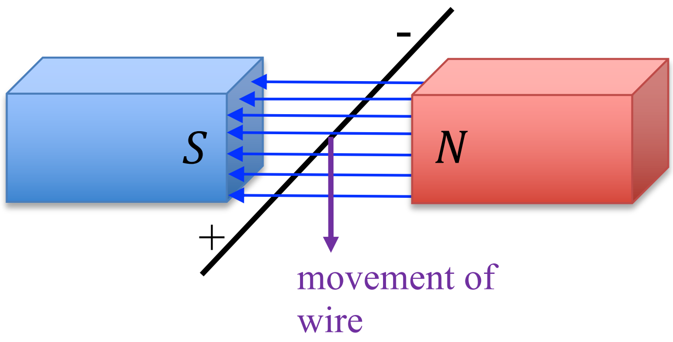
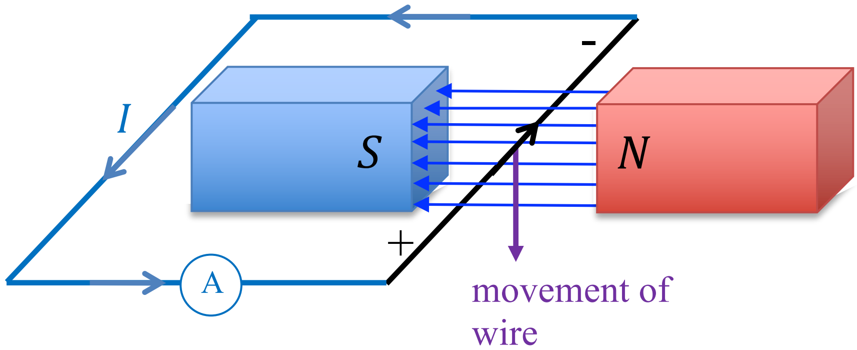
7.4.1 The generator effect

When a wire is moved through a magnetic field, and the wire 'cuts' through magnetic field lines ('lines of magnetic flux'), a potential difference is induced (produced) across the ends of the wire.

videos



If the ends of the wire are included in a circuit, a current (I) will flow.

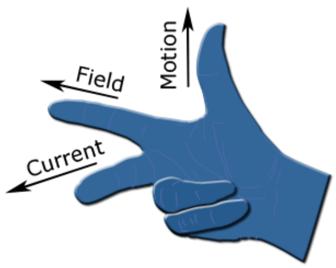


A potential difference is induced only if the movement of the wire cuts through field lines.

(1) Describe a movement of the wire (above) which will not induce a potential difference across the ends of the wire.

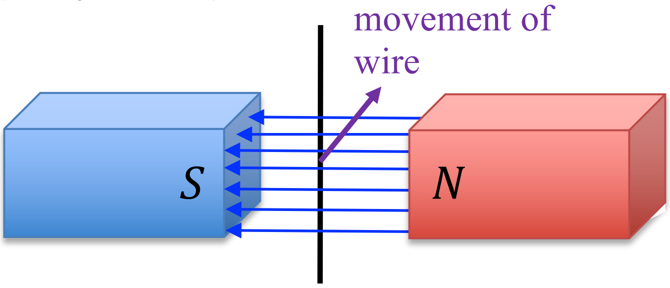
(2) Describe two ways that a higher potential difference could be induced.

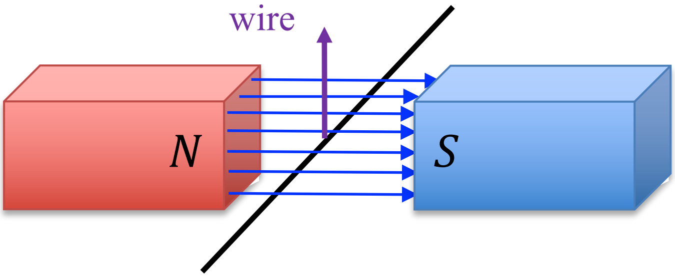
(3) What do you think happens if the wire is stationary in the magnetic field?



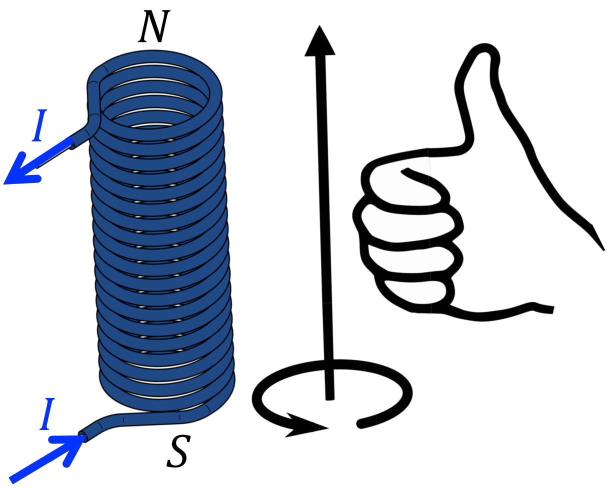
The direction of the current produced can be found using Fleming's Right Hand Rule. The first finger points in the direction of the magnetic field (N to S), the second finger shows the direction of the current and the thumb points in the direction of movement of the wire.

(4)✐ *What is the direction of current in the following situations? (Note: Assume the wire is part of a circuit.)*



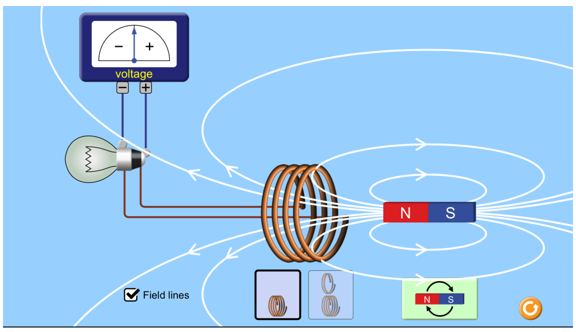


When we pass an electric current through a coil of wire, a magnetic field is generated which has the same shape as that of a bar magnet. One end becomes a magnetic north (N) pole, and one becomes a magnetic south (S) pole.



To determine which end is a N pole, wrap your fingers of your right hand in the direction the current is looping. Your thumb should point towards the N pole of the magnet.

We can induce a potential difference across the coil of wire if we move the coil in a magnetic field. Run the following simulation: https://tinyurl.com/nm5mw59



Check the field lines box.

Now move the magnet towards the solenoid, from right to left.

(5)✐ *What do you notice about the induced potential difference?*

(6)✏What happens if the magnet is stationary?

Now select two different coils.

(7)✏Which coil gives the biggest potential difference when the magnet is moved towards it?

(8)✏What other factor determines the size of the induced potential difference?

(9)✏What other factor (which can't be changed in the simulation) would affect the size of the induced potential difference?

Move the N pole of the magnet towards the coil.
(10)✏From the direction of current flow through the bulb (and coil), work out the polarity of the pole closest to the bar magnet. (Hint: Use Fleming's Right Hand Rule. If the voltmeter goes negative, the current is flowing anticlockwise.)

(11)✏Move the N pole of the magnet away from the coil. What do you notice about the induced potential difference compared to when moving the magnet towards the coil?

(12)✏From the direction of current flow, work out the polarity of the pole closest to the bar magnet when the N pole is moved away from the coil.

Lenz's law

Lenz's law states that *'the direction of the current is always such as to oppose the change that causes the current'*.

(13)✏Do your answers to the questions (above) support Lenz's Law? Explain.