7 Electricity and magnetism

Magnetic poles

- When two magnets are brought close together they exert a force on each other.
- Two **like** poles **repel** each other. Two **unlike** poles **attract** each other.
- Attraction and repulsion between two magnetic poles are examples of **non-contact force**.
- The field is strongest at the poles of the magnet.

Permanent and induced magnets

- Induced magnetism always causes a force of **attraction.**
- When removed from the magnetic field, an induced magnet **loses** most/all of its magnetism quickly.
- To increase the strength of a solenoid you can increase the current, adding more turns or add an iron core.

Compass

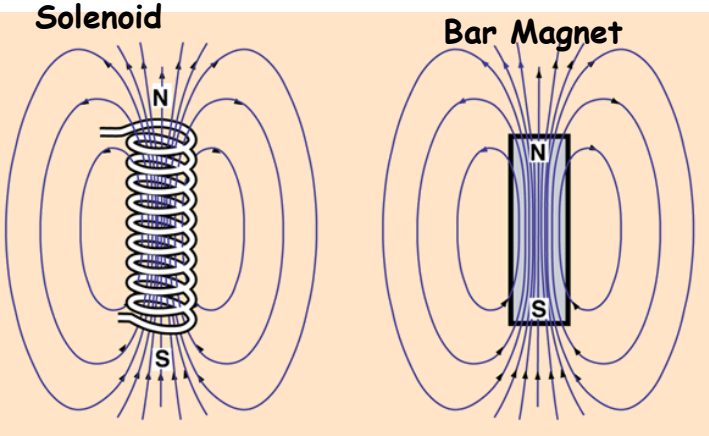
- A magnetic compass contains a small bar magnet. The Earth has a magnetic field.
- The compass needle points in the direction of the Earth's magnetic field.

Shapes of magnetic fields.

NOUT SIN
(North OUT South IN)

Solenoid

Adding an **iron core** increases the strength.

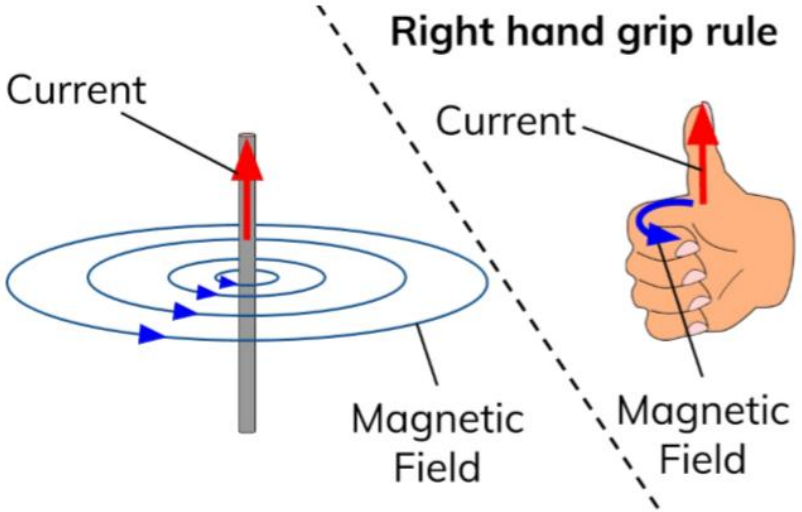


Definitions

Magnetic field -the region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt, and nickel).
Pole – the places where the magnetic forces are strongest.
Permanent magnet produces its own magnetic field.
Induced magnet is a material that becomes a magnet when it is placed in a magnetic field.
Electromagnet – a Solenoid with an iron core.

Current in a wire

- When a current flows through a conducting wire a magnetic field is produced around the wire.
- The strength of the magnetic field depends on the current through the wire and the distance from the wire.



Higher Tier only

The motor effect

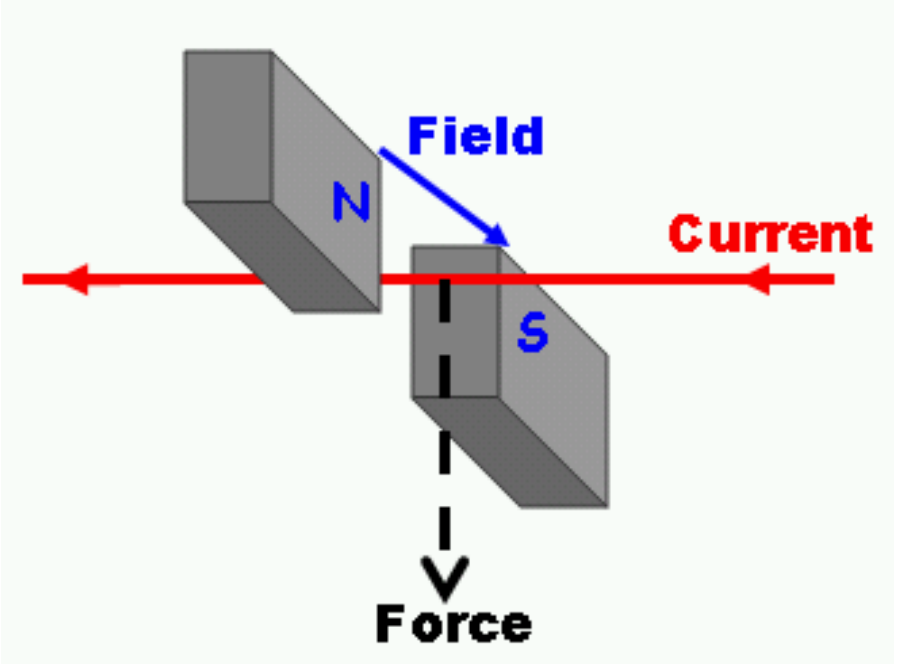
The motor effect is the term used when a current-carrying wire in the presence of a magnetic field experiences a force.

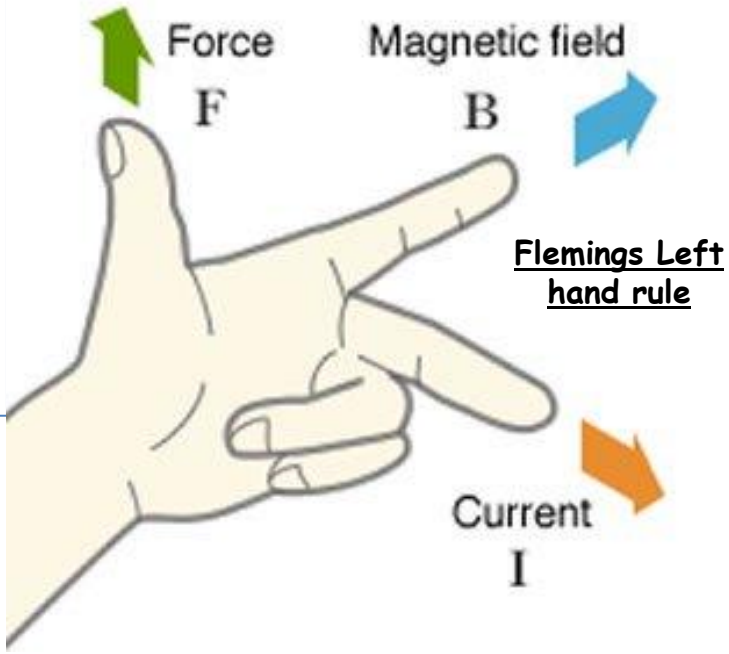
You can **reverse** the direction of the force by reversing the current or the field.

The size of the force on the conductor depends on:

- the **magnetic** flux density
- the **current** in the conductor
- the **length** of conductor in the magnetic field

A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor.





Flemings Left hand rule

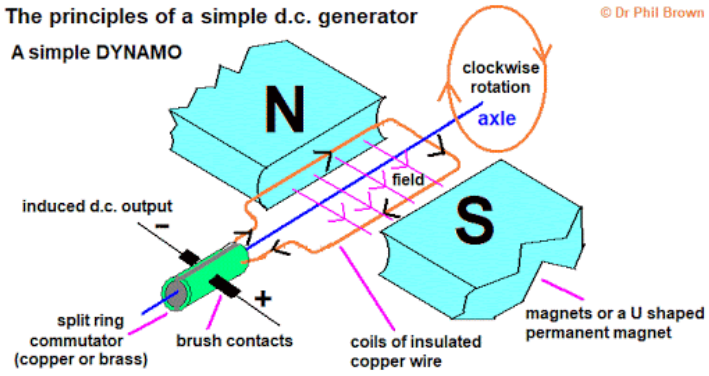
Triple only

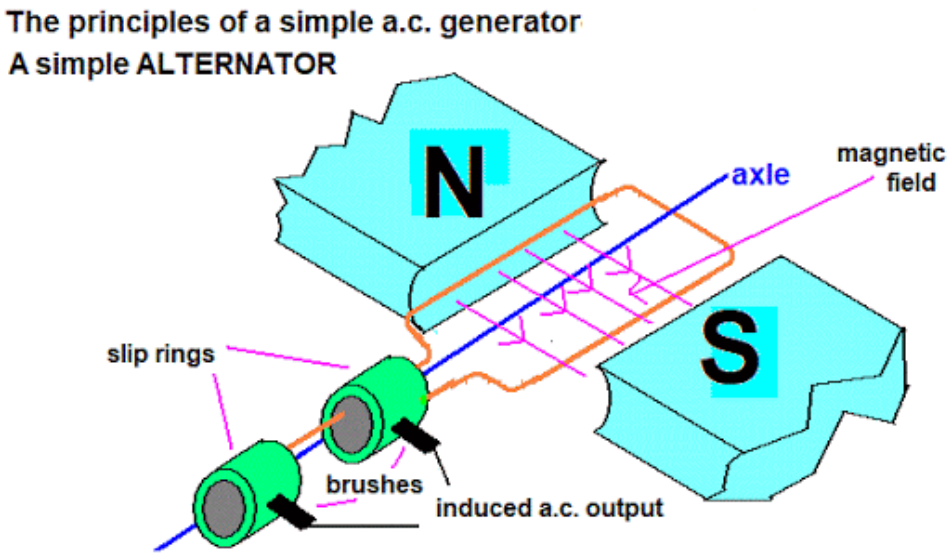
Loud speakers, headphones and microphones

- Loudspeakers and headphones use the motor effect to convert variations in **current** in electrical circuits to **sound waves** by causing a cone to move.
- Microphones use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits.

Transformer

- A basic transformer consists of a **primary coil** and a **secondary coil** wound on an **iron core**.
- Iron is used as it is easily magnetised.
- An alternating current in the primary coil of a transformer produces a changing magnetic field in the iron core and hence in the secondary coil. This induces an alternating potential difference across the ends of the secondary coil.
- If the secondary coil is part of a complete circuit an induced current will flow in the secondary coil.
- If transformers were 100% efficient, the electrical power output would equal the electrical power input.
- Power is transmitted at **high potential differences** along the National Grid.





The generator effect

- This consists of a **coil of wire** rotating in a **magnetic field**
- A current is induced when the magnet **moves** relative to the coil.

A current can be induced if:

- the magnet is held stationary and the **coil is moved**
- the **magnet is rotated** close to the coil.

The size of the induced potential difference (and so induced current) can be increased by:

- increasing the **speed** of movement
- increasing the **strength** of the magnetic field
- using more **turns** on the solenoid.
- If the direction of motion of the conductor or the polarity of the magnetic field is reversed, the direction of the induced potential difference and any induced current is reversed.
- The generator effect is used in an **alternator** to generate a.c. and in a **dynamo** to generate d.c.