ASEN 3300, Fall 2023: Lab 1 Report Submission

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Section:	012

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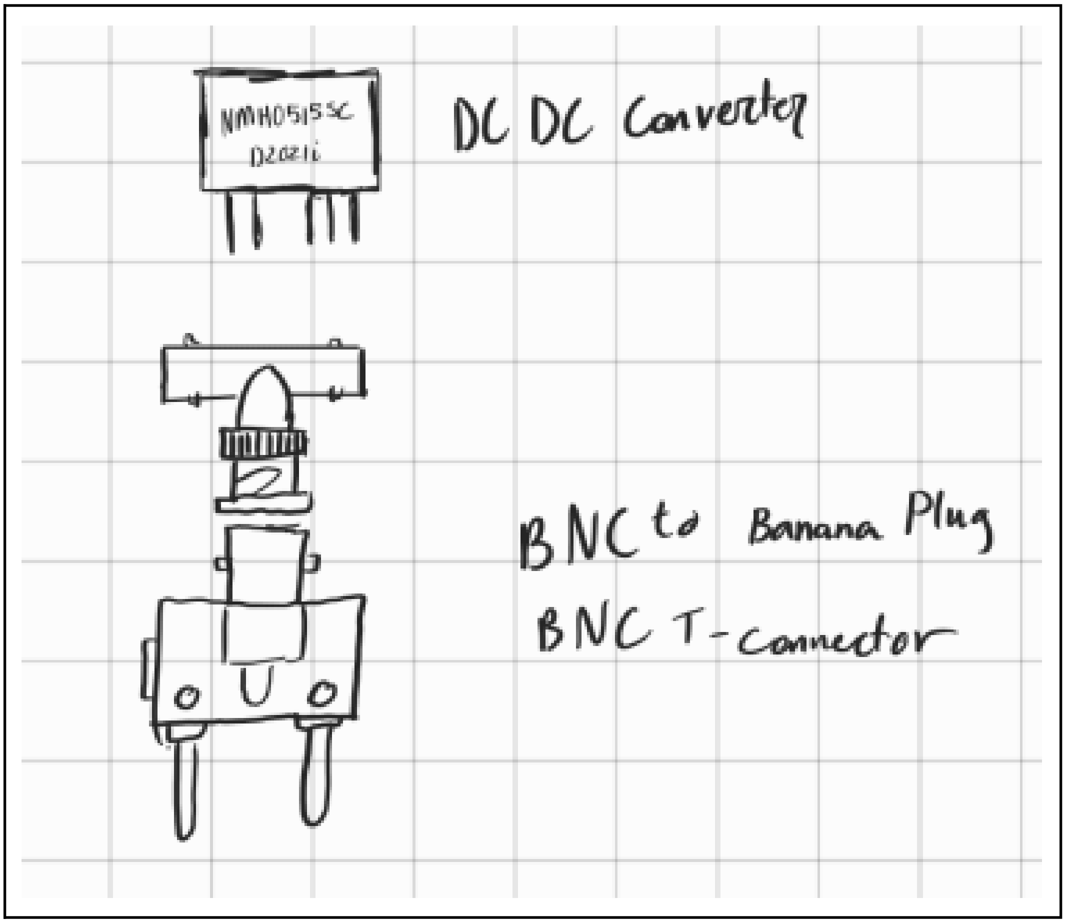
4. Experiment (25pts)

4.1. Inventory (4 pts)

a. Record your response to 4.1.a in the table below:
(Enter one part, or set of parts, in each box; e.g. “1 kΩ resistors (5)”)

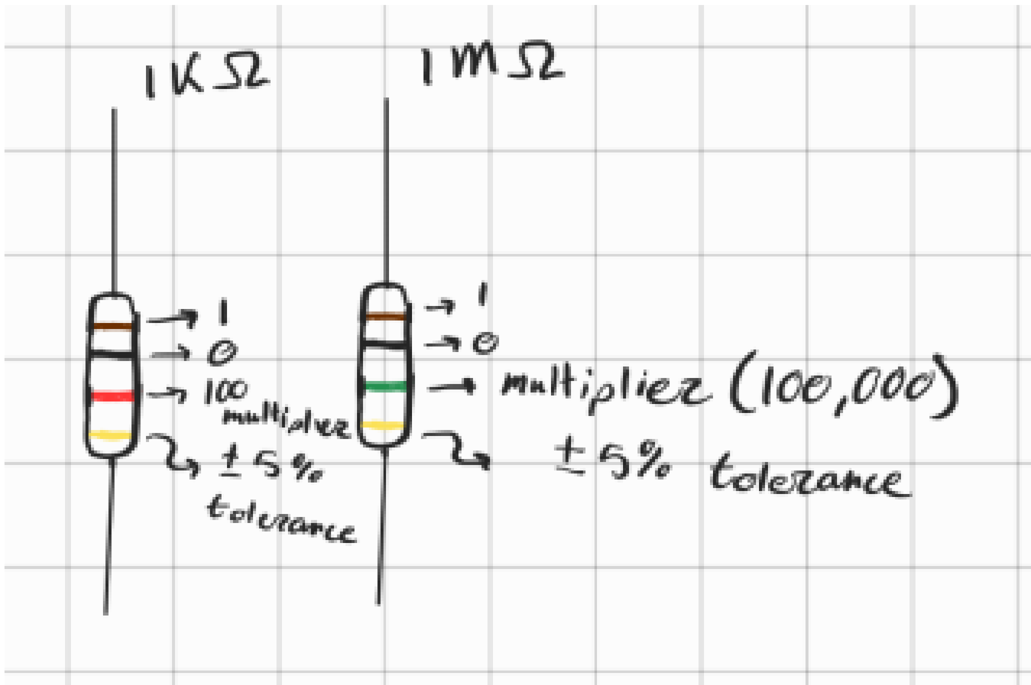
Jumper wire kit	USB-A to USB-Micro cable	100 kΩResistor (3)	NMH0515SC-DC DC Converter
Breadboard	BNC Cables (3)	1 MΩ Resistor (3)	2N7000TA-MOSFET (2)
BNC to banana plug/T connector	BNC to Alligator Pigtail	10 MΩ Resistor (3)	LM358 Op. Amp (4)
Arduino due	Alligator clips (2 red, 2 black)	1 mF Capacitor (2)	LM317 Power Regulator (2)
Accelerometer kit	332 Ω Resistor (4)	0.1 mF Capacitor (2)	
12”/18” banana plug	1 kΩ Resistor (11)	10 pF Capacitor (2)	
8” banana plug	3.3 kΩ Resistor (5)	1 mF Polarized Capacitor (2)	
Anti-static wrist strap	5.1 kΩ Resistor (3)	1N4001 Diode (2)	
24” banana plug (2)	10 kΩ Resistor (4)	1N5232B Zener Diode (2)	
36” banana plug	33 kΩ (3)	LED (2)	

b. Record your response to 4.1.b below



4.2. Resistor Measurements (11 pt)

a. Record your response to 4.2.a below:



b. Record your response to 4.2.b below:

Resistor (Manufacture Stated Value)	Measured Value
R1 (1 kΩ)	.979 kΩ
R2 (1 kΩ)	.976 kΩ
R3 (1 MΩ)	.990 MΩ
R4 (1 MΩ)	.991 MΩ

c. Record your responses to 4.2.c below:

First measurement:	.402 MΩ
Second measurement:	.468 MΩ

d. Record your responses to 4.2.d below:

Two 1kΩ resistors in series:	1.97 kΩ
Two 1MΩ resistors in series:	1.99 MΩ

e. Record your responses to 4.2.e below:

Two 1kΩ resistors in parallel:	.489 kΩ
Two 1MΩ resistors in parallel:	.497 MΩ

4.3. Voltage and Current Measurements (10 pt)

b. Record your response to 4.3.b below:

Power supply voltage measured with DMM:	+4.993 V

c. Record your responses to 4.3.c below:

Voltage across first resistor:	+2.5V
Voltage across second resistor:	+2.505 V

d. Record your response to 4.3.d below:

Current through circuit:	2.54 mA

e. Record your responses to 4.3.e below:

Voltage across first resistor:	+ 2.39 V
Voltage across second resistor:	+2.37 V
Current through circuit:	2.5 μA

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5. Analysis (25 pts)

5.1. Comparison of Resistor Measurements

a. Record your responses to 5.1.a in the table below:

Resistor:	**Manufacturer value: (resistor value +/- tolerance as marked on resistor)**	**DMM Measurement (Ohmmeter):**	**Calculated (From V and I):**
1 kΩ	1 kΩ +/- 5 %	.979 kΩ	.984 kΩ
1 kΩ	1 kΩ +/- 5 %	.976 kΩ	.986 kΩ
1 MΩ	1 MΩ +/- 5 %	.990 MΩ	.956 MΩ
1 MΩ	1 MΩ +/- 5 %	.991 MΩ	.948 MΩ

The 1 MΩ resistor had a much lower value when calculated because of the internal resistance of the DMM.

b. Record your response to 5.1.b below. **Don't forget to mention the effect of the DMM input resistance in your discussion.**

The calculations agree with values measured by the DMM for the majority. With the 5 % tolerance, it is expected to not measure the exact resistance. And with our measurements we saw that tolerance in action as the values were not exact. And after using Ohm's law to find the calculated values we saw similar values with respect to the 5% tolerance. For example, the 1 kΩ was measured at .979 kΩ and it was calculated at .984 kΩ. But when we calculated the mega Ohm resistor, we saw a lower value than what was measured. This is because the voltage was only around 2.39V compared to the expected 2.5 V. After some research we discovered the internal resistance of the DMM is around 10 MΩ. And by measuring a 1 MΩ resistor, it is able to create a drop off in voltage, thus having a lower calculated value. Finally, we also observed the current to drop significantly from 2.54 mA to 2.5 µA when using the 1 MΩ. This makes sense when looking at Ohm's Law, as the resistance increases and the voltage stays the same, the current must decrease.

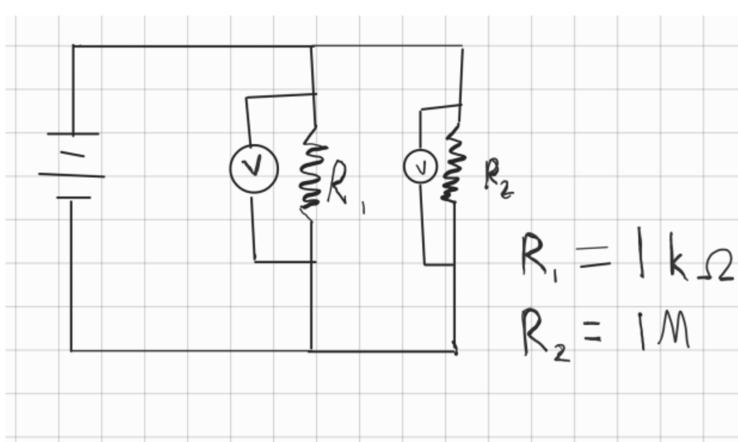
5.2. People Comparison

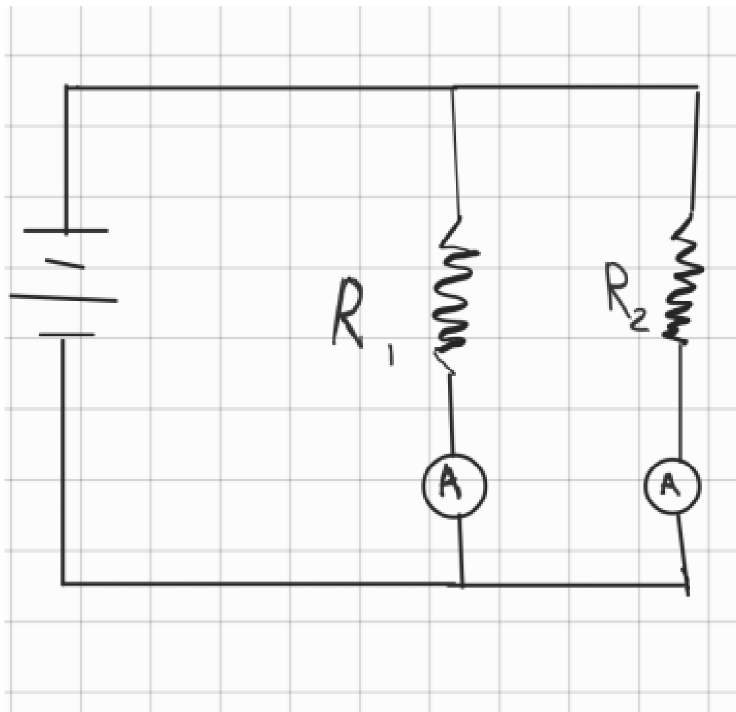
a. Record your response to 5.2.a below:

When measuring the resistance of our bodies, we found that regardless of which finger/hand was being measured, the resistance values were between 0.4 MΩ-0.46MΩ. This result stayed within that range for all of our group members. Touching the wires in various different ways does change the resistance. This could be due to the different path that the current might take through your body. It’s hard to determine what this path might be, but we observed that touching the wires with two different hands does typically result in a higher resistance. Overall, the human body has a high resistance.

5.3. 1 MΩ and 1kΩ

a. Record your response to 5.3.a below:





b. Record your responses to 5.3.b below:

Voltage across 1 kΩ resistor:	5 V
Voltage across 1 MΩ resistor:	5 V

c. Record your responses to 5.3.c below:

Current through 1 kΩ resistor:	5 mA
Current through 1 MΩ resistor:	0.005 mA

d. Record your responses to 5.3.d below:

The voltage across each resistor would remain the same when changing the 1 MΩ resistor to a 10MΩ resistor. Similarly, the current through the 1 kΩ resistor will remain 5 mA after the switch. However, the current through the new 10 MΩ resistor will decrease to 0.0005 mA.

5.4. Power Ratings / Dissipation

a. Record your responses to 5.4.a below:

$$P = I^2 R$$

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.25}{5}} = 0.22\,A$$

With only a 5Ω, 0.25W resistor, the required current would be 0.22A, which would cause the resistor to heat up and possibly start smoking. This would result in a broken circuit.

5.5. Ammeter Design

a. Record your response to 5.5.a below:

In the pre-lab, the sense resistance value was 50 mΩ. In order to measure currents between 0-20 mA, the sense resistor value would go up to 15 Ω. This would make the minimum required resolution of the voltmeter 1.5 mV in order to measure currents with +/- 0.1 mA precision.

b. Record your response to 5.5.b below:

$$P = I^2 R = (0.02)^2 (15) = 0.006\,W$$

The maximum power dissipated by the sense resistor would be 0.006 W or 6 mW.

c. Record your responses to 5.5.c below:

With a 100 Ω resistor, the new maximum power dissipated would be 0.04 W, meaning that the maximum voltage across the circuit would be 2 V. This is way higher than the 0 - 300 mV range of the voltmeter. This could only work if we were using a voltmeter with a higher range of voltage values.