

Physics Education

Electromagnetism: Force on a Current Carrying Wire

Recently I conducted an experiment with my students to investigate the force acting on a current carrying wire in a magnetic field. This experiment is performed by many physics teachers only this time I was able to improve upon it with software. Please read on

This experiment was conducted using the Ezilog USB data logger - <http://www.logint.com.au/ezilog.html>

Aim: To determine the relationship between the current in a wire and the magnetic force acting on the wire.

Theory:

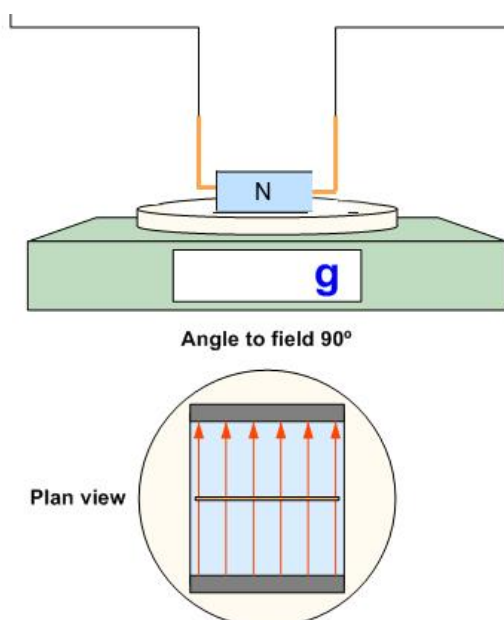
When a current carrying wire is placed into a magnetic field it experiences a force given by the equation

$$F = BIl$$

Where F= Magnetic Force
B= Magnetic Field Strength
I = Current
L = Length of wire in the field

Method :

1. Tape two bar magnets separated by 1cm onto a cardboard sheet and place onto an electronic balance.
2. Place a heavy wire between the magnets as indicated below



3. Connect a suitable current source and ammeter to the wire. (Comment. We have a 15A current source which we use for this experiment, but don't have an ammeter which will read 15 A so I used a +/- 25 V data logger sensor across a 1 Ohm resistor to be able to measure the current. I also connected the balance to the data logger to record both current and mass (which was then converted to force) with the data logger.

4. Change the current and record readings of current and mass in the table below

| Current (Amps) | Mass (g) | Force (N) |
|----------------|----------|-----------|
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5. Plot a graph of Force vs Current.

Discussion:

1. What is the shape of the line in your graph?
2. What does the slope of this graph represent?
3. Determine the value of this slope.

Comment: It should be possible to estimate the magnetic field intensity (B) using the slope determined in 3. This does require a good estimation of the effective length of wire (l) in the field. This will depend upon your actual experimental design. With the data logger you can measure the magnetic field intensity using a magnetic field sensor.

Conclusion. Write a conclusion to this experiment ensuring that you address the Aim.