Date of Lab__________ Date of Submission 4/17

Physics Laboratory Report

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Title Magnetic Fields and Coils

Co-workers

Summary

There are three labs in here about Magnets, Magnetic Fields and coils. We started from looking a various types of magnets, and finally found out how magnets are important in our life of using electricity.

Teacher's Comment

* レポートは、日本語あるいは英語で記載すること。
* この用紙をレポートの表紙として使うこと。
* 実験日から一週間目にあたる日か、それ以前に提出すること。

Magnets and Magnetic Field

Introduction

Objective:

Learn the kinds and properties of the magnet. With that magnet, observe the magnetic field using iron fillings.

Theory:

Magnets have two poles, N & S. Opposite poles attract and like poles repel.

The direction of magnetic field $\vec{B}$ is he direction in which the north pole of a compass points.

Experiments

Experiment 1 Magnets

Materials: Usual (Ferrite & Aluminum-nickel-cobalt) magnets, Neodymium Magnet, Magnetizer, coins, nails, tissue papers.

Method:

- Take various magnets on your hand, and observe the strength. Be careful not to pinch your fingers with them.
- Observe what kind of objects will react upon the magnet, using coins, nails, tissue papers, etc.
- Find two weak magnets, and place it on the magnetizer. Put them in a separate box, make sure that opposite poles will contact, and push the button.

Experiment 2 Magnetic Field

Materials: Plastic cup, zip lock, gauze, board, iron fillings, rubber band compass.

Method:

- Fill the cup with iron fillings, cover the opening with gauze, and fasten with a rubber band.
- Place a board on top of a usual magnet.
- Sprinkle the iron fillings evenly on the board, and observe the pattern.
- When the experiment is over, collect the iron fillings using a magnet in a zip lock, so that it will not stick on the magnet.
- Do the same experiment using a stronger, U shaped magnet.

Result

Result 1 Magnets

- Neodymium magnet was so strong, that it was hard to separate the two of them.
- Nails got attracted by the magnet, tissue paper reacted slightly. Coins were not attracted by the magnet. The nail sticking to the magnet also attracted the other nails.
- The magnetizer worked, and made the magnets stronger.

Result 2 Magnetic Field

The iron fillings made a pattern like this;

When we place the compass above the line of iron fillings, it showed the direction of magnetic field.

Discussion

Discussion 1 Magnets

The nail sticking to the magnet also attracted the other nails, due to induction.

Discussion 2 Magnetic Field

By placing the compass above the line of iron fillings, we could observe that the direction of magnetic field $\vec{B}$ is he direction in which the north pole of a compass points.

Magnetic Field around a Current, Clip motor

Introduction

Objective: 1. Understanding induced force by magnet.

2. Making a simple motor.

Theory:

Tohei's right hand rule:

First finger=current, second finger=field, third finger=force

Fleming's left hand rule:

First finger=field, second finger=current, third finger= thrust (force)

Right hand rule:

It is used to determine the direction of the magnetic field around a current-carrying wire. For the magnetic field by a linear current, the point of you're the thumb of your right finger is the direction of the current. Then curl your other four fingers, to show the direction of the magnetic field around the wire. As for the magnetic field by a circular current and magnetic field by a coil, the thumb will point the direction of the magnetic field, and the other four curled fingers will show the current.

Magnetism: the ultimate source of any magnetic field in nothing more than the motion of electric charge.

Crookes tube: it is a partially evacuated gl ass cylinder with two metal electrodes, one at either end. When a high voltage is applied between the electrodes, electrons travel in straight lines from the cathode to the anode.

Experiments

Experiment 1 Magnetic Field around a Current

Material: coils, compass, magnet, aluminum foil, Crookes tube, cables, power.

Method 1:

- Electrify the looped coil and the solenoid.
- Place a compass underneath it, and watch the direction where S points.

Method 2:

- Hang the aluminum foil, and make sure the bottom will be in between of the N and S of the U shaped magnet.

- Electrify the aluminum foil, and observe the direction in which the foil moves.
- First, put the N upright.
- Next, put the S upright.
- Lastly, change the direction of current.

Method 3:

- Activate the Crookes tube.
- Put a U shaped magnet next to the tube, and guess which side faces it by observing he light in the tube.
- Put a U shaped magnet above the tube, and guess which side faces it by observing he light in the tube.

Experiment 2 Clip motor

Material: Ferrite Magnet, copper wire, clips, battery, knife, rubber band, mini jumper cable, plastic cup

Method:

- Make a coil like the right picture.
- Take off enamels from the wire. (One side completely, and only a half for the other side.)
- Stick a paper clip on each side of a bottom of a plastic cup, and put a magnet on it.
- Use paper clips to hold the coil.

Result

Result 1 Magnetic Field around a Current

1. When the current is flowing clockwise (observing from above), S points up. When the current is flowing counterclockwise (observing from above), S points down.
2. When N is up and current flows from right to left, the aluminum foil moves toward the magnet. When S is up and current flows at same direction, the foil moves away from the magnet. When you change the direction of a current, the foil moves towards the magnet.
3. When the light goes down, then the N pole faces the tube. When the light goes up, then the S pole faces the tube. When the light goes left while the magnet is above, the S pole is facing the tube.

Result 2 Clip motor

By comparing clip motor made by various students, I found out that the smaller and tighter (which means many turns of coil, because they are same in length), the faster and stronger the coil spins. Also, the coil spins faster when the magnet is close. You have to make sure that the edge of the coil is straight, or it is difficult for it to spin faster.

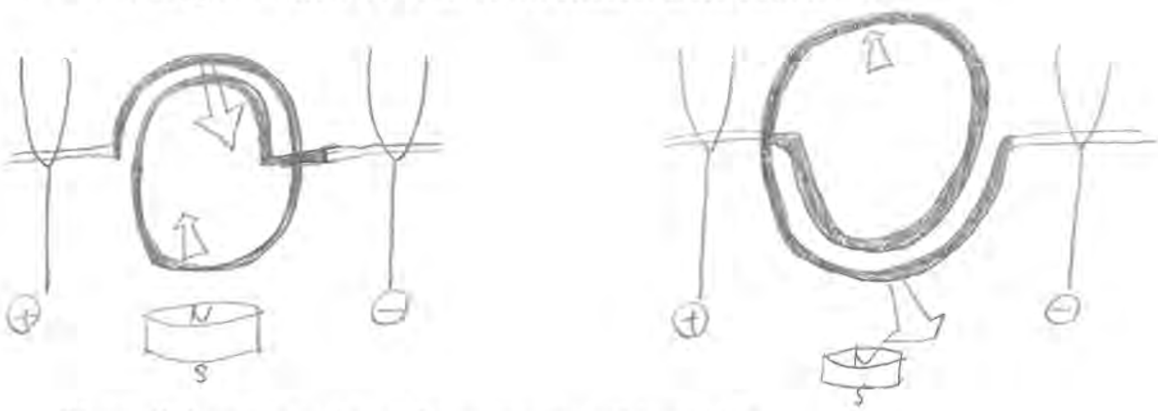
Discussion

Discussion 1 Magnetic Field around a Current

We can use the Tohei's Right Hand Rule to figure out the direction of current, magnetic field, and force. As for the current- carrying, we can use the right thumb rule.

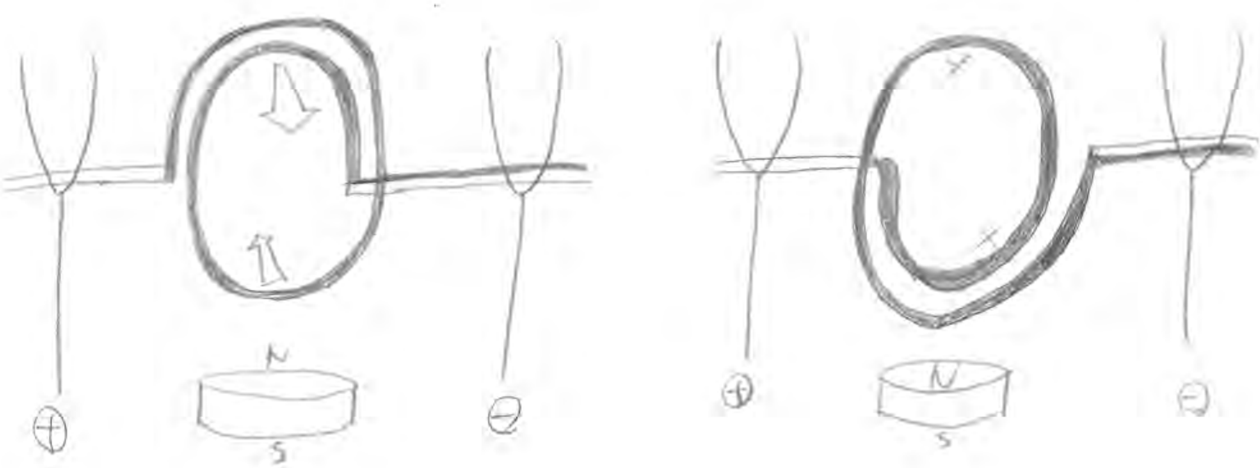
Discussion 2 Clip motor

1. What happens when we remove all enamel from both sides?



The coil does not spin, and repeats switching sides.

2. What happens when we keep one side of enamel half removed and other side completely removed?



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My Opinion

I think we had an amount of labs to understand how current, magnetic field force work. When the motor spin, I was happy because I usually fail doing labs using currents properly. I personally enjoy the experiment using iron fillings and making the pattern of magnetic field.

Generation / Electromagnetic Induction

Introduction

Objective:

To generate electricity by electromagnetic induction, and understand why it functions.

Theory:

Lenz's Law: When a Bar Magnet approaches toward the center of the coil, the coil generates a current, using a magnetic field that is opposite to the magnets', as if to chase it away. On the other hand, when a Bar Magnet moves away from the coil, it generates a current with a same magnetic field as a magnet, as if to keep it with it. We can use a right hand with a thumb up to determine the direction of the current. In this case, your thumb indicates the North Pole, of the magnetic field.

Experiments

Experiment 1 Electromagnetic Induction

Materials:

Bar Magnet, Galvanometer, Enameled wire($0.5m \times 2$) Clockwise 10 turns and Counterclockwise 10 turns.

Method:

Move the bar magnet, back and forth inside the coil. During that process, change the speed of the magnet. Observe the direction and value the indicator points.

Experiment 2 Electromagnetic Induction pt2

Materials: Bar Magnet, Galvanometer, coils with 400 to 1600 turns.

Method: Do the same thing as Experiment 1, by using coils with 400 to 1600 turns.

Result

Result 1 Electromagnetic Induction

Clockwise:

When the North Pole of the magnet approached the coil, the Galvanometer points +. When the magnet moves away, the Galvanometer points −. When the South Pole of the magnet approached the coil, the Galvanometer points −. When the magnet moves away, the Galvanometer points +.

Counterclockwise:

When the North Pole of the magnet approached the coil, the Galvanometer points −. When the magnet moves away, the Galvanometer points +. When the South Pole of the magnet approached the coil, the Galvanometer points +. When the magnet moves away, the Galvanometer points −.

The faster the magnet moves, the clearer the value of the Galvanometer.

Result 2 Electromagnetic Induction pt2

The indicator of the Galvanometer pointed the same way as the Experiment 1 as the magnet approached and moved away. The more amounts of turns in coil, the more amount of current. That is, the indicator shows the direction clearly in a bigger swing, as the turns of the coil increases.

Discussion

Electromagnetic Induction

We can use our right thumb to point the North Pole, and other four curled finger as a direction of the current. We decide the direction of the thumb, and then apply the direction of the current to the coil. According to the Lenz's Law, to describe why the direction of the current alters with the change of poles or direction of the turns.

My Opinion

The Lenz's was new to me, so it was interesting to see how we can generate current with coil and a magnet. The generating station uses this mechanism in a much bigger scale, so it was quite surprising to know that this small generator is related to the electricity we use today.

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