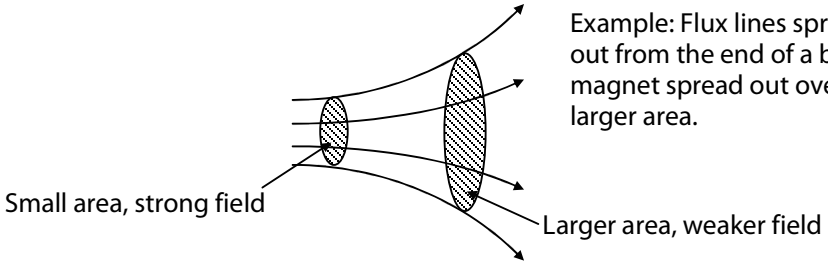
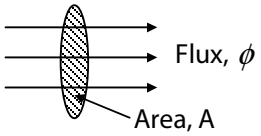
Faraday's law of induction

Flux, ϕ is represented by a magnetic field lines and measured in Webers, Wb.



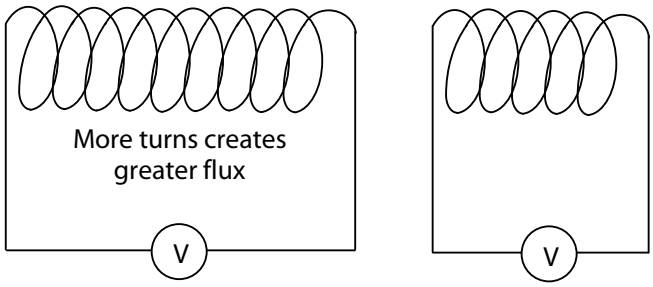
Magnetic flux density, or field strength if given by flux divided by area.

$$B = \frac{\phi}{A}$$



Faraday's law: If the flux threading through a circuit changes then an EMF is induced. The size of this EMF is proportional to the rate of change of flux linkage in the circuit.

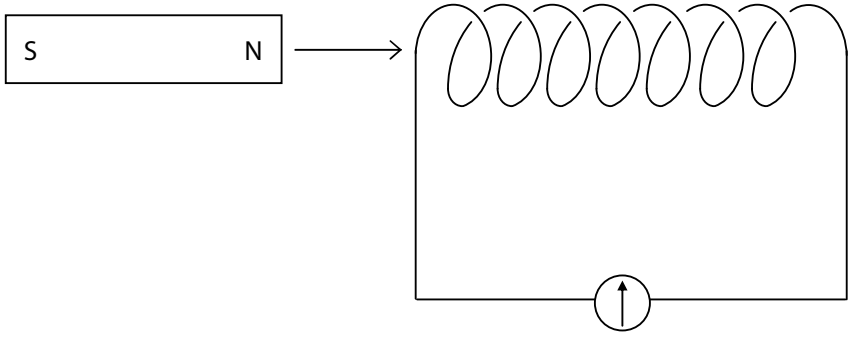
$$\varepsilon \propto \frac{d\phi}{dt}$$



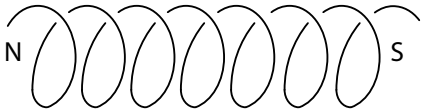
A flux ϕ going through a coil of *N* turns generates total flux linkage $N\phi$. So

$$\varepsilon \propto N\frac{d\phi}{dt}$$

So the flux produced can be determined in terms of the EMF produced. Lenz's law (or Faraday's second law of induction) is what determined the direction of the induced EMF, and explains how energy is conserved when a current is induced.



The direction of an induced EMF is always such as to oppose the change of flux that produced it. In the above circuit as the bar magnet is moved into the coil the induced current produces a north pole on the left to repel the magnet.



As the magnet the opposite happens so as to attract the magnet (and oppose its withdrawal). Therefore in Faraday's law the constant of proportionality is -1 to account for Lenz's law.

$$\varepsilon = -N\frac{d\phi}{dt}$$

These notes are from a lesson on 22/09/2004.