Pre-Project 2
The Basic Beakman's Motor

Read over the write ups from past semesters on the Beakman's Motor. Also, look over all of the materials provided for the Electronic Instrumentation course, including the PowerPoint presentation on this project. You will find them at http://hibp.ecse.rpi.edu/~connor/education/EILinks.html#Proj1

In this studio session, you are to build the basic motor using a DC power supply for your 1.5 Volt source. You will also have a (probably dead) battery to see how the configuration goes together. Once you build the motor, you need to test it. It does not matter how fast it goes, only that it actually turns. Once you get it going, have a TA verify that you have completed this task by signing below.

In addition to building a working motor, you must also estimate the inductance and resistance of your coil. You should calculate both terms and also measure them. The resistance can be measured with the multimeter and the inductance with the bridge. Make sure that you note the values for these parameters so that you will have them available when you begin the project.

Did You Clean Up?

Name: ____________________

Name: ____________________

Name: ____________________

Name: ____________________

It is essential in this and the final project 2 work that you demonstrate your speed to a TA and then have them sign to show that you have completed this part of the project.

Speed: ____________________.

TA: ____________________

Coil Inductance

Measured

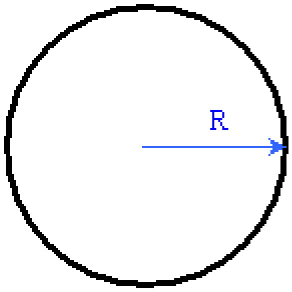
Calculated (provide formula)

Coil Resistance

Measured

Calculated (provide formula)

The measurement and calculation of inductance was done reasonably well by most students, once they realized that they cannot use the formula for an ideal solenoid. The analysis of an ideal solenoid assumes that it is much longer than its diameter, which is clearly not the case for the several turn coil used in the motor. Such a coil is known as a short solenoid or just a dipole-like coil. There is a short discussion of how to handle the short solenoid on page VII-21 of the class notes. Fortunately, the EMC lab at Missouri-Rolla has provided a collection of formulas for the inductance of various configurations, including this type of coil. From their page at http://emcsun.ece.umr.edu/new-induct/ they provide the inductance of a circular coil:



- **N:** *number of turns*
- **R:** *radius of the circle*
- **a:** *wire radius*
- **μr:** *relative permeability of the medium*

$$L_{circle} \approx N^2 R \mu_0 \mu_r \left[\ln\left(\frac{8R}{a}\right) - 2.0 \right]$$

While this site does this calculation for you, it is important that you apply this formula yourself to be sure that you understand it. In your project report, you should include your complete calculations.

For resistance calculations, it is necessary to know the size and conductivity of the wire used. Again, this is such a standard activity that there are very helpful online tools for finding resistance of wires. http://www.megaconverter.com/mega2/ has a wire resistance applet that makes this problem trivial. However, you should be sure that you know the basics of how the resistance was determined. All necessary info is included in the applet. As for measuring resistance, most students did this incorrectly. The coil resistance was measured by connecting it to the multimeter using about a meter length of coaxial cable. Unfortunately, very few students recognized that the resistance of the cable was a significant contribution to the measured value. To remove this effect, short circuit the mini-grabber connectors at the end of the cable and note the value of the cable resistance. This should be subtracted from the value measured for the coil. Remember that everything is part of the circuit. This is one of the most important lessons to learn from this course. We hope we design systems in which everything is not important (and most things are not), but we always have to make sure and not assume anything.