Name_____ Period_____ Date_____

CONCEPTUAL PHYSICS | **Activity**

36.5 Magnetism: Electric Currents and Magnetic Fields

ELECTRIC MAGNETISM

Purpose

In this activity, you will investigate the electric origin of magnetic fields.

Required Equipment and Supplies

large battery (6 V lantern battery or 1.5 V ignitor battery)
4 small compasses
small platform (a discarded compact disc or equivalent)
support rod with base
ring clamp
connecting wires

Discussion

In Magnetic Personality, you investigated the magnetic field around various configurations of bar magnets. But where does the magnetic field come from? What's going on inside a bar magnet to make it magnetic? In this activity, you will discover the origin of all magnetic fields.

Procedure

Part A: Current Across a Compass

Step 1: Set a compass on your desktop and allow the needle to settle into its north-south alignment as shown in Figure 1.

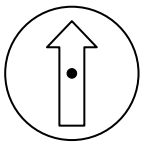


Figure 1

Step 2: Stretch a connecting wire across the top of the compass as shown in Figure 2. Rotate the wire clockwise and counter-clockwise so that you can see that the wire itself has no affect on the compass needle.

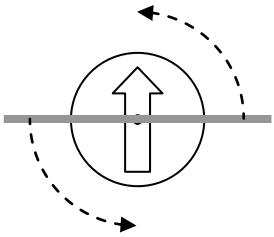


Figure 2

Step 3: Connect the stretched wire to the battery to form a short circuit and again rotate the wire back and forth as shown in Figure 3. Keep the short circuit connected for no more than 10 seconds.

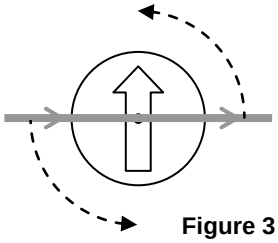


Figure 3

What effect does the current-carrying wire have on the compass?

Step 4: Determine which is more effective in deflecting the compass needle: north-south current or east-west current. Keep in mind that short circuits must not be allowed to run more than 10 seconds and compasses must be level to work properly.

Current has the greatest effect on the compass needle when it runs

___ north-south. ___ east-west.

Step 5: Try placing the wire **below** the compass and then running current through it.

Does the current affect the needle when the wire passes below the compass?

Step 6. Try reversing the direction of the current by reversing the connections to the battery.

What difference does reversing the direction of current have on the deflection of the needle?

Part B: Current Through a Platform of Compasses

Step 1: Arrange the apparatus as shown in Figure 4. Connecting wire passes through the center of the platform. The platform is supported by the ring clamp. The compasses are placed on the platform. Devise a method to have the connecting wire as vertical as possible as it passes through the compass platform.

Step 2: Before running any current through the wire, examine the compass needles by looking down from above the platform. Notice they all point north as indicated in Figure 5.

Step 3: Arrange to have current passing upward through the platform as shown in Figure 6. Connect the wire to the battery and tap the platform a few times. Record the new orientations of the compass needles in Figure 6.

Step 4: Reverse the direction of the current so the current passes downward through the platform. Connect the wire to the battery and tap the platform a few times. Record the new orientations of the compass needles in Figure 7.

The ability of an electric current to affect a compass needle was discovered by Hans Christian Ørsted, a Dutch high school teacher, in 1820. The observation established the connection between electricity and magnetism. We now know that **all** magnetic fields are the result of moving electric charge (even the magnetic fields of bar magnets). Ørsted's discovery stands as one of the most significant discoveries in the history of physics.

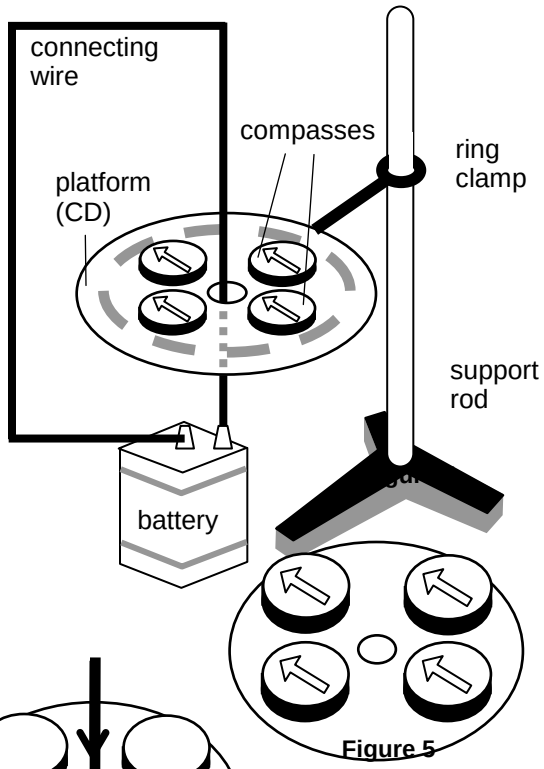


Figure 5

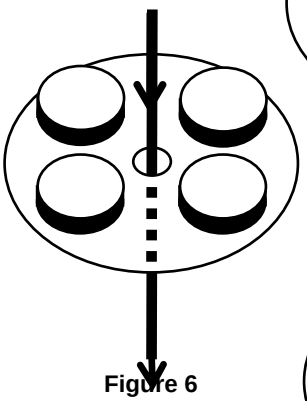


Figure 6

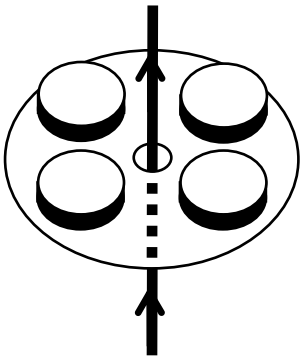
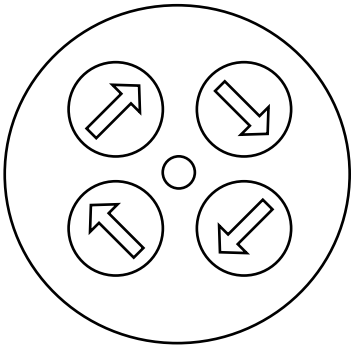


Figure 7

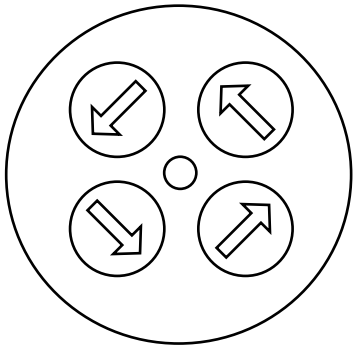
Summing Up

1. Current is passing through the center of a platform that supports four compasses. You are looking straight down at the platform. What is the direction of the current in each configuration shown below: coming toward you or going away from you?

a.



b.



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2. The direction of the magnetic field around a wire can be related to the direction of the current in the wire. If you imagine grabbing the wire with your thumb pointing in the direction of current, your fingers wrap around the wire in the direction of the magnetic field. Which hand must you use for this exercise to give the correct relationship between the direction of the current and the direction of the magnetic field: your left or right?

_____

3. What is the source of **all** magnetic fields?

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