PS 12a Names:

Lab 8: Driven Oscillators and Resonance

In this lab you will analyze the behavior of driven oscillators and plot a resonance curve.

Warm Up

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.

How does the motion of your arm compare to the motion of the mass in these three cases?

Part I: System Properties

The lab setup consists of a motor connected to a mass-spring system damped magnetically. Remember that the equation of motion for a linearly damped harmonic oscillator is:

$$x(t) = A\exp(-\beta t)\sin(\omega t + \delta) + C$$

Q1: Use the logger pro curve fitting utility to determine β and ω for the spring system (remember to include units).

β = _____ ω = _____

Q2: What frequency ω_R should you drive this system at to get the maximum amplitude response (resonance)? Show your work!

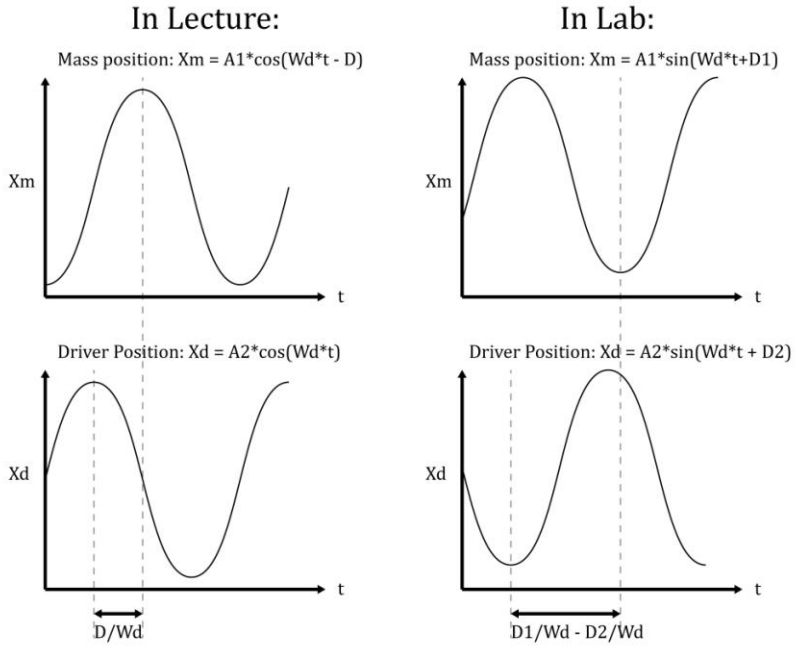
ω_R = _____

Q3: What's the theoretical Q value for this system? Show work, include units.

Q = _____

Part II: The Driven Oscillator

Select different driving frequencies and measure the amplitude response and phase difference by fitting the data to sinusoidal functions. You should measure the driving frequency and other parameters using the Logger Pro fit tool. Determining the phase difference can be a bit tricky; see the diagram to the left for an illustration of how to measure the phase.



Q4: Fill in the following table:

Driving ω_D (s^{-1})	Measured A (cm)	Measured δ	Calculated A * (cm)	Calculated δ *
ω_R = _____				
$\omega_R + \beta$ = _____				
$\omega_R - \beta$ = _____				

*Optional columns

Q5: Take enough additional data to fill out an **A vs. ω_D** plot and a **δ vs. ω_D** plot (with ω_D on the x-axis). Use subplot to put the two plots on the same figure. Optional: use your measured β and ω from Part I to overlay the theoretical models for $A(\omega_D)$ and $\delta(\omega_D)$ on your plots.
Print your figure and attach separately or submit it to the lab 8 dropbox. Additionally, upload a workspace that contains just your A, ω_D, and δ arrays.

Q6: What's the width at $\max(A)/\sqrt{2}$ of the A vs. ω_D plot?

Q7: Is your δ vs. ω_D consistent with what you found in the Warm Up?