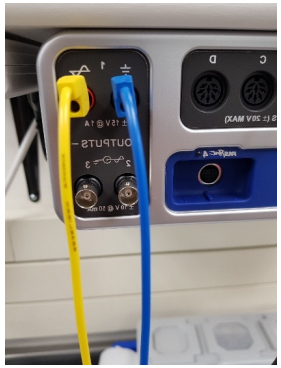
Physics 1E03: Lab 4

INDUCTORS AND THE LR CIRCUIT

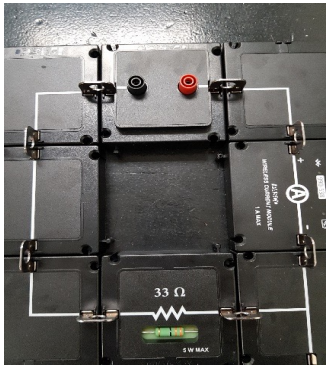
Lab Objectives

- 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

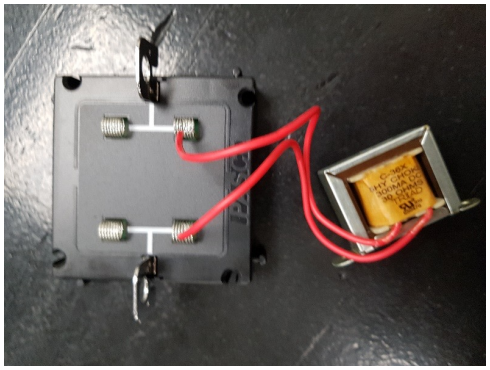


PASCO Capstone Software



Circuit Building Blocks

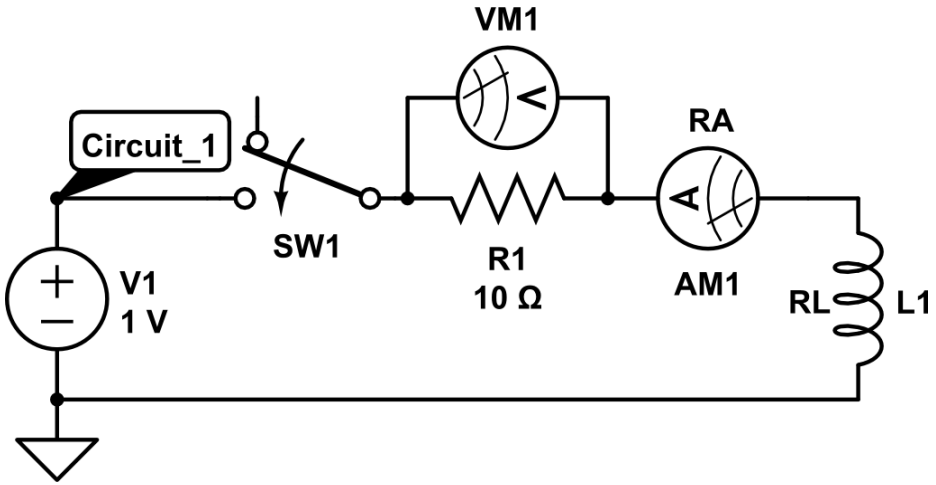
Digital Voltmeter & Ammeter



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

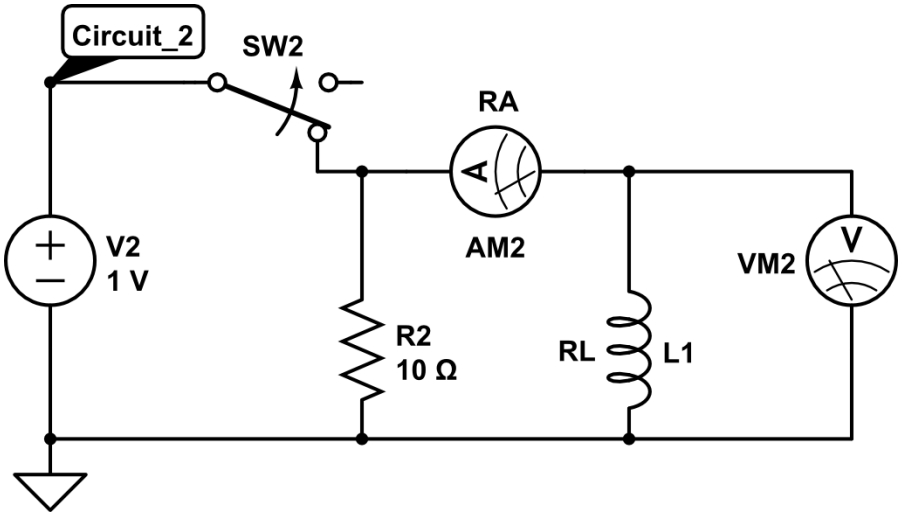
- Repeat the previous steps, but now setting the power supply voltage at 2V then 4V
  - For the 4V case only, take a screenshot of your plots

- 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

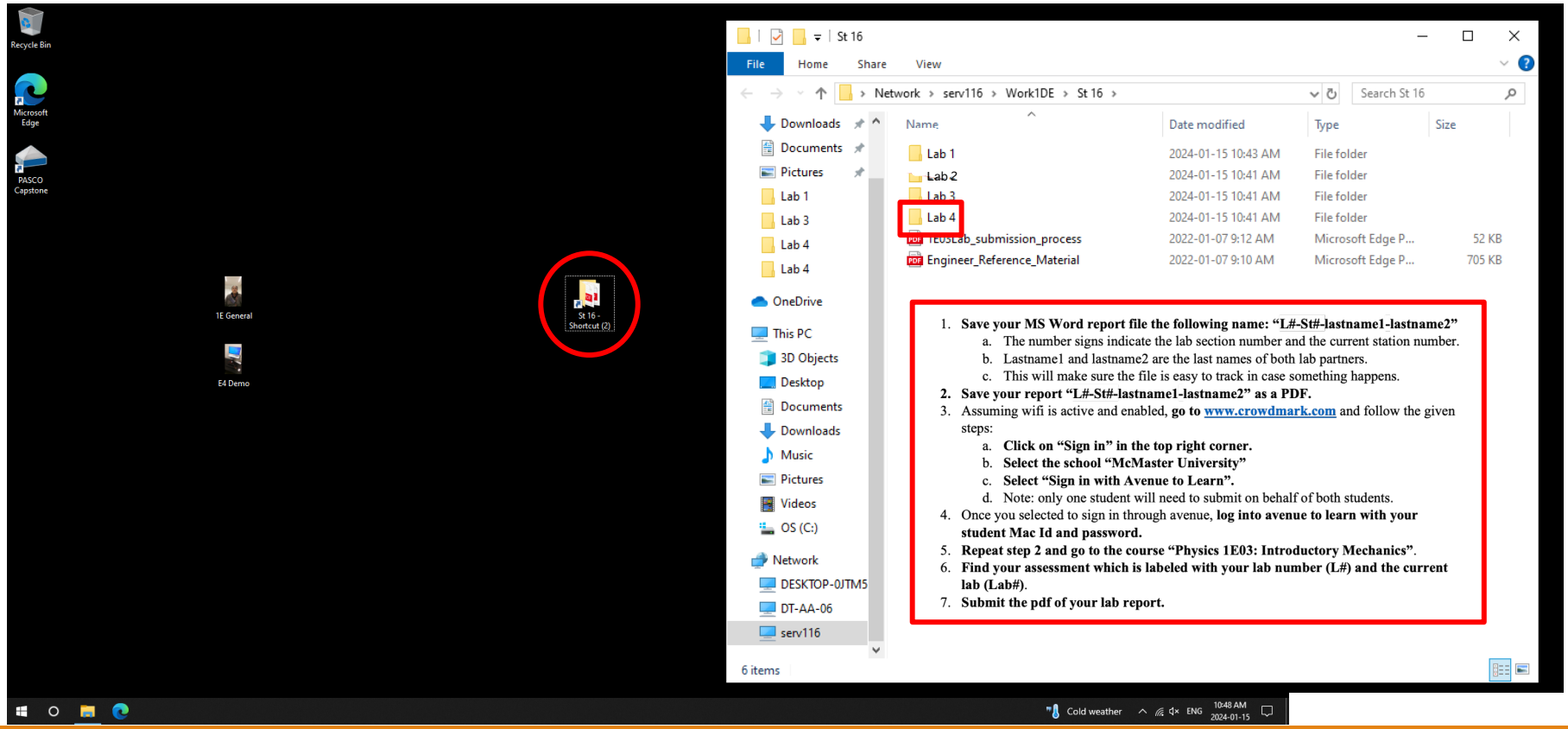
- Using the data, plot a ln(I) vs. time graph over the appropriate range in time
- Include a line of best fit on your plot, and use it to find the inductance
  - Hint: The current equation for a discharging capacitor in an RC circuit is

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

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

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

Saving and submitting the report



Good Luck!