Worksheet: Motors and Generators

Name: _____ Group name: _____

The motor, which you will build are the rotor and the commutator. The rotor consists of the coil made of loops of wire. The cmmutator in most motors reverses the current. Our commutator will work a bit differently interrupting the current. Your goal is not just to build the motor, but to understand and explain **how it works**.

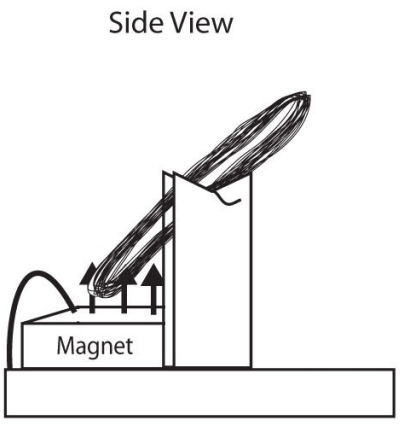
1. **Build the setup**:

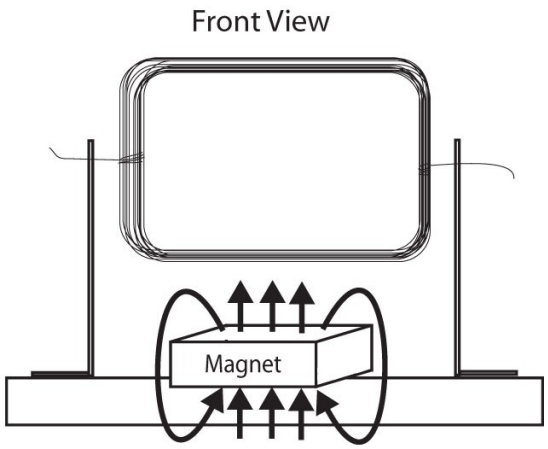
   (a) **Build the rotor**: Pull about 10 cm (4 in) of copper wire through the slot of the wooden form and wind the remaining copper wire tightly around the wooden form until there are about 10 cm of wire left.

   (b) Count the number of loops as you wind it: _____

   (c) Carefully remove the loops from the wooden block. Secure the ends, which will form the axle, by wrapping the wire around the loops two or three times

   (d) **Commutator**: The copper wire is insulated with a layer of plastic enamel. Remove the insulation on **one** side of the wire – be sure to remove isnsulation from the same side of both axles (see prelab). Put the wire on a wooden block and use the steel "knife" or abrasive board to sand-off the insulation.





   (e) **Optimize the rotor**: An evenly balanced rotor that is not slowed by gravity will make a better motor. Straighten the axle as smoothly as possible and center them. Shape the coil so that it rotates freely and sits in any position without one side rotating to the bottom.

(f) **Assemble the Motor**: mount the rotor on the V-shaped contacts as shown in the diagram. Mount the magnet.

(g) **Check your set-up**: Hook up an ohmmeter to both V-shaped contacts. Measure the resistance when the insulated side is "up" (both exposed axles are making contact) and when you rotate the rotor such that the insulated side is down.

2. **Power up**: Wire up a 3V battery with a switch to each of the V-shaped contacts (not the wires, of course!). The motor will need a bit of a push to start. If everything is right, it should spin continuously once you close the switch.

   (a) Try adjusting the position of the magnet to see what orientation and distance is optimal. Hold the magnet in your fingers and notice the force (!) What force does the magnet feel?

   (b) Draw a picture of the setup and draw the magnetic field lines present when the wire is making contact:

   (c) Figure out how to reverse the direction the motor spins. There are at least three ways to do this – what are they?

   (d) Add a second magnet. You will need to fiddle with the position of the magnet pair to avoid collision with the rotor. What happens and why?

3. A **generator** is the inverse of a motor: motion makes electricity. You have built everything it takes to generate electrical power.

   (a) Remove the leads from the battery and connect to the multimeter to DC-volts (mV scale). Spin the rotor by with a finger and measure the voltage of the maximum as the rotor spins. Be careful not to bend the axle or push the rotor of the supports.

   $V =$ _____ _____

   (b) Predict what happens if you reverse the direction of rotation and give an explanation.

   (c) Verify your prediction.

4. Hook up the hand crank generator to the capacitor. Mind the polarity: red = +. Charge the capacitor by rotating the crank, then let go of the crank. Record what happens: