



Classical Mechanics
Lab 9
The Ballistic Pendulum
with Angular Momentum
Week 10

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Overview

- two more measurements
- data analysis
- what else you can do in this time

Purpose of the Lab

To get experience using the conservation of energy together with the conservation of **angular** momentum.

From your measurement of the height that the pendulum rose, you can make a new “prediction” of the range of the ball when fired off the front desk.

You will add this to your lab report for lab 7, to compare your new and old predictions, and the measured range.

Lab report

You add this to the lab report for lab 7. The report will be due at the end of 11th week.

You must record two length measurements in your lab book.

You **do not** need to answer the questions posed in the lab your lab book now.

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:

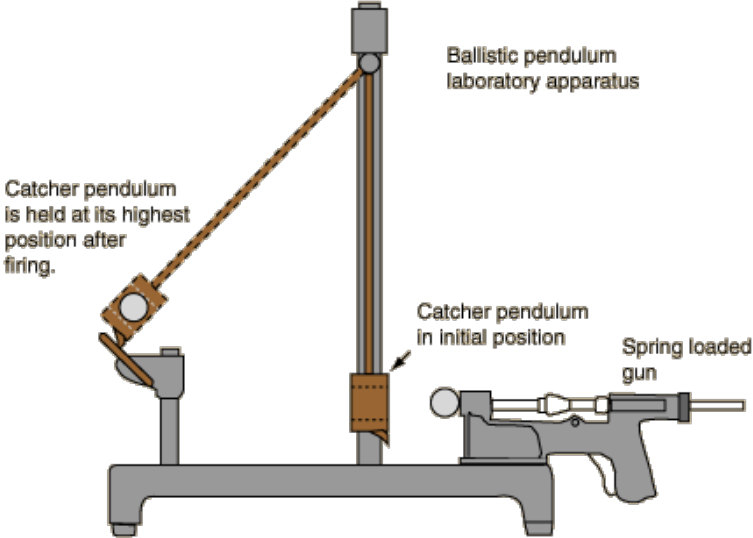
- diagrams and tables are often very helpful
- do not make statements without evidence
- do error analysis or give percentage differences where appropriate

Theory

You will need to make another “prediction” of the range of the ball, this time using the idea of conservation of momentum.

Fortunately, you have just seen a problem very similar to that.

Ballistic Pendulum Assembly Schematic

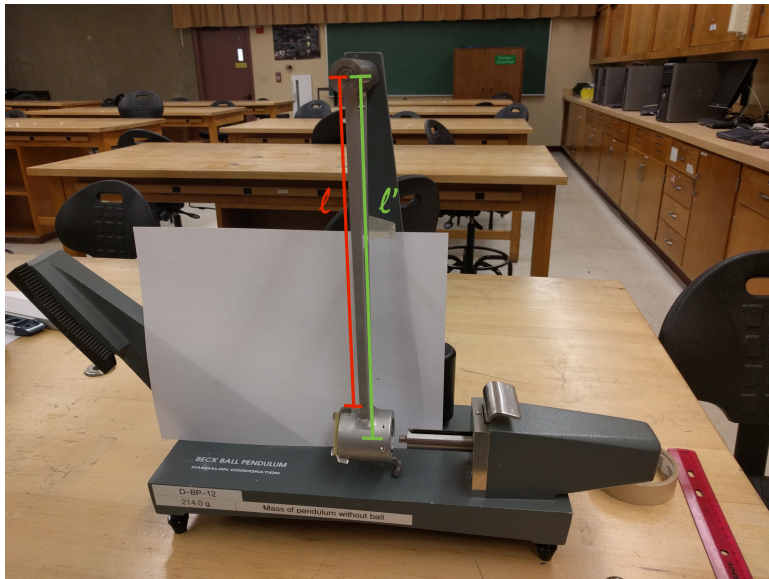


Two more measurements...

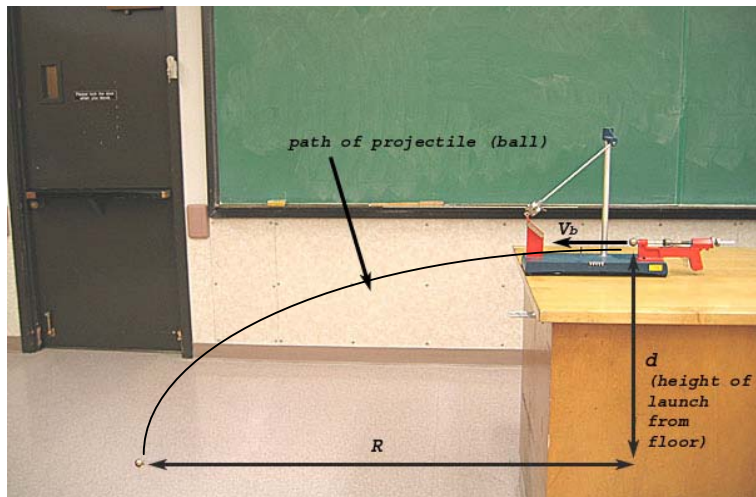
You will need 2 more measurements:

- 1 the distance from the pivot to the center of mass, ℓ
- 2 the distance from the pivot to the point where the ball strikes the catcher, ℓ'

Ballistic Pendulum Assembly: Two Lengths



Checking your prediction for the Range



Analysis

Do a discrepancy test comparing the measured range and the new prediction.

Compare the old and new predictions also.

How big an effect does imagining the entire mass of the pendulum is at the center of mass during the collision have on the value of the predicted range?

Was this the biggest source of error in the experiment, or were other errors/effects more significant?

Other things to do

- Write up your lab report. I can loan you a laptop if you need it.
- Make up a previous lab.
- Practice using measurement equipment.
- Work on physics problems.

