

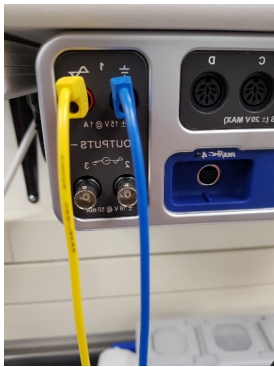
Physics 1E03: Lab 4

INDUCTORS AND THE LR CIRCUIT

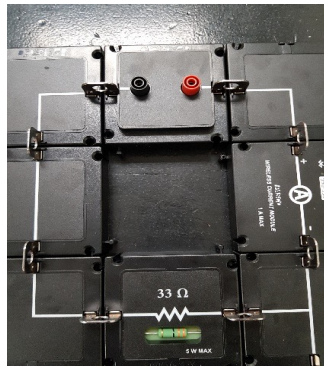
Lab Objectives

- Experimentally examine an inductor and how it is connected to a circuit
- Interpret the effects of internal resistance on circuit analysis from various circuit elements
- Experimentally measuring the internal resistance of various circuit elements
- Charging an inductor through a series RL circuit to determine the time constant and inductance
- Discharging an inductor through a parallel RL circuit and interpreting the effects of internal resistance

Equipment



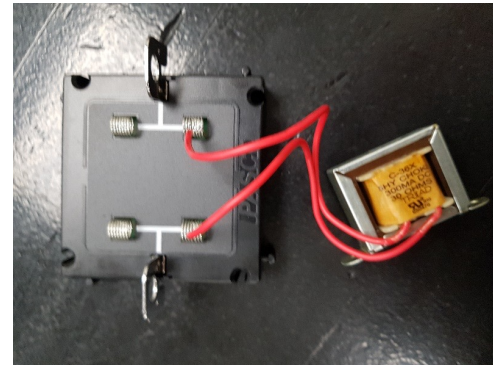
PASCO Capstone
Software



Circuit Building
Blocks



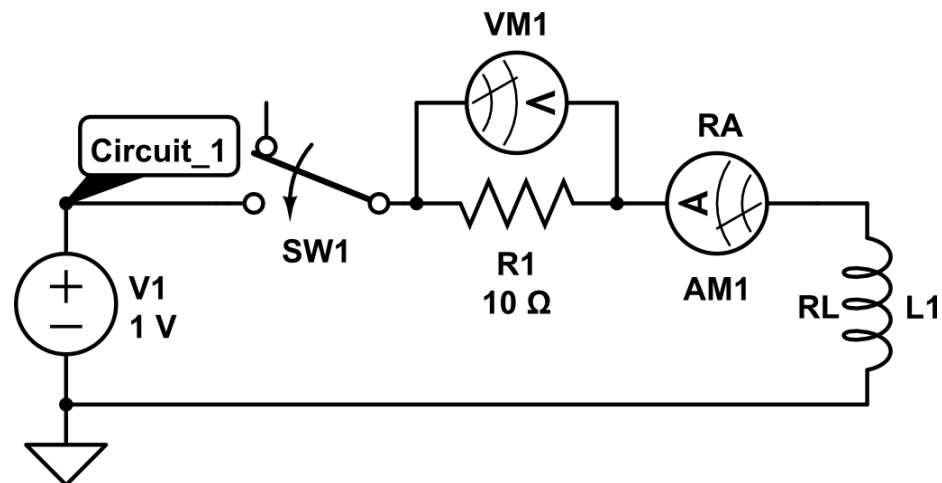
Digital Voltmeter & Ammeter



Inductor

Part 1: Charging Through an LR Circuit

- Goal is to measure the time constant and inductance of Circuit_1
- Start by measuring the resistances of the ammeter and inductor
 - Record these values in your report
- Set up a Voltage vs. Time and Current vs. Time plot in Capstone, then build Circuit_1



Part 1: Charging Through an LR Circuit

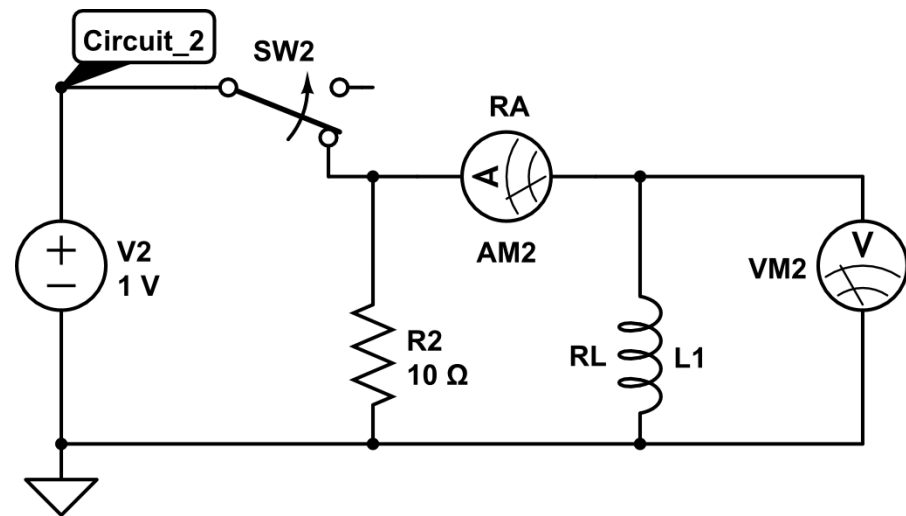
- Making sure the **switch is kept open**, set the **power supply to 1V**, then turn it on
- After you start recording, close the switch, then use the data to compute the time constant
 - Hint: This occurs at the time when the current is about 63% of its maximum value
- Record this value in your report, as well as the maximum value of the voltage

Part 1: Charging Through an LR Circuit

- Repeat the previous steps, but now setting the power supply voltage at 2V then 4V
 - For the 4V case only, take a screenshot of your plots
- Average over your results and find the standard deviation of your data
 - Hint: Excel has a built-in function to do this for you, using AVERAGE and STDEV
- Repeat previous steps again, now replacing the resistors in Circuit_1 with 33Ω then 50Ω

Part 2: Discharging through an LR Circuit

- In this part, we will try to find the inductance using a line of best fit
- Set up a **Voltage vs. Time** and **Current vs. Time** plot on Capstone, then build Circuit_2
- Making sure the **switch is kept closed**, turn the power supply on and start recording
- Open the switch, then paste a copy of the plots in your report



Part 2: Discharging through an LR Circuit

- Using the data, plot a $\ln(I)$ vs. time graph over the appropriate range in time
- Include a line of best fit on your plot, and use it to find the inductance
 - Hint: The current equation for a discharging capacitor in an RC circuit is

$$I(t) = I(0)e^{-\frac{R_T}{L}t}$$

$$\text{Or, } \ln(I(t)) = \ln(I(0)) - \frac{R_T}{L} t$$

where $R_T = R + R_{Ammeter} + R_{Inductor}$

Saving and submitting the report

1. Save your MS Word report file the following name: “L#-St#-lastname1-lastname2”
a. The number signs indicate the lab section number and the current station number.
b. Lastname1 and lastname2 are the last names of both lab partners.
c. This will make sure the file is easy to track in case something happens.

2. Save your report “L#-St#-lastname1-lastname2” as a PDF.

3. Assuming wifi is active and enabled, go to www.crowdmark.com and follow the given steps:
a. Click on “Sign in” in the top right corner.
b. Select the school “McMaster University”
c. Select “Sign in with Avenue to Learn”.
d. Note: only one student will need to submit on behalf of both students.

4. Once you selected to sign in through avenue, log into avenue to learn with your student Mac Id and password.

5. Repeat step 2 and go to the course “Physics 1E03: Introductory Mechanics”.

6. Find your assessment which is labeled with your lab number (L#) and the current lab (Lab#).

7. Submit the pdf of your lab report.

Good Luck!