P1310L, Harmonic Oscillators
Lab 13, Work Sheet

Submitted by: _____ Experiment's date: _____

Team members:

1.- _____ 2.- _____

3.- _____ 4.- _____

Introduction

Write a short paragraph about the purpose of this lab.

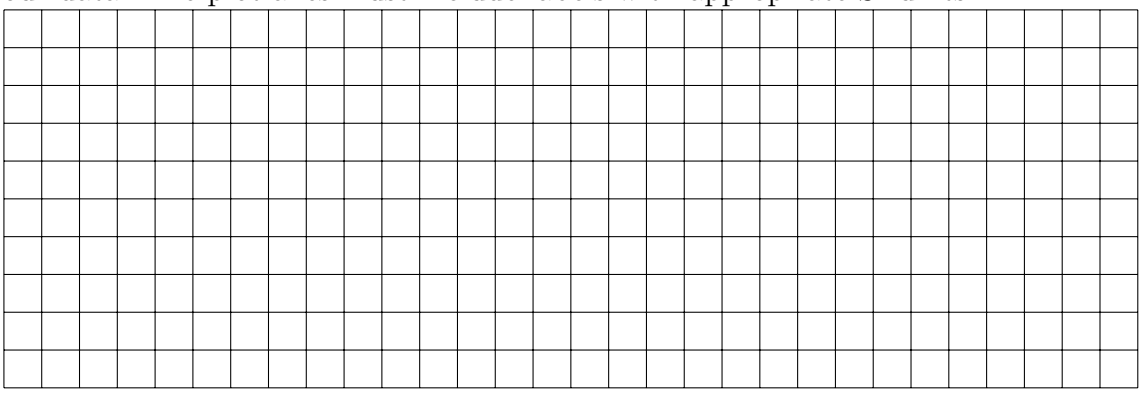
Analysis

Mass-Spring Oscillator:

1. Show that $x = x_0 cos(\omega t)$ is a solution of equation (13.5). Do this by substituting equation (13.6) into both sides of equation (13.5) and solving the necessary derivatives. Then solve for ω and see if your answer matches equation (13.7).

2. Calculate the natural frequency f, in Hz, from the average period of the system.

3. In the grid below, make a scatter plot of force vs. length. Draw the best-fit line for your data. The plot axes must include labels with appropriate SI units.



4. Find the slope of the best-fit line.

5. Calculate the spring constant k in base SI units.

6. Calculate the theoretical frequency using equations (13.3) and (13.7).

7. Calculate the relative percentage error of the frequency and discuss any differences.

Resonance:

8. Compare (by relative percentage error) the measured *natural* frequency f from the previous section to your measured *resonant* frequency f_r.

The Pendulum:

9. From equations (13.10) and (13.3), calculate the theoretical value of the period T.

10. Compare this theoretical T to your measured periods using percent error.

11. The slight change of the period with amplitude is caused by the restoring force becoming non-linear due to the $sin(\theta)$ term in equation (13.8). Is this apparent in your data? Explain.

12. Calculate the percent error in the period of the pendulum for your largest amplitude swing versus your smallest amplitude swing. Use the small amplitude period as the theoretical value.

Conical Pendulum:

13. Determine the angle θ of your pendulum. Hint: Figure (13.1) in the lab manual may be helpful. You will need to use trig. Make a sketch to show the angle you are trying to determine.

14. Calculate the theoretical value of the period T, using equation (13.11).

15. Using percent error, compare your measured period to the theoretical value and explain any differences.

Conclusion

Summarize your results and write a brief reflection on the experiment; in particular, comment on whether the theory makes reasonable predictions despite the observed variability.