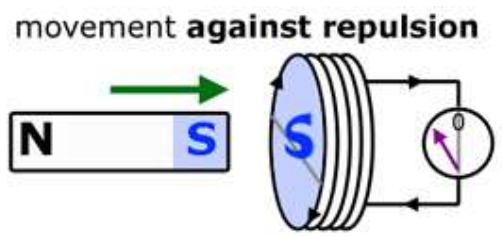
Lenz's Law

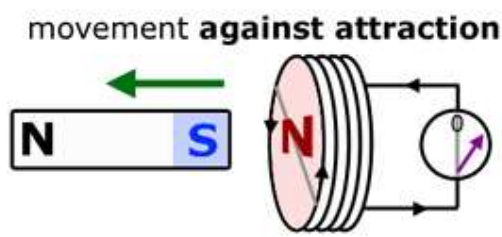
Lenz's law states that the current induced in a circuit due to a change in a magnetic field is directed to oppose the change in flux and to exert a mechanical force which opposes the motion. ... This means that the direction of the back EMF of an induced field opposes the changing current that is its cause.

Lenz's Law examples

- Moving a magnet into/out of a coil

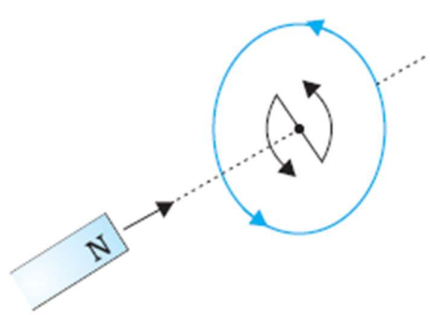


The magnet is moved towards the coil as shown. There is a temporary magnetic field induced in the coil which opposes the motion. The S-S repel, which pushes against the direction of the magnet.



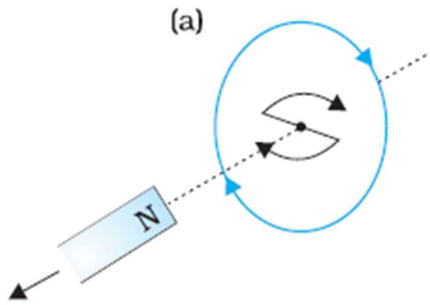
The magnet is moved away from the coil. This time there is a N-S, which attract, opposing the motion of the magnet.

- Bar magnet through a loop of wire:



(a)

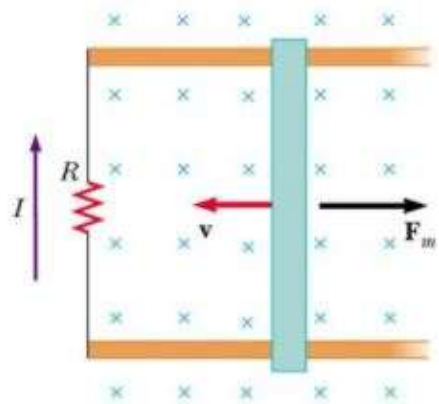
(a) When approaching the loop, magnetic flux is increasing, and thus, magnetic field must oppose the increase, with a counter-clockwise current.



(b)

(b) When leaving the loop, the magnetic flux is decreasing, and the current is now clockwise.

- Rolling rod



Force on the rod must oppose the motion. Hence, if it moves towards the left, a force to the right will appear, indicating a clockwise induced current.

Use right-hand rule first to find the direction of the current in the loop = clockwise.

Secondly, use the left hand rule to find direction of force on the rod due to the current = to the right.

Lenz's law and conservation of energy

If Lenz' Law was violated and current could be induced that actually supported the change in flux instead of opposing it, this would be a catastrophe. Inducing a current that feeds the magnetic field which created it in the first face would start a runaway process of current feeding the change in flux, feeding the current, feeding the change in flux and so on. Energy would be created out of nothing and would grow exponentially, violating the law of conservation of energy!