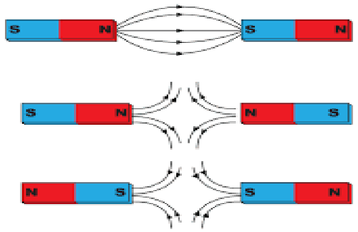
Topic 7 – Magnetism and Electromagnetism

science physics

Magnets



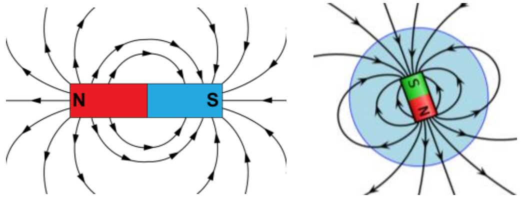
2 like poles will repel
2 unlike poles will attract
Magnetic materials Iron, steel (contains iron), nickel and cobalt

Permanent magnet – produces its own magnetic field and can attract or repel another magnet
Induced magnet – Becomes a magnet when it is placed in a magnetic field (temporary and can only attract another material)

Magnetic field

'A region around a magnet where a magnetic material will experience a force'

Magnetic field goes North to South.
Magnetic field is strongest at the poles
The strength of the magnetic field decreases the further you get from the magnet

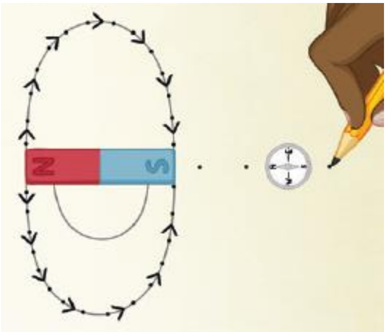


The way a compass needle behaves tells us the earths core is magnetic

Plotting a magnetic field

Plotting compasses can be used to show the magnetic field.

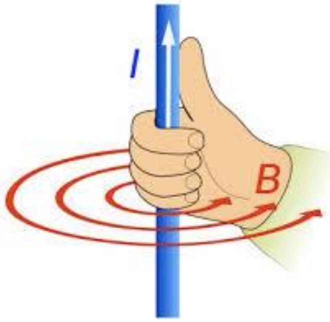
Place them around the bar magnet
Mark the direction of the arrow at each point
Join the arrows to show the magnetic field.



Magnetic Field around a current carrying wire

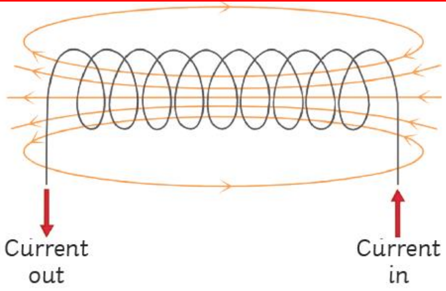
When a current flows through a wire, a circular magnetic field is produced around the wire. It is stronger closer to the wire.

Right hand grip rule shows the direction of the magnetic field.



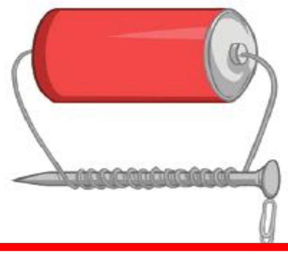
Solenoids

A solenoid is a coiled wire. This increases the strength of the magnetic field. It is strong and uniform (the same strength everywhere) inside the coil



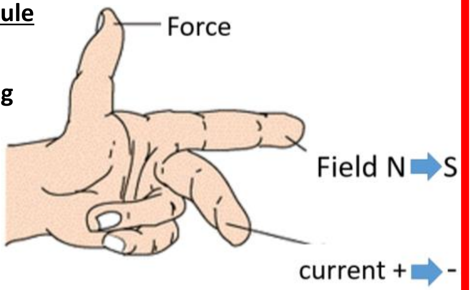
Electromagnets

A solenoid with an iron core.
Electromagnets are induced magnets that can be turned on and off
The magnetic field can be increased by:
1. Adding turns of wire onto the coil
2. Increasing Current
3. Adding an iron Core



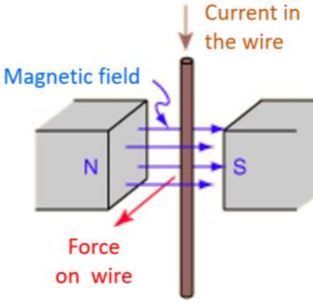
HT Flemming's Left Hand Rule

This is use to show the direction of the Force acting on a current carrying conductor placed in a magnetic field. The motor effect



HT The Motor Effect:

A current carrying conductor will experience a force if it is placed cutting a magnetic field. The conductor will not experience a force if it is parallel to the magnetic field conductor in the field (m)



HT The Motor Effect Equation

$$F = BIL$$

force (N), = magnetic flux density (T) x current (A) x length (m)

F : force (N),

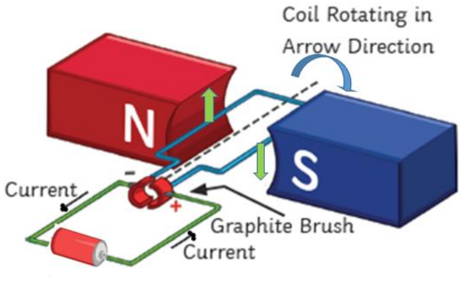
B : magnetic flux density (T) or (Tesla)

I : the current (A) or (Amps)

L is the length of the wire in the field (m)

HT The Motor

The forces on the sides of the coil ↑↓ cause it to turn. The split ring commutator and brush contacts maintain an electrical contact, switching the current direction in the coil every half turn. Without these the coil would come to rest in a vertical position

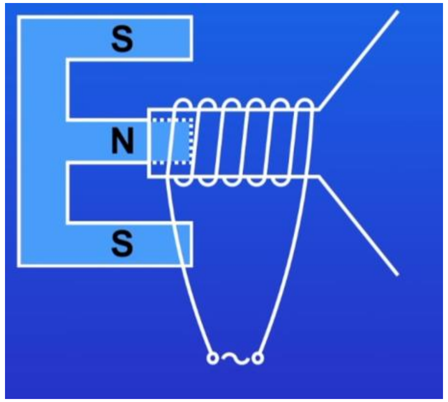


The force on a motor can be increased by: increasing the strength of the magnetic field increasing the size of the current. This will make it turn faster. The direction it turns can be changed by reversing the current or the magnets

Topic 7 – Magnetism and Electromagnetism Physics only content

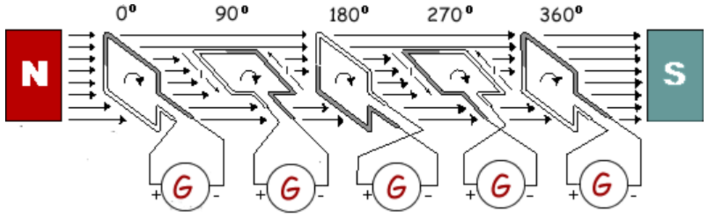
Loud speakers and headphones

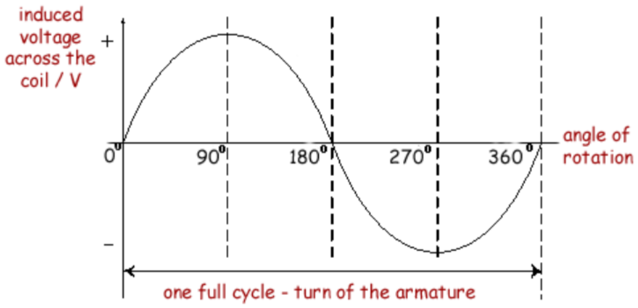
An alternating current flows in the coil, this is in a magnetic field so a force acts on the coil to move it in and out. The vibration of the coil is at the same frequency as the a.c and produces a sound wave also at the same frequency



Generator effect

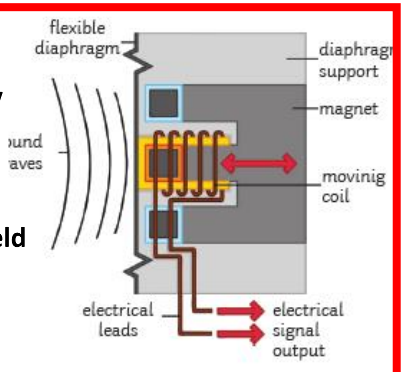
If a magnet is moved into a coil of wire or a coil is turned in a magnetic field then a potential difference is induced across the ends of the coil.
Dynamos generate d.c
Alternators generate a.c





Microphones

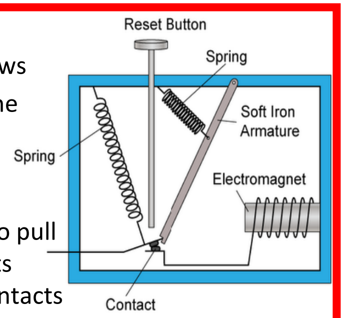
These work the opposite way to loudspeakers. The sound wave causes a flexible diaphragm to vibrate, this moves a coil in a magnetic field and this generates a.c of the same frequency as the sound wave



Use of electromagnet 1 : Circuit Breaker

Turns off a circuit if too much current flows

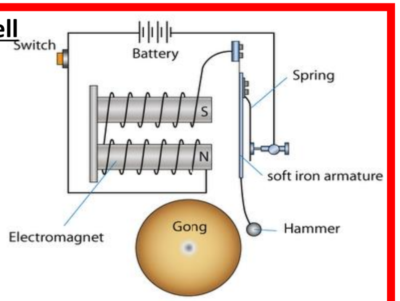
- The electromagnet turns on when the circuit is made
- It attracts the iron armature
- If the current gets too high the electromagnet gets strong enough to pull the armature away from the contacts
- The large spring can now pull the contacts apart breaking the circuit



Use of electromagnet 2 : Electric Bell

Uses a make and break circuit

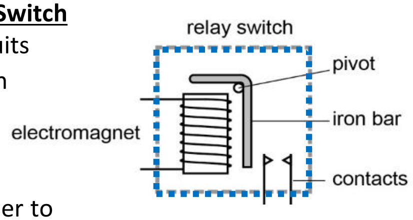
- The electromagnet turns on
- It attracts the iron armature
- Which pulls the hammer to strike the bell
- Breaking the contacts
- Turning off the electromagnet
- The spring pulls the armature back to make the circuit again



Use of electromagnet 3 : Relay Switch

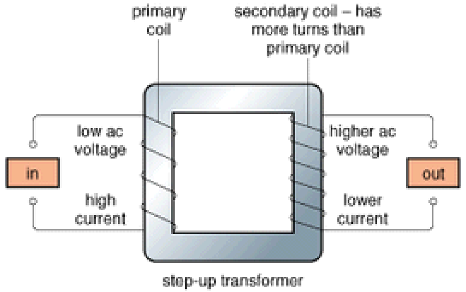
Used to control high power circuits

- The electromagnet turns on
- Attracts the iron bar
- Which rocks on the pivot
- Pushing the contacts of the higher power circuit together to turn it on

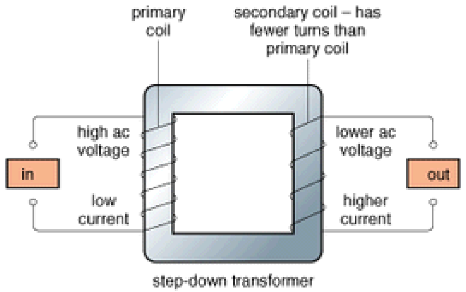


Transformers

- The transformer has an iron core which is easily magnetized
- An alternating current is provided to the primary coil
- This induces a changing magnetic field in the iron core
- This induces an alternating current in the secondary coil



In a step-up transformer the potential difference across the secondary coil is more than the potential difference across the primary coil.



In a step-down transformer the potential difference across the secondary coil is less than the potential difference across the primary coil.

Transformer equation:

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Vp and Vs are the primary and secondary potential differences

Np and Ns are the primary and secondary turns on the coils

If transformers are 100% efficient, the electrical power output would equal the electrical power input (Watts) P=V x I

$$V_p \times I_p = V_s \times I_s$$

Ip and Is : primary and secondary current in the coils

The National Grid: Transformers are used in the national grid. A step up transformer increases the p.d before the electricity is transmitted across the country. This reduces the current in the transmission cables. A low current means less heat is generated and so less energy is lost due to heating in the cables.