1103 Period 19: Magnetic Forces and Electromagnets

Caution: Our class activities use strong magnets. While these magnets are not dangerous to your health, they can permanently damage objects with magnetic information. Keep iPhones, watches, credit and ID cards, calculators, memory sticks, and laptop computers away from the magnets on your table.

Activity 19.1: What Are the Properties of Magnets?

1) Permanent magnets: Experiment with the magnets, magnetic toys, compasses, and other materials on your table to answer the questions.

   a) Are magnets always attracted to one another, or can they repel each other? Describe or draw diagrams to show when two magnets attract and when they repel.

   b) Can a magnet attract any materials other than another magnet? List some materials that are attracted to a magnet.

   c) Do you think a dollar bill is attracted to a magnet? Prediction: _____ Watch as your instructor holds a dollar bill and gently brings a magnet near the bill. What happens?

   d) If a magnet is broken into pieces, what happens to the pieces?

Activity 19.2: How Do Magnetic Domains Store Information?

2) Magnetic Domains

   a) Hang a paper clip from a permanent bar magnet. Touch another paper clip to the end of the first clip. Now touch a third clip to the end of the second clip. How long a chain of paper clips can you make? ________ Explain what holds the clips together.

   b) What do you think would happen if a strong magnet was placed against a magnetic storage device such as a video VHS tape? Why would a magnet affect a tape?
Activity 19.3: Magnetic Forces and Magnetic Fields

3) Magnetic Forces
   a) Place two disc magnets on a wooden dowel so that one magnet "floats" above the other. What force(s) act on the floating magnet?

   b) What happens if you press the floating magnet down? Does the strength of the magnetic force change as you move the magnets closer together?

   c) How does the magnetic force depend on the distance between the magnets?

   d) If the floating magnetic has a mass of 5.0 grams, how large is the magnetic force that holds it up?

4) Magnetic Fields
   a) Move a magnet on the 2-dimensional square filled with liquid and iron filings. Place a cylindrical magnet inside the 3-dimensional shape with iron filings. Why do the filings clump in certain places?

   b) Draw a diagram of a magnet and its field.

   c) Place the small compass magnaprobe on the model of the Earth. If like magnetic poles repel and unlike poles attract, why does the north end of the magnaprobe point toward the geographic North Pole of the globe?
Activity 19.4: How Are Magnetic Forces Related to Moving Charges?

5) Magnetic Force on a Current

a) Place a wire between the ends of a large C shaped magnet. Briefly touch the ends of the wire to both terminals of a 3 battery tray. What happens to the wire?

b) Change the direction of the current flowing through the wire by switching the leads to the battery. Describe what happens.

c) Your instructor will demonstrate a metal swing placed near a large magnet. What happens when the swing is connected to a direct-current source?

6) A Current-Carrying Wire Induces a Magnetic Field

a) Press the black button on the board with a small compass connected to a battery. Make sure that the board is level and no large magnets are close to it. Describe what happens.

b) Your instructor will demonstrate a flicker light. What causes the light to flicker?

7) Parallel Current-Carrying Wires: Your instructor will demonstrate the force between two parallel current-carrying wires.

a) Do the currents in the wires flow so that the wires attract or repel?

b) If the direction of the currents in both wires were reversed, would the wires attract or repel?

c) If the direction of current in one wire was reversed, but the current in the other wire was kept the same, would the wires attract or repel?

d) Group Discussion Question: In each of these examples, the compass needle, the flicker light, and the parallel wires, what is the source of the magnetic force? Explain why the objects moved.
Period 19 Exercises: Magnetic Forces and Electromagnets

Write answers to the questions below. Show your mathematical steps and the units of the quantities. This sheet with your answers should be turned in at the beginning of Period 20.

1. Calculating magnetic force:
   A 6.5 gram magnet floats above another magnet, as shown in the diagram.
   a) Why does the top magnet float?
   b) Find the amount of force that supports the top magnet.

2. Illustrating electromagnetic force:
   Numerous classroom activities and demonstrations illustrated that a current-carrying wire is surrounded by a magnetic field. Describe three of these activities or demonstrations.
   a) 
   b) 
   c)