

Resistance and Ohm's Law

Name _____ ID _____ TA _____

Partners _____

Date _____ Section _____

Please be careful about the modes of the multimeter. When you measure a voltage, you are not allowed to use current mode (A), and vice versa. Otherwise, the fuse in the multimeter will be burned.

1. **Test of Ohm's Law:** Resistance value measured with the multimeter: _____

	Voltage (V)	Current (mA)	Reversed Current (mA) (Current after flipping the resistor)
1			
2			
3			
4			
5			

*The purpose of measuring reversed current is to see if a current value will be changed by flipping the resistor. Just make sure of that for 2 or 3 cases.

*You will plot the data as voltage vs. current. According to Ohm's Law, the slope of the line should be the resistance.

If you know how to plot them, and how to get the slope with some software, such as Microsoft Excel, you can do this during the lab. However, you have to show it TA before you leave. For the write-up, you should save the file in a diskette or something.



2. Resistors Connected in Series or in Parallel:

➤ Direct Measurements

		Voltage (V)	Current (mA)	Resistance (kΩ) (=voltage÷current)
1	R_1			
2	R_2			
3	both in series			
4	both in parallel			

➤ Confirmation of Resistance Addition Rules

(Series connection) $R_1 + R_2 =$ _____

(Parallel connection) $\left[\frac{1}{R_1} + \frac{1}{R_2} \right]^{-1} = \frac{R_1 R_2}{R_1 + R_2} =$ _____

*Those results should be agreed with the resistance values of 3 and 4 in the above table.

3. Currents and Voltages in Complex Circuits:

$R_1 =$ _____, $R_2 =$ _____, $R_3 =$ _____

V (source voltage) = _____, $V_{ab} =$ _____, $V_{bc} =$ _____

$I_1 =$ _____, $I_2 =$ _____, $I_3 =$ _____

Are your results consistent with these equations? _____

$$V(\text{source}) - V_{ab} - V_{bc} = 0$$

$$I_1 = I_2 + I_3$$

How about if you compare these ratios?

$R_3/R_2 =$ _____, and $I_2/I_3 =$ _____

Are those close? (They should be the same.) _____

Please see the next page. You have one more project to do.

Post -lab Project (Answer the questions to TA orally before you leave, and write this on your report.)

Human body can be recognized as a circuit. For the circuit elements, it has the muscles and fat. In fact, muscles have more water. It means that muscles have less resistance than fat since water plays a role of conductor. Therefore, if you grab the probes of multimeter, you can find out your resistance change.

For the application, if you know your volume and weight, you could calculate your muscle or fat percentage.

? Question ?

Actually, the resistance in your body is not constant. You will find that, after taking shower, the resistance will be lowered. Why is it? Do you come up with the other similar cases? How do you apply this to some medical devices?



Lab Procedure for Resistance and Ohm's Law

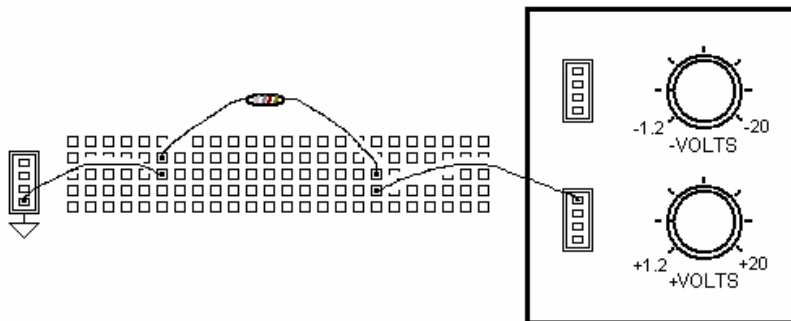
Please be careful about the modes of multimeter. When you measure a voltage, you are not allowed to use current mode (A), and vice versa. Otherwise, the fuse in multimeter will be burned.

1. Test of Ohm's law

- **Pick up one resistor, and measure the resistance with the multimeter directly. The mode of the multimeter should be selected as 'Ω.'**
- **Using the breadboard (middle of the Circuit Trainer), make a simple circuit to measure the voltage and the current associated with the resistor you chose.**

To make the circuit, you should follow this procedure:

- a) As the TA mentions, one column constructed with 5 holes has the same contact. But different columns have different contacts.



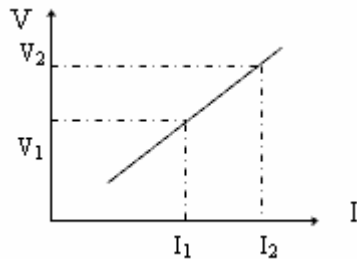
- b) You will connect the legs of a resistor to different columns' holes respectively.
 - c) Using two wires, one is connected to ground, and the other will be connected to the variable voltage source.
- **You will measure 5 different voltages and currents, but you should note that the voltage and current has to be measured for each change by the variable voltage source. You CANNOT measure only voltages 5 times first, and then measure 5 different currents. It will not explain Ohm's law.**
 - **With careful about selecting the modes, measure the voltage and current. However, those measurements are different as follows: (The TA explains this.)**

Voltage measurement → parallel with the circuit

Current measurement → series with the circuit

- **Make sure the “Reversed Current” is the same as the “Current.”**
Just flip the resistor, and measure the current only two or three of the five measurements. In fact, it does not change anything, and means that a resistor does not have polarity.

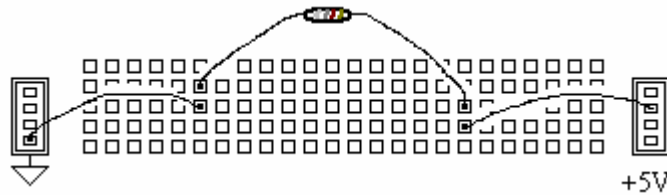
- **Plot the data, voltage vs. current; then, find the best-fit line and the slope. See if the slope corresponds to the resistance directly obtained by multimeter.**



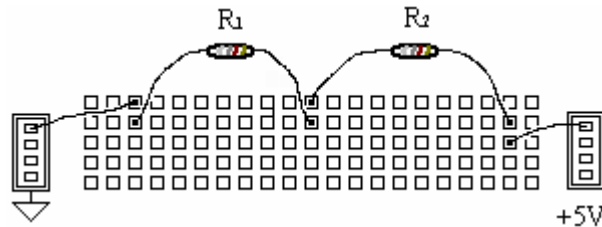
$$\text{slope} = \frac{V_2 - V_1}{I_2 - I_1}$$

2. Resistors Connected in Series or in Parallel

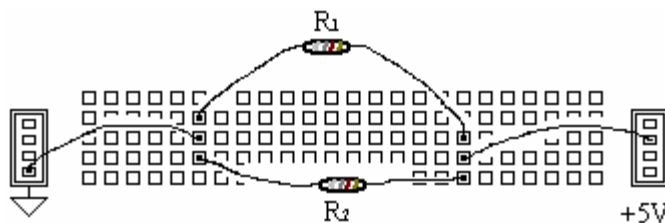
- **Pick up two kinds of resistors. You have to obtain each resistance by using Ohm’s law, so make the following circuit for R₁ and R₂.**



- **Following the same procedure as in the 1st part, measure the voltage and currents. Then calculate the resistances by using Ohm’s law.**
- **Make the following series circuit, and then measure the voltage and current flow for the whole circuit.**



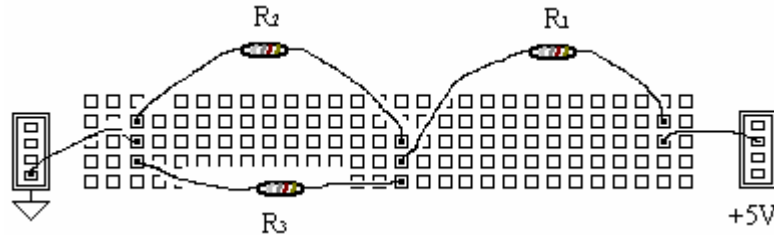
- **Make the following parallel circuit, and then measure the voltage and current flow for the whole circuit.**



- **Calculate the total resistances for series and parallel theoretically.**
You will use R₁ and R₂ to calculate them, but these are from the first two experimental data. As you notice, these calculated ones should correspond to the last two experimental data.

3. Currents and Voltages in Complex Circuits

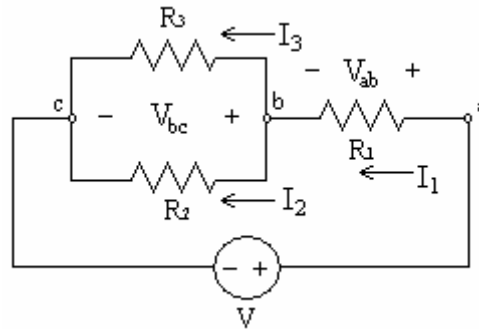
- **Pick up three resistors and measure each resistance with multimeter.**
For this, you do not need to calculate the resistances of resistors by Ohm's law. You will measure those directly (without source voltage).
- **Make the following circuit.**



- **Measure each voltage and current associated with the resistances. Refer to the following circuit diagram.**

To measure the tricky. If you are not

currents will be a little sure, please ask the TA



- **To make sure a simple circuit theory (an application of Ohm's law) explained by the TA, calculate equations on the data sheet.**

4. Lab report

- **Please write down what you learned, and discuss whether you obtained consistent results. If not, please state why.**