

Each week, you will have to write a conclusion a section from the previous week's lab assigned by your TA. In your conclusion, you should summarize the physics concepts you studied in that section, describe your results, and do some error analysis. Your conclusion does not need to be long (one to two paragraphs is usually enough), but length alone will not guarantee full credit. Conclusions should not exceed one page.

Physics Concepts

Each lab will explore one or more physics concepts. During lab, you will test whether the world works the way your professor said it does in lecture. This often takes the form of an assumption and an equation based on this assumption. In this section, you should demonstrate that you understand what equation you are testing and where that equation came from. Do not include a repetition of the lab procedures since your TA already knows the procedure.

Results

In this section, you will describe whether the equation you tested is consistent with your measurements. You will do this by comparing your predictions with your actual measurements. If you have numerical results, be sure to show your TA what your results were by including both the predicted and measured numbers. Do not merely say that your measurements did or did not agree with your predictions without supporting your statements. You only need to include your results, not your raw data. Do not hand in your in-lab notes. Always include the correct units.

Error Analysis

In order compare your results with your predictions, you need to know how much error is in your numbers. For example, if you predicted 52 but you measured 50, your prediction and measurement differ by 4%. Your prediction would be consistent if you had measured everything to the nearest 10% but it would not be consistent if you measured everything to the nearest 1%.

In this section, you should describe the biggest sources of error for your measurements and give an estimate of how large it is.

If your measurements and predictions are close to each other, do not say that there was no error. All data has error. Do not mention mistakes you made or that you could have made. Do not mention rounding or calculation error since you do the calculation again more carefully if this is causing problems.

Example Procedure

This is included only to give context to the example conclusion. Your conclusion should not include the procedure.

In a lab studying centripetal forces, students moved a tennis ball on a string in a horizontal circle. In the section of interest, they wanted to study the relationship between the angle of the string from vertical and the frequency of the ball's motion.

They measured a length of string so that it was 0.25 m from the center of the ball to their fingers. They then used trigonometry to determine the radius of the circle that would cause the string to be at 30°, 45°, and 60° (0.125 m, .177 m, and 0.217 m). They placed a ruler under the center of the circle so that they could see what the radius of the

Example Conclusion

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circle was and know when they were moving the ball at the right frequency. They measured the time it took the ball to complete ten rotations using a stopwatch. Their data appears in the following table.

| | Measured Radius (m) | Actual | $g \tan(\theta)$ (m/s/s) | 10 T (s) | f (Hz) | Acceleration (m/s/s) |
|-----|---------------------|--------|--------------------------|----------|--------|----------------------|
| 30° | 0.13 | 31° | 6.0 | 9.1 | 1.10 | 6.2 |
| 45° | 0.18 | 46° | 10.2 | 8.5 | 1.18 | 9.8 |
| 60° | 0.22 | 62° | 18.2 | 6.8 | 1.47 | 18.8 |

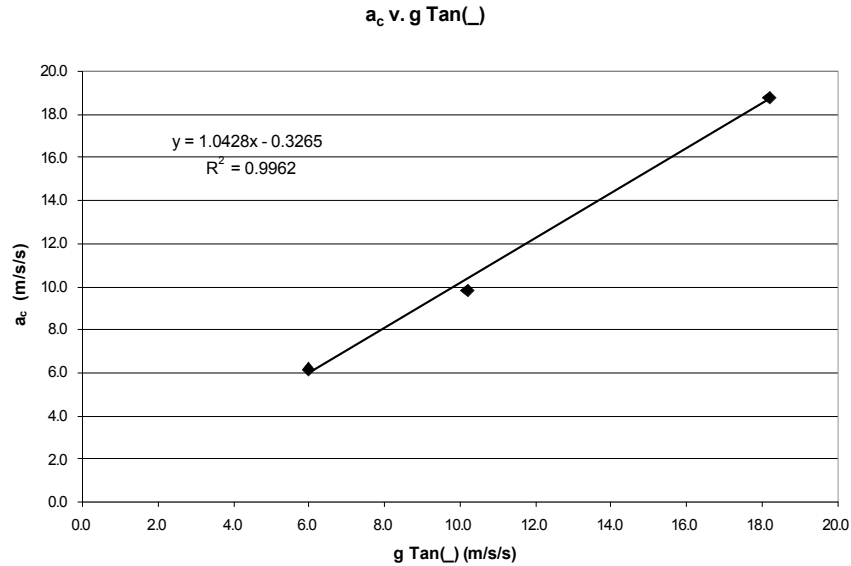
Example Conclusion

Concepts: In this lab, we studied the motion of a tennis ball on a string moving in horizontal circles. Because the ball is not accelerating vertically, the vertical component of the tension cancels the weight ($T \cos(\theta) = mg$). Because the ball is moving in a horizontal circle, the horizontal component of the tension is a centripetal force ($T \sin(\theta) = m (2\pi f)^2 R$). Combining these two equations gives us $g \tan(\theta) = (2\pi f)^2 R = a_c$. In this section, we studied whether this equation held as the angle changed.

Results: We took measurements of radius and frequency at three different angles, and we were able to calculate a_c and $g \tan(\theta)$. We used Excel to plot a_c v. $g \tan(\theta)$ and plotted a line of best fit through the points. Since a_c and $g \tan(\theta)$ should be the same, we expected the slope to be 1.00. The slope of our line was 1.04. Our plot is at the end of this conclusion. As expected, the centripetal acceleration increased as the angle increased, going from 6.2 m/s^2 at 30° to 18.8 m/s^2 at 60° .

Error Analysis: Errors in this lab came from our measurement of the radius and the period. The radius shifted by about 1 cm because the person moving the ball could not maintain a constant motion. This caused an error of about 5-10%. Error in our measurement of the period came from the limit of our reaction time. This caused an error of about 0.3 s, which is about 3-5%.

Because the difference between our measurements and predictions was smaller than our error, our experiment confirms our predictions the angular dependence of circular motion.



Notes

- Whenever you have two variables that you expect to be related with a constant, the slope of your best fit line should be equal to that constant. When calculating the slope, you can use Excel, use a graphing calculator's linear regression function, or manually draw a line of best fit and measure the slope. Do not calculate the slope by calculating the rise over the run between two points. This method does not include all of the measurements you have made.
- The questions in the lab can help you get an idea of what concepts and results are important in a particular section.
- Your conclusion can be either handwritten or typed.
- As with the rest of the homework, you can discuss your conclusion with your classmates, but what you hand in must be your own work.
- If you received permission to attend another section the previous week, note this at the top of your conclusion. Different sections will receive different sections of the lab about which to write.
- This quarter, real life examples should not be included.