Name:________________________________ **Date:** ______________________

Partner:________________________________ **This worksheet has two sides!**

Part I: Resistor

1. What is the color code for your resistor? (   ) (   ) (   ) (=   %)
2. Use the color code to look up the expected value of the resistance.
   The color code includes an uncertainty! R_{code} = (__________ ± __________) Ω
3. Use the multimeter in Ω mode to determine R at least 5 times: R_{meter} = (__________ ± __________) Ω
4. Use your plot of ΔV vs I to determine the resistance yet again: R_{plot} = (__________ ± __________) Ω
5. Discuss/explain with numbers: What do you think the "true" resistance is?

Part II: Light Bulb

1. The light bulb is not "ohmic", so in any real sense, it doesn't even have a resistance. Yet, when we use the multimeter in Ω mode, we still get a number. Do that at least 5 times, and write the average result and it's uncertainty here:

   R_{bulb} = (__________ ± __________) Ω

2. You used trendline and linest to determine a best fit curve of the form $\Delta V = a_0 + a_1 I + a_2 I^2 + a_3 I^3$. Compare the two closely, then write the coefficients. Each has units as specified by the equation itself. For example, a_2 must be in V/Amp^2. So, include the units! Any use of scientific notation must occur OUTSIDE of the parentheses:

   a_0 = (__________ ± __________) __________
   a_1 = (__________ ± __________) __________
   a_2 = (__________ ± __________) __________
   a_3 = (__________ ± __________) __________

3. Explain why a parabolic (an order 2 polynomial) wasn't sufficient to describe the light bulb.

4. This question requires some (minimal) calculus. Use your cubic equation to determine the slope of your curve fit when $I = 0$.

   slope = __________ ± __________ Ω

5. Explain what you think the multimeter was doing when you used it to get a resistance for the light bulb.

Part III: LED

1. You were required to use a resistor in series with the LED. Use the multimeter to find just one measurement of its actual resistance:

R_{meter} = (__________ ± __________) Ω

2. Diodes, including LEDs, are so non-ohmic that the ohmmeter setting won't tell you anything at all. However, some multimeters have a diode setting. Get a hand held multimeter, put it into diode mode (—▶|—), and try it both ways (i.e., swapping whether the red and black probes touch this leg or that leg of the diode). One of the two connections will cause the LED to light (a little), and it will also tell you a number. Write that number here. Don't worry about uncertainty.

Diode Value = V_D = (________) V

Keep track of which leg of the diode is which! We will say V and I are positive when the diode is in the direction that can light.

3. What color was the LED when it was lit? color = ____________________

4. For diodes, it is customary to plot I_{diode} vs ΔV_{diode}, instead of the other way around. Your plot should have two fairly clear segments at (almost) right angles to each other. Without using trendline, linest, or a calculator, write the equation that you see when $\Delta V < V_D$.

when $\Delta V < V_D$, $I(\Delta V)$ = ____________________

5. For the "other" portion of your plot, we notice that $I > 0$. Without using trendline, linest, or a calculator, write the equation that best describes this behavior.

when $I > 0$, $\Delta V(I) \approx$ ____________________