

Name/NetID:

PRE-LAB #2: DC Circuits

Teammate/NetID:

In Experiment #1 we learned how to take measurements, plot graphs and draw circuit schematics. In Experiment #2, you will employ these skills in order to explore the behaviors of simple circuits. This pre-lab assignment will provide a quick review of plotting graphs and introduce some background topics and terminology that we will need for Experiment #2. *Please use the Notes margin on the right for both notes to yourself about the experiment as well as for feedback to your TA on the quality or clarity of the lab procedure. Thanks!*

Section AB/BB:

0 1 2 3 4 5 6 7
8 9 A B C D E F
(circle one)

Generating Graphs in MATLAB

The generation of graphs using MATLAB is a task that you will be asked to do in virtually every experiment for the remainder of the semester and a task you will likely need to accomplish outside of lab as you prepare your final report. Using software to analyze data is one example of “scientific computing”. Let’s take a moment and practice generating a graph in MATLAB once again. You will need access to a copy of MATLAB. All students can obtain a free student version of MATLAB from CITES WebStore. Unfortunately, the license verification is done over the network so the computer running MATLAB MUST be connected to a node with Illinois.edu address. So if you want to work from home you must be connected to a network and be able run the CITES VPN client so it looks like you are on campus. If you would rather not put MATLAB on your computer all of the computes in the EWS labs can run MATLAB.

Question 1: Compose a plot for the following data collected on voltage and current relationship of a resistor. Attach your plot to at the end of this assignment.

Voltage (V)	Current (A)
1.0269	0.0010
2.0917	0.0021
2.8871	0.0029
4.0431	0.0040
5.0159	0.0050

Table 1: Typical IV relationship of a resistor.

The Interpretation of Basic Circuit Laws

Around 1825, Georg Ohm performed some experimentation in circuits and formulated a mathematical description that we now refer to as Ohm's Law. **Ohm's Law** says that when a voltage differential, V , is applied across a resistive device (of resistance, R), the current that flows through that device is directly proportional to that voltage. Mathematically

$$I = \frac{V}{R} \quad (\text{one formulation of Ohm's Law})$$

The constant resistance, R , depends on the construction of the device and is assumed to remain constant. You will need knowledge of Ohm's Law to answer some of the questions in this procedure.

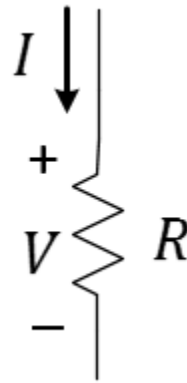
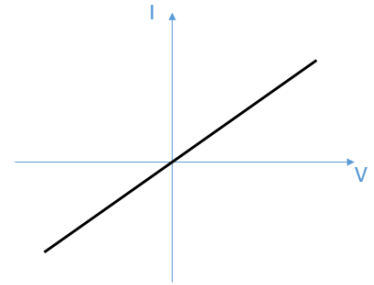


Figure 1: The resistor is an element follows Ohm's Law. The current and voltage with the polarities labeled above will produce a positive value for resistance, $R = \frac{V}{I}$.

Question 2: For a given resistor, what happens to the voltage drop across that resistor if the current flowing through it is cut in half?



The Current-Voltage (IV) curve of a resistor is a straight line of slope $1/R$.

Think about it...

What kind of "things" are Ohmic and which are not? Pencil carbon, your finger, a textbook? Use an Ohmmeter to experiment! Are there certain chemical structures that determine what might make a device Ohmic?

Background and Terminology

In the previous lab we learned best practices in taking measurements, plotting graphs, and drawing basic circuit schematics. In this lab we will be employing these skills when we take measurements on some basic *direct-current (DC)* circuits. Although the term “direct current” is commonly used in reference to systems with electric charge flowing in a single uniform direction, it is often achieved by supplying the circuit with a constant voltage. Such a supply is often called a *DC-voltage supply* or a *DC-power supply*.

Let us consider the equipment most commonly used in an electrical engineering laboratory for conducting experiments. The term **source** will refer to *a device that is capable of supplying energy to the circuit*. In your lab experiment, you will use the DC-power supply, model HP3631A, as your source. It will be able to generate a user-determined DC voltage (constant-voltage mode) or a user-determined DC current (constant-current mode). The term **load** (also known as a **power sink**) will refer to *a device that absorbs power* (often dissipating it as heat). A resistor is a typical load device. Finally, we have **measurement devices**. A measurement device may contain sources and loads but is intended to have minimal impact on the circuit being measured. A measurement device often utilizes electromagnetic principles (consider, for example, a galvanometer) to achieve its purpose. The upcoming lab’s measuring device is a digital multimeter, model HP34401A. It can measure the voltage across an electrical device, the current flowing through a circuit path and the resistance of devices. The HP3631A and the HP34401A devices also have additional functionality which you can learn about by reading their user manuals.

Question 3: Do you think a measurement device (like, say, a voltmeter) might be considered a power sink? Explain your reasoning.

Build Your Car Chassis

This is a great time to construct your car body (also called a “chassis”) to have it ready for when you will need it in the lab. You can find instructions on the course’s laboratory website. If you have any difficulty, you should ask for help in office hours or at the end of your next lab meeting.