Lab 2c: Motors and Generators.

Names:
1.) ___________________________
2.) ___________________________
3.) ___________________________

Learning objectives:

- Current carrying wires can produce a torque on a magnet
- Understand the basic parts of a motor
- A change in magnetic flux produces an emf across a coil that helps maintain the state of the coil

Activities:

- Produce a torque on a magnet array
- Make a simple motor
- Dissect a simple motor
- Observe magnetic damping
- Drop a magnet down a copper pipe
- Measure the efficiency of a generator/capacitor/motor system

Warm-Up:

Take a look at the generator on the following PHET.

http://phet.colorado.edu/en/simulation/generator

Activity 1:

1.) Suspended above the table is a magnet array positioned over a current carrying wire. The wire can be switched on and off using the switch provided.

A.) What is the arrangement of magnets on the array? Draw the field lines here.

B.) What happens when you close the switch. Why?

C.) Modify the switch to make this “motor” twice as efficient. Draw a schematic

Activity 2: Demonstration Motor

The TF will take a few minutes to look at a small demonstration motor. Make sure you identify the source of the magnetic fields, commutator, armature, and the brushes.

Activity 3: Building a Simple Motor

1. Form a coil by wrapping the wire around a whiteboard marker. Leave about 4 cm of straight wire at each end.

2. You will need to modify the coil in some way to allow a current to flow at the appropriate times. Perform this modification and describe what you did.

3. Place your coil on the holders provided

4. Hook up the power supply to provide a substantial current

5. Place a magnet near the coil

6. Give the loop a spin and it should start rotating on its own. Slight adjustments may need to be made to get the motor to function.

7. Show a TF a working motor

Activity 4: Dissecting a Motor

1.) Dissect a small motor and comment on how this motor is better than the one you constructed. Try to identify the armature, commutator, brushes, and magnets. Reassemble your motor and apply a small voltage. Slowly increase the voltage and see what happens.

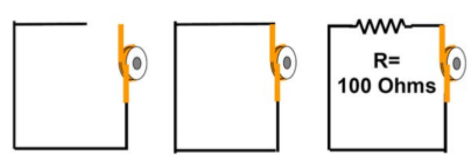
2.) Now instead of applying an external voltage try measuring the voltage across the coils when you manually spin the motor. Try using the oscilloscope on the bench.

Activity 5: Magnet Pendulum

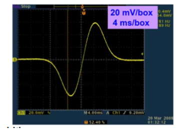
Place the small coil so the magnet on a pendulum swings close to the face of the coil.

1.) Start with a small amplitude on the pendulum. Rank the following in terms of how quickly the pendulum is being damped. Remember to start the pendulum with the same small amplitude each time.

A.) Coil is open
B.) Coil is shorted
C.) Coil is in series with 100 ohms



2.) Now place the scope probe across the resistor. Swing the pendulum and observe the voltage signal across the coil.

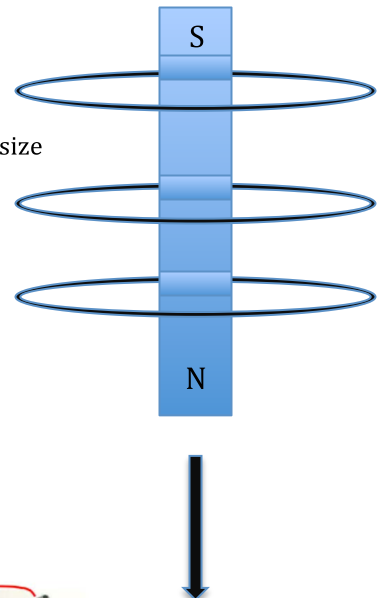


A.) What is the period of the pendulum?
B.) What happens to the current in the coil as the pendulum is passing by? How do you know?
C.) How do the currents compare as the pendulum passes from the right compared to the left?

Activity 6: Magnet Down a Copper Pipe

Drop a magnet down the copper pipe and observe what happens. What does this imply about the currents being produced in the copper?

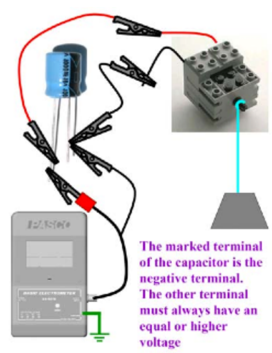
Where does the gravitational potential energy go?



Here is a magnet that is being dropped through three wire loops. What is the relative size and direction of the currents in each of the three loops?

Activity 7: Efficiency of Generator

Use the weight attached to a generator to charge the capacitor. Use Logger Pro and the voltage probe to monitor the voltage across the capacitor. When the weight has fallen all the way down then remove the large weight and allow the built up charge to lift the mass hanger upwards.



Look at the energy added to the system, the energy stored by the system, and finally the energy that we end up with. Calculate each of the following.

A.) How much energy do you start with before the weight is dropped?

B.) How much energy is stored in the capacitor?

C.) How much energy do we end up with?

What is the efficiency from A to B, B to C, and finally the overall efficiency A to C?