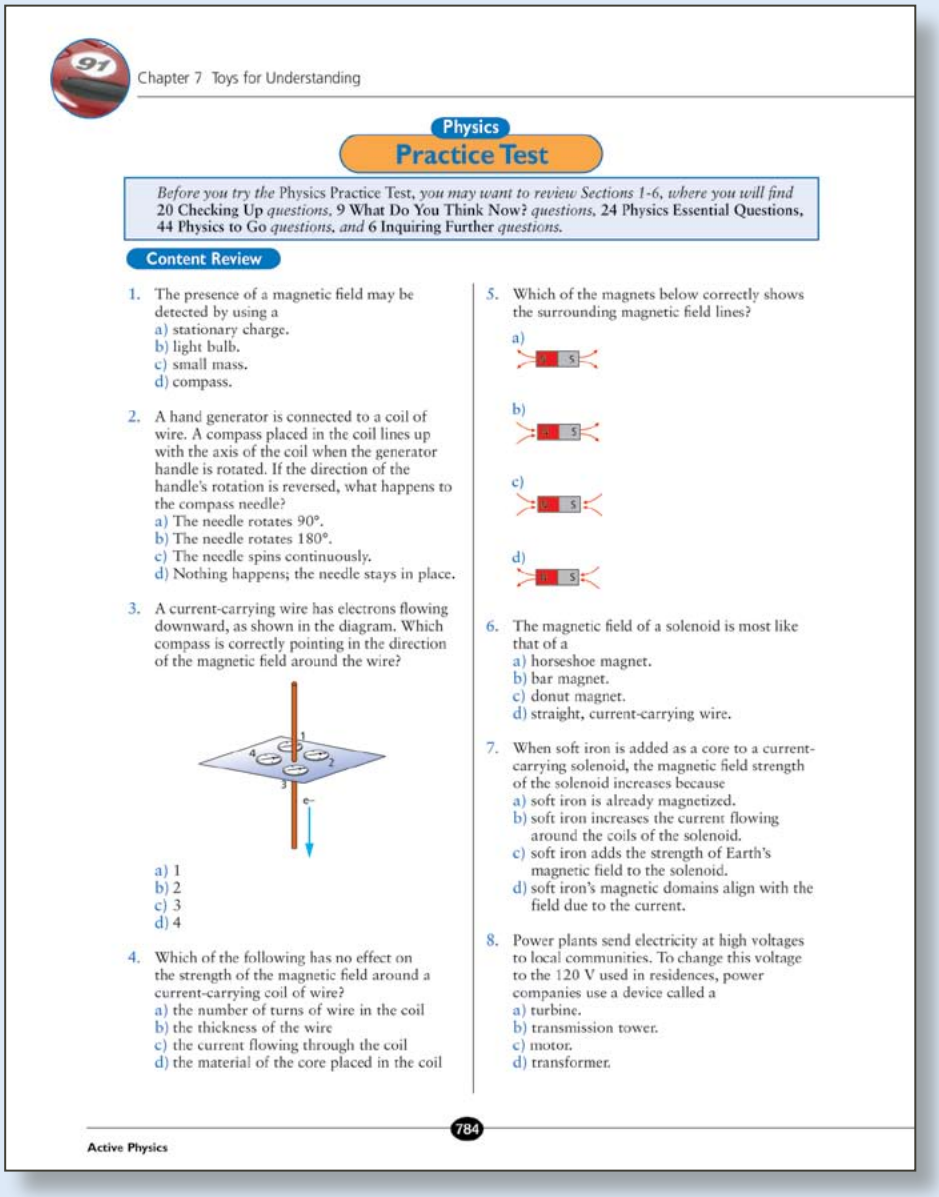
Physics Practice Test

The *Physics Practice Test* is provided as a Blackline Master on the *Teacher Resources* CD.

7b Blackline Master



Content Review

1.d)

A magnetic compass has a small bar magnet that is free to rotate and can interact with a magnetic field. Although a moving charge can interact with a magnetic field, a stationary charge does not. A regular light bulb and a mass do not interact with a magnetic field unless the mass has magnetic properties or the light bulb is composed of a gas.

2.b)

The needle rotates 180°. The magnetic field produced by a current (moving charge) changes direction when the current changes direction. Reversing the rotation of the hand-cranked generator reverses the direction of the current, which in turn reverses the direction of the induced magnetic field.

3.c)

Students should use the left-hand rule, placing their thumb in the direction of electron flow. Their fingers wrap around in the direction of the induced magnetic field.

4.b)

The thickness of the wire. The other choices all affect the strength of the induced magnetic field.

5.d)

Magnetic field lines always point away from the magnetic north pole and toward the magnetic south pole.

6.b)

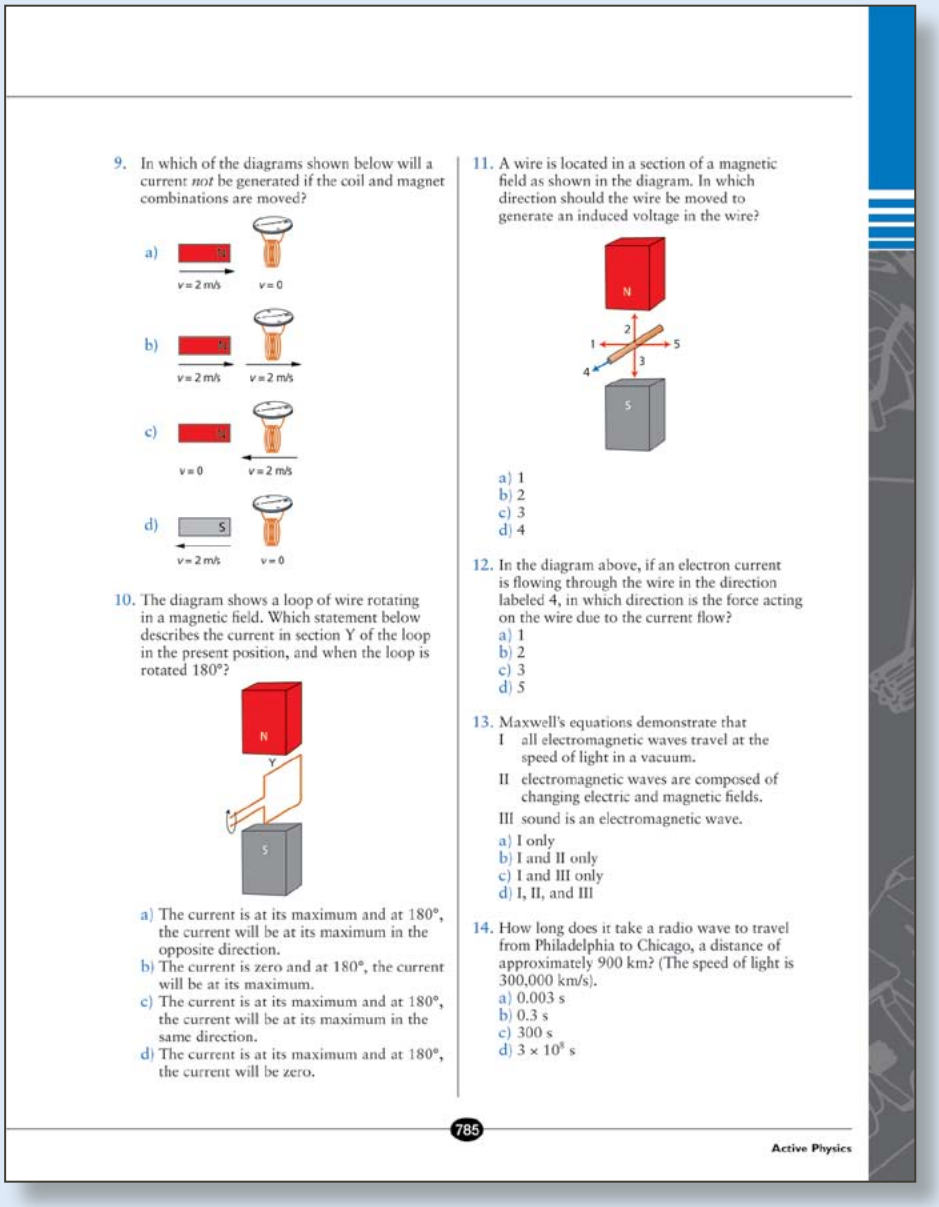
The magnetic field of a solenoid is most like a bar magnet. Discussions should refer to the *Investigate* students have completed to map out the field lines of both bar magnets and solenoids.

7.d)

Soft iron's magnetic domains align with the field due to the current. Soft iron has magnetic properties; however, its magnetic domains are generally randomly oriented and hence do not produce a net magnetic field.

8.d)

Transformers are used to step up or step down the voltage by inducing a current in a nearby coil due to the fluctuating magnetic



9. In which of the diagrams shown below will a current *not* be generated if the coil and magnet combinations are moved?

a) N, v = 2 m/s; coil v = 0
b) N, v = 2 m/s; coil v = 2 m/s
c) N, v = 0; coil v = 2 m/s
d) S, v = 2 m/s; coil v = 0

10. The diagram shows a loop of wire rotating in a magnetic field. Which statement below describes the current in section Y of the loop in the present position, and when the loop is rotated 180°?

N, Y, S

a) The current is at its maximum and at 180°, the current will be at its maximum in the opposite direction.
b) The current is zero and at 180°, the current will be at its maximum.
c) The current is at its maximum and at 180°, the current will be at its maximum in the same direction.
d) The current is at its maximum and at 180°, the current will be zero.

11. A wire is located in a section of a magnetic field as shown in the diagram. In which direction should the wire be moved to generate an induced voltage in the wire?

N, S, 1, 2, 3, 4, 5

a) 1
b) 2
c) 3
d) 4

12. In the diagram above, if an electron current is flowing through the wire in the direction labeled 4, in which direction is the force acting on the wire due to the current flow?
a) 1
b) 2
c) 3
d) 5

13. Maxwell's equations demonstrate that
I all electromagnetic waves travel at the speed of light in a vacuum.
II electromagnetic waves are composed of changing electric and magnetic fields.
III sound is an electromagnetic wave.
a) I only
b) I and II only
c) I and III only
d) I, II, and III

14. How long does it take a radio wave to travel from Philadelphia to Chicago, a distance of approximately 900 km? (The speed of light is 300,000 km/s).
a) 0.003 s
b) 0.3 s
c) 300 s
d) 3×10^8 s

785

Active Physics

fields produced by the alternating current occurring in a primary (original) coil.

9.b)

There is no relative motion between the coil and the magnet, so the coil does not interact with a changing field; hence, no current is induced in the coil.

10.a)

The current is at a maximum and, after rotating 180°, the current will be at a maximum in the opposite direction. The maximum occurs when the current and field lines are perpendicular as the wire cuts through the field lines.

11.a)

This direction moves the wire perpendicular to the field lines so it is cutting across field lines.

12.d)

Electron flow is opposite to the standard defined direction of current.

13.b)

Electromagnetic waves do not require a medium to propagate through.

14.a)

0.003 s.

$$t = d/v = \frac{900\ \text{km}}{300{,}000\ \text{km/s}} = 0.003\ \text{s}$$

CHAPTER 7

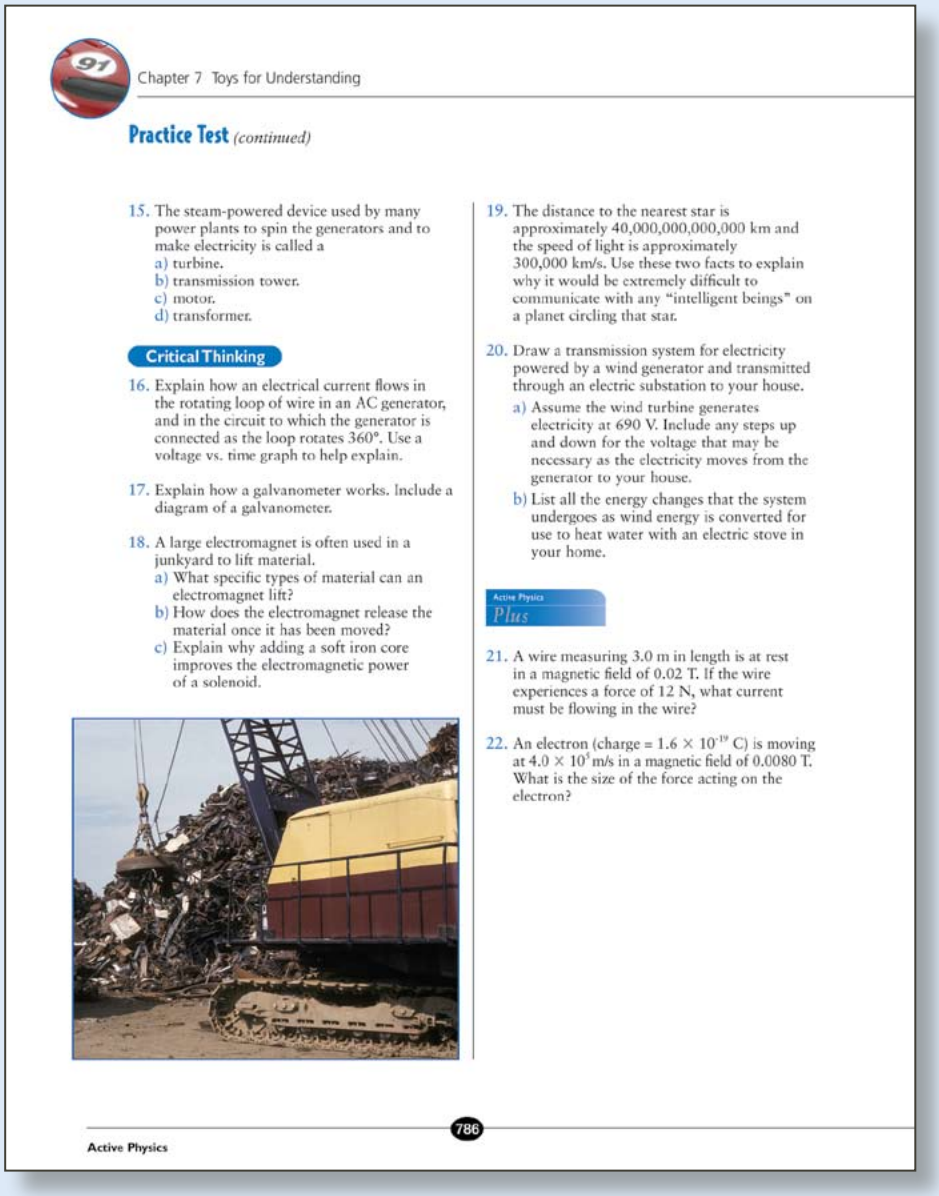
15.a)-d)

Students should be able to define all of the items listed.

Critical Thinking

16.

As the loop rotates, it will generate a maximum voltage and maximum induced current when it cuts perpendicularly through the field lines. Assume the plane of the coil starts parallel with the faces of the north and south poles of the magnet. As the loop rotates 90°, the voltage and the current will go to a maximum. When the loop rotates to the 180° position, no field lines will be cut and hence, the induced current and voltage will be zero. When the loop rotates to the 270° degree position, the current and voltage will once again be at a maximum, but this time in the opposite direction. As the loop goes back to the original position, the cycle will start over again. In the intermediate positions, the current and voltage are increasing and decreasing smoothly according to a sine wave. The voltage would change in time as shown in the diagram. Graphs showing induced current versus angle of the loop are shown.



Practice Test *(continued)*

15. The steam-powered device used by many power plants to spin the generators and to make electricity is called a
    a) turbine.
    b) transmission tower.
    c) motor.
    d) transformer.

Critical Thinking

16. Explain how an electrical current flows in the rotating loop of wire in an AC generator, and in the circuit to which the generator is connected as the loop rotates 360°. Use a voltage vs. time graph to help explain.

17. Explain how a galvanometer works. Include a diagram of a galvanometer.

18. A large electromagnet is often used in a junkyard to lift material.
    a) What specific types of material can an electromagnet lift?
    b) How does the electromagnet release the material once it has been moved?
    c) Explain why adding a soft iron core improves the electromagnetic power of a solenoid.

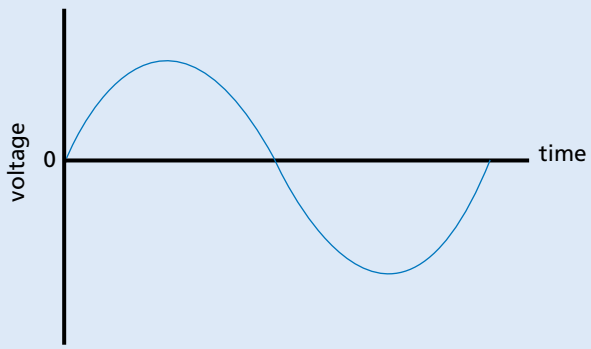
19. The distance to the nearest star is approximately 40,000,000,000,000 km and the speed of light is approximately 300,000 km/s. Use these two facts to explain why it would be extremely difficult to communicate with any "intelligent beings" on a planet circling that star.

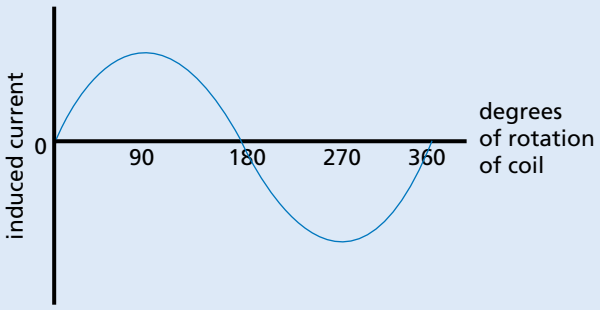
20. Draw a transmission system for electricity powered by a wind generator and transmitted through an electric substation to your house.
    a) Assume the wind turbine generates electricity at 690 V. Include any steps up and down for the voltage that may be necessary as the electricity moves from the generator to your house.
    b) List all the energy changes that the system undergoes as wind energy is converted for use to heat water with an electric stove in your home.

Active Physics Plus

21. A wire measuring 3.0 m in length is at rest in a magnetic field of 0.02 T. If the wire experiences a force of 12 N, what current must be flowing in the wire?

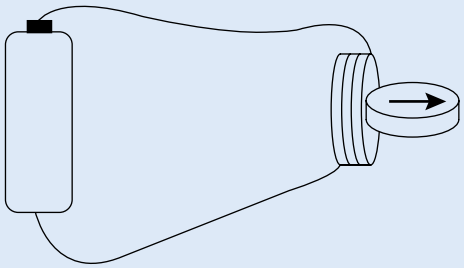
22. An electron (charge = 1.6×10^{-19} C) is moving at 4.0×10^{5} m/s in a magnetic field of 0.0080 T. What is the size of the force acting on the electron?





17.

A simple galvanometer consists of a coil of wire wrapped around a compass. As current flows through the coil, the compass deflects from its normal position to line up with the magnetic field of the coil. The stronger the current in the coil, the stronger the magnetic field, and thus, the more the compass needle deflects from its normal position. A simple galvanometer would appear like the one shown in the diagram below.



18.a)

Electromagnets can pick up mainly iron and steel.

18.b)

When the electromagnet has the current turned off, it stops being a magnet, and the steel and iron will drop.

18.c)

The soft iron core is made from thousands of small metallic crystals called domains. Each domain is magnetic, but they point in random directions so there is no net magnetic effect. When an external magnetic field is supplied by the solenoid, many of the domains line up with the solenoid's field, increasing its strength tremendously.

19.

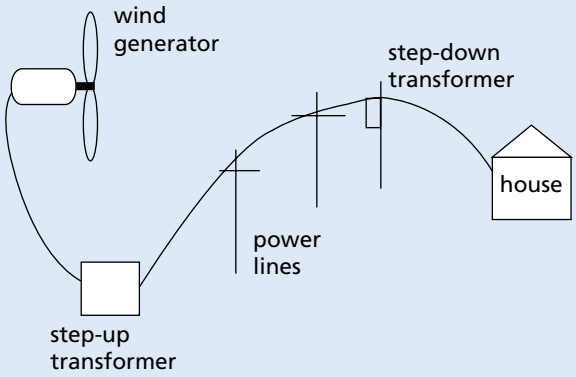
The fastest way to communicate would be using light (electromagnetic waves). If you use the equation $v = d/t$, where d is the distance and v is the speed of light in a vacuum, you have

$$t = d/v = \frac{40,000,000,000,000 \text{ km}}{300,000 \text{ km/s}} =$$

1.3×10^8 s $\approx$ 4 years

This means it would take 8 years to get a reply! This is not an easy way to have a conversation.

20.a)



20.b)

The kinetic energy of the wind is converted to the spinning mechanical energy of the turbine by the propellers. The generator converts the spinning mechanical energy of the turbine to electrical energy. The electrical energy is converted to heat energy by the resistors in the stove to heat the hot water.

21. Active Physics Plus

A wire that is 3.0 meters long is at rest in a magnetic field of 0.02T. If the wire experiences a force of 12 N, what current must be flowing in the wire? _____

Answer: 200 A

22.

An electron (charge = 1.6×10^{-19} coulomb) is moving at 4.0×10^5 m/s in a magnetic field of 0.0080 T. What is the size of the force acting on the electron?_____

Answer: 5.1×10^{-16} N