

## Force fields and electromagnets

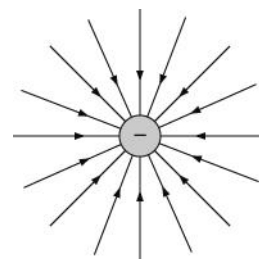
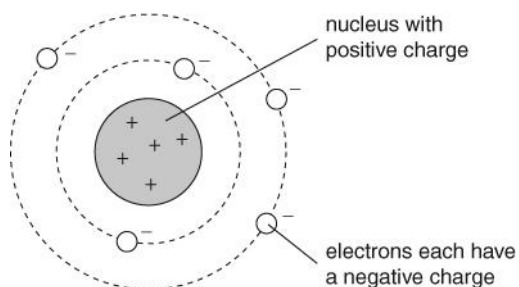
### Static electricity

An **atom** consists of a central **nucleus** with small particles called **electrons** moving around it. An atom normally has no overall **charge** because it has the same number of positive and negative charges.

When you rub two materials together, electrons may be transferred from one material to the other. If the objects are insulating materials, the object that gains electrons has a negative charge of **static electricity**. The object that loses electrons has a positive charge.

A positively charged object will attract a negatively charged object. Two objects with the same charge (both positive or both negative) will repel each other.

The space around a charged object where it will attract or repel other charged objects is its **electric field**. The arrows on the diagram show the direction a positive charge would move.



### Resistance

The **resistance** of a component is a way of saying how easy or difficult it is for an electric current to flow through it. The size of a current depends on the resistance of the circuit and on the voltage that is 'pushing' the current:

- the higher the voltage, the higher the current (if the resistance stays the same)
- the higher the resistance, the lower the current (if the voltage stays the same).

All metals conduct electricity, but some metals are better conductors than others. The resistance of a wire depends on:

- the material from which it is made
- its length (longer wires have higher resistances)
- its thickness (thicker wires have lower resistances).

### Calculating resistance

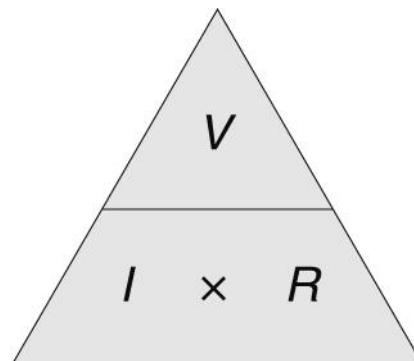
The units for measuring resistance are **ohms**, and the symbol is the Greek letter omega ( $\Omega$ ).

Voltage, resistance and current are related by this formula:

$$\text{voltage} = \text{current} \times \text{resistance}$$

To calculate a resistance, you need to measure the current in amps and the voltage in volts.

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

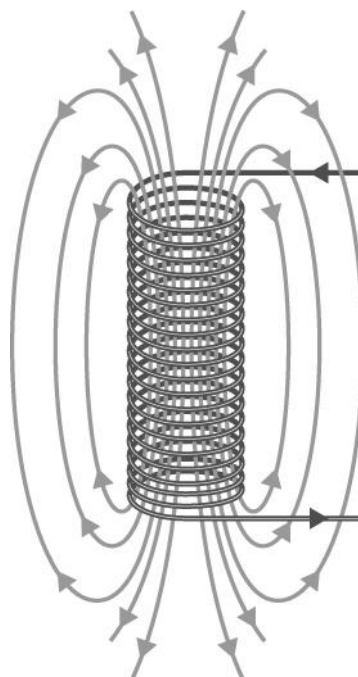


## Electromagnets

A bar magnet is a **permanent magnet**, because it is always magnetic. A wire with electricity flowing through it has a **magnetic field** around it. An **electromagnet** is a coil of wire with an electric current flowing through it. It is only magnetic while the current is flowing. The shape of the magnetic field of an electromagnet is similar to the magnetic field of a bar magnet.

You can make an electromagnet stronger by:

- increasing the number of coils of wire
- increasing the size of the current (by increasing the voltage)
- using an iron core.



## Motors

If a wire carrying a current crosses a magnetic field, the wire will experience a force. This is the **motor effect**.

An electric motor consists of a coil of wire in a magnetic field. When there is a current in the coil, there is a force on each side of the coil that makes it turn.

The speed of the motor (or the force it provides) can be increased by:

- increasing the size of the current
- increasing the strength of the magnetic field
- increasing the number of turns of wire on the coil.

