Electromagnetic Induction

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CHAPTER 1 Electromagnetic Induction

- Define electromagnetic induction.
- Explain how electromagnetic induction occurs.
- Describe the current produced by electromagnetic induction.
- Identify ways that electromagnetic induction is used.

The girl on the left in this photo is riding a stationary bike. She's getting exercise, but that's not the real reason she's riding the bike. She's using her muscle power to generate electricity through a process called electromagnetic induction.

What Is Electromagnetic Induction?

Electromagnetic induction is the process of generating electric current with a magnetic field. It occurs whenever a magnetic field and an electric conductor, such as a coil of wire, move relative to one another. As long as the conductor is part of a closed circuit, current will flow through it whenever it crosses lines of force in the magnetic field. One way this can happen is illustrated in the **Figure** 1.1. The sketch shows a magnet moving through a wire coil.

Q: What is another way that a coil of wire and magnet can move relative to one another and generate an electric current?

A: The coil of wire could be moved back and forth over the magnet.

The Current Produced by a Magnet

The device with the pointer in the **Figure** 1.1 is an ammeter. It measures the current that flows through the wire. The faster the magnet or coil moves, the greater the amount of current that is produced. If more turns were added to the coil or a stronger magnet were used, this would produce more current as well.

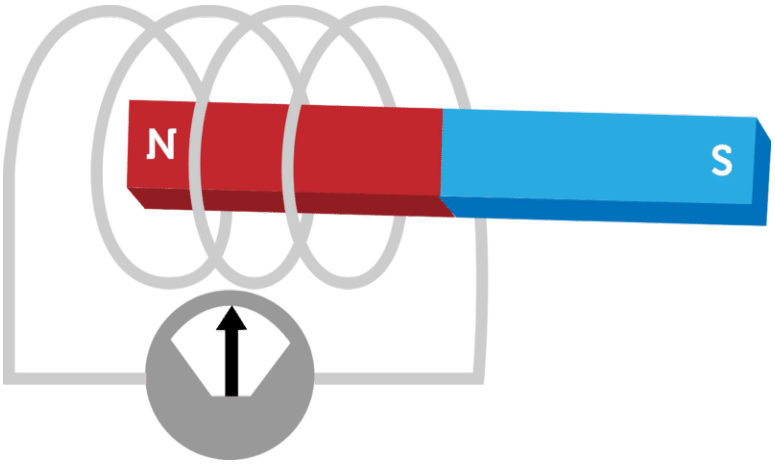

FIGURE 1.1

The **Figure** 1.2 shows the direction of the current that is generated by a moving magnet. If the magnet is moved back and forth repeatedly, the current keeps changing direction. In other words, alternating current (AC) is produced. Alternating current is electric current that keeps reversing direction.

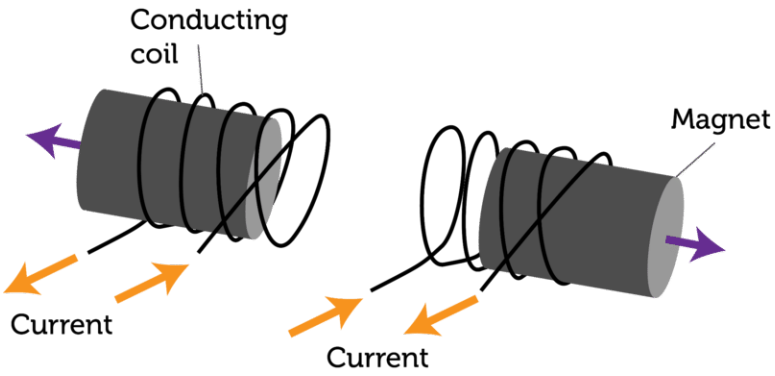

FIGURE 1.2

How Electromagnetic Induction Is Used

Two important devices depend on electromagnetic induction: electric generators and electric transformers. Both devices play critical roles in producing and regulating the electric current we depend on in our daily lives. Electric generators use electromagnetic induction to change kinetic energy to electrical energy. They produce electricity in power plants. Electric transformers use electromagnetic induction to change the voltage of electric current. Some transformers increase voltage and other decrease voltage.

Q: How do you think the girl on the exercise bike in the opening photo is using electromagnetic induction?

A: As she pedals the bike, the kinetic energy of the turning pedals is used to move a conductor through a magnetic field. This generates electric current by electromagnetic induction.

Summary

- Electromagnetic induction is the process of generating electric current with a magnetic field. It occurs whenever a magnetic field and an electric conductor move relative to one another so the conductor crosses

lines of force in the magnetic field.

- The current produced by electromagnetic induction is greater when the magnet or coil moves faster, the coil has more turns, or the magnet is stronger. If the magnet or coil is moved back and forth repeatedly, alternating current is produced.
- Electric generators and electric transformers use electromagnetic induction to generate electricity or change the voltage of electric current.

Review

1. What is electromagnetic induction? When does it occur?
2. How could you increase the amount of current produced by electromagnetic induction?
3. Explain how a moving magnet and a coil of wire can be used to produce alternating current.
4. List two devices that use electromagnetic induction.

References

1. Christopher Auyeung. Generic schematic for a coil and magnet configuration . CC BY-NC 3.0
2. Christopher Auyeung. Visualization of how a coil and magnet can generate electricity . CC BY-NC 3.0