The Simple Pendulum

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Abstract

The acceleration g due to gravity was measured by timing the period for a simple pendulum of length 0.92 m with a photogate. Multiple periods were used to reduce the uncertainty. The acceleration was found to be $(9.79 \pm 0.04)\,\mathrm{m/s^2}$, in agreement with the expected value of $9.81\,\mathrm{m/s^2}$.

1 Introduction

LaTeX is a system for typesetting documents, particularly those containing mathemtics. You specify the logical structure and content of your article (such as paragraphs, sections, equations, figures) and LaTeX handles the formatting. The "documentclass" you select determines the overall style. LaTeX also includes facilities to automatically number and refer to equations, figures, and references. Documents are stored in a non-proprietary plain text format that you can edit and use on nearly any computer system.

Words are separated by one or more spaces. Paragraphs are separated by one or more blank lines. The output is not affected by adding extra spaces or extra blank lines to the input file.

Commands for LaTeX begin with a backslash (\). Comments start with a percent sign (%); Everything from the percent sign up to the end of the line is ignored.

Emphasized text is typed like this: *this is emphasized*. Bold text is typed like this: **this is bold**.

There are 10 special characters for LaTeX. Most can be printed by putting a backslash in front of them: \$ & # % _ { and }. A backslash is rendered by \ and a caret is given by ^. The tilde is complicated, but for simple cases, the math symbol $\sim$ often works.

Various example files (from Overleaf, the Tex Users Group, or from a Journal site) give many more detailed examples, but this file may be sufficient to get you started.

Entering numbers with units is made easier by the SI package. You can either abbreviate units, e.g. $L = 0.929\,\mathrm{m}$, or you can spell the unit out: $L = 0.929\,\mathrm{m}$. (Look at the .tex source file to see the different commands.) This also works for more complicated combinations of units: $g = 9.8\,\mathrm{m/s^2}$, or, spelling the units out $g = 9.8\,\mathrm{m\,s^{-2}}$.

See below for more examples, including uncertainties.

2 Theory

The period for a simple pendulum of length L is given by

$$T = 2\pi\sqrt{\frac{L}{g}} \tag{1}$$

which can be re-arranged to solve for g:

$$g = 4\pi^2\left(\frac{L}{T^2}\right) \tag{2}$$

Add any more details here that are relevant.

3 Experiment

Describe what you did here. For these informal reports, keep it very brief, but give essential detail.

The simple pendulum was made with an aluminum plum bob attached to a thin string. The top of the string passed over the edge of a razor blade, providing a clean sharp pivot point. The period was timed with a photogate attached to a computer running LoggerPro.

Add any other details you think relevant.

4 Data and Results

4.1 Initial Data Acquisition

This example will use the results from the example in section 3.9 (pg. 68) in Taylor's text. The length was measured to be $L = (0.9295 \pm 0.0010)\,\mathrm{m}$. Give more details on how you determined that length.

The period was measured for 20 trials. The resulting periods are shown in Fig. 1. Note that LaTeX automatically numbers figures. You label the figure with the `\label{figurename}` command, and refer to it with the `\ref{figurename}` command. (The same pair of commands work for labeling equations as well.) A common convention is to preface figure names with "fig:" so that it's easy to remember whether a particular tag refers to a figure or equation.

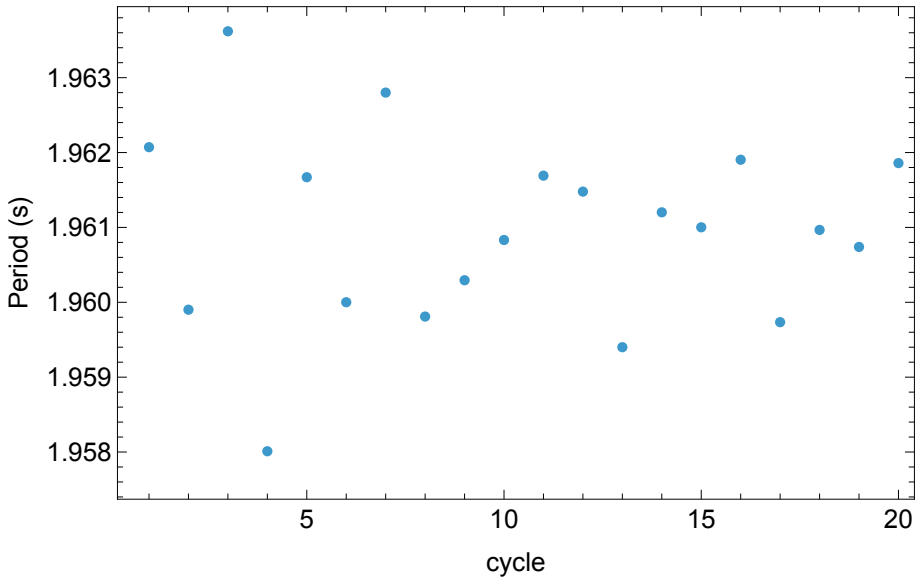

Figure 1: All figures should have a caption that describes the figure.

The average period and its uncertainty were determined from a statistical analysis of the period measurements to be

$$T \pm \delta T = (1.936 \pm 0.004)\,\mathrm{s} \tag{3}$$

Include any other observations and findings for the initial data set.

4.2 Extensive Data Acquisition

The average period and its uncertainty were determined from a statistical analysis of the (how many?) measurements to be

$$T \pm \delta T = (1.936 \pm 0.004)\,\mathrm{s} \tag{4}$$

Include the second graph as well.

The acceleration due to gravity was then computed using Eq. 2 to be

$$g \pm \delta g = (9.790 \pm 0.004)\,\mathrm{m/s^2} \tag{5}$$

where the uncertainty was estimated including both the uncertainties due to L and T by

$$\delta g = \sqrt{\left(\frac{\delta L}{L}\right)^2 + \left(2\frac{\delta T}{T}\right)^2} \tag{6}$$

5 Conclusion

State here whether the results agree or disagree. Identify the main sources of uncertainty and any other significant observations.