P7 Knowledge Organiser – 4.7.1 - Magnetism

Poles of a Magnet
The poles of a magnet are the places where the magnetic forces are strongest. 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.

Permanent Magnets
A permanent magnet produces its own magnetic field.

Like poles repel
Opposite poles attract

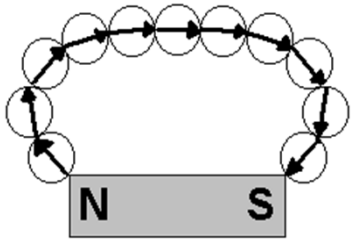
Induced Magnets
An induced magnet is a material that becomes a magnet when it is placed in a magnetic field. Induced magnetism always causes a force of attraction. When removed from the magnetic field an induced magnet loses most/all of its magnetism quickly.

Electromagnetism
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. Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. The magnetic field inside a solenoid is strong and uniform. The magnetic field around a solenoid has a similar shape to that of a bar magnet. Adding an iron core increases the strength of the magnetic field of a solenoid. An electromagnet is a solenoid with an iron core.

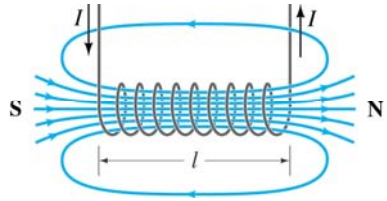
Motors
A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor. The size of the force can be increased by increasing the current or using a stronger magnet. The size of the force depends on the angle between the wire and the magnetic field. The force is greatest when the wire is perpendicular to the magnetic field and zero when the wire is parallel.

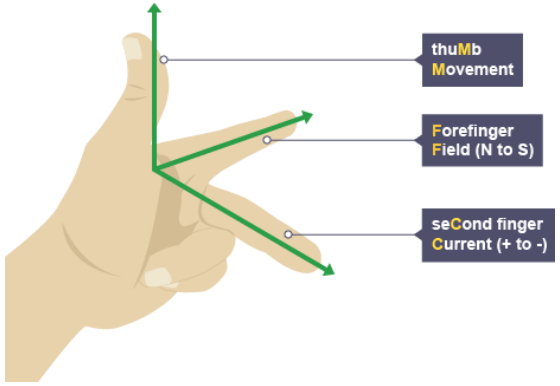
Magnetic Fields
The region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt and nickel) is called the magnetic field. The force between a magnet and a magnetic material is always one of attraction. The strength of the magnetic field depends on the distance from the magnet. The field is strongest at the poles of the magnet. The direction of the magnetic field at any point is given by the direction of the force that would act on another north pole placed at that point. The direction of a magnetic field line is from the north (seeking) pole of a magnet to the south(seeking) pole of the magnet.

Plotting a Magnetic Field
Mark a dot near the north pole of a bar magnet and place the tail of the compass needle above the dot and mark a second dot at the tip of the needle. Repeat this with the tail of the next compass over the new dot until you reach the south pole. Repeat this with further lines.



Solenoids
A solenoid is a long coil of insulating wire and they are used in lots of electrical devices where a strong magnetic field is needed. When a current is passed through the wire the magnetic field increases in strength if the current is increased and reverses in direction if the current is reversed.





Flemings Left Hand Rule (HT)
When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the conductor exert a force on each other. **This is called the motor effect**. You need to be d be able to show that Fleming's left-hand rule represents the relative orientation of the force, the current in the conductor and the magnetic field.

Magnetic Flux Density
For a conductor at right angles to a magnetic field and carrying a current:

Force = Magnetic Flux Density x Current x Length

Quantity	Symbol	Unit
Force	*F*	N
Magnetic Flux Density	*B*	T
Current	*I*	A
Length	*l*	m

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Uses of the Generator Effect (Physics HT only)

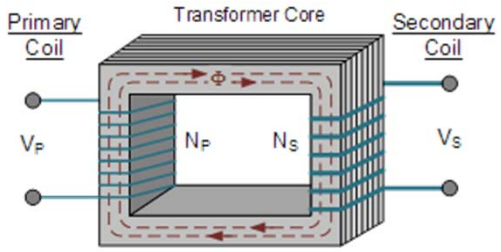
The generator effect is used in an alternator to generate ac and in a dynamo to generate dc.

Loudspeakers (Physics HT only)

Loudspeakers and headphones use the motor effect to convert variations in current in electrical circuits to the pressure variations in sound waves.

How Transformers Work (Physics HT only)

Two coils of insulated wire are wound around an iron core. The primary coil is connected to ac and when the current passes through the primary coil potential difference is induced in the secondary coil.



Efficiency of a Transformer.

If transformers were 100% efficient the electrical power output would equal the electrical power input. This is represented by the equation:

V x I = V x I

Induced Potential (Physics HT only)

If an electrical conductor moves relative to a magnetic field or if there is a change in the magnetic field around a conductor, a potential difference is induced across the ends of the conductors. If the conductor is part of a complete circuit a current is induced in the conductor. **This is called the generator effect.**

An induced current generates a magnetic field that opposes the original change, either the movement of the conductor o the change in magnetic field. The size of an induced potential current/potential difference is affected by the strength of a magnetic field, the speed at which the conductor crosses through the lines of the magnetic field.

Transformers (Physics HT only)

A basic transformed is made up of a primary coil and a secondary coil wound on an iron core. Iron is used as the core as it is easily magnetised. For each of these coils they have a number of turns and a potential different across the coil. You can calculate the number of turns or potential difference for either of these coils using the equation:

$$\frac{\text{Potential Difference Across Primary Coil}}{\text{Potential Difference Across Secondary Coil}} = \frac{\text{Number of Turns On Primary Coil}}{\text{Number of Turns On Secondary Coil}}$$

In a step up transformed the voltage of the secondary coil is greater than the voltage of the primary coil while in a step down transformed the voltage of the secondary coil is less than the voltage of the primary coil.

Quantity	Symbol	Unit
Potential Difference Across Primary Coil	V_p	V
Potential Difference Across Secondary Coil	V_s	V
Primary Coil Number of Turns	N_p	
Secondary Coil Number of Turns	N_s	
Primary Coil Current	I_p	A
Secondary Coil Current	I_s	A