Classical Mechanics
Lab 4
The Air Track as an Inclined Plane
Week 5

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Feb 3, 2016

Overview

- Lab report
- Equipment
- Procedure for gathering data
- Data analysis

Purpose of the Lab

To investigate the acceleration of an object on an inclined plane in a very-low-friction environment.

To gain experience with the standard deviation of measurements and graphing on a computer.

Lab report

You need to do a lab report for this lab. The report will be due ??

You must record all data for this lab in your lab book.

You **do not** need to answer the questions posed in the lab in your book, but you do need to answer them in the report.

Lab report

Style of the lab report: pretend you are a scientist. Your goals:

- clearly communicate precisely what you did, and the results you got
- let others know exactly how to repeat your experiment, confirm your results
- give an introduction to the reader of any theory involved

Lab report

What to assume about the reader:

- they do not know what was on the instruction sheet
- they do not know what precise equipment you used
- they already know how to use all of the equipment
- they are skeptical

Lab report

The lab report should contain:

- an introduction: what are you investigating in this experiment, introduce a reader to what you did and how
- the hypothesis: the theoretical predictions you are trying to test
- a description of the experimental procedure and all equipment used
- your data / measurements
- analysis: how well did your data agree with the predictions?
- conclusion: Does the theory seem correct? Does your data support it? If not, why not? If there are a few data points that deviate from predictions, try to explain what may have occurred. Were there any sources of experimental error? Were they systematic or random? What would you do differently in the future to improve this experiment? What other related questions could you investigate in similar experiments?

Lab report

Other things:

- diagrams and tables are often very helpful
- do not make statements without evidence
- do error analysis or give percentage differences where appropriate

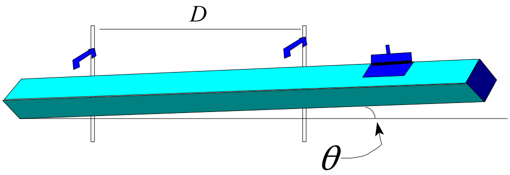
Theory

You will need to find expressions for

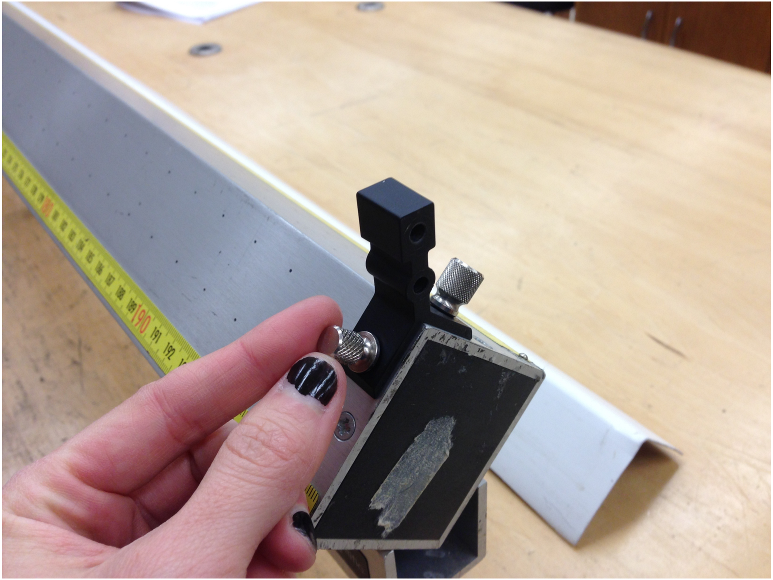
- the theoretical acceleration of the glider, in terms of the angle of the incline, θ, and g
- the acceleration of an object that has initial speed $v_i = 0$, and covers distance Δx in a time t, assuming constant acceleration.

Air Track

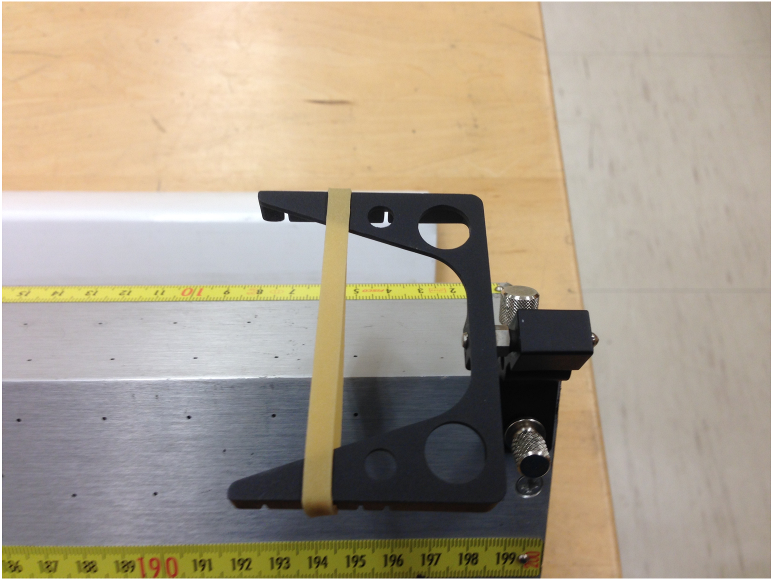
Moving an air track is a two-person job!



Air Track End Brackets



Air Track End Reflectors



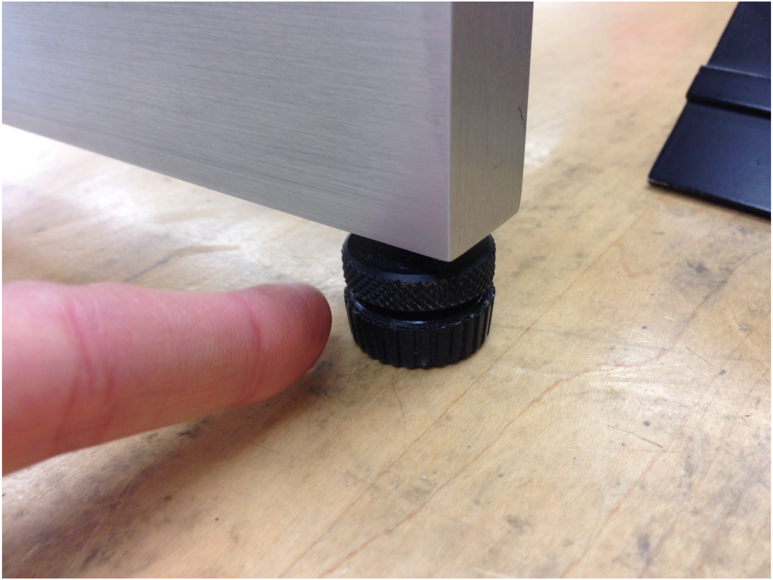
Blower


AIR SUPPLY
MODEL SF-9216
POWER
OFF
ON
1
2
3
4
5
0
AIR OUTPUT
PASCO scientific

Blower Hose

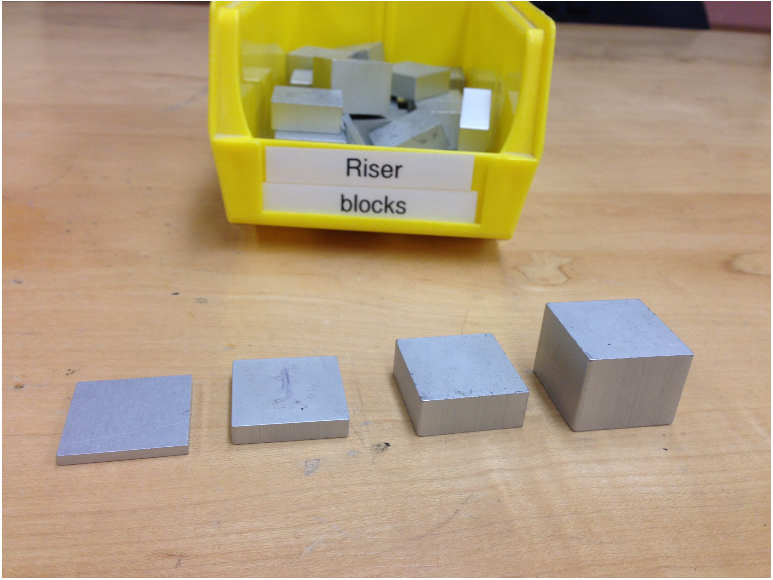

CAUTION!
The device to which the Air Supply is connected must provide a minimum of 0.4 square inches (2.6 cm²) of air exit area. An area less than this will restrict air flow and may cause motor over heating.

Leveling the Air Track

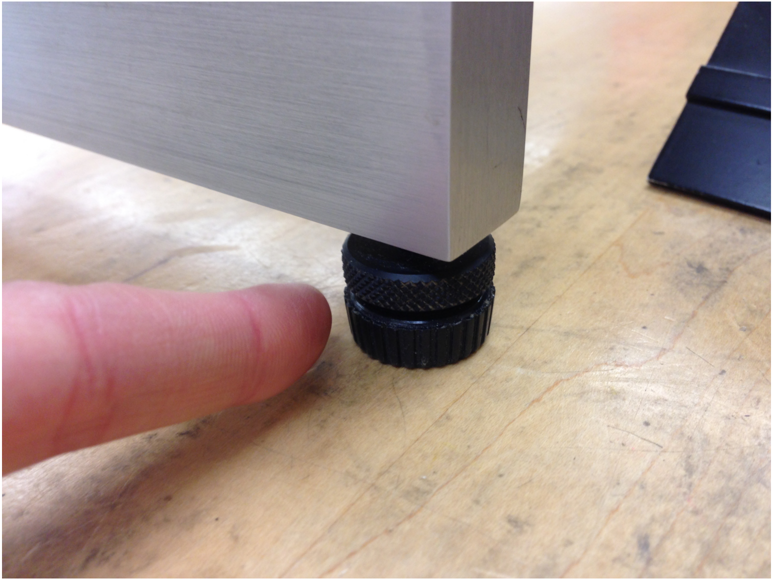


Attaching a Flag to a Glider

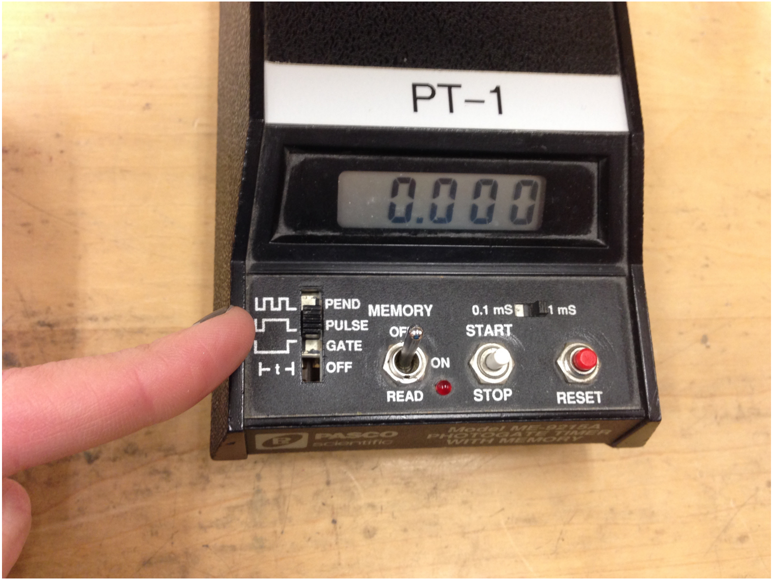
Riser Blocks



Where to Put the Riser Blocks



Photogate Timers: Pulse Mode



Photogate Timers

Set the toggle switch located above the Start button to "1 ms".

When it is set this way, the number on the screen is in **seconds**, so long as you are in PULSE mode.

The times you will read out in this experiment will on the order of seconds, unlike in the previous lab.

Analysis

Find your theoretical acceleration value, a_t, using your measured value of the riser height, and trigonometry.

Find your experimental of "calculated" acceleration, a_c, using your measured time and distance.

You will have to find the uncertainty **only in the experimental value**.

You will do this using the standard deviation.

$$\delta a = \sigma_a = \sqrt{\frac{\sum_{i=1}^{n}(a_i - \bar{a})^2}{n}}$$

Graph Analysis

You will make a graph of your average values of acceleration for each of 5 incline angles against the sine of the angles.

Use a computer!

Use the "trendline" feature to find a best-fit line.

From the slope of that line you will be able to determine the value of g.