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Physics Laboratory Report

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Title Electrical Current and Circuit

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Summary

In this lab, we used black papers which worked as resistrs. We calculated the resistance of them and also predicted them with using Ohm's law. The second lab was based on circuit. Also, we used Ohm's law to predict the Ampere, voltage, and resistance (Ω). Comparing prediction and observation was very helpful and interesting.

Teacher's Comment Very good experiment and report.

Tohei

* 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。

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Introduction

This lab was based on connecting paper resistors and measuring current and voltage.

Objectives:

There are two main objectives in this lab.

1. First of all in the connecting paper resistors lab, the objective is to determine how much the resistance of the different kinds of paper is and record them. Also, to predict the resistance of different size of papers by using Ohm's law.
2. In the measuring current and voltage lab, the objective is to measure current and voltage. Not only measuring, but to understand Ohm's law well enough.

Theory:

In this lab, we used the process of Ohm's law and by this law, we can find out how much the resistance is. Other than that, we can find out how much the volt, and current is. The equation is $I = V/ R$. In the series connection, we use $R = R_1 + R_2$. In the parallel connection, we use $1/ R = 1/ R_1 + 1/ R_2$. Therefore in this lab, we are going to use these equations to predict the resistance, volt, and cuurent.

Experimental

Apparatus:

- Black paper
- Scissors or cutter
- Ruler
- Tester
- Clip
- Battery- 8V
- Resistor
- Ammeter
- Voltmeter
- Jumper cables

Methods:

1. The first lab is connecting paper resistors. We are going to cut the black paper with scissors into 17cm × 5cm, 8.5cm × 5cm, 17cm × 2.5cm, 8.5cm × 2.5cm, combination, two sheets (17cm × 2.5cm), two sheets (17cm × 2.5cm+8.5cm × 2.5cm), and our own originals. Then we are going to measure the resistance of these different kinds of papers by using multimeter. The picture below is how to measure. Also, before we measure the resistance by multimeter, we are going to use Ohm's

law or R = pl/ S to predict how much ohm the resistance have. L is for the length of resistance and S is for the cross section of the resitance.

2. The next lab is measuring current and voltage. There are two circuits like the picture below. For the first one, we are going to measure the resistance of R1 with a multimeter beforehand. Next, predict the values of the ammeter and voltmeter. Then select appropriate ranges of the meters and make the circuit. Finally, measure the current and voltage and compare those numbers with the observed and predicted values. For the second circuit, first of all, select R1 and R2 and measure their resistance values. Then do the procedures similar to the first circuit one.

Results:

1. Table 1: Measured Resistance of Black Papers

#		Resistance KΩ		Black Paper
		Prediction	Observed	
1.	17cm×5cm		38.6 KΩ	
2.	8.5cm×5cm	19.3 KΩ	23.5 KΩ	
3.	17cm×2.5cm	77.2 KΩ	78.6 KΩ	
4.	8.5cm×2.5cm	38.6 KΩ	37.1 KΩ	
5.	combination	57.9 KΩ	60.7 KΩ	
6.	two sheets (17cm×2.5cm)	38.6 KΩ	44.6 KΩ	
7.	two sheets (17cm × 2.5cm+8.5cm×2.5cm)	25.7 KΩ	30.4 KΩ	
8.	Originals (two sheets: #2 and #4)	12.9 KΩ	19.3 KΩ	

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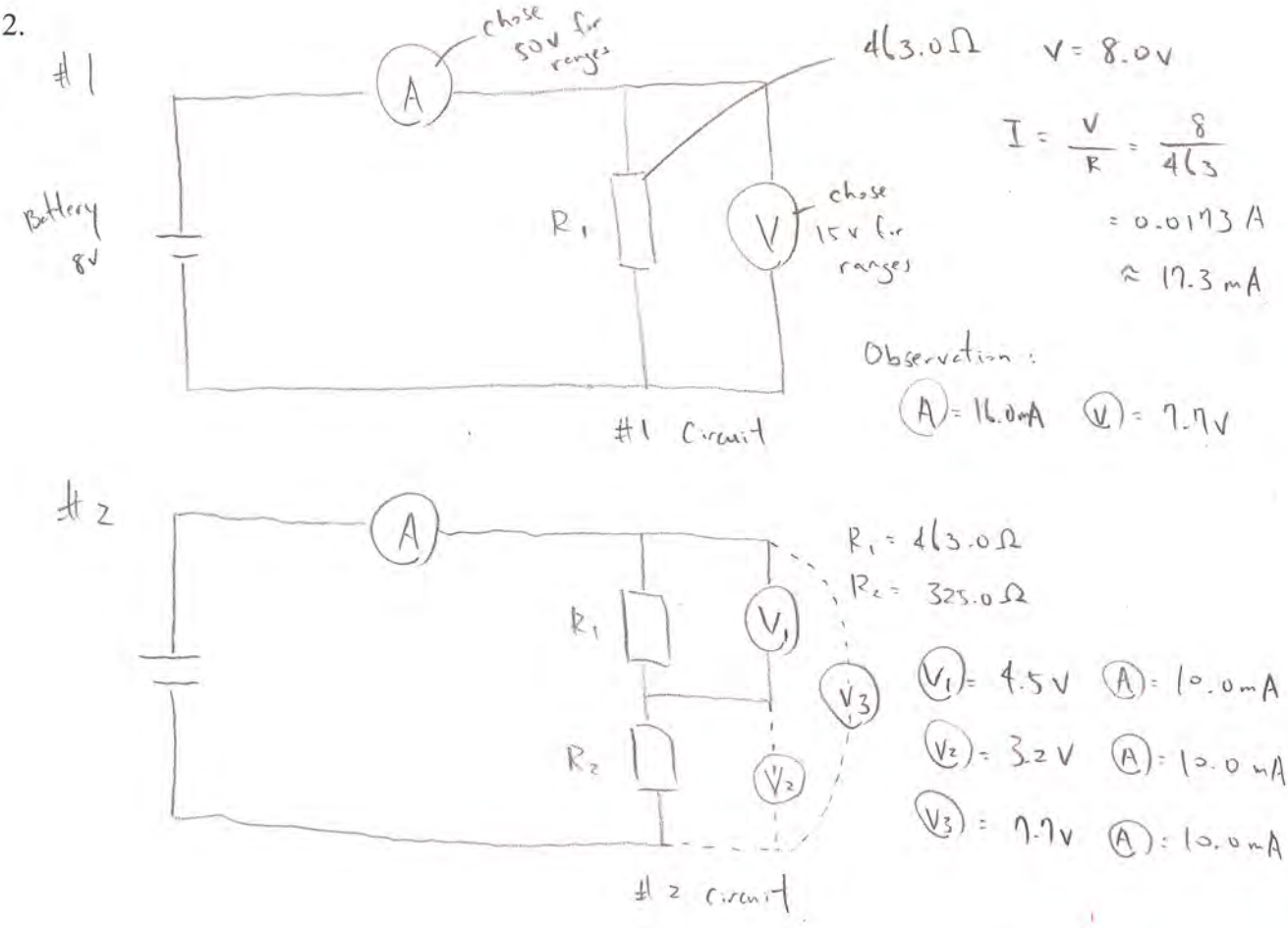
2.



$R_1 = 463.0\,\Omega$ $V = 8.0\,V$

$I = \frac{V}{R} = \frac{8}{463}$

$= 0.0173\,A$

$\approx 17.3\,mA$

Observation:

(A) = 16.0mA (V) = 7.7V

$R_1 = 463.0\,\Omega$

$R_2 = 325.0\,\Omega$

V_1 = 4.5V (A) = 10.0mA

V_2 = 3.2V (A) = 10.0mA

V_3 = 7.7V (A) = 10.0mA

Good observation!

Discussions:

1. In the first lab of measuring the resistance of paper resistors, we can use the equation R=L/S. For #1, the paper is cut into 17cm × 5cm and 17 divided by 5 is 3.4 KΩ. This piece of paper's resistance was 38.6 KΩ. For #2, it becomes 8.5cm divided by 5cm and got 1.7 KΩ. From this result, I can tell that the resistance would be half of 38.6 KΩ so, I predicted 19.3 KΩ for #2. Also, I noticed that if the resistance is high the harder for the current to go through, and lower the resistance, the easier for the current to go through. The observation of #2 was 23.5 KΩ. The two numbers become different, but this happens in the lab. For the rest of prediction, we do the same procedures as before. For #3, 17cm divided by 2.5cm which is 6.8 KΩ. This is twice the number of the first paper, so I predicted 38.6 KΩ times 2 is 77.2 KΩ. I got 78.6 KΩ and this is close enough to the prediction I made. For #4, I got 8.5 divided by 2.5 is 3.4, so 38.6 KΩ as prediction. I got close to the prediction, 37.1 KΩ as my observation. #5 is different from other one. I used the series connection equation. It is $R=R_1+R_2$. Since this combination is 8.5cm × 5cm and

8.5cm×2.5cm, I will add the prediction of #2 and #4. Which I got is 19.3+38.6= 57.9 KΩ. I got 60.7 KΩ as my observation. #6 and #7 is also different because we should use the equation of parallel connection which is $1/R=1/R_1+1/R_2$. Since the paper of #6 is two sheets of 17cm×2.5cm, I did 1/R=1/77.2+1/77.2. Then I got 38.6 KΩ as my prediction. The observation was 44.5 KΩ but it is still close enough. The paper of #7 is 17cm×2.5cm+8.5cm×2.5cm, so I did 1/R=1/77.2+1/38.6 and got 25.7 KΩ as my prediction. 30.4 KΩ was my observation for #7. Since I had time, I made my own original. It is two sheets of #2 and #4. So I use the parallel equation. I did 1/R=1/19.3+1/38.6 and got 12.9 KΩ as prediction. 19.3 KΩ was my observation and it is close to my prediction. In this lab, I noticed the position of clip makes the change in the multimeter numbers. When I clip the black paper deep, the number is higher than when I clip the black paper shallow. I believe this is because when the clip goes deep, the length of the paper shortens. When I clip shallow, the paper is longer than the paper clipping deep. The shorter the paper, the more current goes through the resistor.

2. In the circuit, there is a voltage drop from one point to another. The energy comes from the battery. In the first circuit of the lab, I measured the resistance with the multimeter and got 463 Ω. Also, I measured the battery with the voltmeter and got 8V. By using the Ohm's law which is I=V/R, I did I=8V/ 463 Ω and got 0.0173A. This is same as 17.3mA. So, this is the prediction of this circuit. While making the circuit with jumper cables, ammeter, battery, voltmeter, and resistance, I chose ammeter as ranges of 50 and voltmeter as ranges of 15. When I measured the ammeter and voltage, I got 16mA and 7.7V. The observation and the prediction was little different but, since it is close I believe this is correct. The difference occurred because of the connection of cables I think. The problem or mistake I did at the first of this lab is connecting the battery beginning with minus charges. The current should move from positive to minus but since I did this opposite, the ammeter read minus.

   In the second circuit, this is concerned about series connection. There are two resistances in this circuit. We had to measure each of the resistors' voltage and the whole resistors. First of all, we measured each resistor. The first one is same as before, 463 and the second resistor is 325. The battery is 7.7V because we used the same one as the first circuit. When I measured the first resistor, I got 4.5V and 10mA. The second resistor is 3.2V and 10mA. The whole circuit is 7.7V and 10mA. I found out that since this circuit is series connection, when I add the first and

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second resistors' voltage, I got the voltage which I measured as whole circuit. 3.2V+4.5V equal 7.7V. Also, we found out that the ampere doesn't change in this kind of series connection.

Conclusion:

There were two main objectives in this lab. We were able to use Ohm's law to determine the calculation of resistance, current, and voltage. The Ohm's law was very helpful to calculate the prediction, but because this is the lab, there were little difference between the prediction and the observation. Also by using $1/R = 1/R_1 + 1/R_2$ for parallel and $R = R_1 + R_2$ for series connection, we were able to get the correct resistance in the second lab which was called measuring current and voltage. We found out that these equations are true by doing this lab.

Impression:

When I was learning the equation of Ohm's law and the equation for series and parallel connection during the teacher's lecture, it was hard to understand. However, by predicting numbers by calculating using these equation and found out the numbers were correct by doing the lab and observation; I got use to these equations. Just hearing lecture will may be help, but using things and experiment will be more helpful to learn. Also making two different kinds of circuits were difficult especially because using many jumper cables. It took time to set up each circuit. When I got the right prediction numbers with observation, I was very happy. This lab was difficult and concerned with numbers. Although, I enjoyed the lab.