

What is the weight of a penny?

Introduction to statical physics

111X Lab 1 Project Series Last Edited May 25, 2023

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Abstract

What is the weight of a penny? A simple question, but what if you could not weigh the penny directly? Today you will practice indirect measurement using statical methods.

Learning Goal(s)

- Reporting a measurement.
- Understand these statical terms: mean, median, standard deviation and uncertainty.
- Experimental design with curated supplies.

Lab Equipment

- A handful of pennies
- Bowl
- String

Theory

Deliverables

Your lab notebook with the different sections outlined below should be submitted on Canvas.

• Theory: in your own words

Getting Started

This lab guide is meant to be used as a reference for the in person first lab of PH1110 or PH1111. Make sure you agree to our lab rules on Canvas before your lab section meets, as it is graded and contains important lab information.

During lab, your instructor will begin with a brief outline of the goal for today: To find the weight of a penny that you do not have access to. There is a penny at the front of the room, and at the end of the lab session your lab instructor will weigh it using a scale. Before they do, however, you must put your best guess on the board.

Your best guess, or estimate of what the pennies weight will be should be in scientific form.

Reporting a measurement

A properly formatted measurement should have the following attributes:

- The correct number of significant figures for the uncertainty: One significant figure unless the leading digit is a 1 or 2, in which case you should use two significant figures.
- The correct number of significant figures for the measurement: At the same order of magnitude (the same decimal position) as the uncertainty. (Numbers with the same order of magnitude, when written in scientific notation, have the same factor of ten. 10 and 20 are the same order of magnitude, 100 is an order of magnitude higher than 10).
- All measurements must have units attached to them.

Make sure your entry on the board as well as in your lab notebook follows all the proper attributes of a measurement. Below we use the units of 'g' which refers to a gram.

Weight of a penny= _____ _ ± _ _g

You are encouraged to use this lab guide's further discussion of statical methods to help you work through this problem, but your lab instructor will not and is not allowed to give you a set method to find said penny weight.

You are encouraged to use the supplies we have laid out at the front of the room and are listed at the top of this lab guide. If you're not sure if you're allowed to use something please ask!

Deliverables

1. Did you write your guess for the weight of a penny on the board correctly using proper scientific format? Include that guess in your lab notebook.

For Lab 2R, **if you are a remote student**, you need to download Tracker to a computer which you can use to analyze video's.

Appendix: TA Notes

First Day Essential Administrative Information

Students need to have agreed to our lab rules in order to access the lab document. That is important because that is where we outline our lab rules around academic dishonesty. At the beginning of the class it is helpful to outline our policies around these following topics, but you do not need to do every topic at the top of the lab. We do recommend speaking up to say something to the students every 30 minutes - 1 hour as it is hard for students to hold everything you said at the top of the hour for the full 2 hours.

- 1. Students cannot submit identical labs, and students who do will get a 0.
- 2. My email is XX, please feel free to reach out, but I am also a student so it sometimes takes me a bit to respond. Please give me 2 working days, and if you haven't heard from me by then please feel free to reach out or contact Dana at ldana@wpi.edu.
- 3. If you ask for an extension at least 24-hours ahead of time you will receive a 1 to 2 day extension, and we do not need a reason for it.
- 4. Late points are by the syllabus 1 point per day up to a half, but you are welcome to be more generous to the students if you wish.
- 5. The lab managers email is ldana@wpi.edu, please reach out to her for any accommodations or personal issues.
- 6. If you cannot make a lab that week please email me or Dana for the remote lab, or attend the open lab session on Friday.
- 7. We will have 5 labs this term, the schedule is on the Canvas page. We have some weeks off, such as Thanksgiving.
- 8. Grading is done on Canvas with a rubric, that you can see before you submit. We recommend you look at it ahead of time.

For the board

Please include the following information on the board, and then anything else is up to you 1 .

- 1. Your and your co-lab instructors email
- 2. When this lab is due (aka 9 pm the day before your next lab)
- 3. Open lab hours (aka Friday at some time)
- 4. The goal for this lab (Find the weight of a penny)

Good questions for the students as you circle

- 1. How many pennies do you think you need to test to achieve a reasonable result?
- 2. Can you quantify the error on that measurement?
- 3. Please consider testing a second method.

 $^{^{1}}$ If you're Holden we know you're going to draw Sir Hogler and that's fine, but also include this information

Recommended Pacing

- 5 minutes in: Give your welcome speech. Try to hit on the first few administrative point, then explain the goal of this lab, point to where the supplies are, and let them go. Try to make this anywhere from 5-15 minutes long.
- 20 minutes in: Circle and start asking students what their plan is. Make sure that they are writing it down for their lab notebook as well.
- 40 minutes in: By now students should have tried at least one experiment. If you have students who are still sitting without measuring anything please encourage them to try something.
- 1 hour in: If students have taken enough measurements to have a decent guess by now (5 is fine, 10+ is best) ask them to justify why that number of measurements is good. Also encourage them to try a 2nd method.
- 1 hour 20 minutes in: Let students know that in 10 minutes you will ask them to all put their best guess on the board, and at the 1 hour 30 minutes mark you will start a discussion about why everyone chose that.
- 1 hour 30 minutes: Students should be reminded to write down all of their peers guesses in their lab notebook. Start a conversation with how students got their methods.
- 1 hour 40 minutes: Weigh the penny using a balance scale the students haven't been allowed to touch. Get one measurement, and then ask a random student to measure it again, and write both numbers on the board. Check in with who got closest, why they think they did, and what would they have done differently?
- 1 hour 50 minutes: Please dismiss the students and remind them that their work is due before the next lab session at 9pm, and to please check the rubric if they want clarification. Also to please reach out if they need an extension.

Grading information and common questions