An Apparatus for Investigating the Magnetic Field due to a Wire

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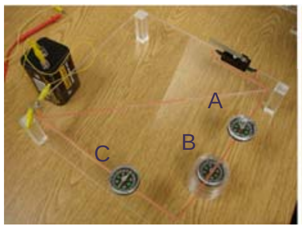
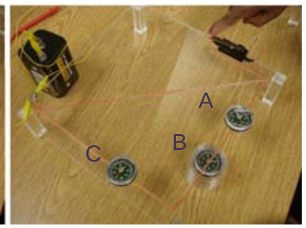
COMPASS DEFLECTION



Open Circuit

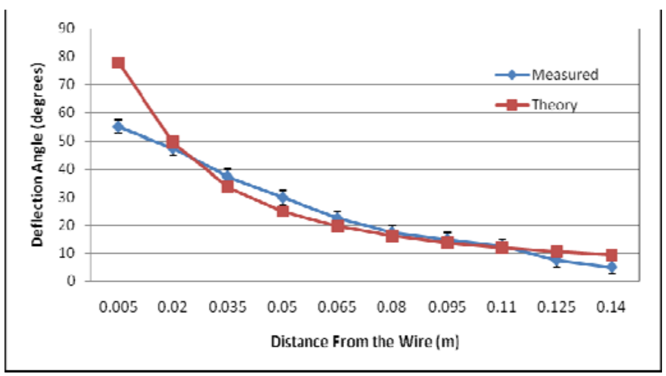


Closed Circuit

A. Above wire, initial direction parallel to wire
B. Below wire, initial direction parallel to wire
C. Above wire, initial direction perpendicular to wire

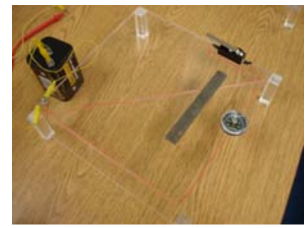
When the switch is closed, compasses A and B deflect in opposite directions and compass C does not deflect.

The deflection angle changes as the compass is raised above the wire. The final angle is determined by a superposition of the Earth's field and the wire's field.



The first point disagrees because the theory assumes that the magnetic field due to the wire does not have any curvature.

RESONANCE

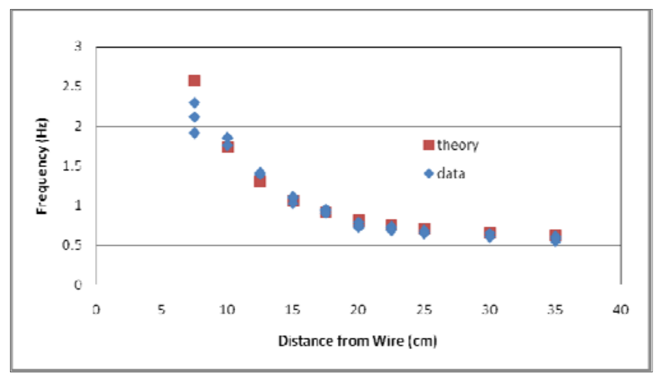


The resonant frequency of a compass needle, of dipole moment, m, and moment of inertia, I, due to an external magnetic field, B, is given by:

$$f = \sqrt{\frac{mB}{I}}$$

In this case, the external magnetic field is due to the Earth, or a bar magnet placed on the apparatus, and not the field due to the wire. Typically, the resonant frequency is around a couple of Hz.

The resonant frequency as a function of the position of a bar magnet relative to the wire is shown below.



The theory assumes the bar magnet is a dipole with the magnetic moment chosen to fit the data (1.6 m^2A). The ratio of the compass's dipole moment to its moment of inertia was measured.