Damped and Forced Oscillators
(LCR)

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4/15/25

1 Abstract

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2 Introduction and Theory

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3 Experimental Procedure

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4 Results and Analysis

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5 Conclusion

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5.1 Acknowledgments

I would like to thank Pratham Bhashyakarla, CWRU Department of Physics, for his help in obtaining the experimental data, preparing the figures, and checking my calculations.

5.2 References

1. Driscoll, D., General Physics II: E&M Lab Manual, "Damped and Forced Oscillators," CWRU Bookstore, 2016.

A Appendix

A.1 Damped Oscillator

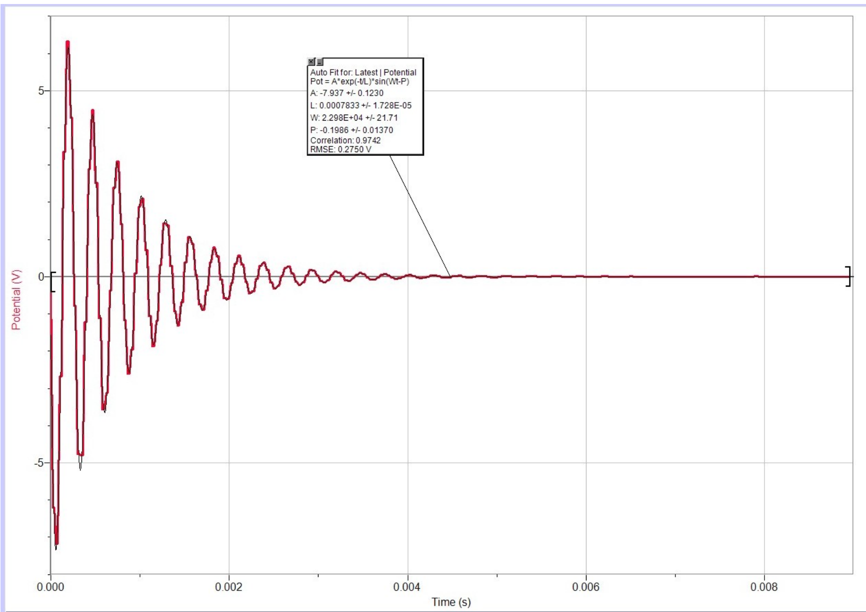

Figure 1: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.022 μ F capacitor and no resistor. The capacitor was measured to have a capacitance of $0.022 \pm 0.001\mu$ F. There is also an 86.6 ± 0.1mH inductor in the circuit.

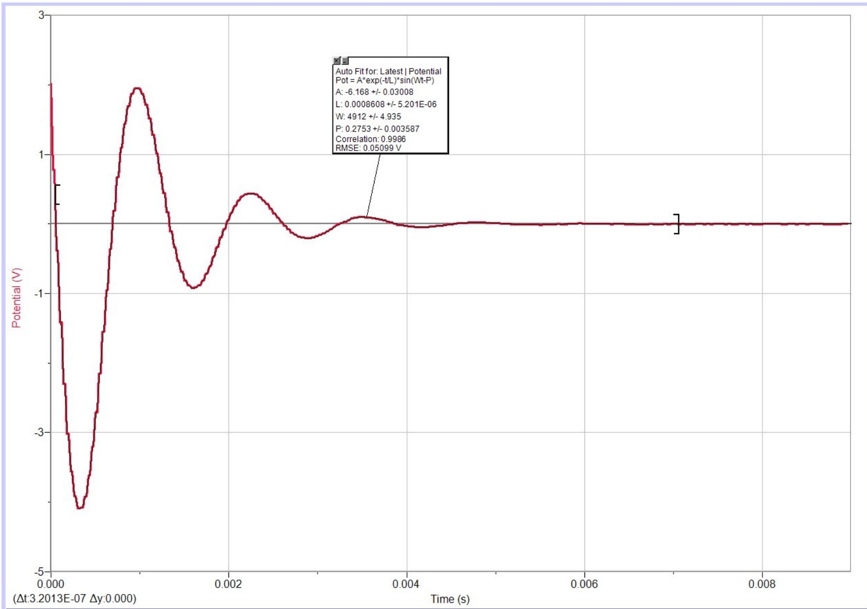

Figure 2: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.47 μ F capacitor and no resistor. The capacitor was measured to have a capacitance of $0.47 \pm 0.01\mu$ F. There is also an 86.6 ± 0.1mH inductor in the circuit.

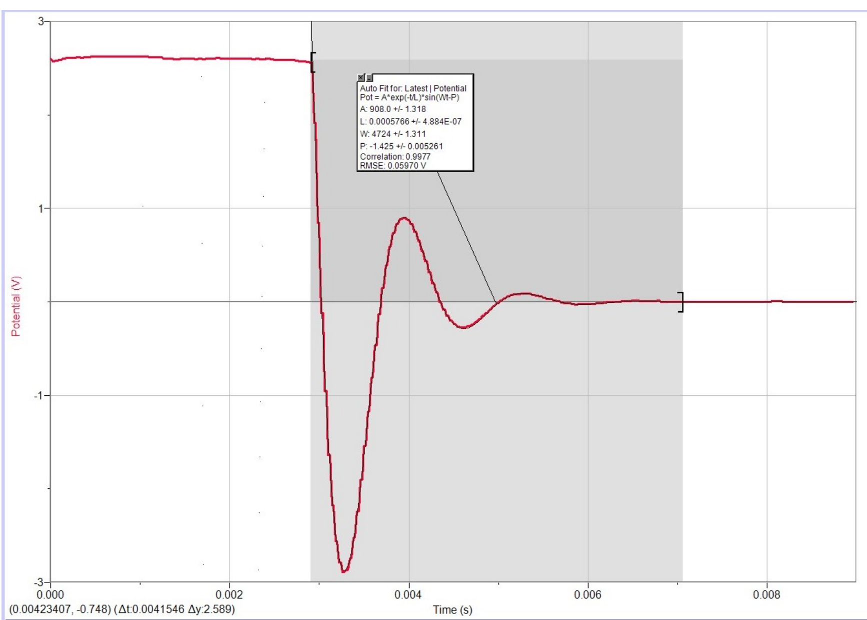

Figure 3: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.47 μ F capacitor and a 100Ω resistor. The capacitor was measured to have a capacitance of $0.47 \pm 0.01\mu$ F, and the resistor was measured to have a resistance of $99.1 \pm 0.1\Omega$. There is also an 86.6 ± 0.1mH inductor in the circuit.

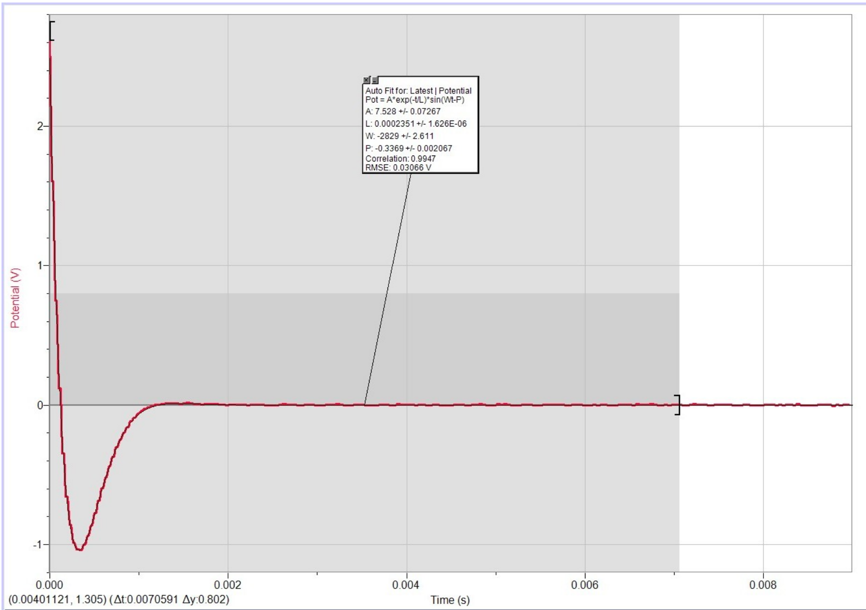

Figure 4: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.47 μ F capacitor and a 500Ω resistor. The capacitor was measured to have a capacitance of $0.47 \pm 0.01\mu$ F, and the resistor was measured to have a resistance of $492.5 \pm 0.1\Omega$. This resistor was created by combining two resistors in parallel, measuring 0.99 ± 0.01kΩ and 0.98 ± 0.01kΩ, respectively. There is also an 86.6 ± 0.1mH inductor in the circuit.

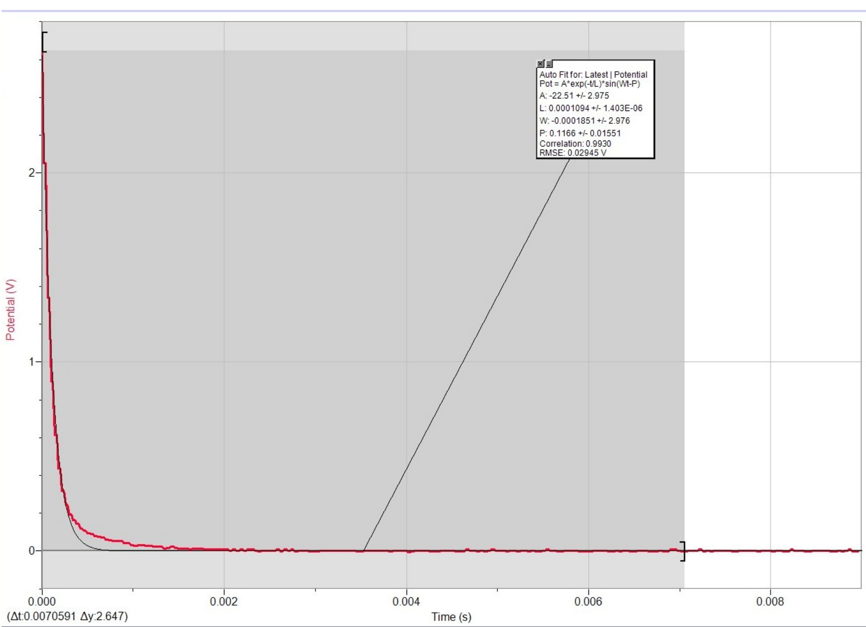

Figure 5: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.47 μ F capacitor and a 1 kΩ resistor. The capacitor was measured to have a capacitance of $0.47 \pm 0.01\mu$ F, and the resistor was measured to have a resistance of 0.99 ± 0.01kΩ. There is also an 86.6 ± 0.1mH inductor in the circuit.

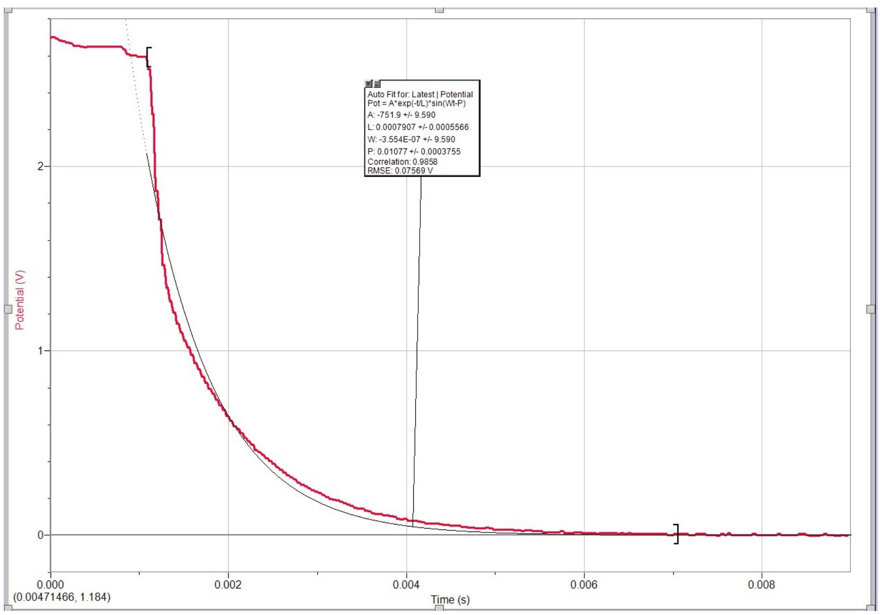

Figure 6: Damped Oscillator plot using Logger Pro of the charge stored in a capacitor inside a circuit with a 0.47 μ F capacitor and a 1 kΩ resistor. The capacitor was measured to have a capacitance of $0.47 \pm 0.01\mu$ F, and the resistor was measured to have a resistance of 1.97 ± 0.02kΩ. This resistor was created by combining two resistors in series, measuring 0.99 ± 0.01kΩ and 0.98 ± 0.01kΩ, respectively. There is also an 86.6 ± 0.1mH inductor in the circuit.

A.2 Resonant Circuit

Frequency (Hz)	Vpp (V)	Gain
2.25 ± 0.01	1.14 ± 0.02	0.07125 ± 0.00125
3.55 ± 0.01	2.02 ± 0.02	0.12625 ± 0.00125
4.85 ± 0.01	3.34 ± 0.02	0.20875 ± 0.00125
6.15 ± 0.01	5.10 ± 0.02	0.31875 ± 0.00125
7.45 ± 0.01	10.40 ± 0.02	0.65000 ± 0.00125
8.00 ± 0.01	10.96 ± 0.02	0.68500 ± 0.00125
8.75 ± 0.01	9.92 ± 0.02	0.62000 ± 0.00125
10.05 ± 0.01	6.88 ± 0.02	0.43000 ± 0.00125
11.35 ± 0.01	4.96 ± 0.02	0.31000 ± 0.00125
12.65 ± 0.01	3.92 ± 0.02	0.24500 ± 0.00125
13.95 ± 0.01	3.20 ± 0.02	0.20000 ± 0.00125
15.25 ± 0.01	2.72 ± 0.02	0.17000 ± 0.00125
16.55 ± 0.01	2.40 ± 0.02	0.15000 ± 0.00125
17.85 ± 0.01	2.16 ± 0.02	0.13500 ± 0.00125
19.15 ± 0.01	1.92 ± 0.02	0.12000 ± 0.00125
20.45 ± 0.01	1.76 ± 0.02	0.11000 ± 0.00125
21.75 ± 0.01	1.68 ± 0.02	0.10500 ± 0.00125
23.05 ± 0.01	1.52 ± 0.02	0.09500 ± 0.00125
24.35 ± 0.01	1.39 ± 0.02	0.08688 ± 0.00125
25.65 ± 0.01	1.31 ± 0.02	0.08188 ± 0.00125
26.95 ± 0.01	1.23 ± 0.02	0.07688 ± 0.00125
28.25 ± 0.01	1.18 ± 0.02	0.07375 ± 0.00125
29.00 ± 0.01	1.12 ± 0.02	0.07000 ± 0.00125

Table 1: Frequency vs. Vpp and Gain with uncertainties. Gain and its uncertainty is calculated by dividing the corresponding Vpp values by 16, the input voltage from the function generator.

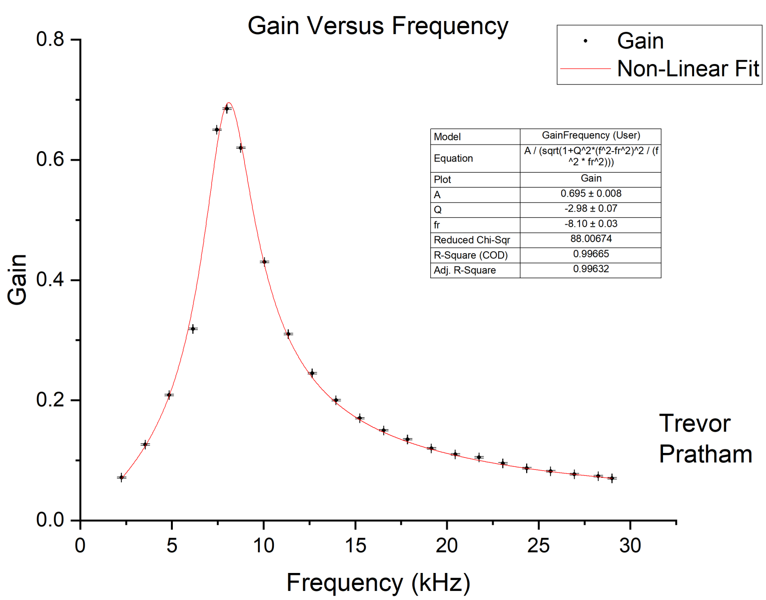

Figure 7: Plot of Gain vs. Frequency from the above table (Table 1). Non-linear fit was made using Origin, and the fitting equation along with its parameters are explained in the Theory section of this paper.

B Other Calculations

B.1 Damped Oscillator

B.2 Resonant Circuit