Chapter 17 Review Answer Key

Understanding Vocabulary

Section 17.1
1. coil
2. solenoid

Section 17.2
3. electric motor
4. commutator
5. armature
6. brushes

Section 17.3
7. electrical generator
8. electromagnetic induction
10. transformer

Reviewing Concepts

Section 17.1
1. Magnetism is created by moving charges.
2. A magnetic field.
3. Wrapping the right hand around a current carrying wire with the thumb pointing in the direction of the current will cause the fingers to wrap in the direction of the magnetic field that surrounds the wire.
4. The magnetic field becomes stronger as the current increases. Field strength is directly proportional to the current.
5. The direction of the magnetic field will be reversed if the current is reversed.
6. The strength of the field surrounding a wire will decrease as the distance from the wire increases.
7. It is easier and safer to work with a small current.
8. A strong magnetic field can be produced by using a smaller current. For example, a 1-amp current flowing through 50 coils produces the same strength of magnetic field as a single wire carrying 50 amps.
9. The force created is very small; also, the field strength of a magnetic field decreases very rapidly with an increase in distance.

Section 17.2
10. electrical; mechanical
11. So that the polarity of the magnets can be more easily reversed at the proper time in the rotation of the rotor.
12. The commutator reverses the polarity of the electromagnets at the proper time in the sequence of rotation.
13. The current must be continually reversed so the electromagnets will continually change polarity.
14. The main parts of all electric motors are the rotor (with magnets of alternating polarity), field magnets (fixed magnets), and the commutator (for reversing current to the electromagnets).

Section 17.3
15. If you move a magnet through a coil of wire it will induce a potential difference in the coil that will cause a current to flow if the coil is part of a circuit.
16. No. A magnet will only induce a voltage in a coil if the magnet is moving relative to the coil.
17. A typical answer might be: The potential difference induced across the ends of a coil is directly related to the speed with which a magnet is passed through a coil. (It is also directly related to the strength of the moving magnet and the number of turns in the coil.)
18. The direction of movement of the magnetic field determines the polarity of the induced voltage. Since the direction of the moving field is continually reversing, the polarity of the induced voltage changes.
19. Generally, it is 120 volts. It may fluctuate a bit, however.
20. The voltage is reduced by using a step-down transformer.
21. power
22. This is a step-up transformer. It increases the voltage. 

Solving Problems

Section 17.1

1. 

2. Doubling the current doubles the strength of the magnetic field. Tripling the current triples the strength of the magnetic field. Quadrupling the current quadruples the strength of the magnetic field.

3. 

4. Answers are:
   a. Using a stronger magnet causes more current to flow.
   b. Moving the magnet toward the coil faster causes more current to flow.
   c. Reversing the magnet's direction causes the current direction to reverse.
   d. Adding more turns of wire cause more current to flow.
   e. Moving the south pole of the magnet toward the coil will cause the current to flow in the opposite direction. (It will flow from left to right through the bulb.)
   f. If the two bulbs are in series, the current will decrease. If the two bulbs are in parallel, the current will increase.

Section 17.2

6. The rotor will spin in a counter-clockwise direction.
7. The inertia of the rotor will cause the north end of the permanent magnet to spin slightly past the electromagnet as its polarity changes, and the pole of the electromagnet closest to the rotor acquires a north pole orientation. For this to occur, the current must be flowing from A to B.

Section 17.3

8. Answers are:
   a. \( \frac{V_1}{V_2} = \frac{T_1}{T_2} \)
      \( \frac{120 \text{ V}}{24 \text{ V}} = \frac{500 \text{ turns}}{T_2} \)
      \( T_2 = 100 \text{ turns} \)
   b. Power Input = Power Output
      \( (V_i)(I_i) = (V_o)(I_o) \)
      \( (120 \text{ V})(1 \text{ amp}) = (24 \text{ V})(I_o) \)
      \( I_o = 5 \text{ amps} \)

Applying Your Knowledge

Section 17.1

1. The web site www.howstuffworks.com has an excellent article on how speakers work.

   Inside the speaker is a permanent magnet and an electromagnet, called the voice coil. The amplifier sends current through the voice coil, which produces a magnetic field. This resulting magnetic field of the voice coil is attracted to or repulsed by the magnetic field of the permanent magnet. Depending on the direction of the current flow, the voice coil rapidly moves toward or away from the permanent magnet.
The voice coil is attached to the speaker cone diaphragm. When the voice coil moves, it pushes and pulls on the speaker cone. This vibrates the air in front of the speaker, producing sound waves. The frequency and amplitude of the electrical signal to the voice coil determines how fast and how far the voice coil (and therefore the diaphragm) moves. How fast and how far the diaphragm moves determines the tone and loudness of the sound produced by the speaker.

Section 17.2

2. Project responses will vary. Nikola Tesla is known for his inventions and discoveries that were far ahead of his time. The AC motor, the alternating current electrical supply system, and the Tesla coil are just a few of his many inventions.

   An internet search using the key words “Tesla” and “AC motor” will lead the student to many web sites detailing the life of Nikola Tesla and his invention of the AC motor. Encourage students to be creative in writing their paper.

Section 17.3

3. Using only the transformer and the 1.5 volt cell, you would not be able to provide a voltage of 6 volts for the cell phone. Transformers require an alternating current to operate. The 1.5 volt cell supplies direct current.

4. A bicycle generator typically runs on one of the wheels. The wheel turns the rotor in the generator. The rotor has a coil of wire on it. The stator has the permanent magnet on it and does not turn. When the bicycle is in motion, the wires on the rotor move through the magnetic field, and generate current.

5. Answers will vary. Neither the propeller nor the generator nor the motor nor the car is 100% efficient. There is always friction and heat which is wasting the available energy. However, if the wind is blowing very hard the wind may turn the propeller enough to move the car. But the motion of the car itself will not generate enough wind velocity to power the car.

   This is a classic example of a perpetual motion machine, which cannot exist. There will always be energy losses due to friction and heat.

6. Magnetic fields are able to pass through many materials like plastic. Alternating current from an electrical outlet may be used to induce a magnetic field to expand and contract past a coil in the base of the toothbrush. This changing magnetic field will induce a current in the coil which can be used to charge a rechargeable battery.