

Olaf Bach

Advanced Physics *Laboratory I*

Lab 1: The Unknown Resistor

## I. Objective

Can we determine the resistance of an unknown resistor using a voltmeter and a known resistor.

## II. Materials

- |                                |                                       |
|--------------------------------|---------------------------------------|
| -Arduino Uno                   | -A known resistor (10.02 k $\Omega$ ) |
| -Breadboard (solderless-board) | -Wires                                |
| -An unknown resistor           | -A computer for data processing       |

## III. Procedure & Code

The circuit was based on the device photograph provided. The main change I made being that the positive and negative wires are connected directly onto the terminal strips because there's only one component circuit on the board and also avoid possible resistance from using power rails.

The code was based on the sample code provided. The change here is that I converted the value given directly into voltage instead of Arduino's value. For some reason I had to divide the value by 0.2046 and then by 1000. If I just divided the value by 204.6 (1023/5) it ended up giving me a value of 1 volt every second.

Link to the code: <https://pastebin.com/aQeNftf9>

Using the circuit and code I was able to find the voltage across the unknown resistor ( $V_2$ ) to be 1.74 volts.

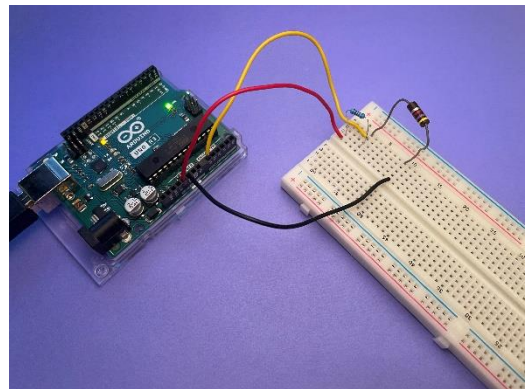


Fig. 1 – Photograph of constructed system

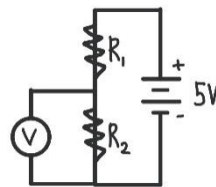


Fig. 2 – Circuit Diagram

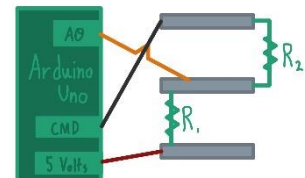


Fig. 3 – Schematic Illustration

#### IV. Data & Mathematical Evaluation

Known Values;	$V_t = V_1 + V_2$	$V_1 = I_1 * R_1; I_1 = I_t$	$V_2 = I_t * R_2$
$V_t = 5V$	$V_1 = V_t - V_2$	$I_t = \frac{V_1}{R_1}$	$R_2 = \frac{V_2}{I_t}$
$R_1 = 10.02k\Omega$	$V_1 = 5V - 1.74V$	$I_t = \frac{3.26V}{10.02k\Omega}$	$R_2 = \frac{1.74V}{0.325V/k\Omega}$
$V_2 = 1.74V$	$V_1 = 3.26V$	$I_t = 0.325V/k\Omega$	$R_2 = 5.35k\Omega$

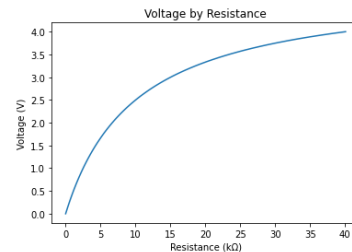
Resistance in one equation;

$$R_2 = \frac{V_2}{I_1} = \frac{V_2}{\frac{V_1}{R_1}} = \frac{R_1 * V_2}{V_1} = \frac{R_1 * V_2}{V_t - V_2} = \frac{10.02k\Omega * 1.74V}{5V - 1.74V} = 5.35k\Omega$$

After some simple arithmetic, I obtained the resistance of the resistor to be 5.35 thousand ohms

I then made a graph to show the resistance of the unknown resistor against the voltage across the resistor

Code for the graph: <https://pastebin.com/9Jr6bS31>



#### V. Conclusion

This was a very interesting lab experience. This was also the first time I've ever touched coding in my life so, pardon if any code is messy or if I set-up the breadboard incorrectly. Ultimately, I obtained a value I was comfortable with, and for my first time I'm proud of my results. I wasn't able to get LaTeX to work, every time I tried inserting a photo the whole application crashed. Next lab I'll work out what was going wrong and will make it over TeX.