PS 12a Names:

Lab 6: Oscillations

In this lab you will analyze the behavior of a mass on a spring oscillating system.

Part I: Measuring the period (T)

Q1: Use the stopwatch to measure 10 periods of the mass on a spring. What is the period?

Period= _____ sec Frequency = _____ Hz

Part II: Analyze the Mass on a Spring Oscillator

Use Logger Pro to take 60 seconds of data
Export the data from Logger Pro and import it into MATLAB.
Save the workspace
Start a new script with different code sections and comments

- Plot the position data with proper title and labels, including units.
- Using the model discussed in the book, including the damping, overlay a plot of the fit function to the data.
- Create a second figure of the residuals between the data and your plot
- Calculate the SSE (Sum of Squared Errors).
- Manually adjust your parameters until you minimize the SSE.

What are your best-fit values?

A =_____m ω =_____ rads/sec φ_0 =_____ rads τ = _____ sec

Find the Spring Constant and the damping constant

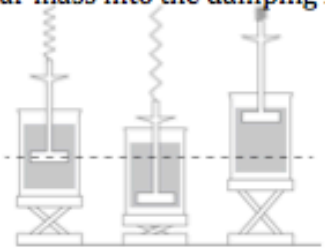
k = _____N/m b= _____ kg/s

- On a new figure, overlay plots of kinetic, potential and mechanical energies.

Part III: The Very Damped Oscillator

Repeat the experiment above, but this time place your mass into the damping fluid provided.

The finite size of the beaker introduces edge effects, especially in the damping mixtures with a lot of corn syrup. Take data where you release the mass close to the top of the beaker and one where you release the mass close to the bottom of the beaker.



What are your best-fit values?

A =_____m ω =_____ rads/sec φ_0 =_____ rads τ = _____ sec

Find the Spring Constant and the damping constant

k = _____N/m b= _____ kg/s

Part IV: Driven Oscillators and Resonance

A.) Grab a sophisticated mass-and-elastic band system and manually drive the system:

1. At a very low frequency below resonance

2. At a very high frequency above resonance

3. At resonance

Q2: How does the motion of your arm compare to the motion of the mass in these three cases? Express this as a phase difference between the arm and mass.

B.) Use information from part II and drive the spring mass system at its natural frequency.

Drive the system for these conditions and attach small graph snapshot for each case. Describe qualitatively what is happening in each case.

Well below resonance:

Slightly below resonance:

At resonance:

Slightly above resonance:

Well Above resonance: