Calculus Based Physics

Title

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Abstract

TODO

1 Introduction

(Sample only, note the functions in bold-facing, italics, etc.)
In 1820, **Biot and Savart** conducted an experiment in ... [1].

The *Biot-Savart Law* is useful in ... [2].

A Helmholtz coil is a device for ... and was named after ... These coils were widely used in ... to produce uniform magnetic fields ...

The objective in this present lab is to ...

2 Theory

State, derive, and describe the important equations that you will need to use to compare theory and experiment. Include diagrams as necessary to help with visualizing variables. Leave mathematical d etails of your derivations on the Appendix section. Below is an example to insert a numbered equation 1 below

$$V = \frac{8\phi\Delta\pi a^{-5}}{\sqrt{3}\lambda\alpha \cdot \delta X \cdot \Sigma} + \nabla\vec{B} + \frac{\vec{E}}{\vec{v}} + \int \psi dL \tag{1}$$

where ψ is the distance to the Sun in units of km, λ is something ... Always explain each variable once introduced. Do not introduce again at a later paragraph.

Example on how to insert an equation on a separate line, unnumbered:

$$s_f = s_0 + v_0 t + \frac{1}{2}at^2$$

or you can state equations or variables within the paragraph like this $v_f^2 = v_i^2 + 2a\Delta s$ or variable ξ.

3 Methods

First, we set up the system. We cut a string of length [INSERT LENGTH] and tied it to both our cart (m_1) and a spring. This spring was then attached to a 100 g mass (m_2). After assembling the system, we set up the ramp. We propped one end of the ramp atop of two textbooks, creating an inclined plane, and tuned the heights of the track's legs to adjust the angle (Θ) of the incline so the cart would remain stationary when placed on it, achieving equilibrium. To finish setting up, we placed two motion sensors to record the movements of the cart and the mass on DataStudio, leaving us with a set-up resembling Fig. 1:

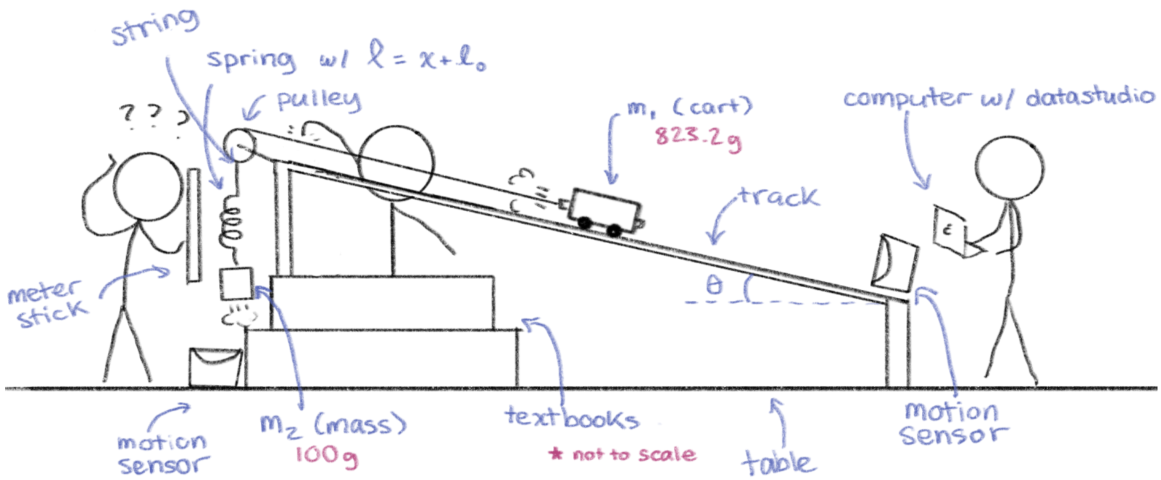

Figure 1: The complete set-up of the system and inclined ramp, artistic liberties taken

Once everything was set up, we began our lab by monitoring the motion of the system. We set the cart into motion with a push and recorded roughly five seconds worth of data. Once we got a good graph of the motion on DataStudio, we chose eight moments to analyze: t1 = 0 s, t2 = 0.24 s, t3 = 0.31 s, t4 = 0.45 s, t5 = 0.57 s, t6 = 0.95 s, t7 = 1.68 s, and t8 = 2.6 s. Using the information from these eight times, [and other stuff used in calculations], we were able to determine quantities like x, y1, y2, Us, Total Ug, Total T, and Total E. To determine the value of x, or the length of the spring, we used the below equation:

$$110.7 - (m_1 + m_2) \tag{2}$$

where $m - 1$ and m_2 are the length the cart has traveled and the length the mass has travelled respectively.

To determine the value of y1 and y2, or [what are they lol] we used the below equation:

$$x = y^2 \tag{3}$$

To determine the value of Us, or spring potential energy, we used the below equation:

$$x = y^2 \tag{4}$$

To determine the total value of Ug, or total gravitational potential energy, we used the below equation:

$$x = y^2 \tag{5}$$

To determine the total value of T, or total kinetic energy, we used the below equation:

$$x = y^2 \tag{6}$$

To determine the total value of E, or total energy, we used the below equation:

$$x = y^2 \tag{7}$$

The value of Total E in particular is instrumental to our lab, as we are assessing the system's conservation of energy or lack thereof. After calculating the total at each of the eight moments, we then compared the values and determined if they were sufficiently similar enough to conclude that the energy of the system was conserved.

4 Results and Analysis

Describe all your results after presenting them. Include tabulated data set, larger tables can also be presented on the Appendix. Here's an example to insert a table - Table 1 is below:

Table 1: Every table needs a caption. Note that the table caption is on top of the table! Note the consistency of precision of table values; do not forget the errors, labels, variables, and units.

Distance, d (km)	Voltage, V (± 0.05 V)	Current, I (mA $\pm 5\%$)
1.2 ± 0.2	0.30	20
1.6 ± 0.4	0.21	30
2.5 ± 0.1	0.18	40
5.9 ± 0.2	0.13	50

Use a full page to present important plotted findings, don't be shy!(See Appendix for e.g.). Your plots should have axes labels with units, error bars, legend, captions, etc.

You can also discuss the sources of errors in this section; include ways on how you may want to improve the experimental methods performed.

5 Conclusion

This section should be brief, concise, but complete. Directly answer your objectives, state your findings with errors, and conclude whether or not you were successful. Briefly explain if not successful.

References

Author, A.N and Another, A. N., 2010, MNRAS, 431, 28.

Appendix: Velocity measurements

Below is an example large table; include mathematical derivations here as well.

Table 2: Every table needs a caption.

distance (m)	V (km s^-1)
0.0044151	0.0030871
0.0021633	0.0021343
0.0003600	0.0018642
0.0023831	0.0013287
0.0044151	0.0030871
0.0021633	0.0021343
0.0003600	0.0018642
0.0023831	0.0013287
0.0044151	0.0030871