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Physics Laboratory Report

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Title Current and Resistance

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Summary

The resistance is closely related to current. The higher the resistance, the harder it is for the current to go through, and the lower the resistance, the easier it is for the current to go through. The way two resistors are connected is also important; series connection and parallel connection. Ohm's Law is required for calculation.

Teacher's Comment This is a very nice 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。

Lab 1: Connecting Paper Resistors

➢ Introduction

1) Objectives

To determine how resistance works by connecting paper resistors that differ in size and shape, and measuring resistances using a multimeter.

2) Theory

- Ohm's Law (V = IR)
- Series Connection ($R = R_1 + R_2$)
- Parallel Connection ($\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$)
- Resistivity ($R = p\frac{l}{s}$)

usually ρ (rho), a Greek letter, is used.

➢ Experimental

1) Apparatus, Materials

Important apparatus used throughout the experiment were:

- Black paper
- Scissors, cutter
- Scale
- Multimeter
- Binding clips

2) Methods

Cut the black papers to the sizes given on the direction sheet, and create resistors by those cut papers. Then, bind the paper(s) with the binding clips, and measure the resistances using the multimeter. Observe reactions. Try experimenting some of the questions by predicting the answers based on the result from the previous questions.

➢ Results

Very good!

Prediction − obs / obs × 100 (%) is better.

	Resistance (Ω)		Error Made
	Prediction	Observed	(Prediction – Observed)
17cm x 5cm	-	35.0	-
8.5cm x 5cm	17.5	17.4	+ 0.1
17cm x 2.5cm	70.0	68.8	+ 1.2
8.5cm x 2.5cm	35.0	35.5	- 0.5
Combination	52.5	57.6	- 5.1

(8.5cm x 5cm & 8.5cm x 2.5cm)			
Two sheets 17cm x 2.5cm	35.0	34.4	+ 0.6
17cm x 2.5cm + 8.5cm x 2,5cm	23.3	20.2	+ 3.1

The first question had to be measured without a prediction since there are no previous data to predict from. The overall observed resistances of paper samples were all very close to what I had predicted. The errors of the predictions from the observations were not far off, the best (closest) prediction being only +0.1 off the real number, and the worst (furthest) prediction being -5.1 off. +0.6% -8.9%

- **Discussion**

Predictions were calculated using equations from Theory. When the paper decreased in its length, the resistance would also decrease. When the paper decreased in its width, the resistance would increase. Resistance increases when the paper is thin and long, because the resistance within the paper becomes concentrated and is crowded. Resistance decreases when the paper is short and fat, because there is more space within the paper which means less resistance. Although these calculations were correct, there were errors with my predictions from the actual observations. That is because the black papers were not accurate enough when I cut them into the sizes given. It may have been either too big or too small, and therefore not exact. The more accurate the paper was cut, the closer the observation will be to the prediction.

- **Conclusion**

Resistance plays a big role because it greatly affects the outcome by its size. The sizes of papers mattered; if the paper was long in width it meant less resistance, and if the paper was long in length it meant more resistance.

- **Comment**

It was fun to play around with the handmade resistors and measuring them using a multimeter. The cut papers should have been more accurate in order to lower the error values and to make the observed values be closer to the predicted values.

Lab 2: Measuring Current and Voltage

➢ Introduction

1) Objectives

To be able to measure the electric current and voltage, by connecting batteries, ammeter, voltmeter, and resistors, and to understand the Ohm's Law.

2) Theory

Ohm's Law (V = IR)

Series Connection ($R = R_1 + R_2$)

Parallel Connection ($\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$)

➢ Experimental

1) Apparatus, Materials

Important apparatus used throughout the experiment were:

- Battery (9V)
- Resistors – various
- Ammeter
- Voltmeter
- Jumper cables

2) Methods

- Measure the resistance of R_1 with a multimeter beforehand. Predict the values of the ammeter and voltmeter. Select appropriate ranges of the meters and make the circuit. Measure the current and voltage. Compare the observed and predicted values.
- Select R1 and R2 and measure their resistance values. Do the procedures similar to #1.

show the circuits by illustrations.

300 Ω or 0.3 kΩ

➢ Results

- The resistance of R_1 was 30 Ω. Therefore, we predicted the value of the ammeter to be 30 mA, and the value of the voltmeter to be 9V. When we

actually measured the current and voltage, the observed results were a little off from the predicted values. The observed value of the ammeter was 21 mA, and the value of the voltmeter was 7.5V.

- The resistance of R_1 was 0.38 Ω and R_2 was 0.67 Ω. The equivalent resistor R was calculated to be 1.05 Ω. Therefore, we predicted the value of the ammeter to be 8.6 mA. However, we did not do this experiment right, so we could not calculate the value of the voltmeter. What we did wrong was that we forgot to note which resistor was R_1 and R_2, that we now have two possibilities for the values of the voltmeter; 3.3V (8.6 mA x 0.38 Ω) or 5.8V (8.6 mA x 0.67 Ω). When we actually measured the current and voltage, the observed results were a little off from the predicted values. The observed value of the ammeter was 8 mA, and the value of the voltmeter was 5V. The observed value of the voltmeter was 5.5V, which is close to one of the predictions. Therefore, I am assuming the value of R_1 was 0.67 Ω.

➢ **Discussion**

In this experiment, there was a Series Connection for the two resistors. However, it is very hard for me to discuss the results, because we were not successful with this experiment in many parts. We were not careful enough when connecting the cables to the ammeter and voltmeter as we may have not connected them properly. Some of us even did not understand what we were supposed to do for the experiment, so there were errors made, for example, when noting the values of the resistors. This led to the misunderstanding of the locations of the two resistors; R_1 and R_2.

➢ **Conclusion**

From this experiment, it was clearly shown that the values of the resistance and the current are closely related; the higher the resistance, the harder it is for the current to go through (therefore higher current), and the lower the resistance, the easier it is for the current to go through (therefore lower current).

➢ **Comment**

It was not a satisfying lab for me since I made some errors that have caused problems when writing this lab report, but I want to learn from this mistake and not repeat it in future.