AP Physics C
Circuit Lab Part 2

Name _____

Group _____

Purpose:

Determine the inductance of unknown inductors to an appropriate level of confidence.
Determine the frequency ω related to the voltage an RLC circuit.

Part 1:

You have a 1Ω resistor, a DC voltage source set at 3V, a set of identical inductors and a voltmeter.
For inductors in series, the equivalent inductance is $L_1 + L_2 + \ \ldots\ L_n = L_{eq}$

Draw your circuit below and clearly indicate the different circuit elements, the location of the switch and the location of the voltmeter.

Setting up LoggerPro so you can see your data:

- Go to Experiment > Data Collection.
- Sampling Rate: Set to 100,000 samples/second.
- Duration: Set to 0.2 seconds.
- Triggering: To avoid capturing "empty" time, go to the Triggering tab.
- Check Enable Triggering.
- Set it to trigger when the Potential increases through 0.5 V.
- Refining the Signal: If your data shows a jagged start, this is Contact Bounce, the physical vibration of the switch. Ignore these first few points during analysis and keep them out of your graph.

Use the Analyze → Statistics option when you have your data to find the value for V_{max} so you can use it to create your linearized graph.

Write out the equation for your graph, including the slope.

_____

Estimate the value of your inductors, showing your work and giving an estimate of error.

Part 2:

You have the same inductors, acting in series as one inductor. Keep using the 1 Ω resistor and now add the capacitor. Create a circuit that will charge up the capacitor and then, using the switch (or not, whatever works for you) change the circuit so it no longer uses the direct current coming from the wall and instead is now an RLC circuit.

Before trying this, predict what your frequency will be, assuming it will act essentially like an imperfect LC circuit. Show your prediction and work below.

Draw your circuit, clearly labeling each component and showing where your voltmeter is located.

Set up LoggerPro similarly to how it was before:

- Sampling Rate: Set to 100,000 samples/second.
- Duration: Set to 0.05 seconds.
- Triggering: Set to "Decreasing through 2.5 V"
- Pre-trigger: Set to 10% to capture the flatline at 3V before the discharge begins.

1. Find the period of oscillation and state the frequency you found.

2. Describe the peaks over time.

3. Find the time it takes for the peak voltage to drop to half of its initial value, $t_{1/2}$. Find the total resistance, including the internal resistance of your inductors, using this relationship:

$$R_{total} = \frac{2L\,ln(2)}{t_{1/2}}$$