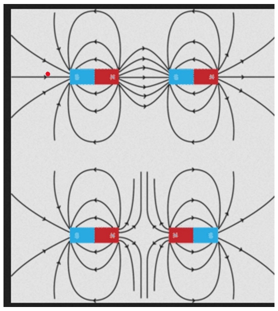
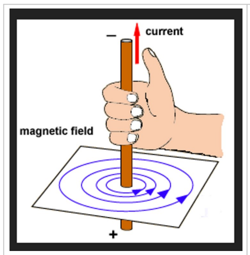
Magnetic Fields

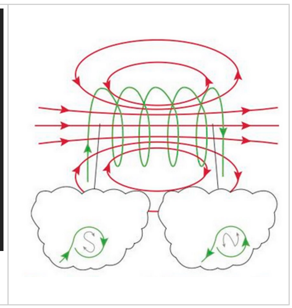
12 December 2019 17:18

Magnetic fields are represented by flux lines. - you need to know the simple field shapes around bar magnets

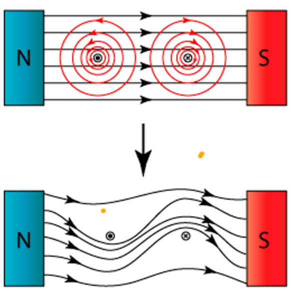


You also need to know how the current in a wire produces lines of flux





And ... You also need to be able to draw up the diagram which shows where the force comes from when you have a current carrying wire in a magnetic field - which leads onto Fleming's Left Hand Rule.



Interaction of the magnetic fields produces a catapult field

Top diagram, right wire. At the top the fields lines from the wire and the B field are parallel and they add, at the bottom anti-parallel and subtract. The effect is shown in the bottom diagram.

Lastly, in the 'quick gcse review' is F=BIL

B is the ***magnetic flux density*** - number of flux lines per unit area - units = Wb/m^2

Onto something harder....

Electromagnetic Induction

- Move a conducting material through a magnetic...
- Creates a force which moves charge carriers to one end of the rod
- Which can lead to a current if we have a circuit.

But its the RELATIVE motion that is important - you could just as well move the magnet.

So the rule is - whenever lines of flux are CUT then an emf is induced.

$$\Phi = BA$$

Remember B = flux per unit area. So if we don't have an 'unit area' but an area of size A then BA is the total magnetic flux flowing.

So.... B = magnetic flux density

$\phi \rightarrow \Phi$ = magnetic flux

There's more...

ΦN = magnetic flux linkage

↑ number of turns of wire in the coil.

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Since N is just a number both ϕ and $N\phi$ have the same units - Weber (Wb)

There is another way to change the Φ - use an electromagnet, and vary the current - this will cause electromagnet to vary in strength.

Faraday's Law

All this is summed up in Faraday's Law

The induced EMF, ε, is proportional to flux linkage change/time taken - or 'rate of change of flux linked'.

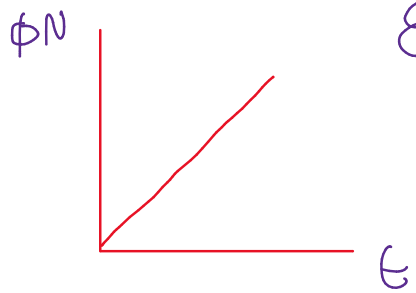
$$\mathcal{E} \propto \frac{\Delta(\Phi N)}{\Delta t}$$

Lenz's Law

In a way this is just the constant of proportionality (or perhaps contributes to it). Either way, Lenz's law tell us that the emf is negative - it has to be or else you'd get energy for nothing. So, Lenz's law tells us that the emf produce acts AGAINST the change that created it.

$$\mathcal{E} = -N\frac{\Delta \Phi}{\Delta t}$$

This is why we have Fleming's right hand rule...



$\mathcal{E}$ = grad

↑ (really it's negative)