



P4 Supplying electricity

Main 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**.

Main 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 main electricity supply in the UK is 50 Hz and its voltage is 230 V.

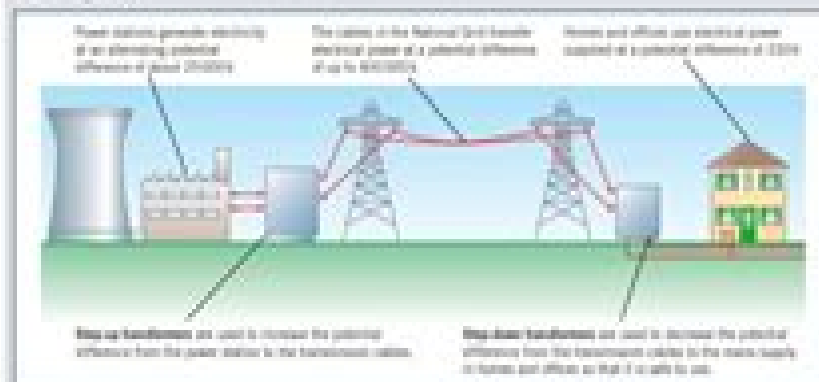
Plugs



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 main electricity.

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



You will learn more about transformers in Chapter 18 of this book.

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:

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

$$P = IV$$

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:

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

$$P = I^2R$$

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:

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

$$Q = It$$

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

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

$$E = QV$$

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

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

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

Remember

This topic has the potential for some high-level maths questions. If you set a question and you can't decide which equation you need to use to solve it, try looking at combinations of equations.

Remember

There are lots of equations in this topic that you need to learn. Find the best way for you to remember them. It could be flashcards, a mnemonic, or changing the lyrics to your favourite song.

Key terms

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

alternating current

alternating potential difference
fuse National Grid

charge flow
short circuit

columns
step-down transformer

direct current
step-up transformer

direct potential difference

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