Chapter 16 – Electromagnets and Induction

Section Review 16.1

1. Why does a compass change direction when it is near a current-carrying wire?

2. What is the shape of the magnetic field created by a current-carrying wire?

3. How can you increase the magnetic field created by a wire? How can you change the direction of the field?

4. Do the two wires inside an appliance cord attract or repel each other? Why?

Section Review16.2

1. Explain how you can use a permanent magnet to make a rotor spin.

2. How do the magnetic poles in an electromagnet reverse?

3. List the three main parts every (DC) electric motor must have.

   a.

   b.

   c.

Section Review 16.3

1. Explain Faraday's law of induction.

2. What is the purpose of a transformer?

Chapter 16 Review
Understanding Vocabulary

Select the correct term on page 402 to complete the sentences.

1. An electromagnet device made using a nail surrounded by a coil is an example of a(n) _____.
2. All electric motors (DC) are made from three basic parts: stationary magnet(s), _____, and _____.
3. The mechanical energy of moving magnets is transformed into electrical energy by a(n) _____ .
4. When a laptop computer is plugged into an electrical outlet, a(n) _____ in the plug reduces the outlet's 120 volts to the 19 volts needed by the computer's battery.

Reviewing Concepts

Section 16.1

1. How is magnetism created?

2. What exists in the region around a wire that is carrying current and that exerts a force on another current-carrying wire?

3. Explain how the right-hand rule can help you determine the direction of the magnetic field lines around a current-carrying wire.

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

5. What effect does reversing the direction of the current in a wire have on the magnetic field?

6. What happens to the magnetic field as you move farther away from a current-carrying wire?

7. Why do we not use a single wire with a large current to create a strong magnetic field?

8. What is the advantage of using a coil to create a magnetic field?

9. Why don't we usually notice the force between current-carrying wires in an extension cord?

Section 16.2

10. A motor turns _____ energy into _____ energy.

11. Why is it necessary to use at least one electromagnet in a motor instead of only one permanent magnet?

12. What is the purpose of the commutator in a motor?

13. Why must the direction of the current in a motor's electromagnets be switched repeatedly?

14. List the three main parts of an electric motor (DC).

    a.

    b.

    c.

Section 16.3

15. What happens as you move a magnet near a coil of wire?

16. If you hold a magnet near a coil of wire, will a current be induced? Explain your answer.

17. State Faraday's law of induction in your own words.

18. Why does a spinning coil near a magnet produce alternating current rather than direct current?

19. What is the magnitude of the voltage provided by most electrical outlets in the homes and buildings in the U.S.?

20. The voltage of the electricity in outside power lines is much higher that the voltage in buildings. How is the voltage reduced?

21. The primary and secondary coils in a transformer have different voltages and currents but the same _____.

22. A certain transformer has more turns in its secondary coil than in its primary coil. Does the transformer increase or decrease voltage?

Solving Problems

Section 16.1

1. Copy the diagram of the wire shown on page 403, and draw the magnetic field lines in the region around the wire. Remember to include arrows to show the field's direction.

2. What happens to the strength of the magnetic field near a wire if you double the current? Triple the current? Quadruple the current?

3. Copy the diagram of the coil shown on page 403 and draw the magnetic field in the region around it. Remember to include arrows to show the field's direction.

4. Explain how each of the following would affect the current produced by a magnet moving toward a coil of wire.
    a. A stronger magnet

    b. Moving the magnet toward the coil at a faster speed

    c. Reversing the magnet's motion so it moves away from the coil

    d. Adding more turns of wire to the coil

    e. Moving the magnet's south pole toward the coil

    f. Adding a second light bulb to the circuit

5. Decide whether each pair of wires or coils at top of page 403 will attract or repel.

    a.

    b.

    c.

Section 16.2

6. At a certain instant, the electromagnet in the motor shown on page 403 has its north pole facing the rotor that holds the permanent magnets. In which direction is the rotor spinning? Explain.

7. The rotor in the motor shown at the bottom of page 403 is spinning clockwise. Is the direction of the current in the electromagnet from A to B or from B to A? Why?

Section 16.3

8. A transformer has 1,000 turns in its primary coil and 50 turns in its secondary coil.
    a. If the voltage in the secondary coil is 120V, what voltage is in the primary coil?

    b. If the voltage in the primary coil is 120V, what voltage is induced in the secondary coil?

9. A laptop computer uses a rechargeable 24-V battery. A transformer is used to convert an electrical outlet's 120 V AC to 24 V DC.
    a. If the primary coil has 500 turns, how many turns must the secondary coil have?

    b. If the current in the primary coil is 1 A, what is the current in the secondary coil? (Hint: First, calculate the power.)

Test Practice

1. The picture on page 404 shows a current-carrying coil. Toward which point is the magnetic field inside the coil directed?
   a. A b. B c. C d. D

2. The diagram on page 404 shows the magnetic field around point P at the center of a straight piece of current-carrying wire. The direction of the current flow is
   a. from A to B b. from B to A c. from P into the page d. from P out of the page

3. Wires 1 and 2 are straight pieces of wire, both carrying current out of the page (see page 404). The wires are 1 m apart. As a result of the magnetic fields associated with the wires, wire 1 will experience a force directed toward point
   a. A b. B c. C d. D

4. The part of an electric motor responsible for reversing the direction of current in the electromagnets of the motor is the
   a. armature b. rotor c. commutator d. brush

5. A device used to transform mechanical energy to electrical energy is a
   a. rotor b. motor c. generator d. transformer

6. A transformer is designed to step 220 V to 2,200 V. If the primary coil has 200 turns, how many turns are on the secondary?
   a. 20 b. 200 c. 1,000 d. 2,000

7. A transformer has 2 A of current and 120 V in its primary coil. If the current in the secondary coil is 0.5A, what is the voltage induced in the secondary coil?
   a. 480 V b. 120 V c. 60 V d. 30 V

8. The device best represented by the diagram on page 405 is a(n)
   a. induction coil b. motor c. generator d. transformer

9. The picture at the top of page 405 shows a solenoid that is free to rotate around an axis at its center, C. The solenoid is placed between two magnets' opposite poles. The direction of the current is shown by the arrow.

   While the current flows in the direction shown, the solenoid will
   a. remain motionless b. vibrate back and forth
   c. turn clockwise d. turn counterclockwise