

Investigating Air Friction

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Abstract

In this experiment we studied the effects of increasing the cross-sectional area of a cart on its acceleration and velocity. Through this, we proved that air resistance exists and is directly correlated to the cross-sectional area of an object, as well as its shape. Furthermore, we found that air resistance can be decreased by keeping cross-sectional area constant and changing the shape of an object.

1 Introduction

Throughout high school physics, we have been calculating the range of projectiles, the velocity of karts, and even the speed of planes - all by assuming that air resistance is negligible. In this experiment, we set out to prove that air resistance does exist, and that it has a significant impact on acceleration and velocity of an object relative to its cross-sectional area.

2 Background

$$a = \frac{1}{2}m\ell^2(\dot{\theta} + \dot{\phi}_0)^2 - mg_e(t)\ell \cos(\theta)$$

$$m\ell^2(\ddot{\theta} + \ddot{\phi}_0) = mg_e\ell \sin(\theta)$$

$$\ddot{\phi}(t) = -\frac{g_e(t)}{\ell} \sin(\phi(t) - \phi_0(t)) \quad (1)$$

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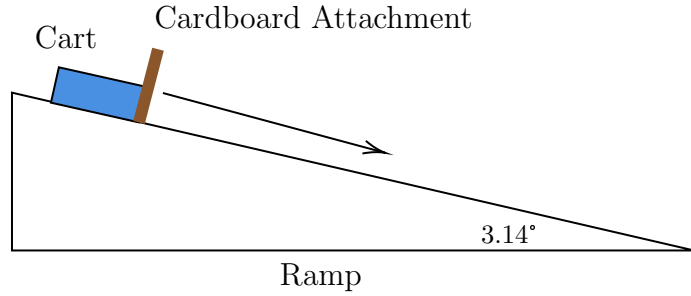


Figure 1: General experimental setup with a *Smart Cart* rolling down a ramp. Cross-sectional area of the cart is changed using a cardboard attachment.

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3 Methods

Give a schematic of the experimental setup(s) used in the experiment (see figure ??). Give the description of abbreviations either in the figure caption or in the text. Write a description of what is going on.

and eventually arrived to the balanced photodiode as seen in the figure ??.

4 Results

In this section you will need to show your experimental results. Use tables and graphs when it is possible. Table 1 is an example.

Table 1: Every table needs a caption.

x (m)	V (V)
0.0044151	0.0030871
0.0021633	0.0021343
0.0003600	0.0018642
0.0023831	0.0013287

Analysis of equation ?? shows ...

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Figure 2: Hyperbolic tangent acceleration vs immediate constant acceleration. The slow approach to the same asymptotic value of 2 meters per second per second induces a lag in the oscillation and also diminishes the amplitude of oscillation.

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For example, it is easy to conclude that the experiment and theory match each other rather well if you look at Fig. ?? and Fig. ??.

5 Conclusions

Here you briefly summarize your findings. Did you learn any new physics? Was everything as expected?

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6 Future Work

Since you had limited time to work on this project, what questions are left outstanding? What would be your next steps?

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References

- [1] A. C. Melissinos and J. Napolitano, *Experiments in Modern Physics*, (Academic Press, New York, 2003).
- [2] N. Cyr, M. Têtu, and M. Breton, IEEE Trans. Instrum. Meas. **42**, 640 (1993).

[3] *Expected value*, available at http://en.wikipedia.org/wiki/Expected_value.