AC / DC MOTOR GENERATOR DEMO ACTIVITY MODEL

CAT NO. PH 1245-N8

Experiment Guide

AC/DC MOTOR GENERATOR DEMO
ACTIVITY MODEL

MAINTENANCE REQUIRED:

Over time magnets will lose their magnetic field strength, especially if they are dropped or hit. The apparatus will generate more current if the magnets are remagnetized before use. You can use EISCO's Magnetizing and Demagnetizing Coil PH 0804A for this purpose.

BACKGROUND:

This apparatus allows students to easily compare and contrast an AC generator and a DC generator. The front of the apparatus has brushes designed to collect direct current (DC) through a split ring and the back of the apparatus has brushes designed to collect alternating current (AC).

Generators are used to produce a voltage or potential difference in wire. An outside source of energy is needed to turn the turbine in the generator. In this case the mechanical energy to turn the generator can be supplied by a student's hand. Generators in the real world can be powered using kinetic energy from falling or moving water or nuclear reactor or wind or steam.

Turning a coil in a magnetic field produces a current through the coil. This current is naturally sinusoidal. Since each coil on either end of the armature produces current, collecting this current from the coil will yield an alternating current (AC).

The armature has two coils of wire attached to each end. As these wires are moved through the magnetic field supplied by the bar magnet, a potential difference or voltage is produced in the wire. The greater the magnetic flux density the wire travels through the stronger the voltage produced.

Using a split ring brushes for the DC generator collect current on only one side of the armature at a time so that the current is always flowing in the same direction. Although current is always flowing the same direction, the magnitude of the current is constantly changing which results in a flickering of the light bulb as the current increases and decreases. This happens for both the AC and DC generator.

The blue end of the bar magnet is typically the North Pole of the magnet, but some magnets can become repolarized. Students can use a small compass to check out the polarity of the bar magnet. They can also see that the metal brackets that hold up bar magnet are also polarized.

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HELPING STUDENTS UNDERSTAND HOW AN AC GENERATOR WORKS:

Students must first have a grasp of the following concepts before they can make sense of how an AC or DC Generator works:

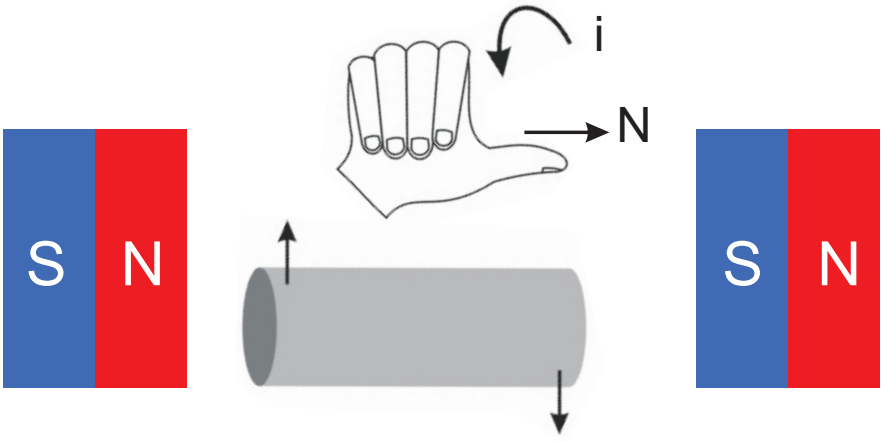
All magnets have a North and South Pole. North and South poles attract. Like poles repel or push each other away.

Some metals are easily magnetized, such as iron, nickel and cobalt or alloys of these metals such as steel. Some metals such as aluminum are not.

Easily magnetized metals can strengthen a magnetic field. This is why there are often iron cores in the middle of coils of wire used foe electromagnets and why the supports for the magnet in our motor are made of easily magnetized metal.

A changing magnetic field induces a current in a wire or coil of wires. A permanent or bar magnet will of course not have a changing magnetic field, but the magnetic flux through the coil can change by rotating the coil in a fixed magnetic field. So that the cross sectional area perpendicular to the magnetic field increases and decreases in diameter. The right hand rule can be used to determine the direction the current flows in the wire.

Likewise, a changing current induces a magnetic field. For example, wrapping a coil around a nail and applying a potential difference will cause the nail to act like a magnet with a North and South Pole. Which end of the nail is the North Pole is determined by using the “right hand rule”.



Conventional current assumes that the current flows from positive charge to negative.

Magnetic field lines go out of North and into South.

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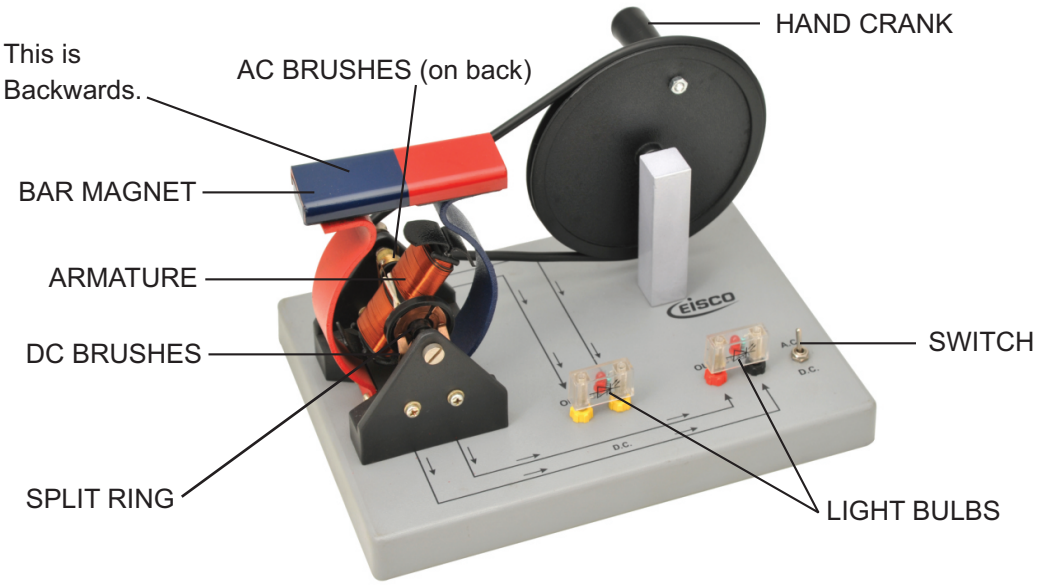
DIAGRAM LABELING ALL PARTS:



OPERATION OF EQUIPMENT:

1. Turn the switch to the down position to allow the DC brushes to collect the current. The black lines on the top of the apparatus show the wires that connect the DC brushes to either side of the light bulb.

2. Turn the hand crank. The faster you rotate the hand crank, the brighter the light bulb will glow.

3. Turn the switch to the up position and the AC brushes will collect the current. The bulb connected to either side of the AC brushes will then glow. The faster the crank is turned, the brighter the light will glow.

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Understanding AC and DC generators (Teacher's Answers)

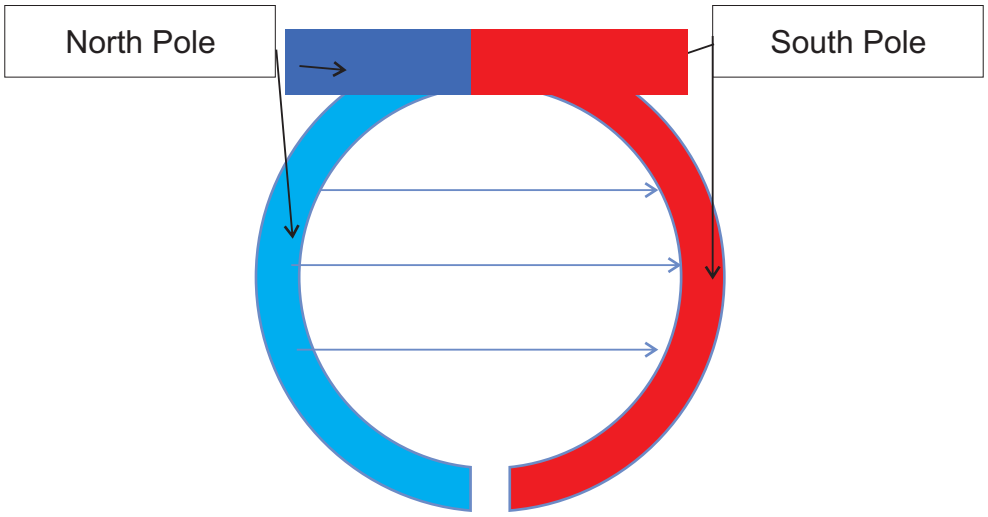
1. Use a small compass to identify North and South Pole of the bar magnet. Justify your answer by describing how your compass behaved.

   The blue end of the bar magnet repelled the North end of my compass. Since like repels like, the blue end of the magnet is North and the red end is South (answers may vary from group to group.)

2. Are the brackets that hold the bar magnet up also magnetized? How do you know?

   The blue bracket is also magnetized as a North Pole because it repels the North end of my compass.

3. On the diagram below label the North and the South Pole of bar magnet and then draw at least three magnetic field lines using directional arrows.



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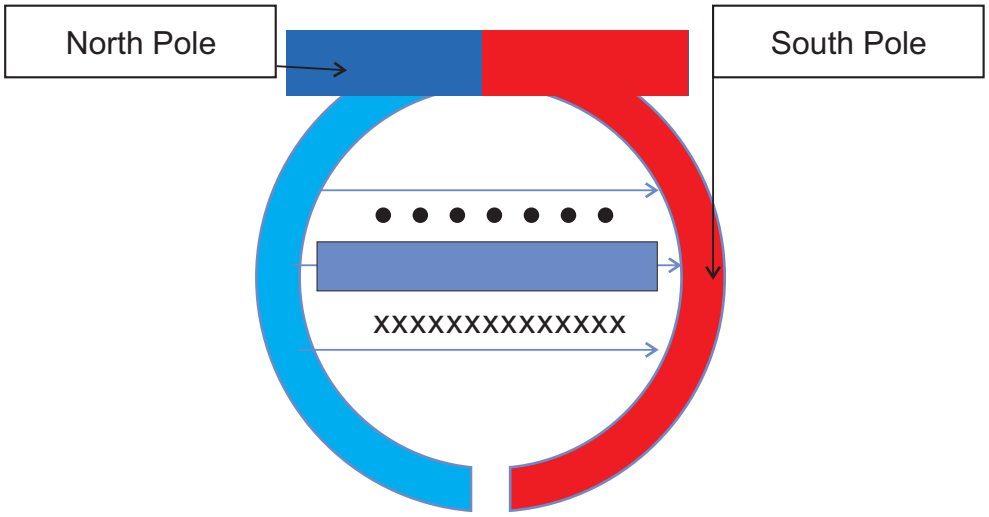
4. The flux density through the coil of wire is going to be greatest when the coils are horizontal. Orient the coil so it is horizontal and then using the right hand rule determine which direction the current will be induced in the wire. Use ● for current coming out of the page and **x** for current going into the page



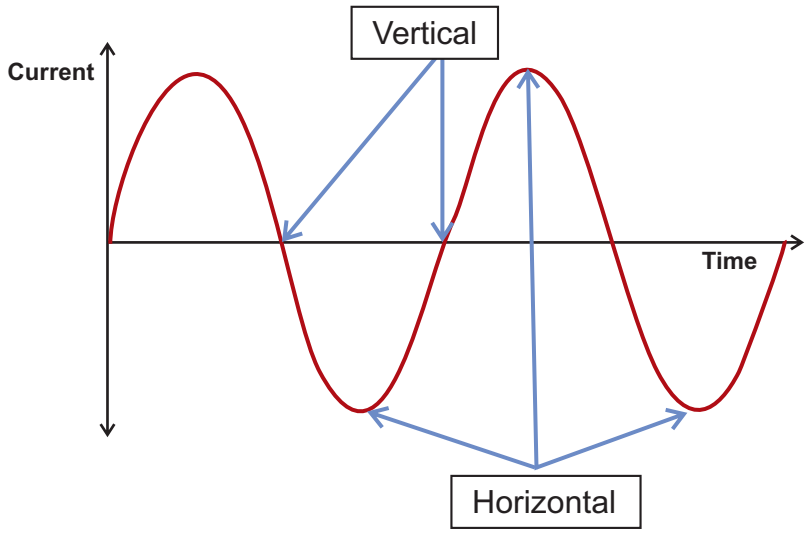
The AC generator:

5. Start on one end of the bulb and trace the complete circuit through the wires in the AC generator until it comes back to the other end of the bulb. Is the circuit ever broken as the coils rotate through their motion?

The circuit is never broken.

6. Notice that one brush carries the current from one half of the armature while the other brush is attached to the other end of the armature and carries the current through that end. Draw a diagram of current vs. time on the diagram below for the AC generator. Start when the coil is vertically oriented and diagram at least one complete rotation. Indicate at least one point where the coil is horizontal and one point where the coil is vertical.

AC GENERATOR GRAPH



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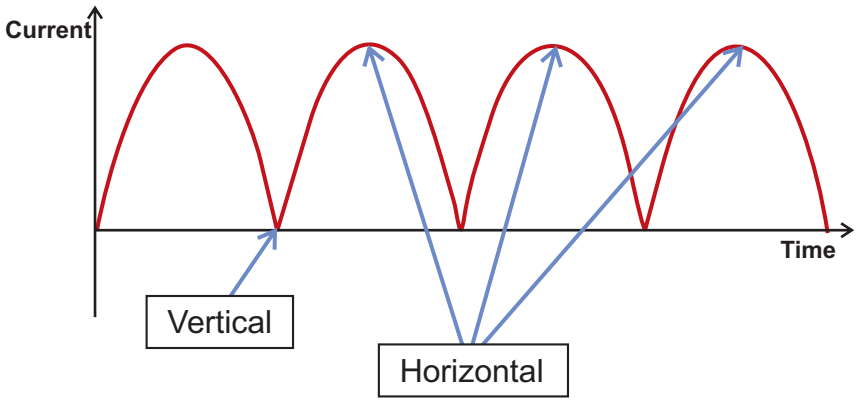
The DC generator:

7. Take a look at the brushes on the DC generator. Slowly turn the crank through one complete rotation and explain how the split ring changes the path for the current to flow.

   The split ring allows the current to flow from the top coil into the light bulb on one side and from the bottom coil to the light bulb on the other side. Just as the coil is about to turn over so the top coil is now on the bottom, the brush starts to collect current from the other side so the one brush is always collecting current from the top coil and the other brush is always collecting current from the bottom coil.

8. Draw a diagram of current vs. time on the diagram below for the AC generator. Start when the coil is vertically oriented and draw at least one complete rotation. Indicate at least one point where the coil is horizontal and one point where the coil is vertical.

DC GENERATOR GRAPH



EXTENSION QUESTIONS:

The bulbs flicker when the crank is turned? Why is this?

Remove the magnet; does the coil turn smoothly without the magnet present?

What is the purpose of the apparatus to hold up the magnet? Why is it made out of metal?

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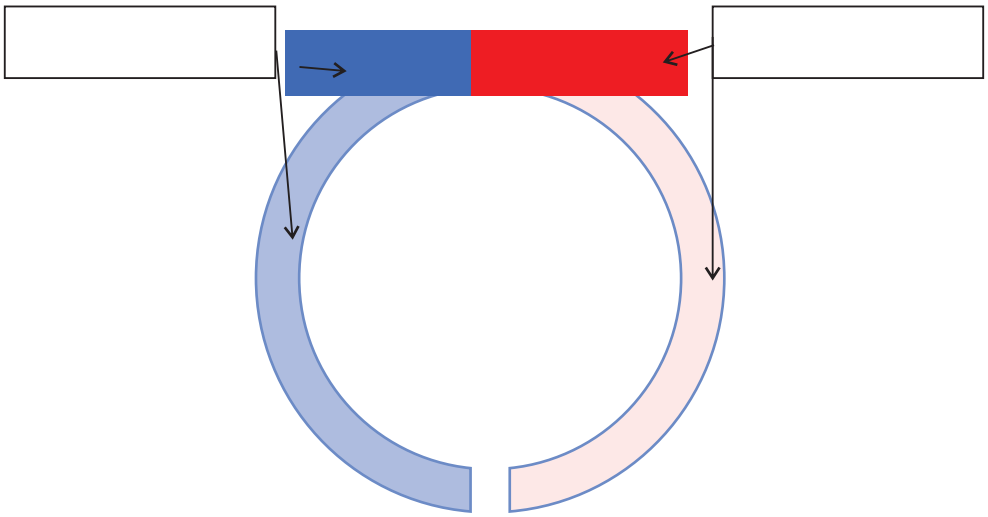
Name:_____ Date:_____

Understanding AC and DC generators

1. Use a small compass to identify North and South Pole of the bar magnet. Justify your answer by describing how your compass behaved.

2. Are the brackets that hold the bar magnet up also magnetized? How do you know?

3. On the diagram below label the North and the South Pole of the generator and then draw at least three magnetic field lines using directional arrows.



4. The flux density through the coil of wire is going to be greatest when the coils are horizontal. Orient the coil so it is horizontal and then using the right hand rule determine which direction the current will be induced in the wire. Use ● for current coming out of the page and **x** for current going into the page.

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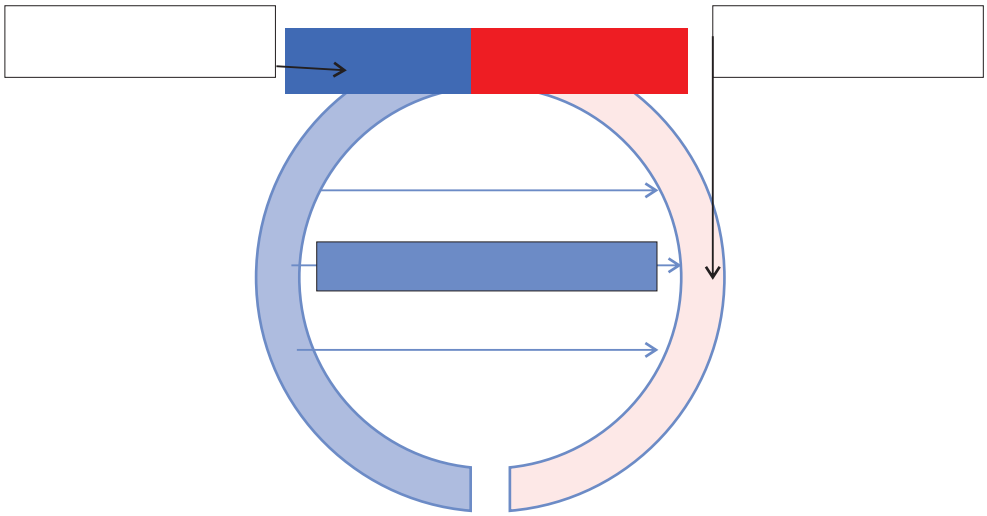

The AC generator:

5. Start on one end of the bulb and trace the complete circuit through the wires in the AC generator until it comes back to the other end of the bulb. Is the circuit ever broken as the coils rotate through their motion?

6. Notice that one brush carries the current from one half of the armature while the other brush is attached to the other end of the armature and carries the current through that end. Draw a diagram of current vs. time on the diagram below for the AC generator. Start when the coil is vertically oriented and diagram at least one complete rotation. Indicate at least one point where the coil is horizontal and one point where the coil is vertical.

The DC generator:

7. Take a look at the brushes on the DC generator. Slowly turn the crank through one complete rotation and explain how the split ring changes the path for the current to flow.

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8. Draw a diagram of current vs. time on the diagram below for the AC generator. Start when the coil is vertically oriented and diagram at least one complete rotation. Indicate at least one point where the coil is horizontal and one point where the coil is vertical.

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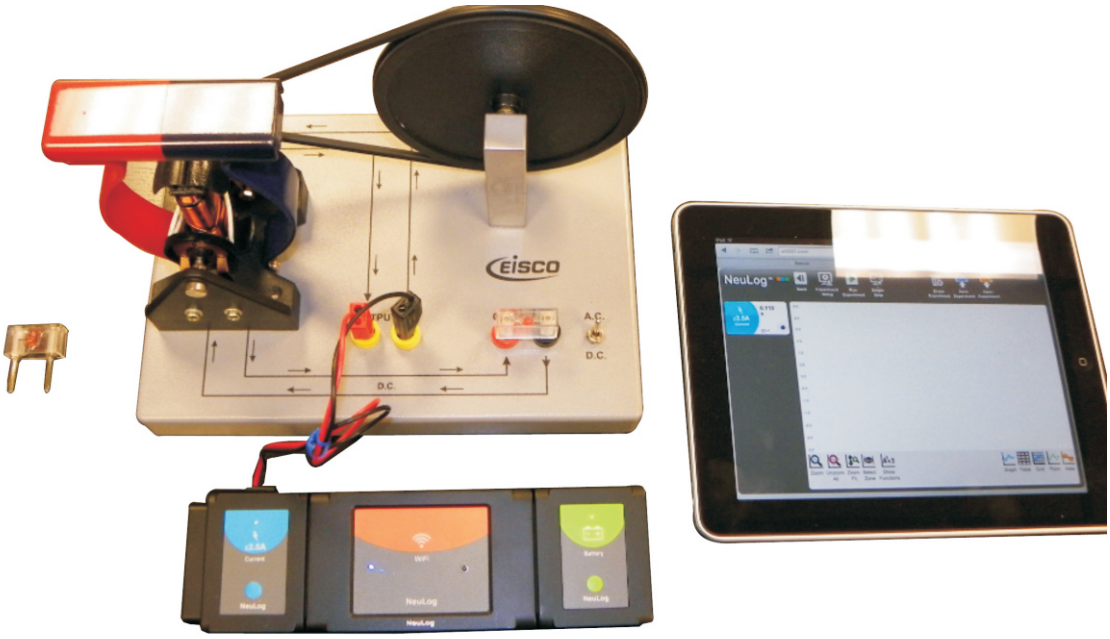
EISCO AC/DC MOTOR GENERATOR WITH NEULOG

Set up for AC :



For DC : just replace AC bridge, remove AC bridge, connect Neulog current Banana plugs

RESULTS FOR AC EXPERIMENT:

Manufactured by :
EISCO
Electronic Instrumentation
12, Mahesh Nagar, Ambala Cantt. 133 001
INDIA

U.S. Distributor :
Eisco Scientific
850 St Paul St, Suite 15, Rochester,
NY 14605