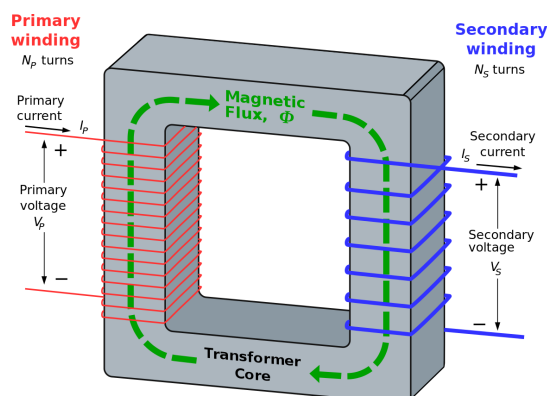


7.5.1 Transformers

Transformers are used to increase ('step up') or decrease ('step down') alternating voltages. Their anatomy is very simple.



They consist of a primary and secondary coil of wire wrapped around a soft iron core. Both primary and secondary coils of wire are coated in electrically insulating material. There is no electrical connection between the primary and secondary coils.

(1) Why does the wire need to be insulated?

When an alternating potential difference is applied across the primary coil, an alternating potential difference is induced across the secondary coil.

If there are more coils ('turns') on the secondary than the primary, the potential difference is increased ('stepped up').

(2) What do you think would happen if there were the less turns on the secondary than the primary?

How a transformer works

From section 7.4, we know that **changing** the magnetic field in a coil of wire induces a potential difference across the ends of the coil. A potential difference is only induced if the magnetic field is **changing** (e.g. moving a magnet towards or away from the coil). No potential difference is induced if the magnetic field is constant (e.g. the magnet is stationary relative to the coil).

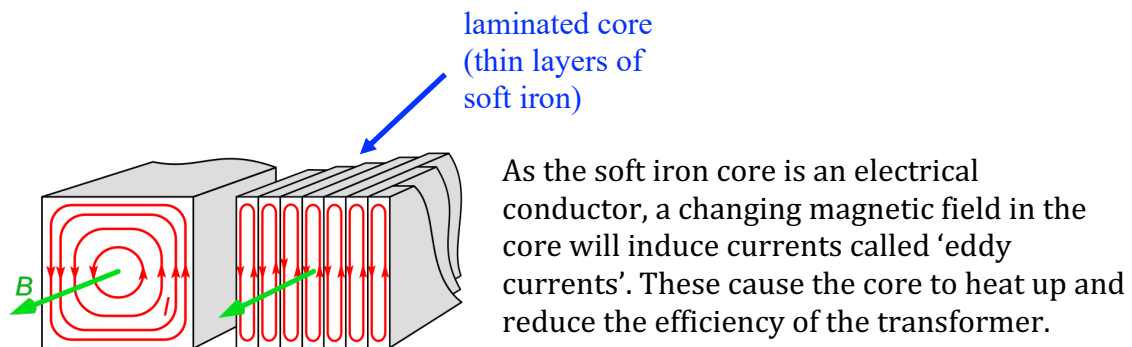
The transformer works by electromagnetic induction in the following way:

- 1) An alternating potential difference across the primary coil causes an **alternating** current to flow in the primary coil.
- 2) An alternating current in the primary coil produces a **changing** magnetic field through the soft iron core.
- 3) The **changing** magnetic field in the soft iron core links to the secondary coil.
- 4) A **changing** magnetic field through the secondary coil induces a potential difference across the secondary coil.
- 5) The potential difference across the secondary coil causes a current to flow in any circuit attached to the secondary coil.

The core is made from 'soft iron'. This means that the iron is easily magnetised and demagnetised, and it loses its magnetisation when removed from a magnetic field.

(3) *Why is a 'soft iron' core needed for transformers? (Hint: Think about what is happening to the magnetic field in the core.)*

(4) *Transformers don't work with direct current (d.c.) supplies. Why? (Hint: Think about the magnetic field produced when there is a steady current in the primary coil and how the potential difference across the secondary coil will respond.)*



One way to reduce eddy currents is to laminate the core.

(5) *Why do you think a thin layer of varnish or plastic is used between the layers of soft iron?*