive stays positive and negative stays negative).

Examples of dc: batteries and dynamos

AC (alternating current) continuously changes direction. All electricity in the home (domestic) is ac.

An ALTERNATING POTENTIAL DIFFERENCE has a changing polarity (i.e. positive and negative terminals keep swapping).

Calculating Electrical Power

Useful relationships: $I = \frac{Q}{t}$ $V = \frac{E}{Q}$ $P = \frac{E}{t}$

$Q = It$ $E = QV$

$P = \frac{QV}{t}$

$P = \frac{I \not{t} V}{\not{t}}$

Power = Current x Potential Difference	$P = IV$

We also know, from Ohm's Law, that $V = IR$

$P = I(IR)$

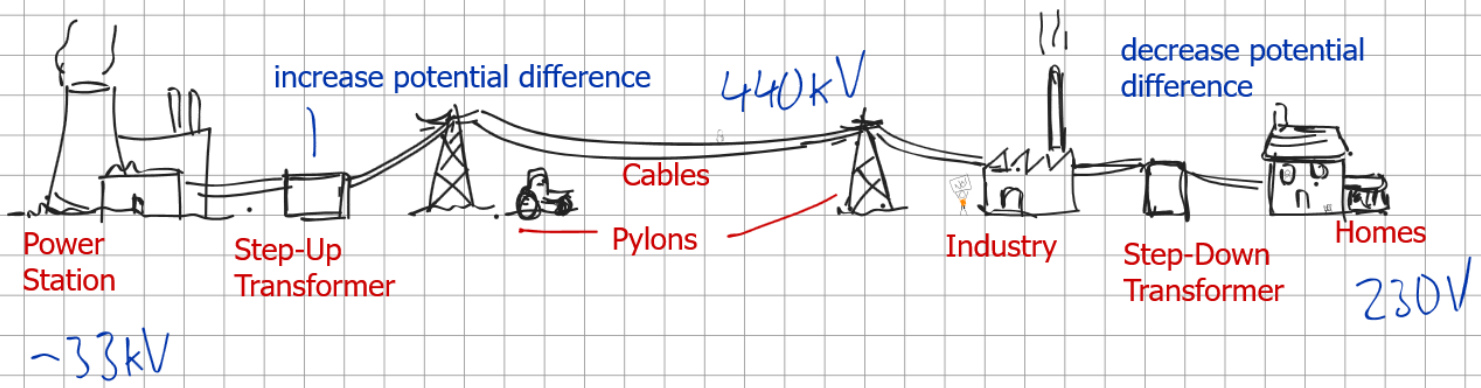
$P = I^2R$

This equation lets us calculate the power dissipated by a component when current flows through it.

The National Grid

12th Sep

The National Grid is a network of CABLES and TRANSFORMERS that connects consumers to power stations across the UK.



We know that the power generated by the power station can be calculated using:

$$P = VI$$

The step-up transformer INCREASES POTENTIAL DIFFERENCE, which means that the CURRENT in the cables DECREASES.

$$P = V\underline{I}$$

stays same ↑ ↓

If we decrease the current we DECREASE the POWER WASTED due to HEATING of the cables, which is calculated using:

$$P = I^2R$$

↓ ↓

The STEP DOWN transformer DECREASES POTENTIAL DIFFERENCE so that it is SAFE to use in the home.

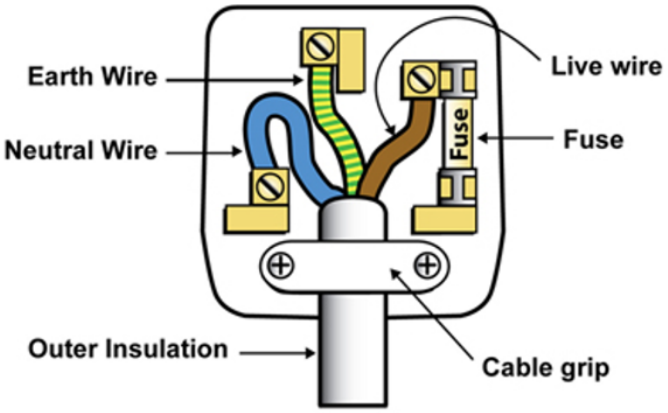
Electricity in the Home

17th Sep

The mains electricity supply in the home has a potential difference of 230 V.

This is an alternating potential difference.

It changes direction with a FREQUENCY of 50 Hertz.



Live wire: At a potential of 230 V. Brown.

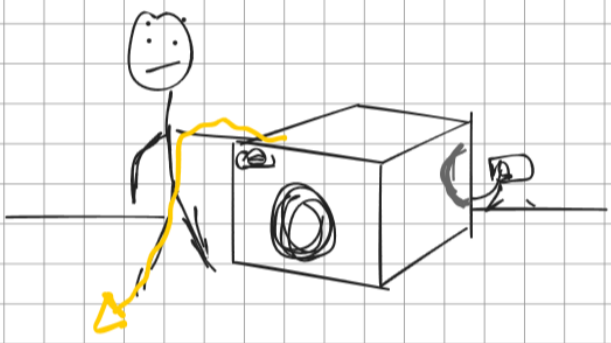
Neutral wire: At a potential of 0 V. Blue.

When a device is working normally its circuit completes the connection between the LIVE and NEUTRAL wires. There is a POTENTIAL DIFFERENCE of 230 V between them, which causes current to flow.

The FUSE is a safety device. If the current gets too high then a wire in fuse melts, and breaks the circuit.

Electrical Safety

24th Sep



If the live wire comes into contact with the metal casing of an appliance, the casing also becomes LIVE.

The ground is at a potential of 0 V.

The casing is at a potential of 230 V.

When the person touches the appliance there is a LARGE POTENTIAL DIFFERENCE which causes a CURRENT to flow.

This is an electric shock.

If this happens and a case becomes live then a LARGE CURRENT would flow through the EARTH WIRE (instead of the person as it has a low resistance).

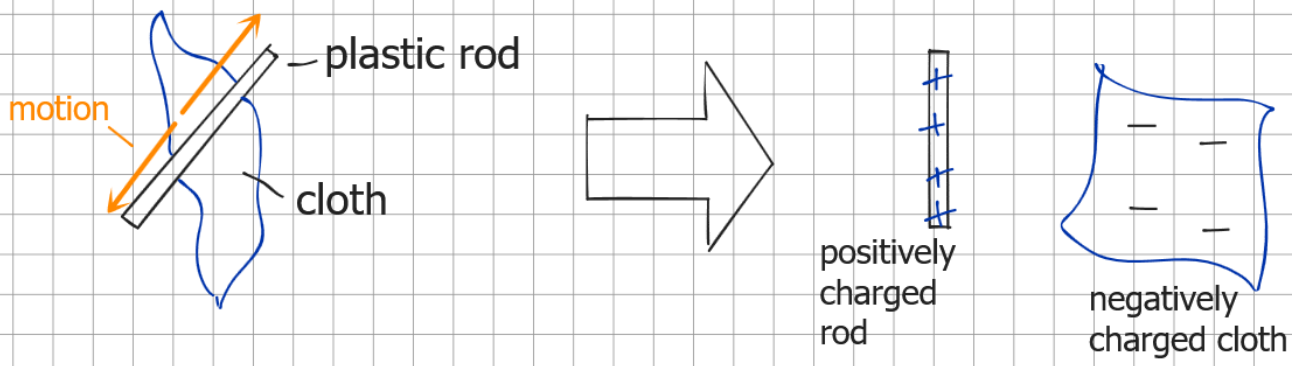
The large current MELTS the FUSE and BREAKS THE CIRCUIT.

Static Electricity

24th Sep

FRICTION between materials can cause ELECTRONS to be transferred between them.

This can cause the materials to become CHARGED, provided that they are not conductive (they don't allow a current to flow through them).



In this example ELECTRONS were transferred FROM THE ROD and TO THE CLOTH.

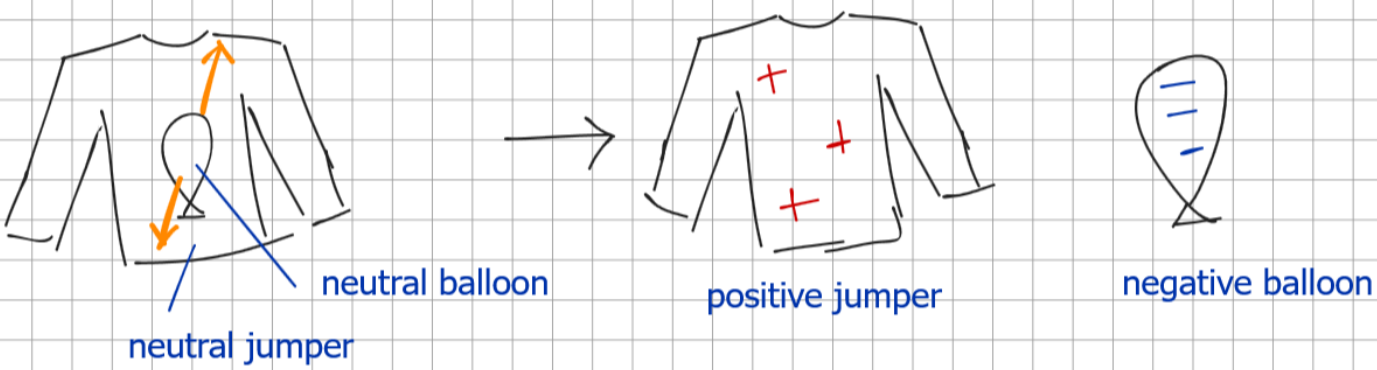
The two objects have OPPOSITE CHARGES, of the SAME MAGNITUDE.

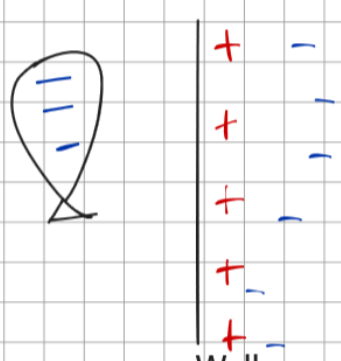
The two objects experience a FORCE OF ATTRACTION.

Two objects with the SAME CHARGE experience a FORCE OF REPULSION.

Induced Charge and Electric Fields

25th Sep





The negative charges (electrons) at the surface of the wall are repelled by the negatively charged balloon (like charges repel).

This INDUCES a positive charge at the wall's surface.

The balloon is attracted to the wall (opposite charges attract).

Electric Fields

26th Sep

The charged cloud induces a positive charge in the kite.

This creates an ELECTRIC FIELD between the cloud and kite.

This can IONISE the air between the two objects.

The ionised air molecules make a region with LOWER RESISTANCE than the surrounding air.

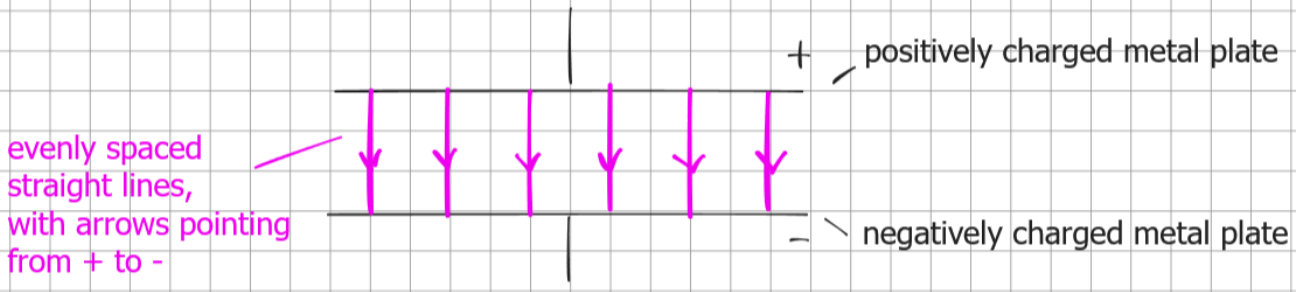
The cloud discharges through the air and through the person to the ground. This is a SPARK.

An ELECTRIC FIELD is a region in space where charged objects experience a non-contact force.

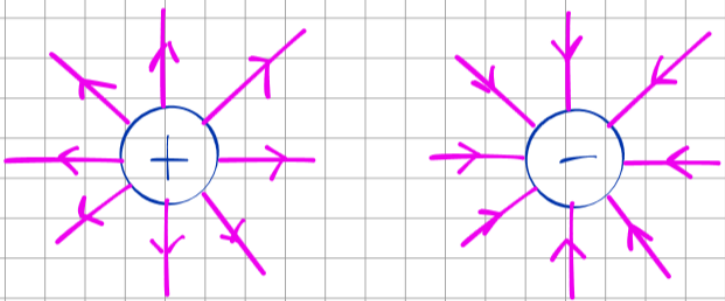
We represent fields in diagrams with FIELD LINES and ARROWS.

- The lines show where the field is
- The spacing of the lines show the strength of the field (closer lines means stronger field)
- The arrows show the DIRECTION OF THE FORCE a POSITIVE CHARGE would experience.

A UNIFORM electric field has the SAME STRENGTH EVERYWHERE:



A charged ball would have a RADIAL FIELD;



The field is stronger closer to the charged object, which is shown in the diagram as the field lines get closer together.

Any force of attraction or repulsion becomes stronger closer to the objects.