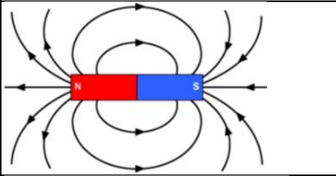
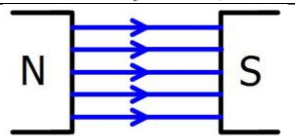
Triple only

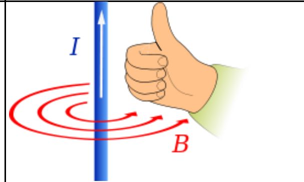
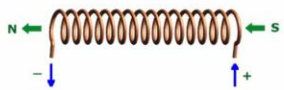
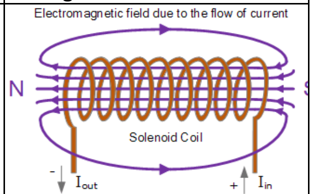
P12 Magnetism and the Motor effect / P13 Electromagnetic Induction

P12a Magnets and magnetic fields

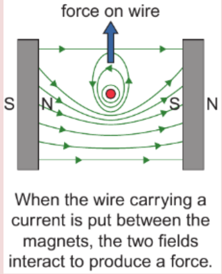
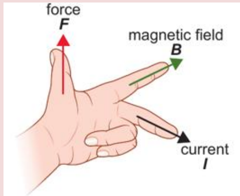
Magnet	An object that has its own magnetic field around it.
Permanent magnet	A magnet that is always magnetic such as a bar magnet.
Temporary magnet	A magnet that is not always magnetic, such as an electromagnet or an induced magnet.
Induced magnet	A piece of magnetic material that becomes a magnet because it is in the magnetic field of another magnet.
Uses of magnets	Motors, loud speakers, generators, door locks, knife holders.
Magnetic field	The area of magnetic force around a magnet where it can affect magnetic materials or induce a current.
Magnetic field lines	Magnetic field lines are a visual tool used to represent magnetic fields.
Bar magnet field shape	
Uniform magnetic field shape	
Magnetic field direction	From North to South.

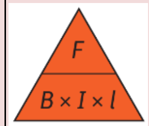
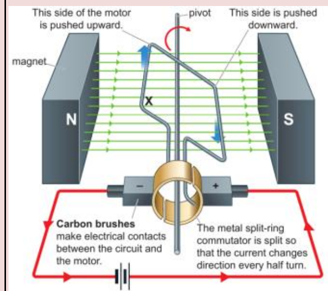
Earth's magnetic field	The North Pole is a magnetic south pole (because it attracts the north of bar magnet).
Magnetic materials	A material, such as iron, steel, nickel and cobalt that is attracted to a magnet.
Plotting compass	A small compass used to find the shape of a magnetic field.

P12b Electromagnetism

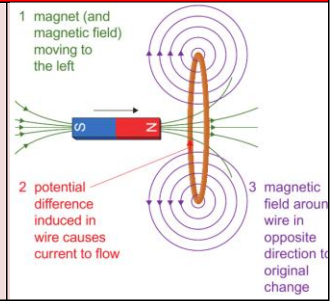
Electromagnetism	Is the study of the electromagnetic force.
Magnetic effect	A current flowing through a wire causes a magnetic field.
Wire magnetic field shape direction (right hand rule)	
Wire magnetic field strength	Stronger nearer the wire and with higher current.
Solenoid	A coil of wire with current running through it. 
Electromagnet	A magnet made using a coil of wire with electricity flowing through it.
Solenoid magnetic field shape	
Solenoid magnetic field direction	From north (negative side) to south (positive side).
Stronger magnetic field of a solenoid	The magnetic field of a solenoid can be made stronger by putting a piece of iron (an iron core) inside the coil or increasing the current.

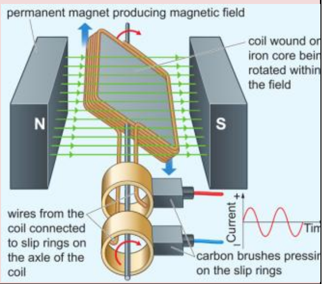
Higher only P12c Magnetic forces

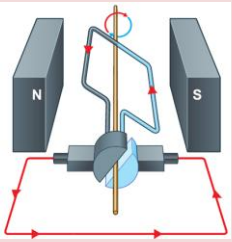
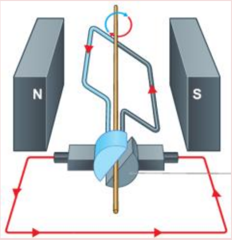
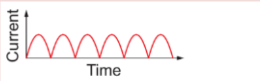
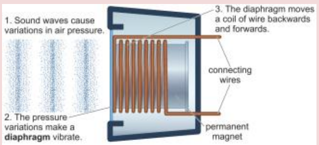
Motor effect	The force experienced by a wire carrying a current that is placed in a magnetic field.
Two magnetic fields interaction	
Direction of force from motor effect	Fleming's left-hand rule – index finger points in direction of magnetic field, middle finger points from + to – current, thumb points 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 (F) = newton (N) Magnetic flux density (B) = tesla (T) Current (I) = amp (A) Length (L) = metre (m)
Electric motor	An electric motor is an electrical machine that converts electrical energy into mechanical energy. 
Split-ring commutator	The commutator ensures that the current is always flowing in the correct direction to make the coil continue to spin.

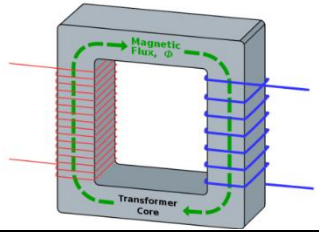
Higher only P13a Electromagnetic induction

Induced voltage (current) in a loop of wire	

Electromagnetic induction	A process that creates a current in a wire when the wire is moved relative to a magnetic field, or when the magnetic field around it changes.
Induce	To create. For example, a wire in a changing magnetic field has a current induced in it.
Factors affecting the potential difference induced in a transformer	- the number of turns in a coil of wire - how fast the magnetic field changes or moves past the coil
Generators	Generator is a dynamo alternator or similar machine for converting mechanical energy into electricity.
Alternator	A machine for converting mechanical energy into electrical energy (alternating current).
Alternator – how it works	The coil of wire rotates inside a magnetic field. As the coil turns, a voltage is induced in the wire. The ends of the coil are connected to slip rings. 
Slip rings	A ring in a dynamo or electric motor which is attached to and rotates with the shaft, passing an electric current to a circuit via a fixed carbon brush pressing against it.
Carbon brushes	A small block of carbon used to carry current between the stationary and moving parts of an electric generator or motor.

Dynamo	A machine for converting mechanical energy into electrical energy (direct current).
Dynamo – how it works	The coil of wire rotates inside a magnetic field. As the coil turns, a voltage is induced in the wire. The ends of the coil are connected to commutator.    The commutator swaps the connections every half-turn so the current in the external circuit always flows in the same direction.
Microphones	Microphones convert the pressure variations in sound waves into variations in current in electrical circuits. 
Loudspeakers	Loudspeakers convert variations in an electrical current into sound waves.

P13b The National grid

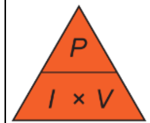
National grid	The system of cables and transformers that transfers electricity from power stations to homes and businesses.
Transmission lines	The wires (overhead or underground) that take electricity from power stations to towns and cities.
Voltage in the national grid	Power station = 25 kV Overhead cables = 400 kV Factories = 33 kV Homes = 230 V
Transformer	A device that can change the voltage of an electricity supply.
Step-up transformer	Increase voltage and decreases current.
Step-down transformer	Decrease voltage and increases current.
Transformer structure	
Coils	Primary coil electricity in, secondary coil electricity out.

Higher only

Transformers and current	Transformers only work with alternating current.
Alternating current	Current whose direction changes many times each second.
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).

Voltage across the coils calculations	$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$ $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ N – number of turns in the coil N_p – primary coil N_s – secondary coil V_p – voltage primary coil V_s – voltage secondary coil

P13b Transformers and energy

Potential difference or voltage	Is a measure of the energy transferred by each coulomb of charge that flows through a wire.
Electrical power	The amount (rate) of energy transferred per second. The units are watts (W). Electrical power = Current x Voltage P = I x V  Power (P) = watt (W) Current (I) =amp (A) Voltage (V) = volt (V)
Conservation of energy in transformers	If the voltage increases, the current decreases, so energy is conserved since: Power = current x voltage
Conservation of energy in transformers	The power supplied to a transformer in the primary coil must be equal to the power transferred away from the secondary coil.

Transformer calculations	Primary coil voltage x primary coil current = secondary coil voltage x secondary coil current $V_p \times I_p = V_s \times I_s$ Voltage (V) = volt (V) Current (I) = amp (A)
Primary coil voltage VS Secondary coil voltage	The potential difference (voltage) is greater in the primary coil if it has more turns than the secondary coil.
Higher only	
Power calculations	power (W) = $\frac{\text{energy transferred (J)}}{\text{time taken (s)}}$, $P = \frac{E}{t}$ electrical power (W) = current (A) × potential differer electrical power (W) = current squared (A)² × resistar

Lesson	Memorised?
P12a Magnets and magnetic fields	
P12b Electromagnetism	
P12c Magnetic forces	
P13a Electromagnetic induction	
P13b The National grid	
P13c Transformers and energy	