Physics 2A
Lab 5
Atwood's Machine
(Week 6)

Lana Sheridan

De Anza College

Oct 30, 2018

Overview

- Purpose
- Theory exercise
- Equipment
- Lab report

Purpose of the Lab

To gain hands-on experience with the Atwood machine and use it to study force and acceleration.

Purpose of the Lab

To gain hands-on experience with the Atwood machine and use it to study force and acceleration.

You will compare the observed acceleration of hanging masses to a prediction you make by applying Newton's 2nd law.

You will also use your observed acceleration to find experimental values for g in the classroom.

Theory Exercise

Starting from free body diagrams, use Newton's 2nd law to derive an expression predicting the acceleration of the masses in the Atwood machine in terms of the masses and g.

Also, use the 1D kinematics equations to find an expression for the acceleration a of an object that travels a distance H in a time t, starting from rest.

In the experiment you will measure the times, t, taken for a mass to cover a distance H, then use that equation to find the acceleration.

Setup

Pulley

Lab Activity

- Setup the apparatus.
- Choose $M_1 \approx 180$ g and $M_2 \approx 150$ g, measuring on the balance to check that your masses plus hangers are close to these values. Record the exact values in your lab book.
- Adjust M_1 and M_2 so that M_2 rises through a height $H = 130$ cm.
- Release M_2 from rest and measure the time of rise t for a total of **5 runs**. Construct a data table to record your values in your lab book.
- Repeat steps (3) and (4) for $M_1 \approx 230$ g and $M_2 \approx 200$ g.
- Calculate a_{exp} and a_{th} for each set of data and find the percentage error.
- Rearrange the expression a_{th} to give an expression for g. Using your experimentally measured values of the acceleration, determine the *experimentally determined* value of the acceleration due to gravity g for each pair of masses.

Percentage Error

We use the usual formula for percentage error.

$$\% \text{ error} = \frac{a_{\text{exp}} - a_{\text{th}}}{a_{\text{th}}} \times 100\%$$

You may also like to find the percentage errors between your values of g and the accepted value of g.

Safety

Once the masses have traveled through 130 cm, you need to stop the masses.

Stop the **top mass** by catching it.

The masses may come flying off the hanger as you stop them. If you catch the top mass, the bottom mass may fall to the ground, but at least you won't have a mass launched upward toward your head.

Lab report

You need to do a lab report for this lab, the Atwood Machine lab. The report will be due Thursday, Nov 8th. (That's before the 2nd test.)

You still should make sure all data is recorded in your lab book.

Calculations for the percentage error should appear in your lab book.

Lab report

Style of the lab report: pretend you are a scientist, writing a paper for other scientists. 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
- you do not need to show all the steps of your calculations, but do give the formulae you use and the data

Lab report

Style of the lab report: pretend you are a scientist, writing a paper for other scientists. 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
- you do not need to show all the steps of your calculations, but do give the formulae you use and the data

Do NOT copy and paste from the instruction sheet!

Lab report

What to assume about the reader:

- they do not know what was on the instruction sheet
- you need to tell them what 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 and theory: the theoretical predictions you are trying to test and the reasoning behind them
- a description of the experimental procedure *in paragraph form* and all equipment used
- your data / measurements

Lab report

(cont'd) The lab report should contain:

- analysis: how well did your data agree with the predictions? (quote uncertainties here)
- conclusion: Does the theory seem correct? Does your data support it? If not, why not? If there are a few data points that seem far out from the others, 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, or using similar equipment?

Lab report

Other things:

- diagrams and tables are often very helpful
- do not make statements without evidence
- give percentage errors where appropriate