PHY132 Practicals Day 9
Student Guide

Summer 2009

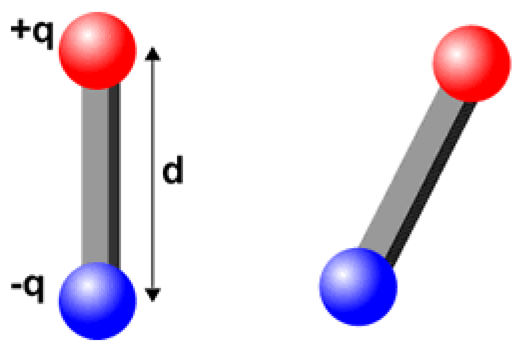
Concepts of this Module

- Interactions of permanent magnets with other magnets, conductors, insulators, and electric charges.
- Magnetic fields of permanent magnets, current carrying coils, and a current carrying straight wire.

EM-Mod.6, Activity 1

A. You are supplied two bar magnets, with the *North* and *South* poles marked. Do the same poles attract or repel each other? Do the opposite poles attract or repel each other?

B. Imagine that you have two electric dipoles, each of which consists of equal and opposite electric charges **+q** and **–q** separated by a constant distance **d**. Would the positive "poles" (i.e. charges) of the dipole attract or repel each other? What about the opposite "poles"? Is there any difference between the interaction of two electric dipoles and two bar magnets?



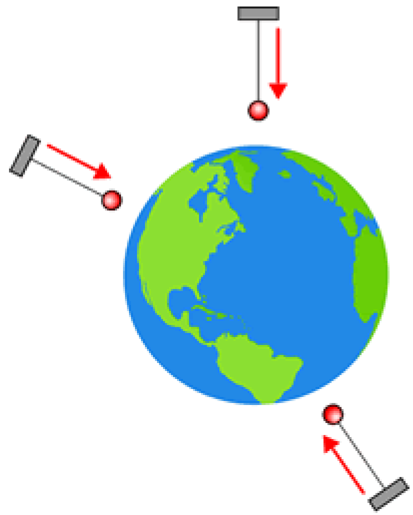
EM-Mod.6 - Activity 5

We can describe the fact that the Earth exerts a gravitational force on all objects near it by saying:

1. The Earth creates a *gravitational field* in all regions of space around it.
2. The gravitational field exerts a gravitational force on all objects in the field.

A convenient definition of the gravitational field is that it is equal in magnitude and direction to the acceleration due to gravity $\vec{g}$ at that point in space. Then the gravitational force exerted on a mass *m* in the gravitational field is:

$$\vec{F} = m\vec{g}$$



We could measure the direction of the gravitational field by taking a mass hanging from a string and observing in what direction the mass hangs. The figure to the right illustrates.

A compass is a little bar magnet that is free to rotate. In this Activity we will use a simple compass the measure the direction of the *magnetic* field around various objects. The procedure is similar to the one we described for determining the gravitational field. We will use the following standard convention:

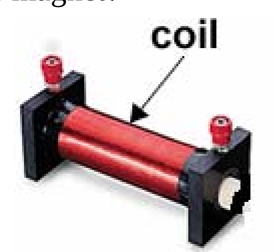
> **The direction of an external magnetic field is parallel to the orientation of the compass, and points from the South to the North direction as marked on the compass.**

All of the fields you will map are sufficiently strong that the Earth's magnetic field is negligible.

Be sure when you are mapping a magnetic field that all other magnets and metals are as far away as possible.

A. Map the magnetic field around one of the bar magnets using the compasses. Use your results to sketch the magnetic field "lines" around the bar magnet. Be sure to include arrows on the lines to indicate the direction of the magnetic field.
B. Place the two bar magnets together, with the North pole of one in contact with the South pole of the other, as shown. Map the magnetic field of the combination and sketch the field lines including the direction of the field. Do you think the field any different from that of a single long bar magnet?

C. In Activities 11 and 12 below you will be using a wire coil, and a plastic plate with a rectangular hole cut in it. Place the coil in the hole. You will place the compasses on the Plexiglas

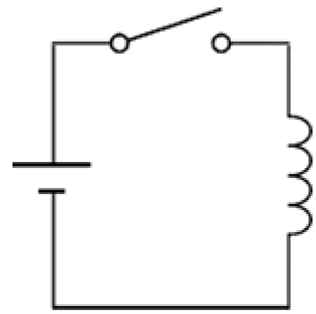


   You will connect the 6V battery to the red sockets on the coil, with a switch to avoid draining the batter.

   The switch you will use is called a *Contact Key*: this type of switch is only on when you hold it down.

The symbol for a coil is shown to the right.

So the circuit diagram of the experiment you will do is:



Use the compasses to map the magnetic field around the coil, and draw field lines including the direction. Compare your results to Parts A and B.

D. In terms of its magnetic field we can model the Earth as a big bar magnet. Is the magnetic North pole located at the geographic North pole (where Santa's workshop is located) or at the geographic South pole (where the penguins live)?

Course Concepts *EM-Mod.6 -Activity 4 [If you have time]*

In Electricity and Magnetism Module 1 Activity 1 you may have put an electric charge on a length of sticky tape by suddenly peeling it off the tabletop and hanging it from the cupboard. You may wish to refer to the Student Guide for that Module and/or your lab book to refresh your memory. Repeat that procedure.

1. Does the magnet exert a force on the charged tape? Is there a difference between the North and South poles?
2. You are supplied with an unmagnetised soft iron rod. Does it exert any forces on the charged tape? Are there any differences between the interaction of the tape with magnet and with the metal rod?
3. What can you conclude about the interaction of stationary electric charges with magnetic fields?

Last revision to this write-up: July 23, 2009 by Jason Harlow.

The EM-Mod.6 Guide Sheet was written by David M. Harrison, Dept. of Physics, Univ. of Toronto in January 2008. EM-Mod.6 Activity 4 is from Lillian McDermott et al, **Tutorial in Introductory Physics**, Magnets and Magnetic Fields I.B, (Prentice-Hall, 2002), pg. 113. Parts of EM-Mod.6 Activity 5 are similar to Priscilla W. Laws et al., **Workshop Activity Guide**, Module 4, Unit 28, (John Wiley, 2004), pg. 725.