**PHYSICS 1E03 LAB 4 WRITE-UP**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**   **Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Partner:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Station Number:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**RESULTS**

**PART 1: Charging through an LR Circuit**

**Internal Resistance of the ammeter RA:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Internal Resistance of the Inductor RL:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Table 1: Time required for $I\left(t\right)$ to reach to $0.63I(t\rightarrow \infty )$

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| Resistance($Ω$) | Time $τ$ to reach $0.63I\left(t\rightarrow \infty \right)$ from $I\left(t\_{o}\right) ∀ τ$ ( ) |
| $$V\left(t\_{0}\right)=1V $$ | $$V\left(t\_{o}\right)=2V $$ | $$V\left(t\_{o}\right)=4V $$ |
| 10 |  |  |  |
| 33 |  |  |  |
| 50 |  |  |  |

Note: $t\_{o}$ is the time at which you close the circuit in Circuit\_1 and $I(t\rightarrow \infty )$ is the maximum value the current asymptotes to.

Table 2: Calculating inductance from average $τ$ values

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| Resistance($Ω)$ | Average $τ$ for each resistor ( ) | Standard deviation of $τ$ for each resistor ( ) | Calculated L with average $τ, L=τR\_{T}$ ( ) | Voltage across the resistor as $t\rightarrow \infty ,$when $V\left(t\_{o}\right)=4V $( ) |
| 10 |  |  |  |  |
| 33 |  |  |  |  |
| 50 |  |  |  |  |

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| Average L (calculated) = |

Place your graphs for Circuit\_1 from the procedure here. **Make sure your resistors value is clearly labelled within each graph.**

**RESULTS**

**PART 2: Discharging through an LR Circuit**

Place your graphs of voltage versus time and current versus time for Circuit\_2 from the procedure here.

$t\_{o}$**=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

$τ=$ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (this is the average value of tau for R=$10Ω$ from Part 1).

$$t\_{o}+2τ=\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$$

Place your graph for the line of best fit of the $ln⁡(I\left(t\right))$ versus $t$ graph here.

**DISCUSSION AND CONCLUSIONS**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Question*** 1. Do we need to consider the internal resistance of our voltmeter when we calculate inductance? Explain.

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***Question*** 2. In Lab 3, we used a similar method to calculate the time constant for a parallel RC circuit when the capacitor was discharging. Is this average value more accurate compared to the average value calculated in Lab 3? Explain why. Hint: will Capstone allow us to measure at a higher frequency?

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***Question*** 3. Is the behaviour of voltage versus time as time gets very large consistent with what the theory predicts? What about the moment the circuit is closed? Compare and contrast between the different resistor values.

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***Question*** 4. How do the voltage and current versus time plots behave in the $t\rightarrow t\_{o}$ and $t\rightarrow \infty $ limit? Compare this to the plots found in the previous part.

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***Question*** 5. Based on your plot of current versus time, how long does it take for the inductor to discharge to 36% of its original current? If we didn’t consider the internal resistance of our circuit elements, the time constant would be expressed as $τ=\frac{L}{R}$. How would our current and voltage versus time plots change if we didn’t consider these internal resistances?

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***Question*** 6. From the slope of your line of best fit, calculate the inductance and the time constant. How close are these values to the previous ones found in part 1 with $R=10Ω$? Justify why you think these values are more accurate compared to the previous ones.

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***Question*** 7. (Challenging) By the end of this lab, hopefully you have come to realize just how important internal resistance can be when analysing the results of any circuit. It often tends to compound itself, leading to unintuitive outcomes. What other sources of internal resistance could be affecting the outcome of our results, and how might we go about modelling its behaviour? Given the resistors we use are on the order of 10$Ω$s, would these extra internal resistance values ultimately change the outcome in a meaningful manner? Finally, why wasn’t internal resistance considered in the other labs in Physics 1E03 (should it have been)? Explain.

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