

REV0; May 3, 2007

Last Lab: The DC Motor

Due Friday, May 11, in Room 305, 4 PM until 6:00 PM

This lab is easy, but also gives a chance for fun and perhaps a little glory.

Incidentally, perhaps, a working motor should convince you that a magnetic field can make something move (in case you doubted that!).

A Prize

We're offering two prizes: one for *fastest* motor (rpm when powered from 9V), the other for *prettiest*¹ motor.

Each winner will get a gift certificate good for some ice cream at Herrell's.

You can build this motor in a half hour; you can also give it more time and thought, if you like. That extra effort would likely go into questions of mechanics, not E & M: the game is to make a motor that spins *fast* (plain old RPM; no minimum torque required!). So, you may find yourself wondering what limits the spin rate of your motor.

1 Pick Up a Kit of Parts

We're handing out kits after class, Thursday, May 3. If you miss this opportunity, apply to Rob Hart (5-2039, SC204) during working hours (9-5).

2 Help Lab Hours

There will be just one long help lab, Thursday, May 10, 3-9 p.m. You can use this session to fix Lab 6, if you failed it.

3 Testing

The panel of judges will test the motors and report back to you by email. Make sure your name is on the motor.

We will accept motors that need a slight push to start.

¹We tend toward the Bauhaus view that function dictates form, but we're not anti-Baroque.

4 Contents of Envelope

- 1 magnet (these are small but powerful. Don't carry it in your backpack with floppy disks or your laptop. Don't let it snap hard against metal or another magnet; the material is brittle and the magnet can shatter.
- 2 thumbtacks
- 2 sheet metal screws
- 1 block of wood
- 2 paperclips
- some insulated copper wire
- 9 volt battery
- 9 volt battery snap-on leads

If you find additional parts in the kit (say, extra thumbtacks), still you may use only the parts listed above.

5 Objective

The goal is for you to build an electric motor using only the materials in the envelope. We are strict about the "only." Don't add even scotch tape, or glue, or an extra thumbtack or two: we'll feel obliged to remove the extra stuff before letting your motor race.

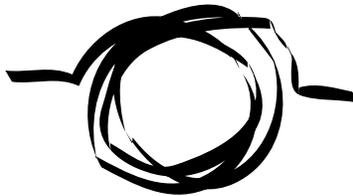
6 Design Suggestions

6.1 coil

Make a coil of the wire with a diameter of perhaps ≈ 1 " ; maybe less. The smaller the diameter, the more turns you will have but that does not necessarily make the motor go faster! Hint: recent experience suggests that *small is beautiful*.

Pull out the ends of the wire (see figure). To make the windings of the coil stay together, you could clip off a few pieces of the wire and use them to twist around the loops at two or three points (the wire is insulated).

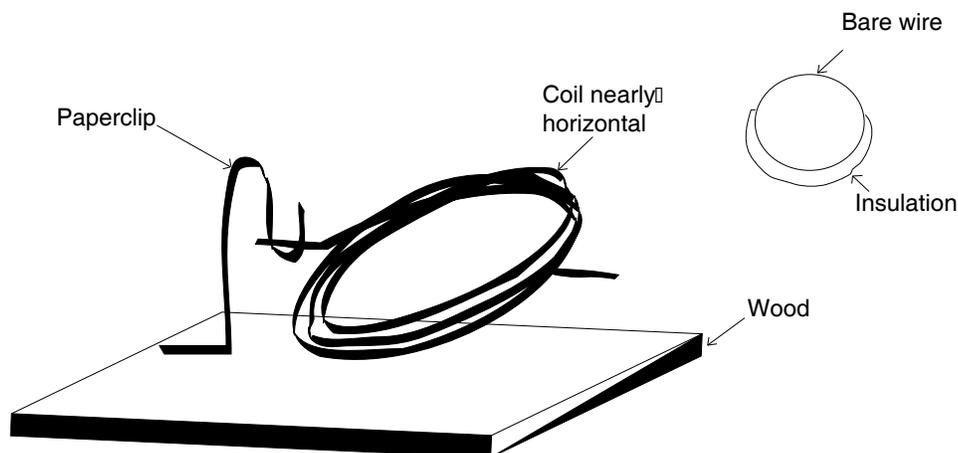
Another observation, based on recent experience: the rotor tends to be jumpy when spinning fast. Do what you can to help a rotor stay in place when spinning fast.



6.2 Support

Make a support for the coil. Use the paperclips as brackets. They can be fastened to the wood with the thumbtacks (quick but flimsy) or with the sheet metal screws (laborious, but secure). Your battery will later be connected to the paperclips which will feed the current through your coil.

The ends of the wire are freely supported by the paperclips (bend them any way you want to). Thus, the coil rests on the paper clip-support brackets. One such bracket is schematically shown in the figure below.



6.3 Commutator

Now comes your low-budget “commutator:” you must remove some of the insulation on the 2 end sections of wire, where the wire makes contact with the paperclips. That is easy to do with a razor blade and/or some sand paper. However, if you remove the insulating material all around the wire, the motor will not rotate! You need a commutator (a scheme for keeping the direction of current-flow in the coil what it ought to be). One solution is to remove the insulating material on only one “half” of the wire (see the figure). You have to think through which half in relation to the plane of the coil!

Place the magnet on the wood next to the coil (what location?).

6.4 Perfect it!

Connect your battery and tinker until you’re happy with your motor’s operation.