Classical Mechanics
Lab 7
The Ballistic Pendulum
Week 8

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Overview

- Equipment
- Procedure for gathering data
- Data analysis

Purpose of the Lab

To investigate how a ballistic pendulum works and to get experience using the conservation of energy together with the conservation of momentum.

You will measure the height that the pendulum rises to and then use that to predict the range of the ball when fired off the front desk.

You will also measure the period of your pendulum **with the ball inside the catcher**. We will use this later.

Lab report

You need to do a lab report for this lab. The report will be due at the end of 11th week.

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

You should do the theory derivations now in your lab book, but you **do not** need to answer the questions posed in the lab the book now.

You **do** need to answer them in the report.

We will do one additional calculation for this lab in week 10.

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

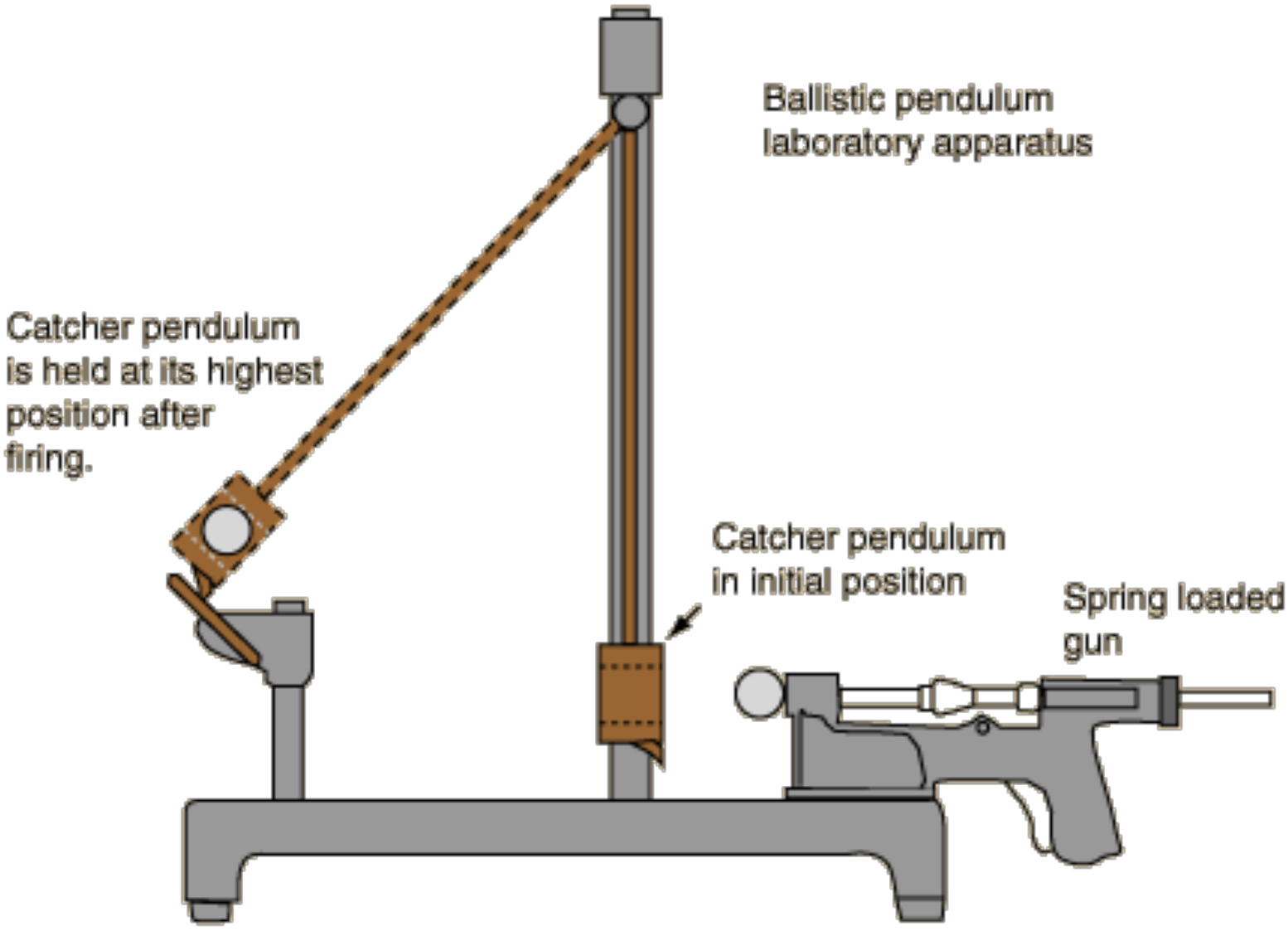
Theory

You will need to determine how the velocity of the ball initially relates to the height the pendulum reaches.

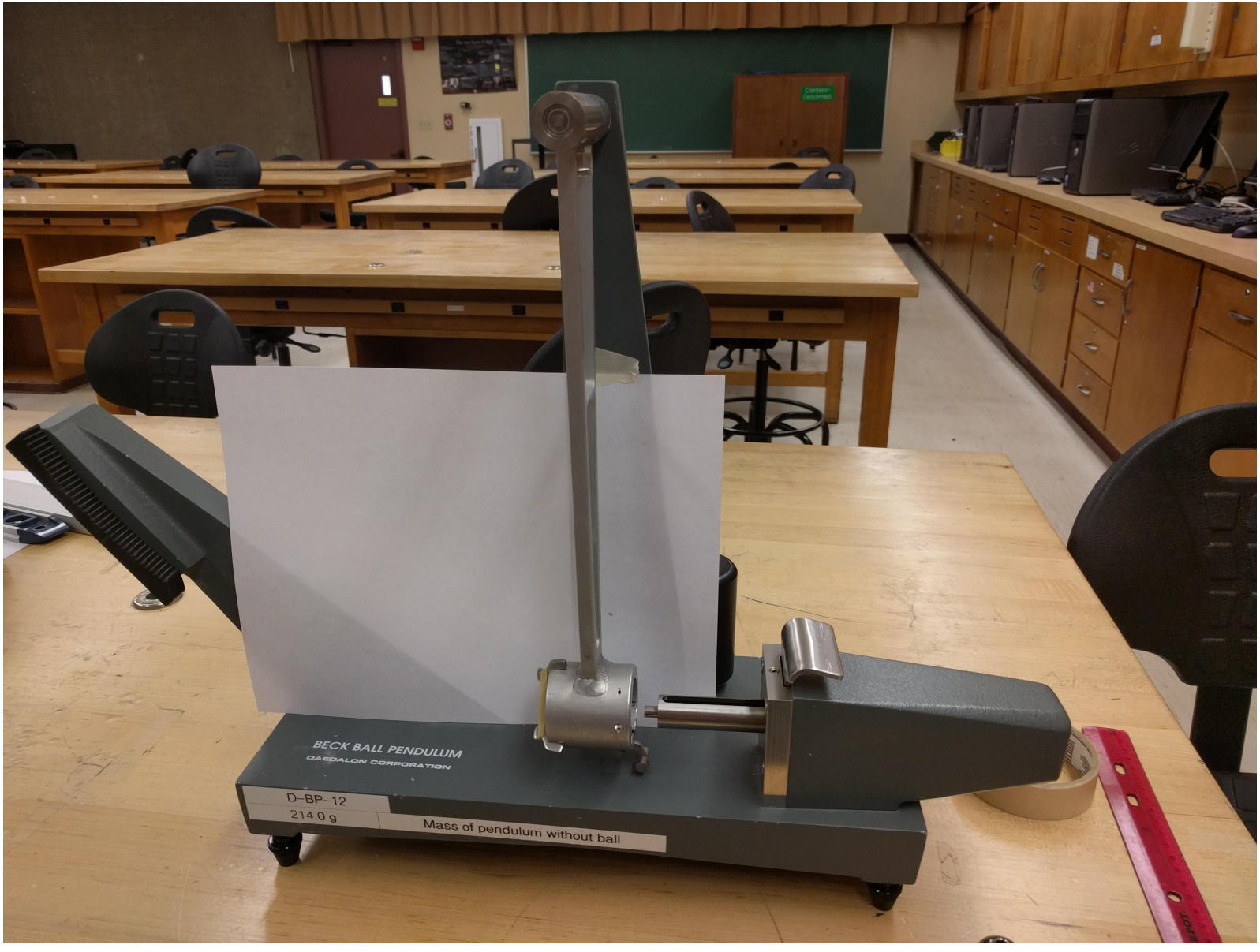
Fortunately, you have just seen how to do that.

Please do write up that derivation in your lab book.

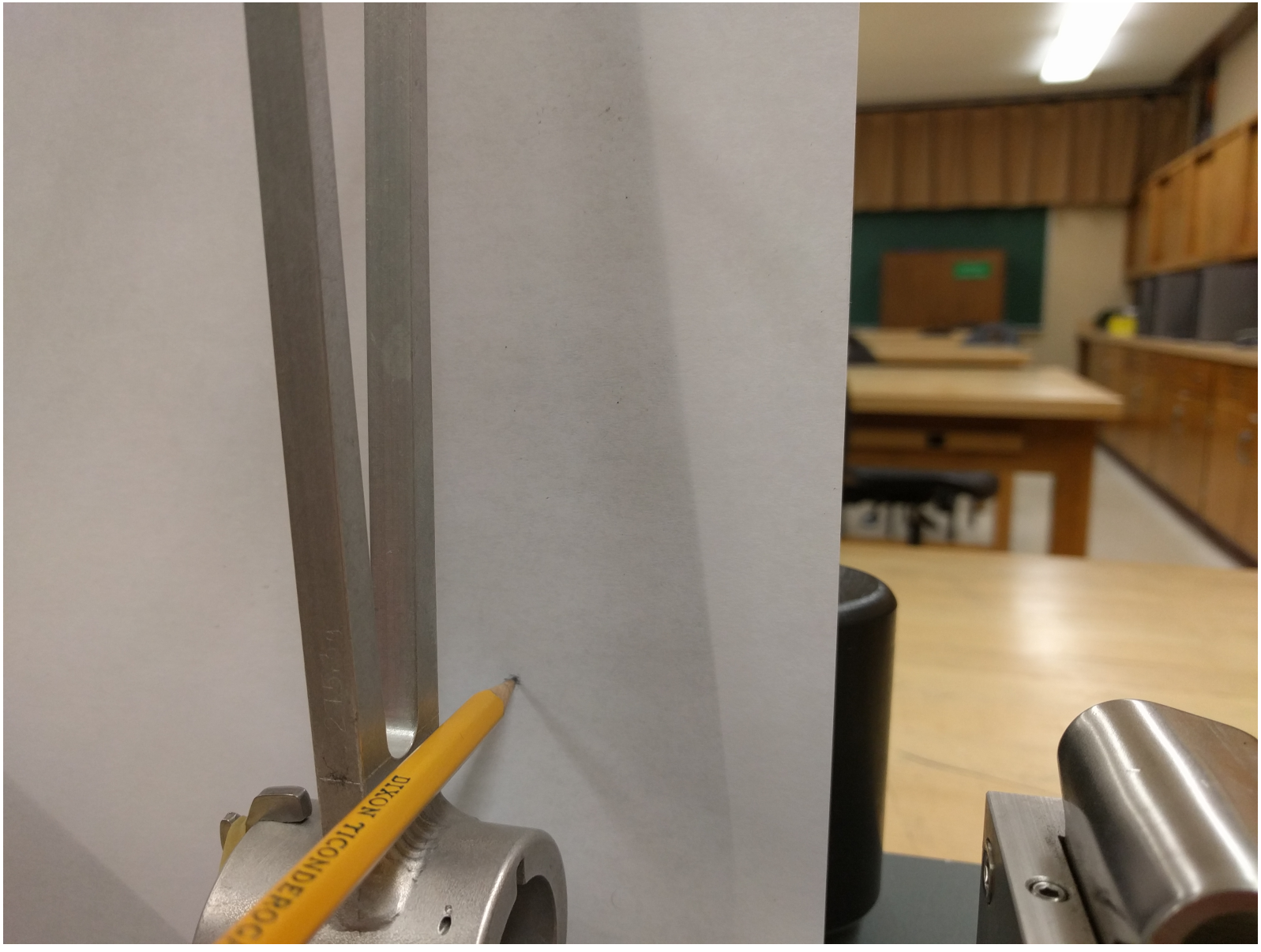
Ballistic Pendulum Assembly Schematic



Ballistic Pendulum Assembly

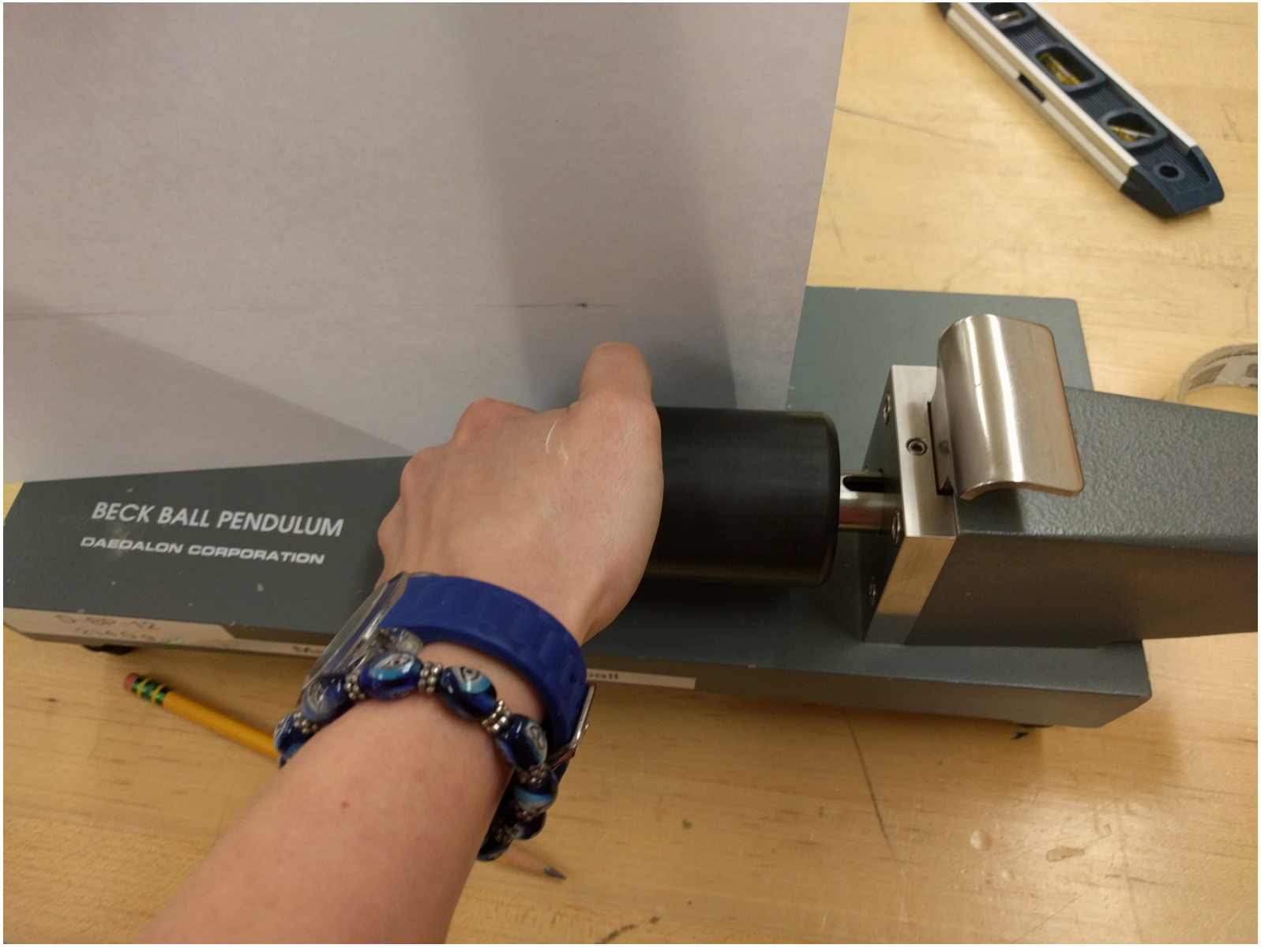


Mark the Center of Mass Line

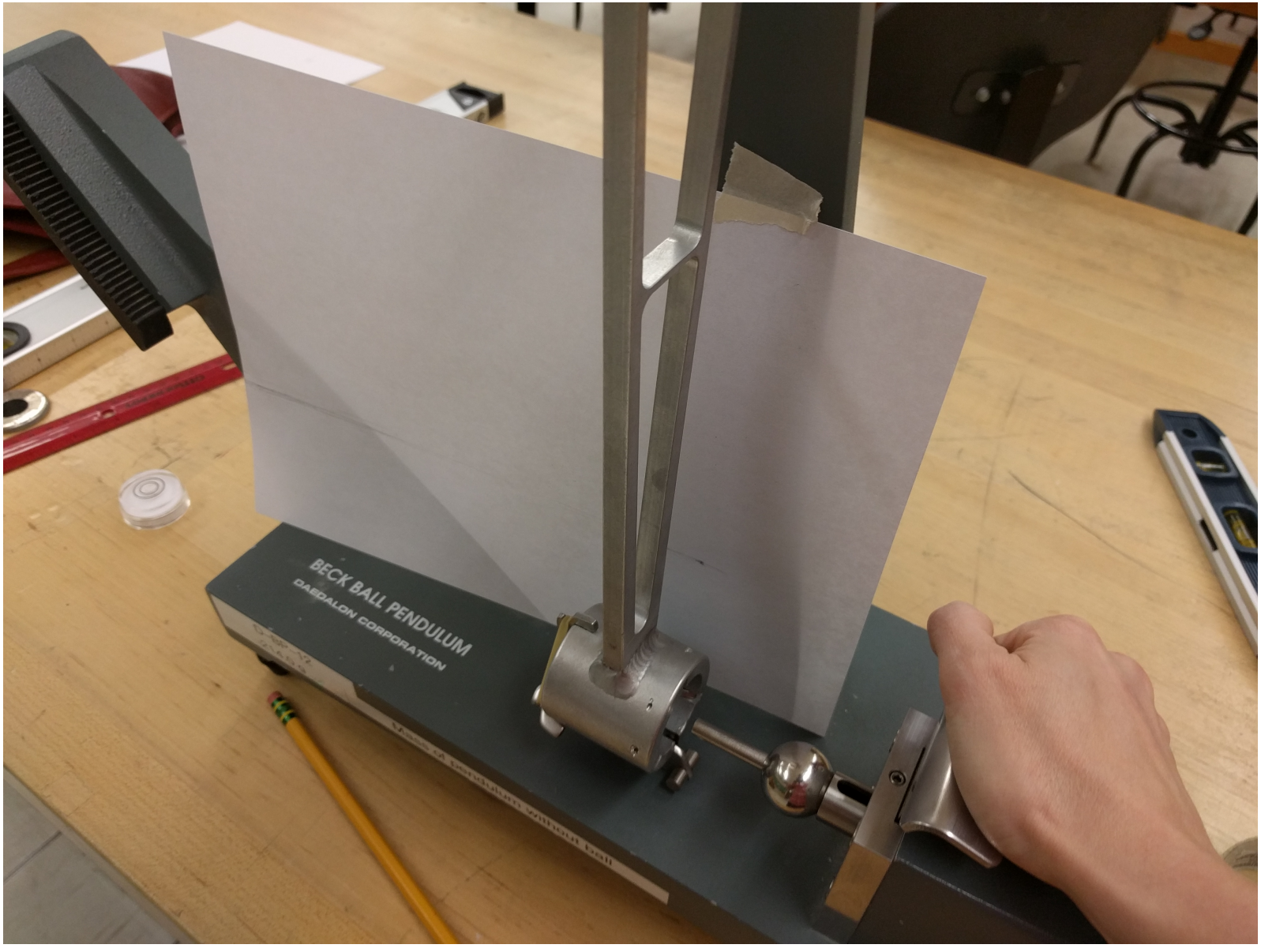


Mark the Center of Mass Line

“Cocking” the Gun

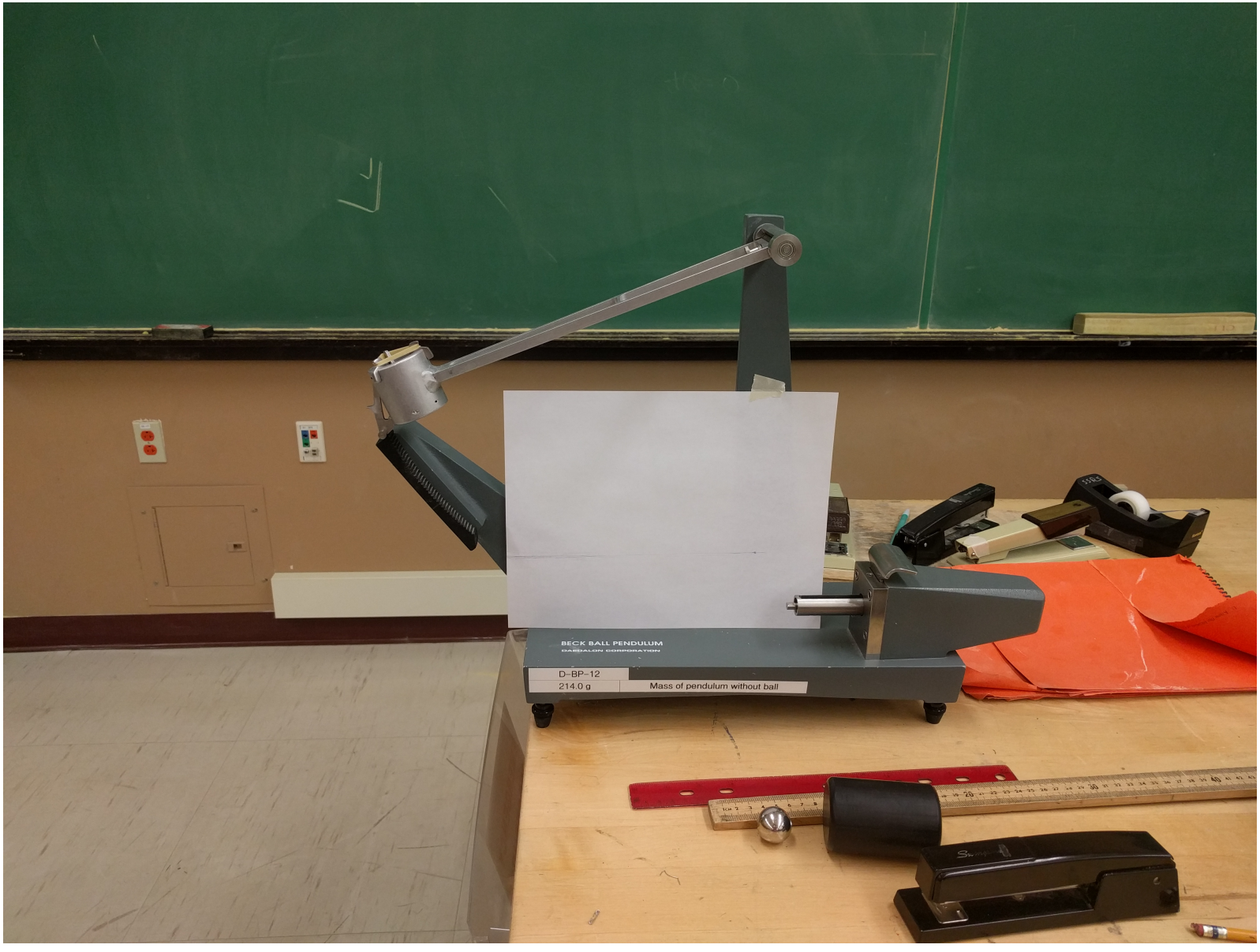


Firing the Gun



Measure Height from the Center of Mass Line

Checking your prediction for the Range



Checking your prediction for the Range

Analysis

Do a discrepancy test comparing the measured range and the predicted one.

Derive an error propagation formula for the uncertainty in the range δR given the uncertainties in the measured quantities.

You do not have to calculate δR unless you wish to. It will come out very small if you do.

Think about errors and approximations in this experiment. (Does δR fully reflect them?)