Lesson 20: Electromagnetic Induction

Between 1820-1821 scientists discovered most of what we have been looking at in recent lessons.

- Because it was obvious that moving charges and magnetic fields were able to interact with each other, scientists began to wonder if a magnetic field could be used to produce an electric current.
- By 1831 the **American Joseph Henry** and the **Englishman Michael Faraday** had each showed it could happen.
  - Henry discovered it first, but Faraday published his results first, so who gets the credit?
    - One of the "rules" in science is that it doesn't matter who actually discovered something first, it matters who got published in a scientific journal first. It sort of counts as being "registered" as the creator of that idea.
  - So, Faraday gets the official credit and we call this effect **Faraday's Law of Electromagnetic Induction**. It is also sometimes referred to as the **generator effect**.

Did you know?
Neither Henry nor Faraday ever disputed each others claims to when they discovered induction. Henry was under pressure to discover something important to show off the smarts of his new country, the recently independent USA. Henry discovered induction first, but then started a series of extra experiments to make sure he was right. This time allowed Faraday to get his work published.

The experimental design that Faraday and Henry used was basically the same...

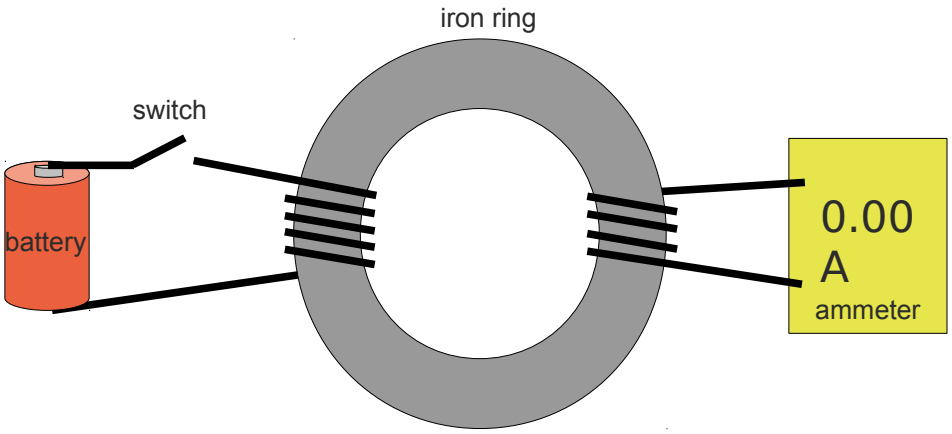


Illustration 1: Faraday's induction apparatus.

If the switch on the left side is closed, current will flow through the loops on that side.

- Since it is wrapped around an iron ring, it will act as an electromagnet.

Faraday (hoped) that the magnetic field in the iron ring would go all the way around to the other loops of wire on the right side and create an electrical current that he could measure on his ammeter.

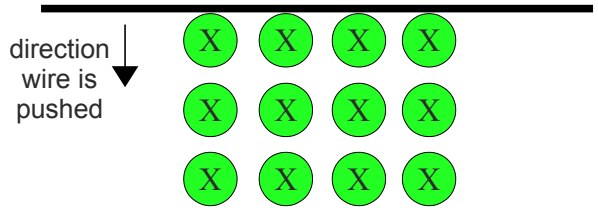
- Faraday never saw the needle move on the ammeter when he ran a steady current from the battery.
  - He did notice that when he first switched the battery on, a current would be measured for a moment.
  - When the battery was shut off, the ammeter would show another small current, this time in the opposite direction.
- Faraday figured out that a ***changing*** magnetic field could produce a current on the other side.
  - Such a current is called an **induced** current.

It is possible to induce current to flow in a wire as long as there is a changing magnetic field involved.

- One way is push a length of wire through a magnetic field, so that the wire is moved perpendicular to the magnetic field.
- The third hand rule can be used to figure out the direction of the induced current in the wire.
  - Fingers point north to south in the direction of the magnetic field as always.
  - Your thumb points in the direction of the wire's motion, since that is the direction that the electrons that are in the wire are moving all together.
  - Your palm points in direction of the force acting on those charges, which tells you which way they are going to be pushed... the direction of the current flow!

Warning!
Many people incorrectly use the "force" part of the third hand rule as the direction the person is pushing the wire. This is wrong. The force in the third hand rule is the magnetic force of the external magnetic field pushing on the charges... the direction they will be forced to move is the direction of the current.

Example 1: Using the following diagram, identify the direction of the induced electron flow current in the wire.



The magnetic field is pointing into the page, so my fingers point into the page.
The wire is moving downwards, so my thumb points down.
My palm is facing left, so the electrons will experience a force pushing them to the left. The induced electron flow current is to the left.

Homework

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