

## Wave Mechanics Labs - Scoring Rubric

Your notebook will be collected at the end of class on \_\_\_\_\_, \_\_\_\_\_ \_\_\_\_\_. The following items should be in your notebook. They should be clearly organized and easy to find. *Auxilliary items* should be taped, glued or stapled into the notebook in the appropriate location; they should not be *hanging loose*. Use an organizational system and label all work. Each lab will be graded separately.

Name: \_\_\_\_\_

Block: \_\_\_\_\_

Item	Score
<p><b>WM2. Vibrating Mass</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes three graphs - one for each mass; mass values are clearly indicted on the graph. Graphs are taped in or adhered. Time values for various peaks are indicated; values are used to determine period; work is clearly shown. Values of height for several points are indicated for one of the graphs and used in the Conclusion/Discussion.</p> <p>___ Conclusion/Discussion includes four claims that represent complete answers to all four questions; answers are accurate. Evidence supporting each of the four claims is described; references to the data section are specific. Reasoning is provided that identifies the connection between the evidence and the claim.</p>	<p>_____/6 (Lab score)</p>
<p><b>WM3. Speed of a Wave</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes the provided data table; it is taped in or somehow attached. Organized and accurate calculations are clearly shown for the first two rows. Standing wave patterns are clearly drawn. Calculations are accurate and complete.</p> <p>___ Conclusion includes a claim that accurately states the variables which do and do not affect the wave speed.</p> <p>___ Discussion of Results provides the logical support for the conclusion. References specific results to show how there is a non-effect or an effect of a changing variable upon the wave speed. Specific trials are explicitly referred to. Uses good logic and good writing.</p>	<p>_____/4 (Lab score)</p>
<p><b>WM4. Vibrating Spring</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes nodal spacing distance and frequency data for the spring, organized in a table with column headings and units indicated. An analysis of the data is clearly evident; this analysis may be in the form of a graph (with power regression or linear regression statistics clearly reported), a trial-and-error number-crunching routine (multiplying, dividing, raising to a power, etc.)</p> <p>___ Conclusion makes a claim that answers the <i>question</i> posed in the Purpose. The mathematical equation determined by the analysis is reported; symbols in the equation are defined. The relationship between the two variables is described in words - e.g., direct, inverse, linear, power, etc.</p>	<p>_____/8 (Lab score)</p>

<p>___ Discussion of Results explains the meaning of the equation; the equation is related to the wave equation; the distance between adjacent nodes is related to the wavelength; the meaning of any constant numerical values within the equation are discussed. The discussion is complete, thorough, and reveals both effort and understanding.</p>	
<p><b>WM5. Guitar Strings</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes provided table; table is complete. Work for calculations are clearly shown and labeled. Data is reasonably accurate.</p> <p>___ Conclusion clearly and thoroughly describes the effect (or non-effect) that doubling, tripling and quadrupling the string length has upon the frequency and the speed. Writing is organized, clear and responds to <i>the question</i>. The conclusions are accurate and consistent with the data.</p> <p>___ Discussion of Results provides the logical support for the Conclusion; specific trials of data are cited as evidence in support of each statement made in the Conclusion section.</p>	<p>___/5 (Lab score)</p>
<p><b>WM6. Closed-End Air Column</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes a diagram with organized and labeled data; units are shown. Work for speed calculation is shown and labeled; adjustments for end effect is shown and labeled. Class data is organized in a table. Individual results are reasonably accurate (after correcting for end effect).</p> <p>___ Conclusion states the experimentally-determined speed of sound in air.</p> <p>___ Discussion of Results includes a well-written error analysis; experimental value for sound speed is compared to the theoretical value. A percent error calculation is performed; work is clearly shown and labeled.</p>	<p>___/4 (Lab score)</p>
<p><b>WM7. Open-End Air Column</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes a diagram with organized and labeled data; units are shown. Work for speed calculation is shown and labeled; adjustments for end effects (both ends) is shown and labeled. Class data is organized in a table. Individual results are reasonably accurate (after correcting for end effects).</p> <p>___ Conclusion states the experimentally-determined speed of sound in air.</p> <p>___ Discussion of Results includes a well-written error analysis; experimental value for sound speed is compared to the theoretical value. A percent error calculation is performed; work is clearly shown and labeled.</p>	<p>___/4 (Lab score)</p>
<p><b>WM9. Timbre</b></p> <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes the provided table; table is complete for the string instrument and two air columns. The instrument name is indicated. Values for the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, etc. harmonics are accurate and consistent with <math>f_n = n \cdot f_1</math>. The closed-end air column instrument is truly closed.</p> <p>___ Conclusion/Discussion explains how the spectra are different for the two types of air column instruments. References are made to the data section to</p>	<p>___/5</p>

<p>illustrate the difference. A connection is made between the specific harmonic frequencies included in the data table and the physics of open-end and close-end standing wave patterns. Discussion reveals an understanding of the spectrum analysis and of air column physics.</p>	
<p><b>WM10. Musical Synthesizer</b></p> <ul style="list-style-type: none"> <li>___ Included, labeled and organized all parts of the lab report.</li> <li>___ Data section includes the instrument name or description, a print out of the waveform and the frequency spectrum from Logger Pro, a table of frequency and relative amplitudes based on measurements from the Logger Pro spectrum, a printout of the Desmos graph, and a complex wave equation used to create the Desmos graph (alternative to equation would be a list of the various frequency and amplitude values used in each sine wave that the equation is composed of). All parts are present, organized, and taped in. Labels, units, etc. are effectively displayed. Desmos graph closely resembles the waveform shown in Logger Pro.</li> <li>___ Conclusion/Discussion reports the complex wave equation and provides an informed and intelligent discussion of the connection between the wave equation and the frequency and relative amplitude values found on the Logger Pro frequency spectrum.</li> </ul>	<p>___/6 (Lab score)</p>