ILLINOIS INSTITUTE OF TECHNOLOGY - PHYS 221 L03

Lab Report - Lab 02: Instrumentation

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Lab 02
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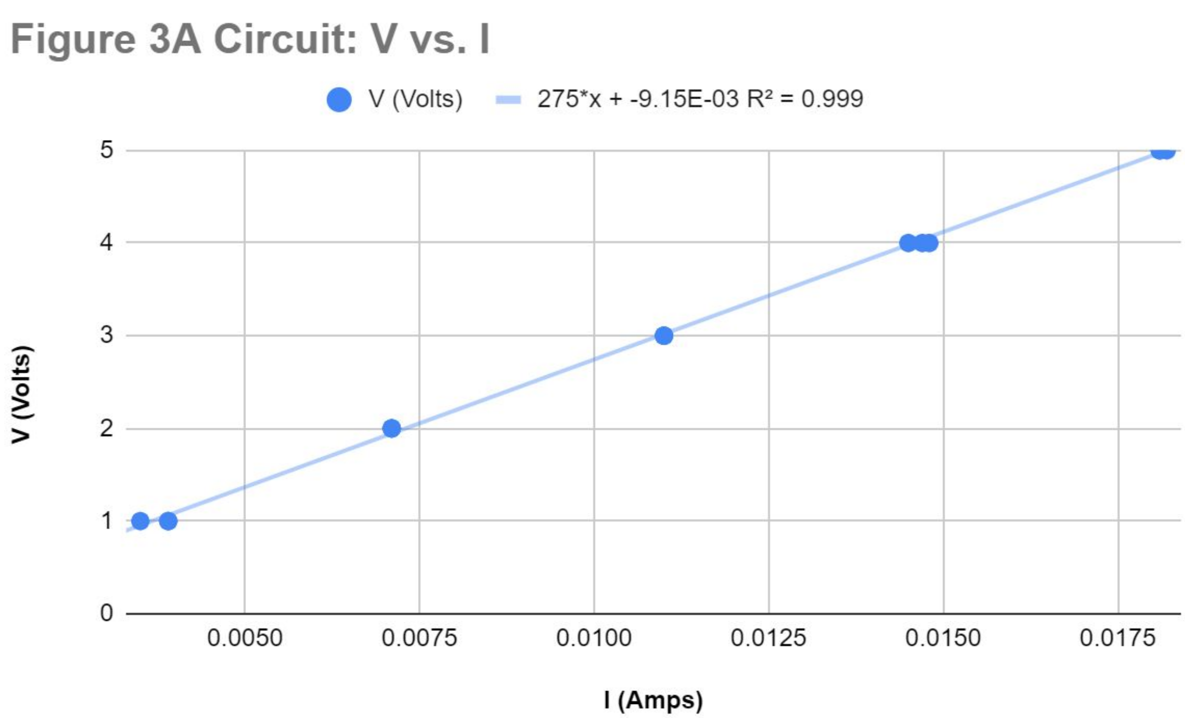
Instrumentation

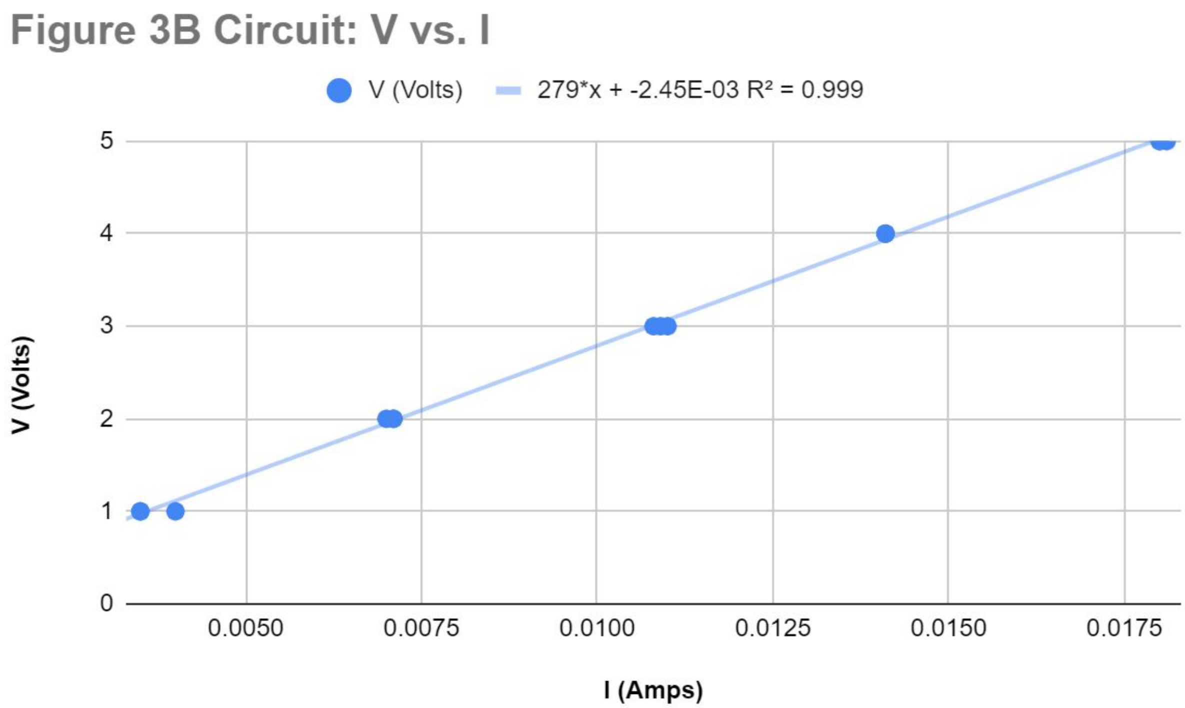
Questions

1. Using the color codes, what is the expected resistance of the resistor? Verify that the actual value is within the tolerance given by the color code by using the Multimeter. What color code would designate a 1 kΩ, 10% resistor?
   a. Red Purple Brown Gold: $27 \times 10^1 \pm 5\% = 270 \pm 13.5\Omega$
      Actual value = 283Ω, $256.5 < 283 < 283.5$
   b. Brown Black Red Silver; $10 \times 10^2 \pm 10\% = 1000\Omega = 1\ k\Omega$
2. Plot V versus I using both of your data set. You may plot both data sets on the same graph if they are clearly and neatly labeled. Prove that the slope of the best-fit line of your data is equal to the resistance R. This is referred to as Ohm's Law; V = IR. Using the best-fit line and Ohm's Law, find the measured resistance for each resistor. Compare any differences. What are the sources of error?

   Data Set 1: Figure 3A Circuit



Data Set 2: Figure 3B Circuit



For data set 1, the equation turns out to be y = 275x - 9.5E-3. For data set 2, the equation turns out to be y = 279x - 2.45E-3. The slopes of the graphs, 275 and 279 respectively, represent the resistance of the circuits. This can be proven through Ohm's Law V = IR, where we graph V/I. When we rearrange the equation, we get R = V/I. Since our slope is V/I, then it is also the resistance. This can be further proven with the actual value of 283Ω. With the percent error formula % error = (|experimental - actual| / actual) x 100%, we find that for data set 1, there is a 2.827% error for the resistance measurement while for data set 2, there is a 1.413% error. In addition, the r^2 values for both graphs are 0.999, which shows that the data is also reliable and accurate.

Some sources of error could include not having the output voltage set to the exact amount needed for the experiment. This is because the course knob to adjust the volts was really sensitive and it was hard to get the exact voltage needed, even with the multimeter. Sometimes the voltage would be off by 0.001 or sometimes 0.002, which could lead to slight differences in the results.

3. If the two experimental values of R that you have obtained are different from each other, which one is closest to the nominal value found using the Multimeter? Why are the experimental values different from each other? Which circuit should give a more accurate reading of the actual resistance?
    a. The resistance measured in the 2nd circuit is closest to the nominal value, the measured value being 279Ω while the actual value being 283Ω.

b. The experimental values are different because the circuits were laid out differently (the ammeter being in different places), distributing the same amount of voltage but measured in different positions within the circuits.
c. Circuit 1 should give a more accurate reading of the actual resistance because the resistance is measured from right before the resistor to after the resistor, while circuit 2 resistance is measured from before the resistor to after the resistor and ammeter, leaving more room for error due to a possible slight resistance in the ammeter.

Part 2 Questions

5. Now slowly increase the voltage output on the power supply to 5 V. What happens to the line on the screen? Change the vertical scale settings (VOLTS/DIV settings) in both directions and describe what happens. Also, adjust the vertical position setting accordingly in order to view the CH2 signal.
    a. The line moves up according to scale (you can see the scale number on the very left of the screen)
6. What happens to the DC voltage display when the CH2 coupling is changed to AC?
    a. The graph gets closer together, and DC voltage only increases slightly. The line also drops to 0, and doesn't move much when you increase voltage.
7. How would you determine the frequency of the sine wave using the oscilloscope?
    a. Measuring the distance between 2 peaks, and then dividing that number by the time between them.
8. Write down the Delta (Δt - the distance between the cursors) and calculate the frequency.
    a. Cursor 1: 620
    b. Cursor 2: 670
    c. 670 - 620 = 50 μs
9. Compare this frequency value to a) the value indicated on the function generator, b) the value found using cursors, and c) the value found by estimating visually. They should all be roughly the same. Which value would you deem to be most accurate? Explain Why.
    a. 1.495 kHz
    b. 1.493 kHz
    c. 1.495 kHz

    The most accurate value is the oscillator value because it is directly connected to the power supply.

10. Write down the amplitude and peak-to-peak values for the sine wave by a) estimating visually, b) using the cursors, and c) using the MEASURE menu (peak-to-peak only). Discuss the differences between the results, if any.
    a. 6 - (-7) = 13 V
    b. 7 - (-6.40) = 13.4 V
    c. 13.2 V

There are very minor differences between the results. These differences may be due to being directly connected to the power supply vs. not being directly connected to the power supply. Since the results are in close proximity to each other, then there is not much to discuss since the results seem precise.

Data sheet

Experiment 2

Part 1

2. 0.283 kΩ Red Purple Brown Gold

3. Table for Figure 3A

Voltage Reading (V)	Amps (A)
1	0.0035, 0.0039, 0.0039
2	0.0071, 0.0071, 0.0071
3	0.0110, 0.0110, 0.0110
4	0.0145, 0.0147, 0.0148
5	0.0181, 0.0182, 0.0181

Table for Figure 3B

Voltage Reading (V)	Amps (A)
1	0.0040, 0.0035, 0.0035
2	0.0071, 0.0070, 0.0071
3	0.0110, 0.0109, 0.0108
4	0.0141, 0.0141, 0.0141
5	0.0180, 0.0181, 0.0180

A/B

Part 2

5. The line moves up according to scale

6. AC = 0 drops down to 0, doesn't move when increase voltage

7. 650×10^{-6} sec., move one cycle left and see the diff in x pos

8. $670 - 620 = 50 \times 10^{-6}$

9. a) 1.495 kHz b) 1.493 kHz c) 1.495 kHz

10. a) 13
b) 7 - (-6.40)
c) 13.2V