



DEMONSTRATION DYNAMO

CAT NO. PH 1246



Experiment Guide

DEMONSTRATION DYNAMO

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 create an electrical DC current by turning a hand crank. The two leads on the back of the apparatus allows for devices such as lamps or small motors to be attached to the apparatus. The back of the apparatus has brushes designed to collect direct current (DC) through a split ring.

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 the kinetic energy of falling or moving water, a nuclear reactor, wind, or steam to turn a turbine.

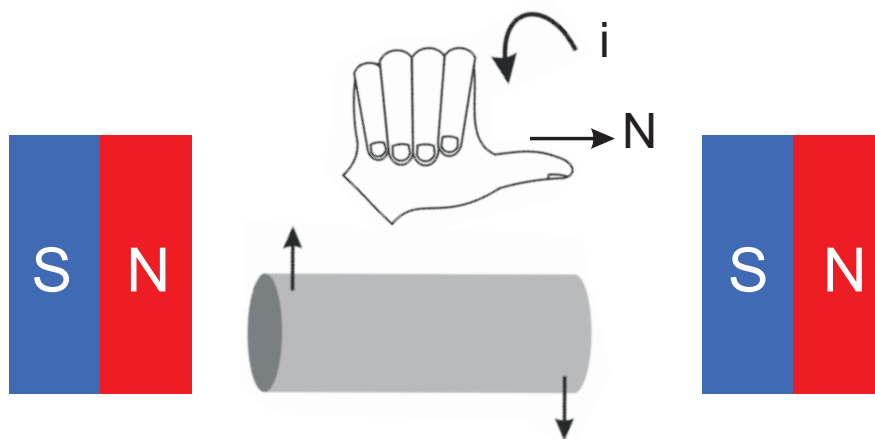
Turning a coil in a magnetic field produces a current through the coil. This current is naturally sinusoidal. Since each coil produces current, collecting this current from the coil will yield an alternating current (AC).

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.

The 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.

In order for students to understand how a generator works they must understand the right hand rule which is illustrated below. As the coil is rotated through the magnetic field, a current is produced which then in turn produces a magnetic field. Take your right hand and wrap your fingers around the coil. Have your thumb point in the direction north and the direction your fingers wrap around the wire will show the direction the current is flowing.



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 a 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 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 a loop can change by rotating the loop in a fixed magnetic field. 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. The end of the nail that 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.

DIAGRAM LABELING ALL PARTS:

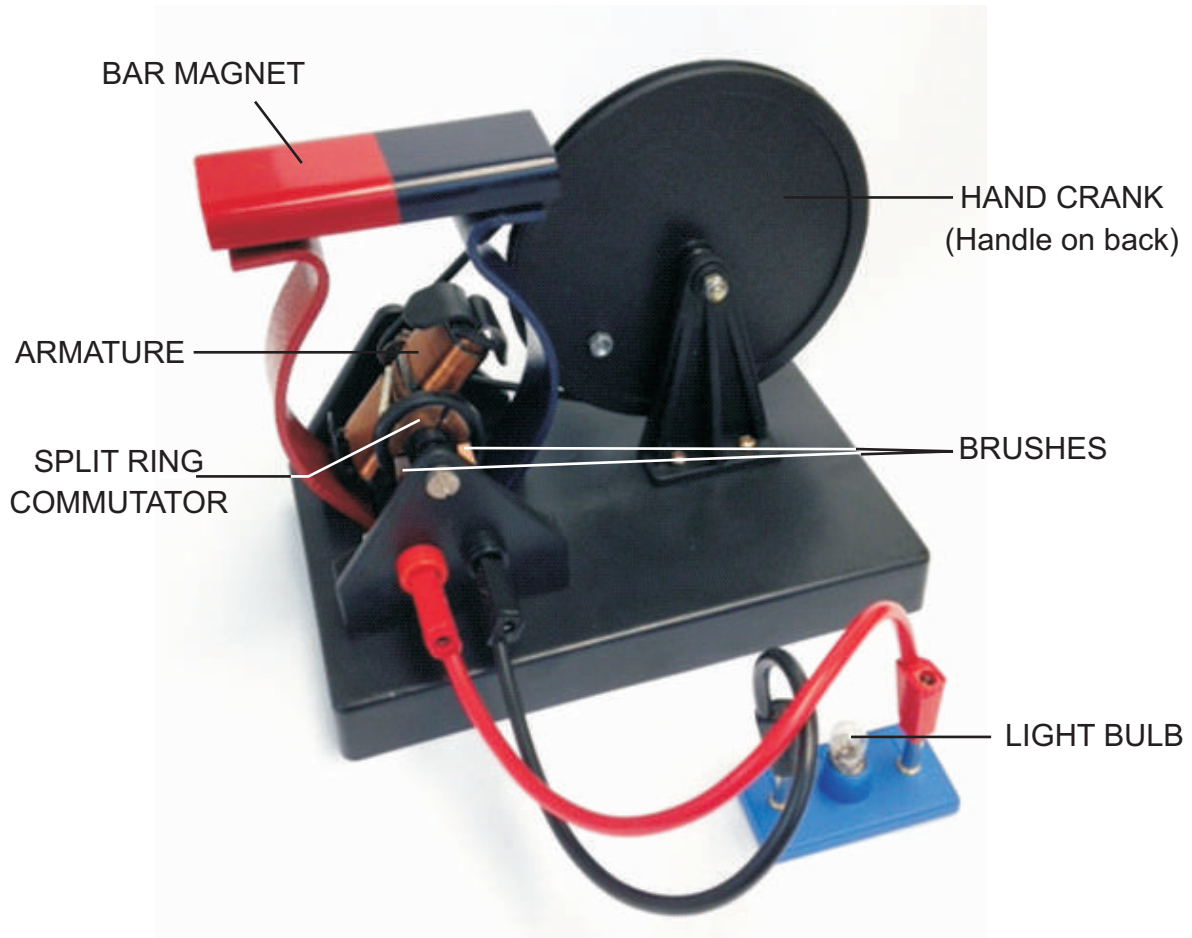


Diagram 1

OPERATION OF EQUIPMENT:

1. Attach a bulb to the leads as shown in diagram 1.
2. Turn the hand crank. The faster you rotate the hand crank, the brighter the light bulb will glow.

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Date: _____

UNDERSTANDING DC GENERATORS (Teacher's Answers)

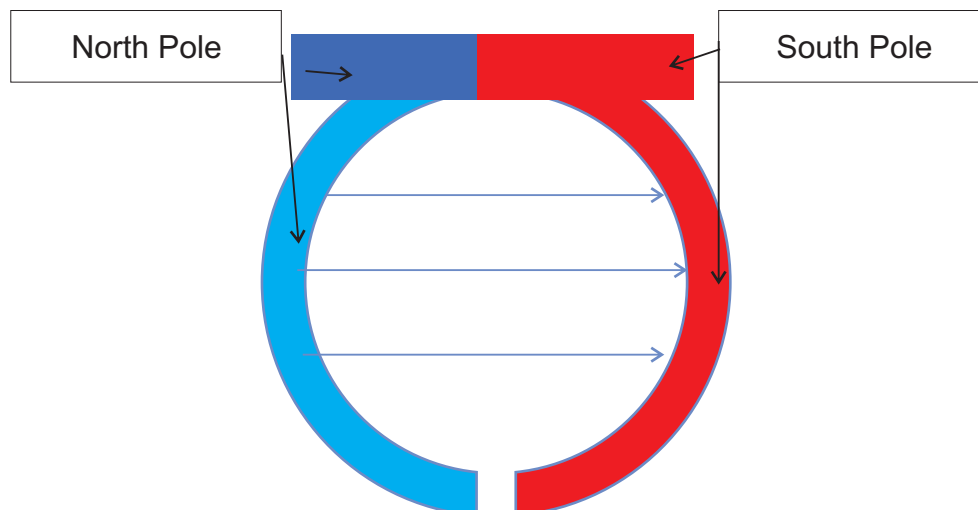
1. Use a small compass to identify north and south pole of the bar magnet. Justify your answer by describing how your compass behaved.

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.)

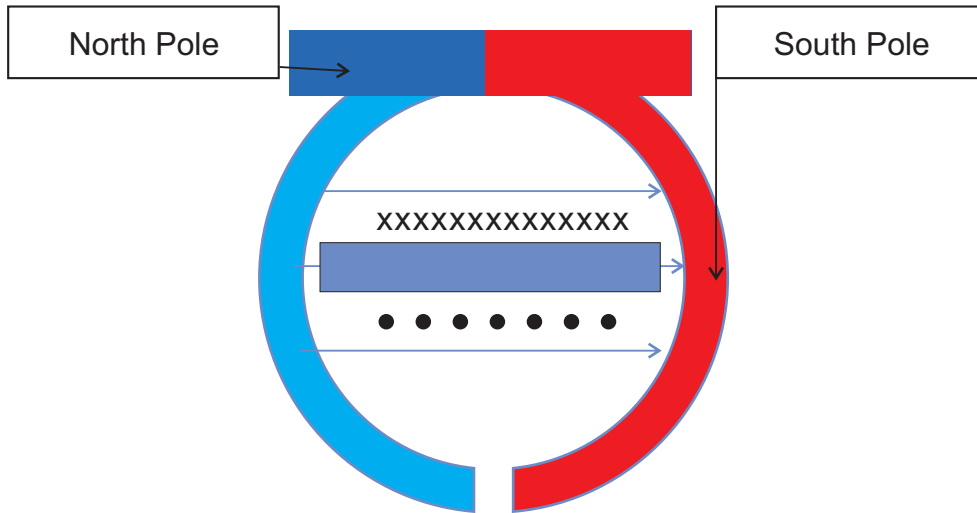
2. Are the brackets that hold the bar magnet up also magnetized? How do you know?

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.



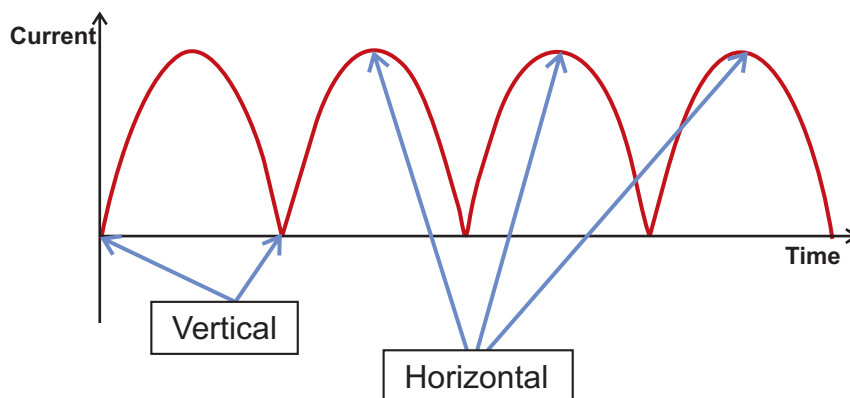
4. The flux density through the coil of wire is going to be greatest when the coils are horizontal. Orient the the coil so it is horizontal and then using the right hand rule determine which direction the current will be induced in the wire. Use **x** for current coming out of the page and **●** for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



5. 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.

6. Draw a diagram of current vs. time on the diagram below for the DC 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.



EXTENSION QUESTIONS:

1. The bulbs flicker when the crank is turned. Why is this?
The bulbs flicker because the voltage is not constant, but varies over time. Maximum brightness occurs when the voltage is maximum, or when the coil is horizontal.
2. Remove the magnet; does the coil turn smoothly without the magnet present?
The coil turns smoothly without the magnet present.
3. What is the purpose of the apparatus to hold up the magnet? Why is it made out of metal?
The apparatus that holds up the magnet also acts as an induced magnet. It increases the strength of the magnetic field and allows more current to be generated through the wires.

Name: _____

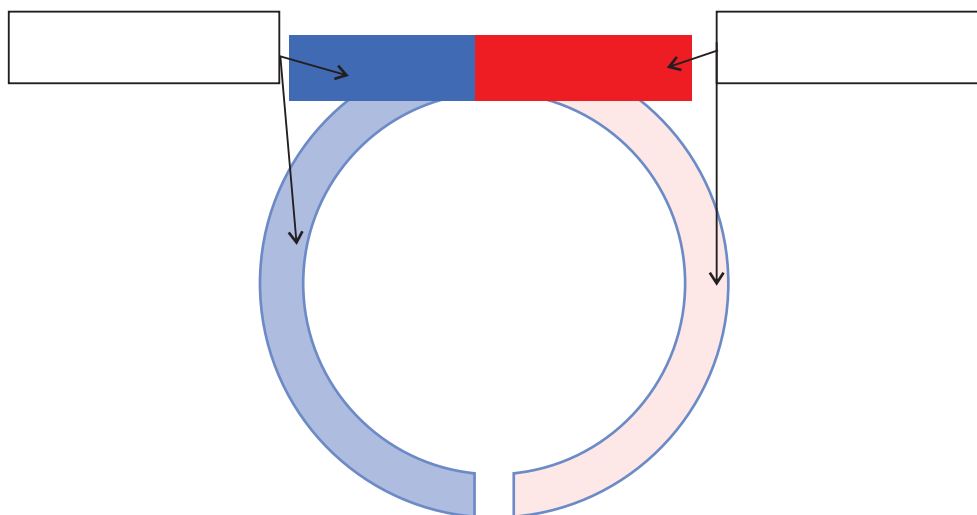
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UNDERSTANDING DC GENERATORS

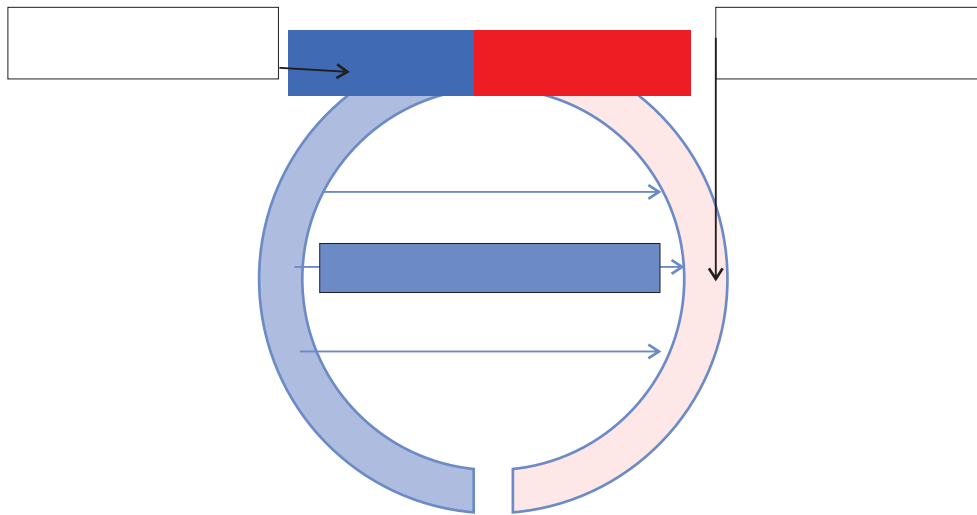
1. Use a small compass to identify north and south pole of the bar magnet. Justify your answer by describing how your compass behaved.

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 **x** for current coming out of the page and **●** for current going into the page.



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