Magnetism Basics

3rd Feb

Magnetic forces are NON-CONTACT forces. They can have an effect at a distance.

The area where a magnetic object experiences this force is called a MAGNETIC FIELD.

Four examples of magnetic materials: IRON, COBALT, NICKEL and STEEL.

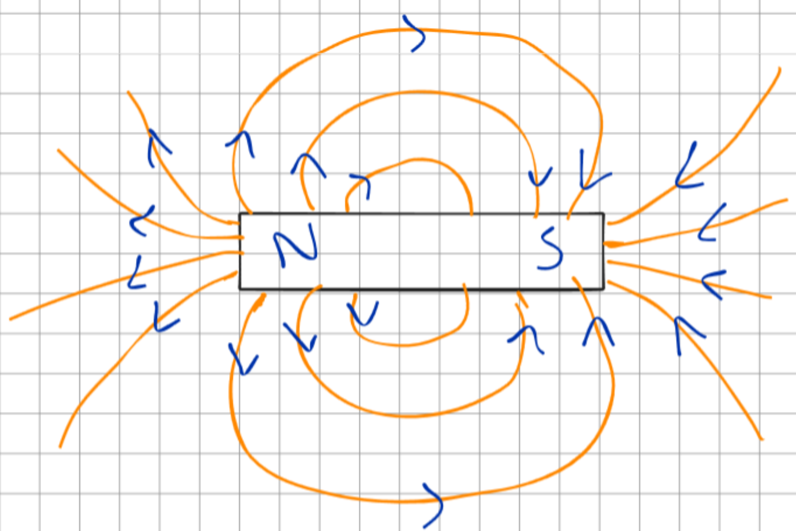
We can draw diagrams to show the SHAPE, STRENGTH and DIRECTION of a magnetic field.

Shape: we use continuous lines to show where the field is

Strength: the closer the lines, the stronger the field

Direction: shows the direction of the force a north pole would feel (the direction a compass needle would point)

Example - field around a bar magnet



When two PERMANENT MAGNETS (such as a bar magnet) are placed next to each other they can ATTRACT each other or REPEL each other.

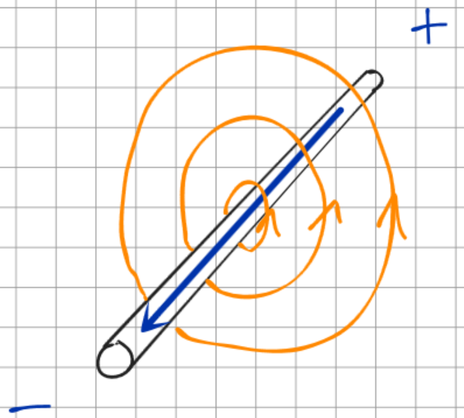
Opposite magnetic poles ATTRACT, like poles REPEL.

If a magnetic material i.e. a piece of iron is placed next to a permanent magnet it becomes temporarily magnetic (INDUCED MAGNET). The force between an INDUCED MAGNET and PERMANENT MAGNET is ALWAYS ATTRACTIVE.

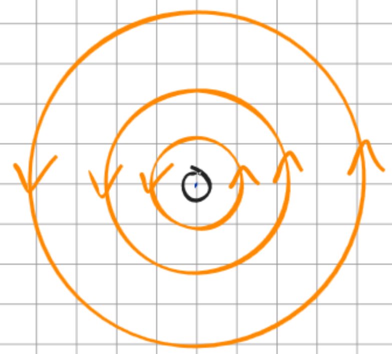
Electromagnets

6th Feb

When a current flows in a wire it CREATES A MAGNETIC FIELD around the wire.



Wire with current coming out of the page towards me, in 3D

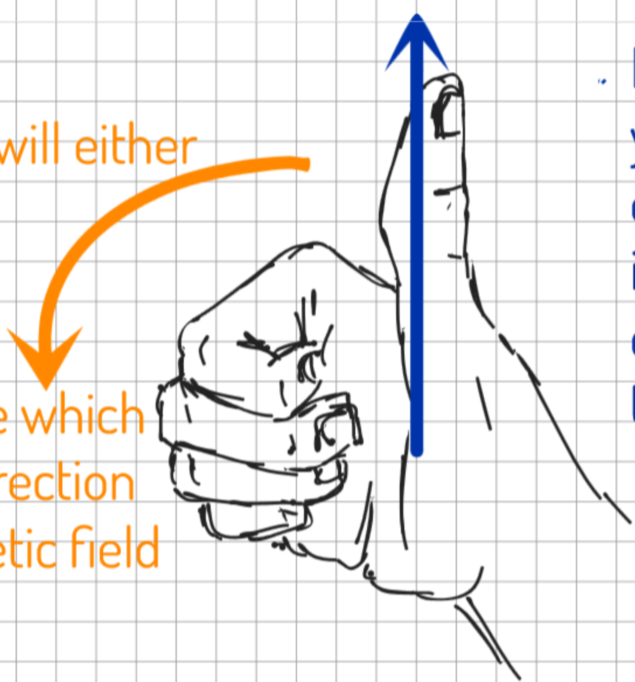


Wire with current coming out of the page towards me, in 2D

Note: always draw at least 3 field lines

We can use the RIGHT HAND THUMB RULE to get the direction of the magnetic field correct.

Your fingers will either curl around clockwise or anticlockwise which shows the direction of the magnetic field



Point the thumb on your RIGHT HAND in the direction of the CURRENT in the wire (remember current flows from POSITIVE to NEGATIVE in a circuit).

We can increase or decrease the strength of the field by increasing or decreasing the size of the current. We can also change the direction of the field by changing the direction of the current (by swapping the connections to the power supply).

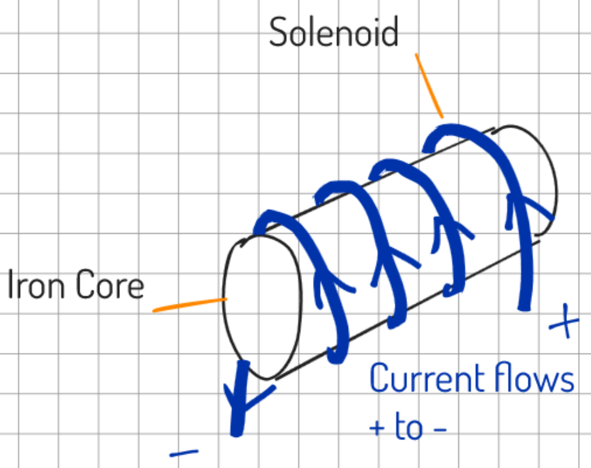
We can also turn the field on and off, by switching the circuit on or off.

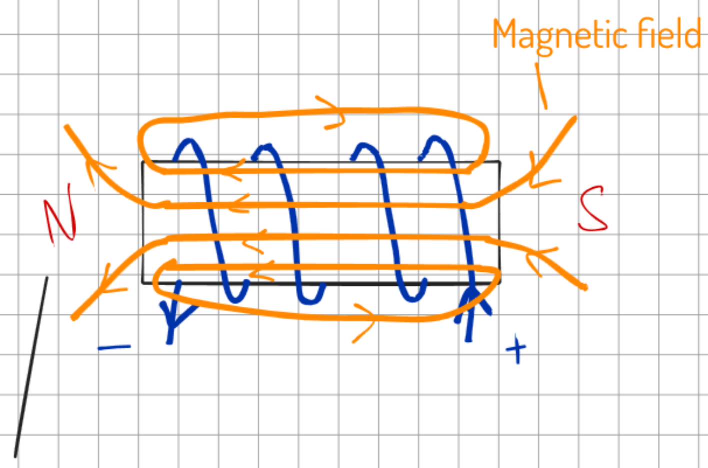
Making Electromagnets

11th Feb

When we pass a current through a wire we create a magnetic field around the wire. To make the field stronger we can INCREASE the current in the wire.

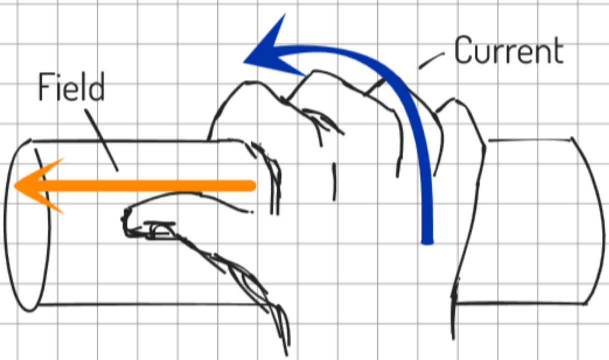
We can also wrap the wire into a coil (called a SOLENOID). The magnetic field around and through a solenoid is much stronger.





Field lines appear to come out of this end, so we can label this end as a 'North Pole'.

We can use the RIGHT HAND GRIP RULE to find the direction of the field INSIDE the solenoid.



Curl your fingers in the direction of the current AROUND THE SOLENOID.

Your thumb shows the direction of the FIELD INSIDE THE SOLENOID.

The Motor Effect

13th Feb

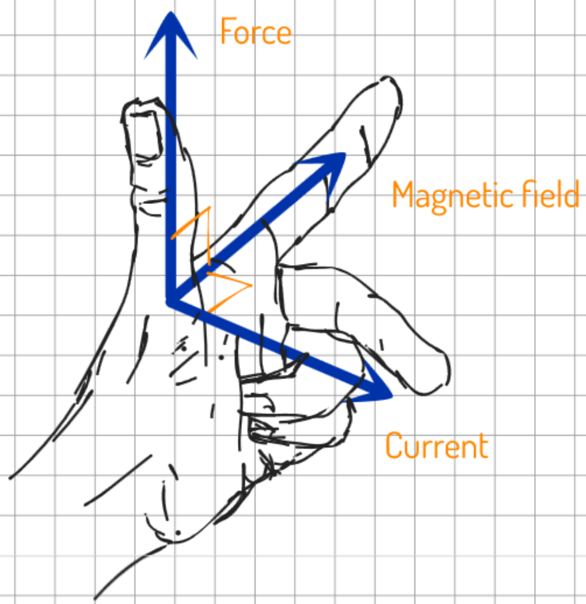
When a conductor carries a current it has a magnetic field around it.

If this conductor is placed in another magnetic field, then the TWO FIELDS INTERACT.

This interaction causes a FORCE.

This is called the MOTOR EFFECT.

We can determine the direction of this force using FLEMING'S LEFT HAND RULE.



- Point your INDEX FINGER in the direction of the permanent magnetic field (N to S)
- Rotate your left hand until your MIDDLE FINGER points in the direction of the CURRENT in the wire (+ to –)
- Your THUMB then shows the direction of the FORCE ON THE WIRE.

The Motor

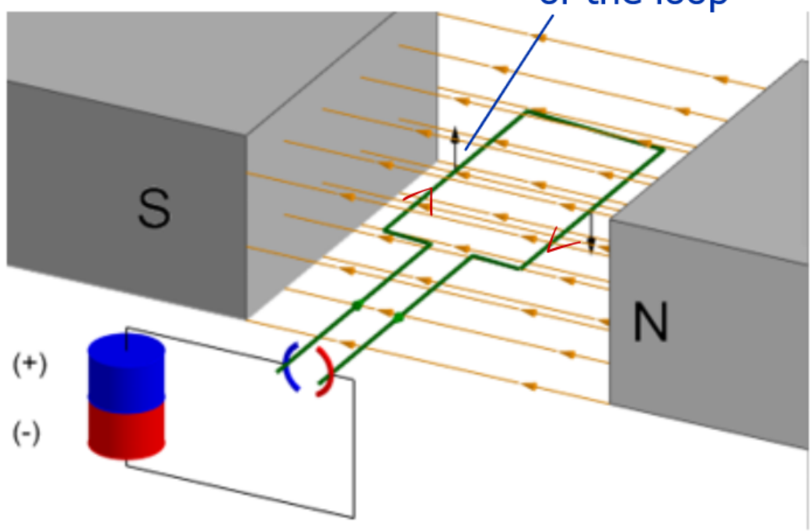
27th Feb

When a current carrying wire is placed in a magnetic field it experiences a FORCE.

A MOTOR uses this force to produce continous motion (rotation).

1.

A force is produced on each side of the loop

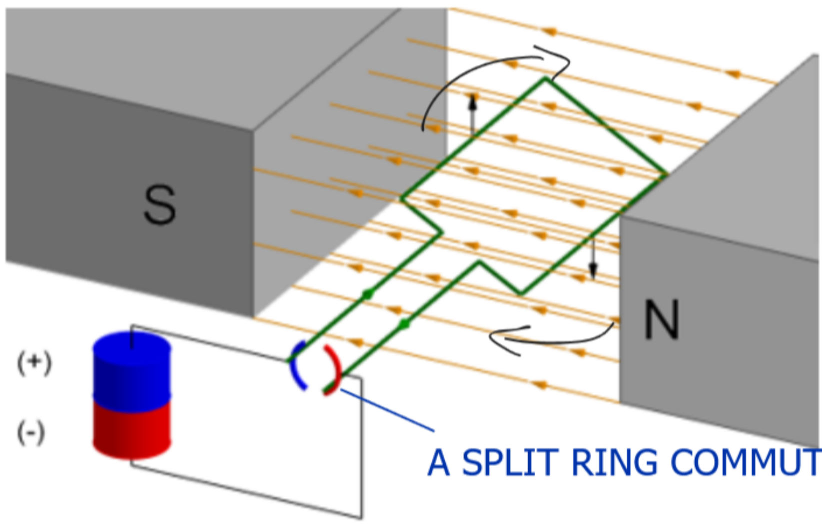


The forces are in opposite directions on each side of the loop because the current is flowing in opposite directions

of

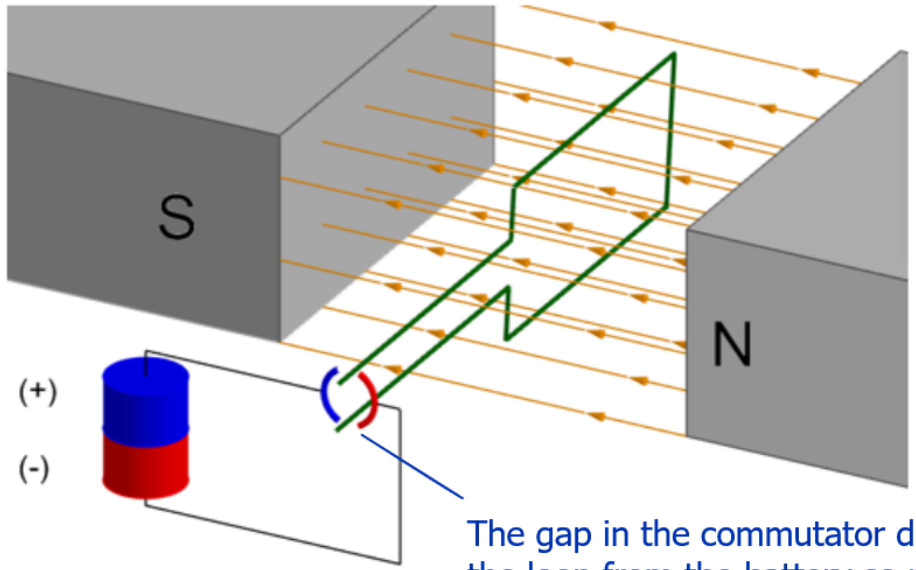
The pair of forces cause the loop of wire to spin

2.



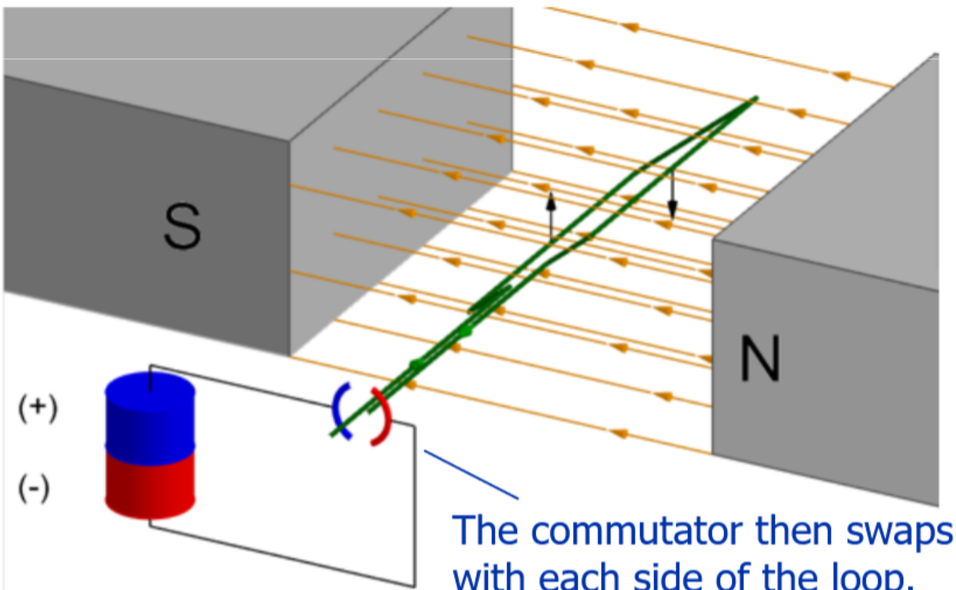
A SPLIT RING COMMUTATOR

3.



The gap in the commutator disconnects the loop from the battery so no current flows. Momentum keeps the loop spinning briefly.

4.



The commutator then swaps the connections with each side of the loop.
This reverses the direction of the forces and keeps the motor spinning.

We can INCREASE the speed of rotation of a motor by;

- Using a STRONGER magnet
- Increasing the CURRENT in the wire
- Adding more loops (turns) of wire

We can calculate the size of the force on the wire using:

Force = magnetic flux density x current x length of wire

$$F = BIl$$

- F – in newtons, N
- B – in tesla, T
- I – in amps, A
- l – in metres, m