Date of Lab February 7th, 2018 Date of Submission February 14th, 2018

Laboratory Report

Title Physics Lab - 026 : Electric Charge - Static Electricity and Electroscope

Homeroom	Section	Name	
11-E			Lilika Okuda

Lab Partners _____ _____

_____ _____

Summary

In this lab, we observed the reactions of objects with the charges and uncharges. I learned and observed three different reactions for electric charges, and those were polarization, induction, and the reactions between charged objects. I also learned that there were three types of object, which were insulator, conductor, and semi-conductors.
Also, it is important to know that the charges objects get is depended on the electronegativity. The objects with stronger electronegativity tend to get electrons and be negative and objects with weaker electronegativity tend to lose elections and be positive.

• Meet a deadline • Write logically • Write clearly • Write with your own words

Teacher's Comments

Very clean descriptions and figures. You understood the world of static electricity very well.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method.	Results	Table/Fig.	Discussion	Clearness	General
+					+ +	+ +	+ +	+ +

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

Introduction:

Objectives: Seeing electric charges in experiments

Lab-1 Charging by rubbing (frictional charging)

Lab-2 Two kinds of electric charges, PLUS and MINUS

Lab-3 Insulators and Conductors

Lab-4 Electroscope

Lab-5 Electric Tray and Van de Graaff Generator

Safety:

- Accidents due to electric shock
- Don't break ebonite or glass rods and keep them in a box

Theory:

- **Frictional Electricity**:

When the objects are rubbed, electrons of one object move to the other object. The object which gains the electrons is charged negatively, and the object which loses the electrons is charged positively. The movement of the electrons are based on electronegativity. The objects with strong electronegativity tend to attract electrons, so they are likely to be negative. The objects with weak electronegativity tend to repel electrons, so they are likely to be positive.

- **Insulator**:

Most of the insulators are non-metallic, and they are also good thermal insulators. The charges in the insulators are not free to move. So, it has few free electrons to move within the insulators.

- **Conductor**:

Conductors are metals, and they are also good thermal conductors. They allow charged to move freely. So, movement of electrons in conductors are free like a gas.

- **Semi-conductor**:

Semi-conductors have the both characteristics of conductors and insulators.

- **Polarization**:

Polarizations is the interaction between charged objects and insulators. This occurs when charged object, either positive or negative, is brought close to the neutral insulator. When this occurs,

atoms in the neutral insulator align based on the charge of the objects. For example, if the positively charged object is brought near the neutral insulator, electrons face to the object and the protons try to repel from it. This makes the surface of the neutral insulator to stretch because protons and electrons try to go to different directions.

There are two types of polarization:

1. Atomic polarization: it is the polarization related to the atom and its protons and electrons
2. Orientation polarization: it is the polarization related to the molecule and its positive and negative charges

- **Induction**:

Induction is the interaction between charged objects and conductors. This occurs when charged object, either positive or negative, is brought close to the neural conductor. When this occurs, charges of the neutral object align based on the charge of the objects. For example, if the positively charged object is brought near the neutral conductor, electrons in neutral conductor, which are free electrons, are attracted to the charged object and the protons in the neural conductor are repelled from the charged object.

Experiments:

Apparatus:

- PVC rod
- Ebonite rod (hard rubber)
- Glass rod
- Acryl resin rod
- Rabbit fur
- Silk
- Suspender
- Polystyrene balls (insulator)
- Aluminum-coated balls (conductor)
- Water
- Cup
- Feeding bottle
- Aluminum Tray
- Polystyrene board
- Plastic cup
- Saran Wrap
- Leaf electroscope
- Van de Graaff Generator
- Discharge electrode
- Insulation Stool
- Grounding wire

Combinations of Rods and Fabrics	
Rods	**Fabrics**
(-) PVC	Rabbit Fur (+)
(-) Ebonite	Rabbit Fur (+)
(+) Glass	Silk (-)
(+) Acryl Resin	Silk (-)
(-) Acryl Resin	Rabbit Fur (+)

Methods:

Lab-1:

1. Hang the polystyrene balls and aluminum-coated balls to the suspender
2. Rub the rod with the fabric and make the rod gain charges
3. Move the rod close to the polystyrene balls (insulator), and aluminum-coated balls (conductor)
4. Observe the reactions of balls and record the result
5. Repeat the experiment using different combinations of rods and fabrics

Lab-2:

1. Set up the apparatus
2. Rub half part of the rod with fabric so half of it has the charges
3. Put the half-charged rod on the suspender
4. Rub other rod with the fabric and make it charged
5. Move the charged rod close to the rod which is put on the suspender
6. Observe the reactions of the charged and uncharged part of the rod
7. Record the result
8. Repeat the experiment using different combinations of rods and fabrics

Lab-3:

3-a:

1. Fill the feeding bottle with water
2. Prepare the cup to catch the water
3. Rub the rod with the fabric
4. Move the charged rod close to the water released from the feeding bottle
5. Observe the reactions of water and record the result
6. Repeat the experiment using different combinations of rods and fabrics

3-b:

1. Prepare the suspender
2. Rub the rod with the fabric
3. Move the charged rod close to the suspender
4. Observe the reactions of the suspender and record the result
5. Repeat the experiment using different combinations of rods and fabrics

Lab-4:

4-a:

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, make sure it doesn't get discharged nor contacted
4. Remove the rod
5. Observe the reactions of the gold leaf and record the observation

4-b:

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, make sure it doesn't get discharged nor contacted
4. Keep the rod close to the leaf electroscope and put the finger on it for grounding
5. Remove the finger first, then remove the PVC rod
6. Observe the reactions of the gold leaf and record the observation

4-c:

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope and get it discharged, but make sure it doesn't get contacted
4. Remove the PVC rod from the leaf electroscope
5. Observe the reactions of the gold leaf and record the observation

4-d:

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope and get it contacted
4. Remove the PVC rod from the leaf electroscope
5. Observe the reactions of the gold leaf and record the observation

Lab-5:

5-a:

1. Rub the saran-wrapped polystyrene board with the fabric
2. Hold the plastic cup of the aluminum tray
3. Bring the aluminum tray close to the polystyrene board
4. Bring the finger near the aluminum tray and make it grounding
5. Separate the aluminum tray from the polystyrene board and do the grounding again
6. Observe the and feel the movement of charges

5-b:

1. Set up the Van de Graaff Generator on the table
2. Put the insulation stool on the floor
3. Connect the discharge electrode to the grounding wire
4. Move the discharge electrode close to the Van de Graaff Generator
5. Observe the reaction of charges

5-c:

1. Set up the Van de Graaff Generator on the table
2. Put the insulation stool on the floor
3. One person stands on the insulation stool and put the hand on Van de Graaff Generator before it is turned on
4. Turn on the switch and observe the charges kept on that person by observing hair of the person
5. Other people hold hands of people next to them and make a circle
6. Person on one end of the circle holds grounding wire
7. Turn off the switch of the Van de Graaff Generator
8. Person on the insulation stool remove one hand from the Van de Graaff Generator, and points the finger to the other person
9. The person on the other end of the circle points the finger to the person on the insulation stool
10. Move their pointed fingers close
11. Observe and feel the movement of charges that came from the person on the insulation stool and absorbed through grounding

Results:

Lab-1: Generate Frictional Electricity		
	Aluminum-Coated Balls	**Polystyrene Foam Balls**
PVC Rod Charged with Rabbit Fur	Attract, then repel	Attract
Glass Rod Charged with Silk	Attract, then repel	Attract

Discussion:

In Lab-1, both polarization and induction occurred.

Polarization occurred when the negatively charged PVC rod or positively charged glass rod was brought close to the Polystyrene balls. Because polystyrene balls were insulators, opposite charges to the rod were attracted and the atoms aligned.

Induction occurred when the negatively charged PVC rod or positively charged glass rod was moved close to the aluminum-coated balls. Because aluminum-coated balls were conductors, they had more free electrons to move. So, after they attracted and contacted each other, electrons in the object with smaller electronegativity moved to the object with higher electronegativity. This made the rods and balls to repel after electrons moved to the other object.

Lab-2: Reaction between Two Charged Insulators			
		Charged Side	**Uncharged Side**
PVC rod Charged with Rabbit Fur	**Ebonite Rod with Rabbit Fur**	Repel	Attract
PVC rod Charged with Rabbit Fur	**Glass Rod with Silk**	Attract	Attract
Acryl Rod Charged with Silk	**Glass Rod with Silk**	Repel	Attract
Acryl Rod Charged with Silk	**Ebonite Rod with Rabbit Fur**	Attract	Attract
Acryl Rod Charged with Rabbit Fur	**Ebonite Rod with Rabbit Fur**	Repel	Attract

Discussion:

In Lab-2, both polarization and the reactions with charges occurred.

Reactions with charges occurred between the charged rod and the charged part of the other rod. Reactions of the two charged rods depended on their charges. Objects with the same charge repelled and objects with the opposite charge attracted each other. For the first, third, and fifth experiment, rods had the same charges so they repelled. For the second and fourth experiment, rods had the opposite charges so they attracted each other.

Polarization occurred between the charged rod and the uncharged part of the other rod. Because the rods were not metals and they were insulators, the rods were neutral. So, rods attracted the opposite charges in the neutral insulator and made them aligned.

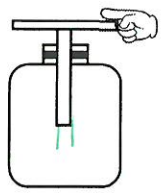
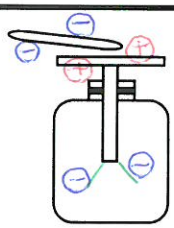
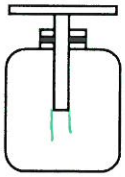
Lab-3: Reaction between Charged Insulator and Water or Conductor		
	Water	**Suspender**
PVC Rod Charged with Rabbit Fur	Attract	Attract
Glass Rod Charged with Silk	Attract	Attract

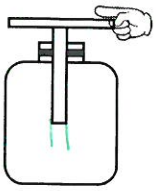
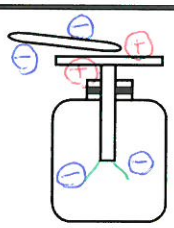
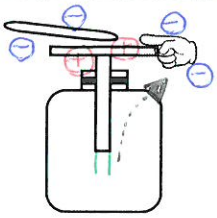
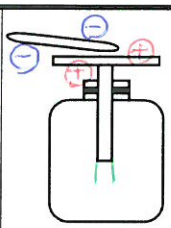
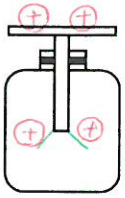
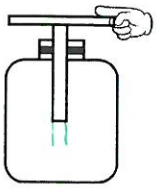
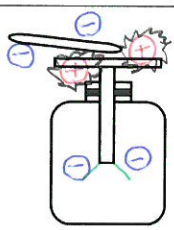
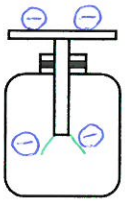
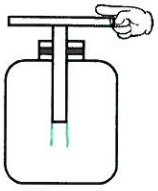
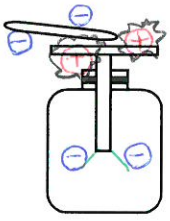
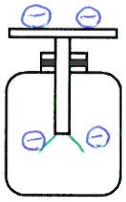
Discussion:

In the Lab-3, Polarization and the Induction occurred.

For the experiment using water and the charged rods, polarization occurred. Water was the neutral insulator, and the molecules of water have the charges. So, the charge in the rod attracted the opposite charge of the molecule. It made the water to be attracted to the rod.

For the experiment using suspender and the charged rod, induction occurred. Suspender was the metal conductor, and there were many free electrons to move. When the charged rods were moved close to the suspender, electrons or protons in the suspender were attracted to the opposite charge in the rods. This made the suspender to be attracted to the rod.

Lab-4: Leaf Electroscope				
				
Grounding	Get the stick close, no discharge			

 Grounding	 Get the stick close, no discharge	 Grounding	 Remove Grounding	 Move the rod away
 Grounding	 Get the stick close and Discharge			
 Grounding	 Contact the Stick			

Discussion:

There were total of four reactions of electric charge in this experiment. All of the reactions are related to the induction.

The first reaction was that the gold leaf opens when the PVC rod was brought close to the leaf electroscope. This occurs because the positive charges of the leaf electroscope were attracted by the negatively charged rod, and the negative charge remained in the gold leaf tries to repel each other. Also, charges didn't move from one object to another because there was no discharge or contact between the rod and the electroscope. So, gold leaf of the leaf electroscope closed after the rod was moved away.

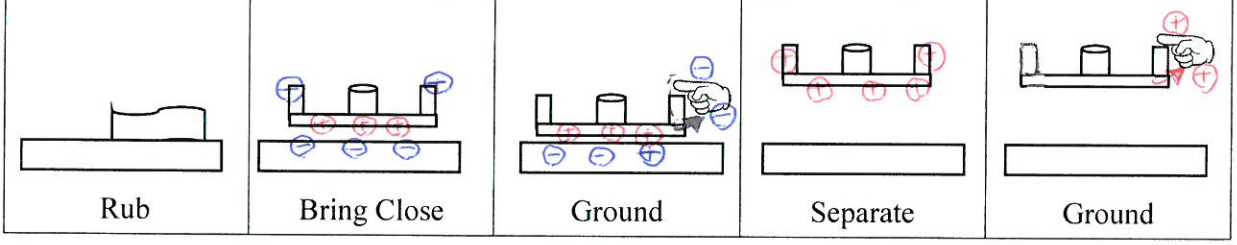
The second reaction was that the gold leaf remains open even though the rod was removed from the leaf electroscope. This occurs when the leaf electroscope was taken grounding while the rod was attracting the positive charges. Positive charges were attracted, so it didn't move. But, negative charges, which were not attracted, moved to the finger. This made the gold leaf to close while taking grounding. But, when the both finger and the rod were removed, positive charges which were attracted

by the rod moved to the gold leaf. So, positive charges repelled each other and the leaf opened without the charged rod.

The third reaction was that the gold leaf remains open after the rod was removed. When the rod and the leaf electroscope got discharged, the positive charges in the leaf electroscope which were attracted by the negative charges of rod moved to the rod. So, the negative charges were remained in the leaf electroscope and it made the gold leaf to be open by the force of repulsion.

The fourth reaction was also that the gold leaf remains open after the rod was removed. When the rod and the leaf electroscope got contacted, the positive charges of the leaf electroscope moved to the rod because negative charges in the rod were attracting the positive charges in the leaf electroscope. So, negative charges were remained in the gold leaf and it made the gold leaf to be open by the force of repulsion.

Lab5-a: Electric Tray

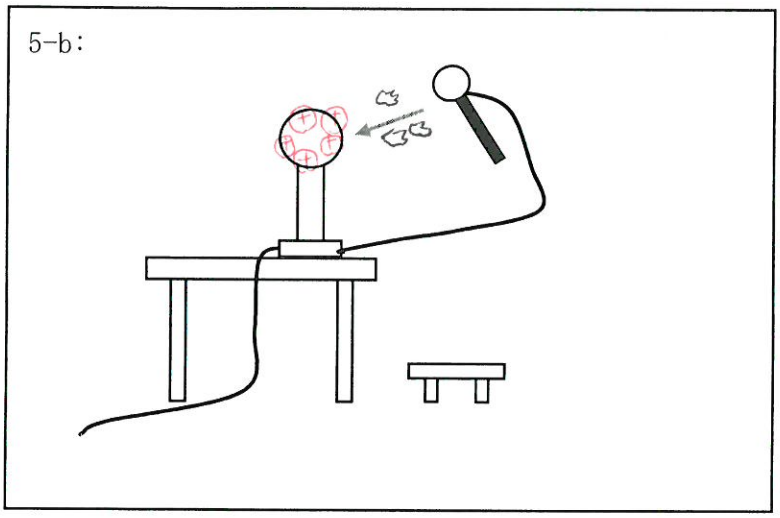


Discussion:

In the Lab5-a, induction occurs between the Aluminum Tray and the Polystyrene board. When the aluminum tray was rubbed, it got the negative charge. Then, it was brought near the aluminum tray, which was the metal conductor. Then, positive charge of the aluminum tray was attracted by the negative charge of the polystyrene board, and the negative charges of the aluminum tray were remained in the edge. So, when the finger was brought close to the edge of the aluminum tray, negative charge moved to the finger and the person can feel the electric charge. Also, person can feel the electric charge again when the aluminum tray was removed from the polystyrene board and the positive charges were released from attraction. So, person can feel the electric charges of both positive and negative charges in this experiment.

Lab 5-b,c: Van de Graaff Generator

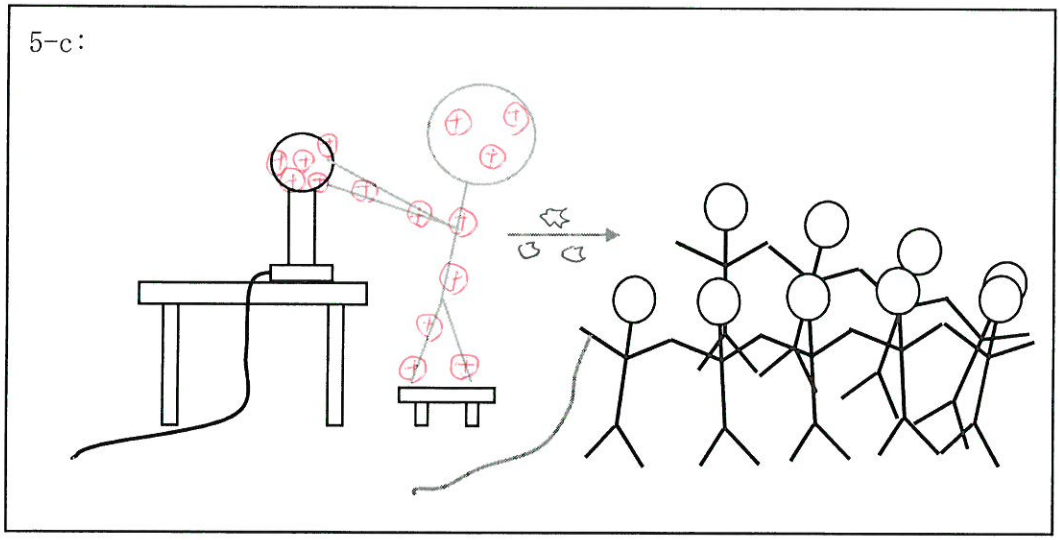
5-b:



Discussion:

Positive charges are generated by Van de Graaff Generator, and they are kept in it. But, when the discharge electrode is brought near the Van de Graaff Generator, positive charges in the Van de Graaff Generator are discharged, and the discharge can be observed as the light and sound.

5-c:



Discussion:

Positive charges are generated by Van de Graaff Generator, and those charges are kept in the person who is putting hand and itself. The positive charges cannot go to other places because the person is standing on the insulation stool. Then, when the switch is turned off and the person on the stool pointed the finger to the finger of other person who is holding grounding wire, discharge occurs and the people can feel the discharge and the movement of positive charges which came from the generator and released through the grounding.

Conclusion:

In the experiment, we could observe the reactions of electric charges. There were total of three types of reactions related to the electric charges. Those were polarization, induction, and the movement of charges. Polarization occurred between the charged object and neutral insulators, induction occurred between the charged object and neutral conductors, and the movement of charges occurred between charged objects. Although all reactions seemed the same, they were very different in their functions. So, it was important to understand the differences among those electric reactions.

Opinion:

This experiment had five labs. Each lab was related to the electric charges and how they react to the objects such as insulator and conductors. It was very interesting to classify the functions of each reactions. Also, the fact that the materials gain either negative or positive charge based on what object they were rubbed or contacted with was fun to learn. Overall, this experiment was very interesting and I could understand about the electric charges better and deeply than before.

Reference:

Lab report of Yamato Oishi (2017)
Lab report of Shutomo Iwai (2017)