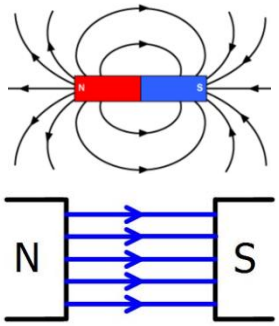
P10-11: Magnetism and electromagnetic induction

Knowledge Organiser

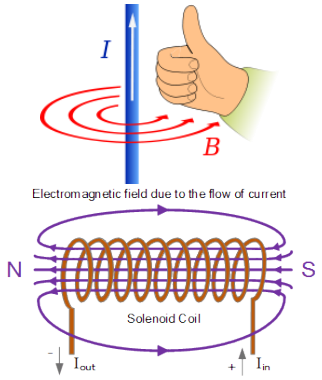
Lesson sequence

1. Magnets and magnetic fields
2. Electromagnetism
3. Magnetic forces (HT)
4. Transformers
5. Transformers and energy

1. Magnets and magnetic fields	
***Permanent magnet**	A magnet that is always magnetic.
***Temporary magnet**	A magnet that is not always magnetic.
****nduced magnet**	When something becomes temporarily magnetic when close to another magnet.
***Uses of magnets**	Motors, loud speakers, generators, door locks, knife holders.
****Magnetic field**	The area of magnetic force around a magnet.
***Bar magnet field shape**	Curved lines going from north to south
****Uniform magnetic field shape**	When the north of one magnet is near the south of another, straight field lines connect them.
***Magnetic field direction**	From north to south
****Plotting a magnetic field**	Draw around a magnet. Place a plotting compass on it and draw a small arrow to show needle direction. Move a cm in that direction and repeat. Connect arrows to form lines. Repeat.
****Earth's magnetic field**	The North Pole is a magnetic south pole (because it attracts the north of bar magnet).

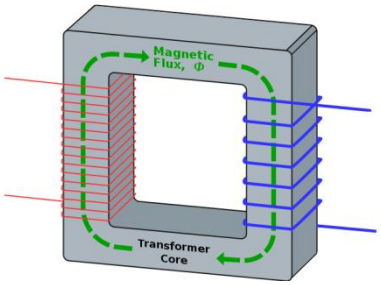


2. Electromagnetism	
***Electromagnetism**	Current flowing through a wire creates a magnetic field around it.
***Wire magnetic field shape**	Concentric circles.
***Wire magnetic field strength**	Stronger nearer the wire and with higher current.
***Wire magnetic field direction**	Right hand rule – thumb points towards negative, field in same direction as fingers.
****Solenoid**	A coil of wire with current running through it.
****Solenoid magnetic field shape**	Outside: similar to bar magnet. Inside: almost uniform
****Solenoid magnetic field direction**	From negative to positive.
****Electromagnet**	A temporary magnet made by placing an iron core inside a solenoid.



3. Magnetic forces (HT)	
***Motor effect**	Force produced when the magnetic field from a permanent magnet pushes a magnetic field from a wire.
****Direction of force from motor effect**	Flemming's left-hand rule – index finger points in direction of magnetic field, middle finger points from + to – current, thumb points in direction of force.
****Force from motor effect is greatest when…**	Magnetic field and electric field are at right angles, wire is longer, current is greater, magnet is stronger.
****Magnetic flux density, B**	The strength of a magnetic field.
****Newtons per amp metre (N / A m)**	Units of magnetic flux density.
****Tesla, T**	Same as newtons per amp metre.
****Calculating forces from the motor effect**	Force = magnetic flux density x current x length F = B x I x L Force = newtons Magnetic flux density = teslas Current = amps Length = metres

4. Transformers	
***Transformer**	A device that changes the potential difference of a an electricity supply.
***Electromagnetic induction**	When voltage in one coil of wire causes a voltage in another.
****Transformer structure**	Two coils of wire wrapped around an iron core. Current goes in the primary coil and comes out from the secondary coil.
****How transformers work**	Current passing through the primary coil induces a current in the secondary coil of higher voltage and lower current 9or vice versa).
****Conservation of energy in transformers**	If the voltage increases, the current decreases, so energy is conserved since: Power = current x voltage
****Transformer calculations**	Primary current x primary voltage = secondary current x secondary voltage $V_p \times I_p = V_s \times I_s$ Voltage = volts Current = amps



5. Transformers and energy	
***National grid**	The system of cables and transformers that transfers electricity from power stations to homes and businesses.
***Voltage in the national grid**	Power station = 25 kV Overhead cables = 400 kV Factories = 33 kV Homes = 230 V
***Step-up transformer**	Increase voltage and decreases current.
***Step-down transformer**	Decrease voltage and increases current.
****Factors affecting the potential difference induced in a transformer**	Coils: more coils → higher voltage Frequency: how many times the magnetic field changes or moves past the wire
****Transformers and current**	Transformers only work with alternating current.