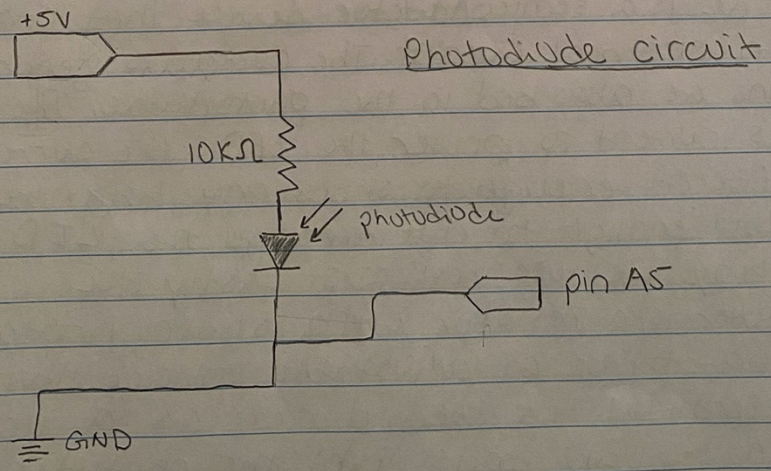
Lab #4

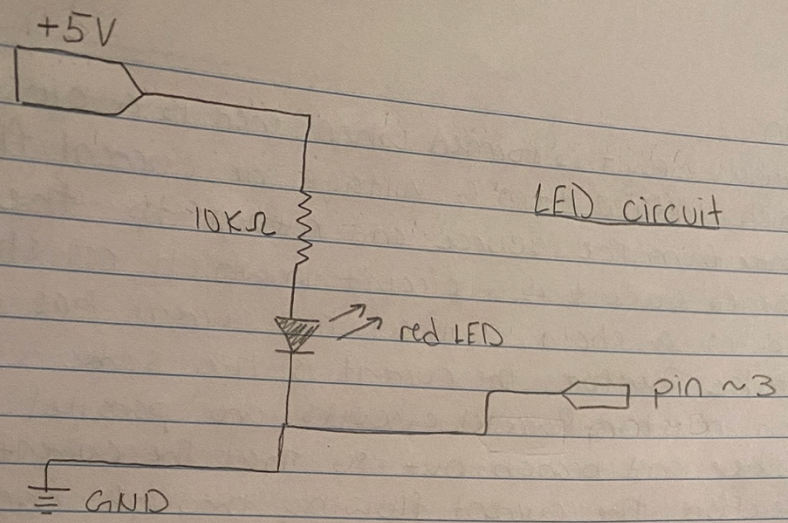
Introduction:

An electrical circuit is formed when there is a closed path in which electrons from a voltage or current flow. Electrons enter from the source and return to the ground. A series circuit is a circuit in which resistors are arranged in a chain, so that the current has one path to take. Therefore, the current is the same through each resistor. Parallel circuits are parallel to each other and branch out so that the current divides. Therefore, the current flowing through each resistor may vary. In this lab, our circuits were composed of 3 resistors, an led light, a photodiode, a variable resistor, and conductive junction wires. The variable resistor controls the brightness of the led light which then is detected by the photodiode and a graph is projected on the computer showing this process. The purpose of this lab was to build a system with three circuits: a photodiode (sensor) circuit, a variable brightness LED circuit and a user-controlled potentiometer (variable resistor) circuit.

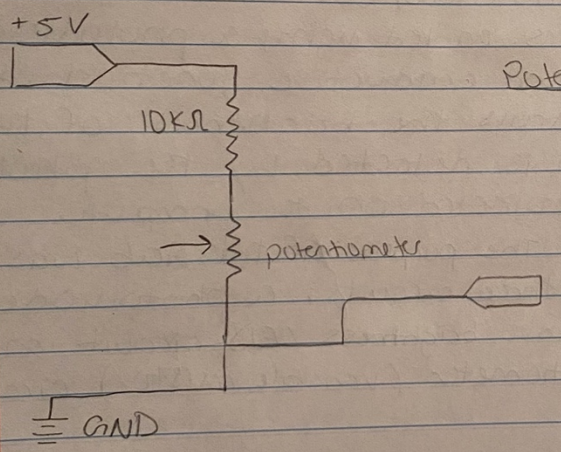
Setup:

1. Photodiode circuit





LED circuit



Potentiometer circuit

2. A photodiode is a semiconductor device that converts light into an electrical current. The current is generated when photons are absorbed in the photodiode. The LED circuit uses current to power the LED. The current must be sufficient enough to show any brightness, but also low enough to not damage the LED - which is why we use resistors. Lastly the potentiometer is a resistor with sliding / rotating contact that forms an adjustable voltage divider. When two terminals are used, it acts as a variable resistor. When the LED emits light, the photodiode recognizes this and absorbs the light to make an electrical current. Then the potentiometer can be used

to change the brightness of the LED, and thus changing the absorbance of the photodiode. This can be observed on the serial plotter in the Arduino program.

3.

Resistance	Max	Min
220Ω	1023.872	1.872
560Ω	967.872	0.880
10,000Ω	678.943	0.875

4. Arduino code attached

Data Analysis:

1. ↗ scatter plot attach

Trial	Resistance	Voltage	Experimental current	Theoretical
1	1.01 KΩ	3.52 V	3.5 mA	3.49mA
2	0.88 KΩ	3.16 V	3.63 mA	3.59 mA
3	0.62 KΩ	2.53 V	4.1 mA	4.08 mA
4	0.40 KΩ	1.80 V	4.47 mA	4.50mA
5	0.23 KΩ	1.39 V	6.21 mA	6.04 mA

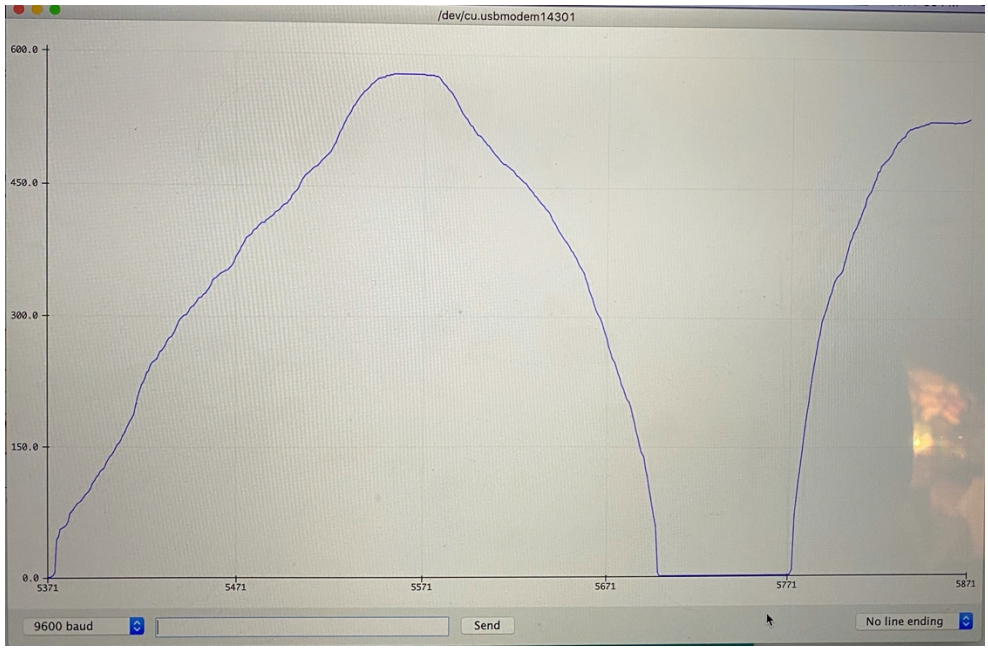
$I = \frac{V}{R}$ ↴

2. Plot picture attached.

Conclusions:

The LED brightness is being varied by a PWM function but does not show up in photodiode measurement because the photodiode is converting the brightness into electrical current. Electrical isolation is important because every measurement we make affects the rest of the currency in the system. In this circuit we electrically isolated one circuit from another using an opto-isolator that communicates information

from one circuit to another using light signals. Our circuit contains the essential components for an opto-isulator because it is built using a photodiode and LED light. When the LED is lit, the photodiode absorbs the light and converts it into electrical current.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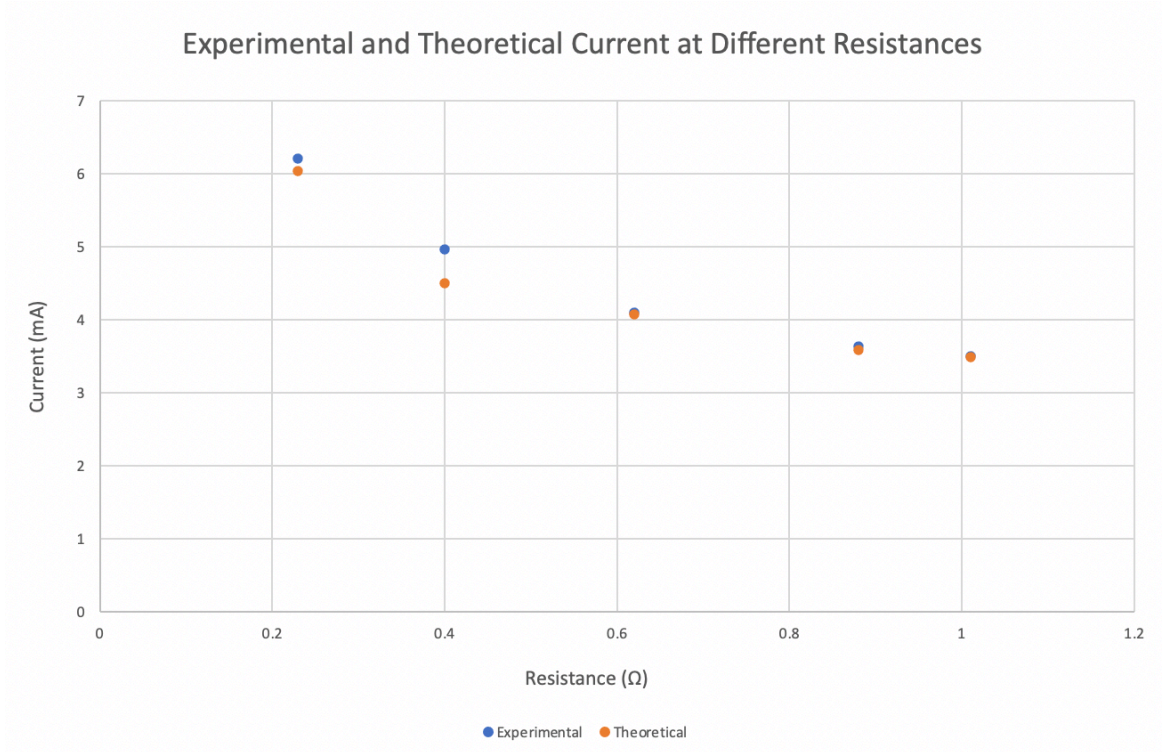
Experimental and Theoretical Current at Different Resistances
Current (mA)
Resistance (Ω)
0
1
2
3
4
5
6
7
0
0.2
0.4
0.6
0.8
1
1.2
Experimental
Theoretical