

Expt. 3 Rubric

Note: Always credit the work of others (i.e. write your lab partner's name at the top of your report)

Note: If you used Excel to do any of your calculations, print out the spreadsheet and neatly cut and paste it into your report. All data and calculations must have labels.

Introduction: Statement of the problem (What is the goal of this experiment? What are we ultimately trying to measure, calculate, and describe? Why is this worth doing? Write a brief summary of procedure. Include all major equations used in your calculations.
(Minus 1 point for not doing this part)

Measurements and *associated uncertainties or standard deviations* for:

- T: Period of mass-spring system
- m: Mass of weight used
- Δx : Thickness of the mass (in the vertical direction)
- t_h : All time data taken at different heights for 4 and 5 holes open. Here you should have many time measurements for each drop height.
- t_{vt} : Time data when mass moves at terminal velocity for 3,2,1,0 holes open
- Δt^* : Time for mass to fall through the photogate after the tube has been "critically" damped by eye.

Graphs/Calculations

Graphs of Velocity vs. Drop Height for 4 and 5 holes open:

(Graphs of course need descriptive titles; axis labels with units; a legend or labeling for multiple data series or fitting lines.)

The two graphs. You may either make two separate graphs or plot both sets of data on the same graph. Be sure to distinguish the two plots with appropriate labels.

Discuss any trends in your graphs and what they mean. If your plots show any odd or unexpected trends, discuss sources of error that may have caused these trends. Use your plots to answer the following questions: Will the mass reach v_t for 6 and 7 holes open? Do you need to check if v_t will be reached with 0,1,2,3 holes open?

Graph of b vs. # holes open:

Calculate k_{spring} (spring constant) and its uncertainty and calculate b_{crit} .

The graph of b vs. # holes open with a smooth line drawn through your points and plot b_{crit} as a horizontal line across your graph. Also, answer: What is a rough estimate for how many holes need to be open to achieve "critical" damping in the tube?

More Calculations and Observations:

An observation of the motion of the mass in the spring-mass-tube configuration after the tube has been "critically" damped according to b_{crit} (i.e. when the predicted number of holes is open). For this observation, sketch the motion you saw in a graph of y (vertical displacement) vs. t (time).

Calculate $k_{\text{by-eye}}$ and its associated uncertainty

Conclusion/Error Analysis: Comparison of k_{spring} and $k_{\text{by-eye}}$; Calculate the discrepancy and its uncertainty, then use t -score to determine the level (a probability) at which these two values are discrepant. What does the value of this probability say about the acceptability/significance of the discrepancy between k_{spring} and $k_{\text{by-eye}}$? What do you conclude about the model used in this experiment? Discuss sources of error (systematic and random). For your discussion of random error, only mention the major sources of random error.

NOTE: "Human error" conveys no useful information.

NOTE: A very large fraction of this rubric is written analysis, both at the end and accompanying the graphs. **Neatness** and **clarity** will be important if you want the TAs to find your thinking and give credit.