Chapter 5: Electricity in the home

Knowledge organiser

Mains electricity

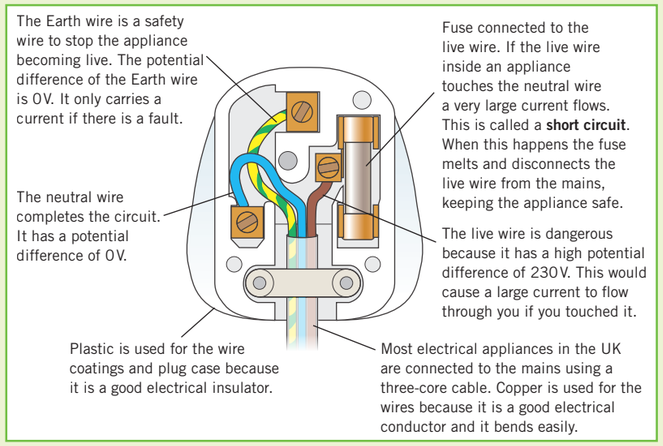
A cell or a battery provides a **direct current (dc)**. The current only flows in one direction and is produced by a **direct potential difference**.

Mains electricity provides an **alternating current (ac)**. The current repeatedly reverses direction and is produced by an **alternating potential difference**.

The positive and negative terminals of an alternating power supply swap over with a regular frequency.

The frequency of the mains electricity supply in the UK is 50 Hz and its voltage is 230 V.

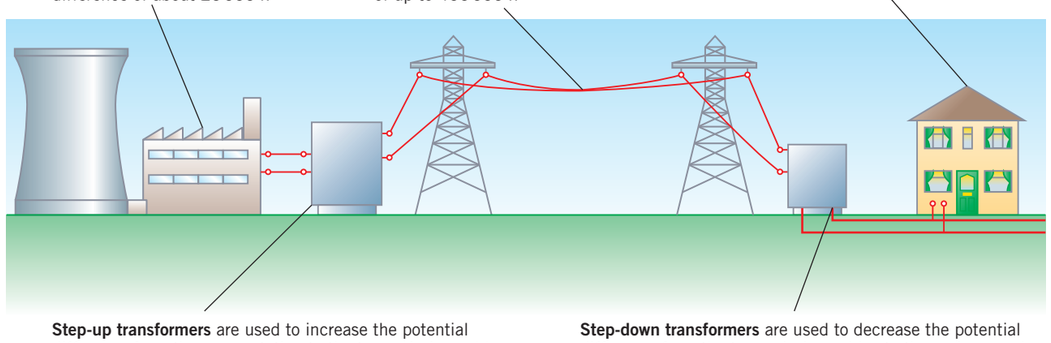
Plugs



The National Grid

The **National Grid** is a nationwide network of cables and transformers that link power stations to homes, offices, and other consumers of mains electricity.

Transformers are devices that can change the potential difference of an alternating current.



By making the grid potential difference much higher, a smaller current is needed to transfer the same power. Therefore, the National Grid is an efficient way to transfer power due to less heating loss in the wire.

Why do transformers improve efficiency?

A high potential difference across the transmission cables means that a lower current is needed to transfer the same amount of power, since:

$$\text{power (W)} = \text{current (A)} \times \text{potential difference (V)}$$

$$P = IV$$ (L)

A lower current in the cables means less electrical power is wasted due to heating of the cables, since the power lost in heating a cable is:

$$\text{power (W)} = \text{current}^2\text{ (A)} \times \text{resistance } (\Omega)$$

$$P = I^2R$$ (L)

This makes the National Grid an efficient way to transfer energy.

If 100% efficiency is assumed:

$$\text{primary potential difference} \times \text{primary current} = \text{secondary potential difference} \times \text{secondary current}$$

$$V_p I_p = V_s I_s$$

Energy transfer in electrical appliances

Electrical appliances transfer energy.

For example, an hairdryer transfers energy electrically from a chemical store (e.g., the fuel in a power station) to the kinetic energy store of the fan inside the hairdryer and to the thermal energy store of the heating filaments inside the hairdryer.

When you turn an electrical appliance on, the potential difference of the mains supply causes charge (carried by electrons) to flow through it.

You can calculate the **charge flow** using the equation:

(L) $$\text{charge flow (C)} = \text{current (A)} \times \text{time (s)}$$

$$Q = It$$

You can find the energy transferred to an electrical appliance when charge flows through it using:

(L) $$\text{energy transferred (J)} = \text{charge flow (C)} \times \text{potential difference (V)}$$

$$E = QV$$

You can find the energy transferred by an electrical appliance using the equation:

(L) $$\text{energy transferred (J)} = \text{power (W)} \times \text{time (s)}$$

Key terms

Make sure you can write a definition for these key terms.

alternating current | alternating potential difference | charge flow | coulombs | direct current | direct potential difference | fuse | National Grid | short circuit | step-down transformer | step-up transformer

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	P5 questions	Answers
1	Why is the current provided by a cell called a direct current (d.c.)?	only flows in one direction
2	What is an alternating current (a.c.)?	current that repeatedly reverses direction
3	What kind of current is supplied by mains electricity?	alternating current
4	What is the frequency and voltage of mains electricity?	50 Hz, 230 V
5	What colours are the live, neutral, and earth wires in a three-core cable?	live = brown, neutral = blue, earth = green and yellow stripes
6	What is the function of the live wire in a three-core cable?	carries the alternating potential difference from the supply
7	What is the function of the neutral wire in a three-core cable?	completes the circuit
8	What is the function of the earth wire in a three-core cable?	safety wire to stop the appliance becoming live
9	When is there a current in the earth wire?	when there is a fault
10	Why is the live wire dangerous?	provides a large p.d. that would cause a large current to flow through a person if they touched it
11	What is the National Grid?	nationwide network of cables and transformers that link power stations to customers
12	What are step-up transformers used for in the National Grid?	increase the p.d. from the power station to the transmission cables
13	What are step-down transformers used for in the National Grid?	decrease the p.d. from the transmission cables to the mains supply in buildings so that it is safe to use
14	How does having a large potential difference in the transmission cables help to make the National Grid an efficient way to transfer energy?	large p.d. means a small current is needed to transfer the same amount of power, small current in the transmission cables means less electrical power is wasted due to heating
15	What two things does energy transfer to an appliance depend on?	power of appliance, time it is switched on for
16	What are the units for power, current, potential difference, and resistance?	watts (W), amps (A), volts (V), ohms (Ω)

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