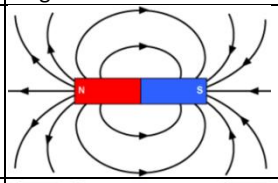
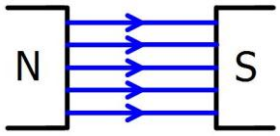
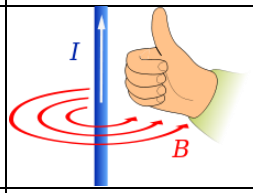
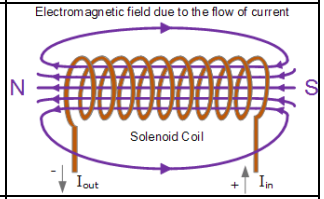
CP10 Magnetism and the Motor effect / CP11 Electromagnetic Induction

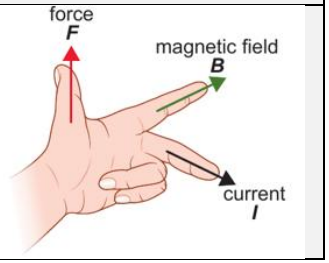
1. Magnets and magnetic fields

Permanent magnet	A magnet that is always magnetic.
Temporary magnet	A magnet that is not always magnetic.
Induced 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	
Uniform magnetic field shape	
Magnetic field lines	From north to south
Earth's magnetic field	The North Pole is a magnetic south pole (because it attracts the north of bar magnet).

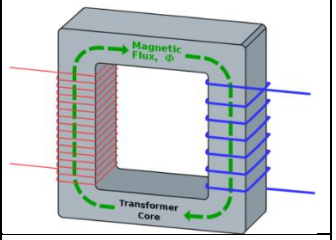
2. Electromagnetism

Electromagnetism	Current flowing through a wire creates a magnetic field around it.
Wire magnetic field shape direction (right hand rule)	
Wire magnetic field strength	Stronger nearer the wire and with higher current.
Solenoid	A coil of wire with current running through it.
Electromagnet	A temporary magnet made by placing an iron core inside a solenoid.
Solenoid magnetic field shape	
Solenoid magnetic field direction	From negative to positive.

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	
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 an electricity supply.
Electromagnetic induction	When voltage in one coil of wire causes a voltage in another.
Transformer structure	
Coils	Primary coil electricity in, secondary coil electricity out
How transformers work	Current passing through the primary coil induces a current in the secondary coil of higher voltage and lower current or 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.

Reviewed AKI August 2022