MAGNETIC FORCE ON A CURRENT

PHYSICS 220
(I-220-31 Rev 9-26-12)

INSTRUCTIONS:

PART A:
(1) Make sure the black magnet is in the lower position by turning the crank 1/2 turn if necessary.
(2) Measure the magnetic field by moving the "Hall" element (see hint "d") into the magnet gap.
(3) Record the magnitude of the magnetic field at every centimeter along the gap region. Centimeter marks have been placed along the Hall element rod to indicate its position.
(4) Raise the magnet with the crank so the coil is now in the center of the field. With NO CURRENT flowing through the coil, check to see that the scale reads 0.00 grams, press the “Tare” button to zero the scale if necessary. Turn on the current supply and coil current meter and adjust the current to 300 ma. Read the scales to measure $F_{\text{meas}}$.

PART B:
(5) Calculate $W_{\text{eff}}$.

PART C:
(6) With the current still adjusted to 300 ma, read the scale. Repeat this at settings of 200 ma and 100 ma. Show that the force is proportional to the current.

HINTS:
(a) The scale reads in "grams" but actually measures the force of gravity given by $mg$ ($g = 9.8 \text{ m/sec}^2$).
(b) Remember that the measured force is associated with 500 turns of wire.
(c) $W_{\text{eff}}$ should be larger than the actual size of the magnet pole faces $W$ which is 6.4 cm.
(d) The Hall element (the small red semiconductor sheet at the end of the probe) must be approximately vertical, which means that the handle must be approximately horizontal.
(e) The magnetic field $B$ (in tesla) = 2 X Voltage (in volts).
   For example: If the voltmeter reads 30 millivolts
   Then $B = (2 \times 0.030 \text{ volts}) = 0.060 \text{ tesla} = 600 \text{ Gauss}$

CAUTION
DO NOT touch the coil, if it is touching the magnet pole face get help.

DO NOT try to adjust the Hall element power supply (under the box). It is calibrated and any adjustment will give you incorrect results.