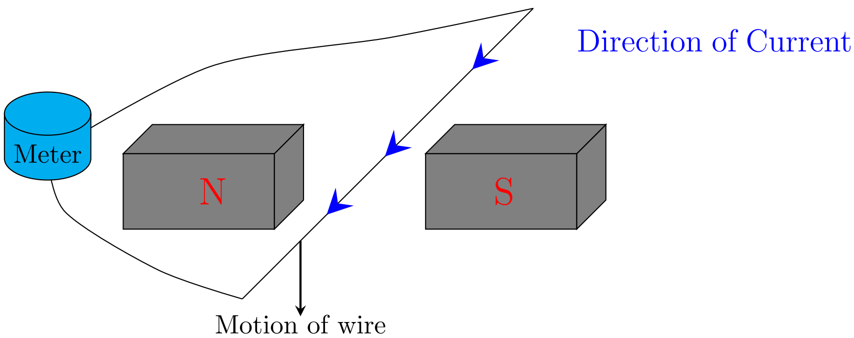
Electromagnetic Induction

1 Generating Electricity



When a conductor is moved through a magnetic field an emf is **induced** across the ends of the conductor

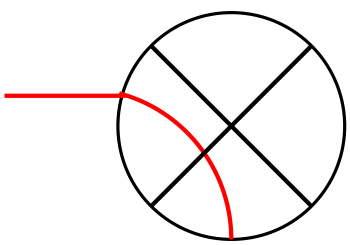
The emf will be greater when:

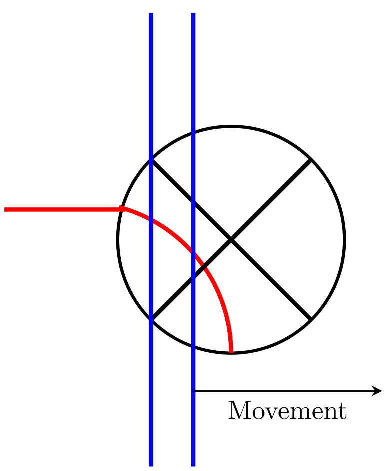
- The conductor is moved more quickly
- The magnetic field is stronger
- There is a longer length of conductor in the magnetic field

No emf will be induced if the conductor is parallel to the field lines

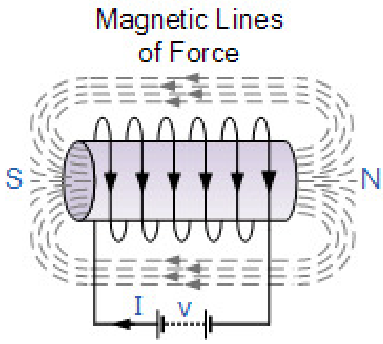
A current will flow if the conductor is part of a complete circuit

1.1 Explaining electromagnetic induction





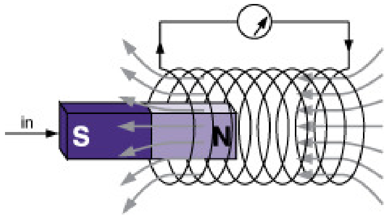
2 The laws of electromagnetic induction



North Pole - Anticlockwise current flow
South Pole - Clockwise current flow

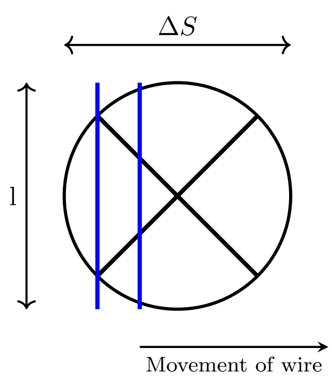
3 Lenz's law

The direction of the induced emf is always such as to oppose the change that is causing it.



As the magnet is pushed into the coil it induces an emf in the coil, this produces a magnetic field which opposes the potion. When removing the magnet the polarity will be inversed.

4 Faraday's law



$$\begin{aligned}\text{Work done} &= F \times S \\ &= BIl \times \Delta S\end{aligned}$$

Charge transfer, $Q = I \times \Delta t$

$$\epsilon = \frac{\text{Work done}}{\text{Charge}} = \frac{BIl \times \Delta S}{I \times \Delta t} = \frac{BA}{\Delta t}$$

B=Magnetic flux density=$\frac{\phi}{A}$
ϕ = Magnetic flux

$$\epsilon = \frac{\phi}{\Delta t}$$

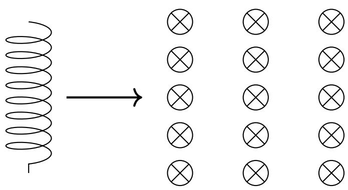
Faraday's law of electromagnetic induction is equal to the rate of change of flux(linkage) through the circuit.

Flux linkage refers to coils, $N\phi$ replaces ϕ where N is the number of coils.

$$\epsilon = -N\frac{\Delta\phi}{\Delta t}$$

This equation may need to be expanded depending on the example

4.1 Example



$\epsilon = -N\frac{B\Delta A}{\Delta t}$