Chapter 12: Electromagnetism

Mini Investigation: How Strong is Electromagnetism?, page 547

A. Answers may vary. Sample answer:
No, when the power was first turned on, I could not pull apart the electromagnet and the soft-iron plate, even when pulling with great force.
B. Answers may vary. Sample answer:
The current necessary to just prevent me from pulling apart the electromagnet and the plate was approximately 0.20 A. Yes, it is surprising that a small current can generate a large force using an electromagnet.

Section 12.1: Magnetic Fields

Research This: The Maglev Train, page 551

A. The main advantage of Maglev technology is that it allows trains to travel at much greater speeds than conventional trains while remaining quiet and smooth.
B. Maglev train technology is not commonly used because Maglev train systems are currently far more expensive to build and maintain compared to conventional train systems. In addition, new conventional trains can use existing tracks but Maglev trains require special tracks to be built.
C.

Comparing conventional train technology to Maglev technology	
Similarities	**Differences**
Both reduce greenhouse gas emissions by reducing number of cars and the trucks on the road.	Maglev trains need new, special tracks while conventional trains can use existing tracks.
Both can move a large number of passengers.	Maglev trains are faster than conventional trains.
Both may reduce reliance on airplanes for long distance travel.	Maglev trains are more expensive than conventional trains.

D. The Maglev train in Shanghai provides people travelling between Shanghai and the international airport with extremely fast and reliable transportation. Its use has reduced pollution by requiring less power because it has less friction. It also reduces overcrowding by transporting large numbers of people quickly.

Section 12.1 Questions, page 552

1. Answers may vary. Sample answer:
The compass is an important tool in navigation because it enables navigators to measure the direction in which they are travelling relative to magnetic north. This is especially valuable at night or when the sky is overcast and the Sun cannot be used to estimate direction.
2. If the magnetic north pole were moved to a point on the equator, navigation would become very difficult. Compass needles would point toward the new pole location on the equator, so all directions shown on the compass would be inaccurate. Also, compasses would be difficult to use near the new poles on the equator because the direction the needle points would change a lot. It would probably be easiest to redefine north and south in terms of the new magnetic poles.
3. I would suspend a small sliver of the magnetite on a string to allow the sliver to align itself with Earth's magnetic field and point in the direction of magnetic north. I would not be able to determine magnetic north by only using the magnetite because either end of the sliver may be pointing toward the north pole. I could use the magnetite as well as other clues, such as the orientation of the Sun, to find the direction of magnetic north. Once I know which way is north (or south), then the opposite end is pointed south.
4. (a) If Earth had no magnetic field the northern lights would not exist because they are caused by charged particles interacting with Earth's magnetic field.
(b) If Earth had no magnetic field, animals that use the magnetic field to navigate when migrating might lose their way and not reach their destination. Some examples animals thought to use Earth's magnetic field to navigate are spiny lobsters, loggerhead sea turtles, and big brown bats.
5. (a) The needles of the top and bottom compasses should be parallel to the magnet. The needle of the left compass should be parallel to the magnet and point to the right. The needle of the right compass should be parallel to the magnet and point to the left.
(b) The needle of he compass would point downward toward the south pole of the magnet.

6. (a) The magnetic field lines should flow from the north end of one magnet to the south end of the other magnet. Magnetic field lines should also flow from the north end of one magnet to the south end of the same magnet.
(b) Magnetic field lines should flow from the north end of one magnet to the south end of the same magnet.
(c) The magnetic field lines should flow from the north ends of both magnet to the south ends of the magnet. Between the south ends of the two magnets, the magnetic field lines get close to parallel.
(d) The magnetic field lines should flow from the north ends of the magnets to the south ends of the magnets. Between the south ends of the two bottom magnets, the magnetic field lines get close to parallel.
7. Answers may vary. Sample answer:
I found that magnetic fields are used in cathode ray tubes (CRTs), which are the main component inside of some television sets and computer monitors. Electrons are fired by an electron gun inside the tube and travel from the back of the device toward the screen at the front of the device. As the electrons travel, they are deflected by a magnetic field inside the tube and they hit the front of the screen at a specified position, creating dots on the screen, or "pixels". All the electrons shot to different positions on the screen create a grid of pixels, which make an image that can be viewed.