Physics: Electromagnetism

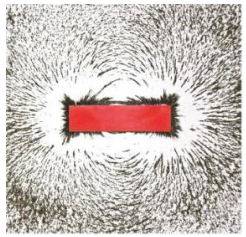
1. Magnets	
Force rule	Opposite poles attract, like poles repel
Magnetic materials	Iron, cobalt, nickel and steel are the only magnetic metals
Magnetic field	The region around the magnet
Induced magnetism	To produce a magnet
2. Induced Magnetism	
Current	Flow of negative electrons
Current Carrying wire	When an electric current passes along a wire, a magnetic field is set up around the wire
Corkscrew rule	Turn the corkscrew clockwise and it moves down, turn the corkscrew anticlockwise and it moves up
Solenoid	Long coil of insulated wire, used in devices, produces a strong magnetic field
Electromagnet	A solenoid wrapped around an iron bar
Induced magnetism	Produces a temporary magnet
3. Magnetic Fields	
Straight wire	Field lines are circular, perpendicular to the wire
Inside a solenoid	Field lines are parallel to the axis of the solenoid
Outside a solenoid	Field line is a complete loop because it passes inside and outside the solenoid
4. Electromagnetic devices	
Scrapyard crane	Scrap vehicles lifted using a powerful electromagnet
Circuit breaker	A switch in series with an electromagnet. When the current is too large, the switch is pulled open and breaks the circuit
Electric bell	When connected to a battery, the iron armature is pulled onto the electromagnet. This opens the make or break switch, and the electromagnet is switched off, the armature springs back and the make or break switch closes again.
Relay	Used to switch an electrical machine on or off, uses a small current on a machine with a larger current
5. The Motor Effect	
The motor effect	A force acting on a wire in a magnetic field when a current is passed through the wire
Increasing the force	The size of the force can be increased by increasing the current and/or using a stronger magnet
Size of the force	Size of the force depends on the angle between the wire and the field lines
Greatest force	When the wire is perpendicular to the magnetic field lines
Zero force	When the wire is parallel to the magnetic field lines
Fleming's left hand rule	Tells you how force, magnetic field and current are related to each other

6. Generator effect	
Generator	Contains a coil of wire that spins in a magnetic field, a potential difference is induced across the ends of the wire when it crosses the magnetic field lines
Electromagnet induction	Happens when a conductor crosses through magnetic field lines
Increasing the p.d.	The faster a conductor crosses the magnetic field lines the larger the p.d. is induced
Alternator	A simple alternating current generator. A rectangular coil that is forced to spin in a magnetic field.
Alternating p.d.	The faster the coil rotates the bigger the frequency of the alternating current
Dynamo	A direct current generator
Moving coil microphone	Generates an alternating p.d. as sound waves make the coil vibrate
Moving coil loudspeaker	Creates sound waves when and alternating p.d. is applied to the coil
7. Transformers	
Transformer	Electrical device used to change an alternating voltage. Two coils of insulated wire wrapped around the same iron core.
Step up transformer	Electrical device used to step up the size of the alternating voltage. Used in the national grid to increase the voltage which decreases the current so it reduces power loss and makes the national grid more efficient
Step down transformer	Electrical device used to step down the size of the alternating voltage
Primary coil	Connected to an a.c. supply
Secondary coil	Connected to component
8. Magnetic Flux Density	
A measure of the strength of the magnetic field	

Figure 1: Magnetic Flux density equation

$$\underset{\text{(newtons, N)}}{\textbf{force, } F} = \underset{\text{(tesla, T)}}{\textbf{magnetic flux density, } B} \times \underset{\text{(amperes, A)}}{\textbf{current, } I} \times \underset{\text{(metres, m)}}{\textbf{length, } l}$$

Figure 2: Two methods used to identify the pattern of the magnetic field lines



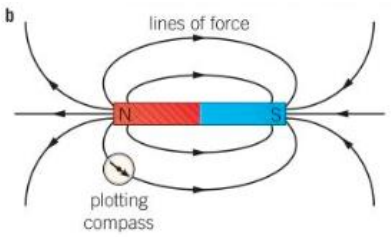


Figure 3: Pattern of the magnetic field in a straight wire

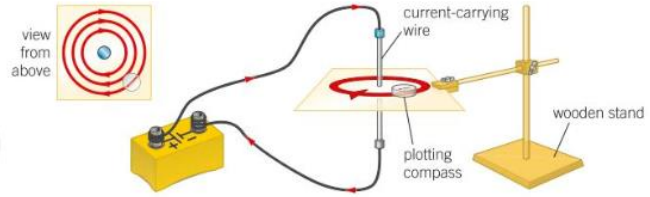


Figure 3: Pattern of the magnetic field in a solenoid

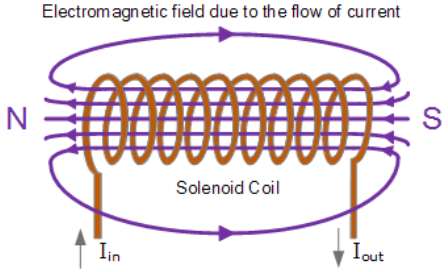


Figure 4: Simple motor

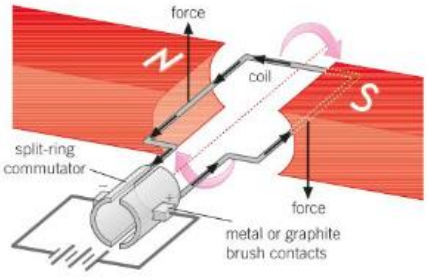


Figure 5: Examples of electromagnets

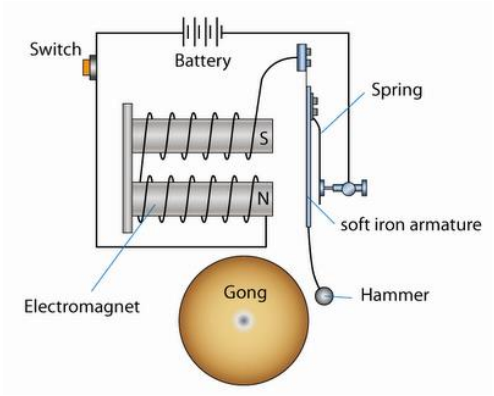
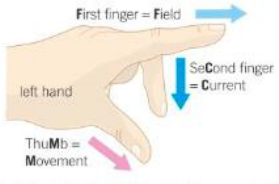


Figure 6: Fleming's left hand rule



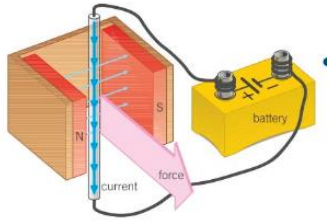
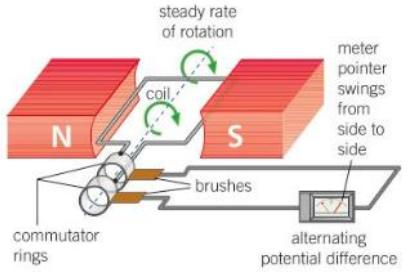


Figure 7: Alternating Generator and oscilloscope display



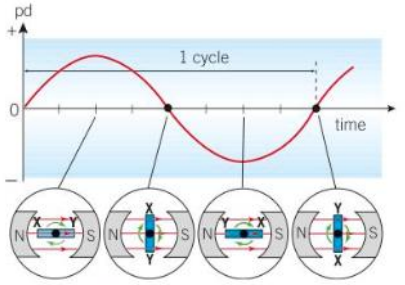


Figure 8: Transformer equation

$$\frac{\text{potential difference across primary coil, } V_p}{\text{potential difference across secondary coil, } V_s} = \frac{\text{number of turns on primary coil, } n_p}{\text{number of turns on secondary coil, } n_s}$$