17.1 Electric Current and Magnetism
What did Hans Christian Oersted conclude from his experiment?
The compass needle moved just as if the wire were a magnet.

How is magnetism created?
By moving charges.

The picture below depicts a wire with no current flowing through it. Notice how the compasses all point North.

As shown below when current flows through the wire the compasses point in a circle.
The strength of the magnetic field depends upon two things:
1. Current – increasing the current, increases the strength of the magnetic field
2. Distance – decreasing the distance, increases the strength of the magnetic field.

What is a solenoid?
A coil with many turns.

Will these wires attract or repel?

![Diagram showing attracting and repelling wires](image)

When the current is in the same direction the wires will attract one another.
When the current is in the opposite direction the wires will repel one another.

17.1 Check Questions
What did Hans Christian Oersted detect in his experiment?

What happens to the magnetic field as you move closer to a current carrying wire?

What effect does increasing the current in a wire have on the magnetic field?

17.2 Electric Motors
Imagine a disk with magnets that can spin. To make the disk spin you must bring another magnet close to it. The South pole of the magnet you are holding will attract the North pole of a magnet on the disk and will repel the South pole of the other magnet on the disk.

Using a magnet to spin a rotor
To keep a rotor turning the electromagnet must switch from north to south as each rotor magnet passes by. The device that makes this happen is called a **commutator**. The commutator switches the electromagnets from north to south and back again as well as switches the polarity of the electromagnets.

What are the three main parts of a motor?
1. A rotating part (rotor) with magnets that alternate.
2. One or more fixed magnets.
3. A commutator.

What is the rotating part of a motor called? **Rotor**

### 17.2 Check Questions

What is the purpose of the commutator?

How does a motor spin?

In which direction will the rotating disk spin? **Counterclockwise**

Where would I place the south pole of a magnet to get the disk to spin in a clockwise direction?
When does electromagnetic induction occur? When current is induced in a wire by a moving magnet.

What is the name of the device that uses electromagnetic induction to produce electricity? Generator.

What happens when you move a magnet in and out of a coil of wire as shown below? Current is produced.

What happens if the magnet stops moving? No current is produced.

What does Faraday’s law of induction tell you about the relationship between current and how fast you move a magnet in and out of a coil? (ie if you move a magnet faster in and out of a coil of wire do you produce more or less current?) The faster you move a magnet, the more current that is produced.

A generator converts mechanical energy into electrical energy.
Voltage relationships in a transformer:

\[
\frac{V_1}{V_2} = \frac{N_1}{N_2}
\]

When you plug in a cell phone, a transformer on the plug changes the outlet’s 120 volts to the 6 volts needed by the battery. If the primary coil has 240 turns, how many turns must the secondary coil have?

On a European trip, you discover that the electric outlets have 240 volts. You realize that you need a transformer, so you quickly wrap 20 turns around the primary coil. If you need 120 volts to run your hairdryer, how many turns do you need to wrap around the secondary?

A transformer has 20 turns on the secondary coil and 200 turns on the primary. What is the secondary voltage if the primary voltage is 120 volts?

How many turns must the primary coil have if it steps down 13,800 volts to 120 volts with 112 turns?

17.3 Check Questions

What is a generator?

What type of energy does it produce?

What happens as you move a magnet toward a coil of wire in terms of electricity?

What is Faraday’s law of induction?

What is a transformer?

When does electromagnetic induction occur?

How do you get the greatest induced current to flow in a coil?

How do you step up voltage?