

General Physics Lab 0

Introduction to Lab Tools

Objectives:

- Download and install the necessary software.
- Practice using the experiment tools (hardware and software)
- Learn how to analyze data using Tracker, Google Sheets, and Graphical Analysis

Equipment:

- Smartphone
- Computer
- [Tracker Video Analysis Software](#)
- [Graphical Analysis Software](#)
- Measure/Level Smartphone App
- [Phyphox Smartphone App](#)
- Spring Balance
- 1 Hot Wheels Car
- 1 Racquetball
- Duct Tape

Procedure:

Follow along on the Writeup and eJournal as you watch the videos. Fill out the requested information and take pictures/screenshots.

Part 1 – Software Setup:

Follow the tutorial video to download and install the software. Use the online version of Tracker **only if** your computer cannot run the desktop version (desktop version is easier to use). If your computer or smartphone is unable to run these programs, notify your instructor ASAP.

Part 2 – Experiment Procedures:

Measure App/Level App

1. Measure the angle of something and take a screenshot on your phone to show the angle. Record this in your **eJournal**.

Phyphox App

1. Accelerometer
 - a. Follow the procedure in the video to identify the x, y, & z axes for your phone. Fill in the axis labels on the diagram in the **eJournal**.
 - b. Take a screenshot of the data you collected and copy it into your **eJournal**.
 - c. Don't worry about exporting the data as a CSV file. The experiments were revised after making this video so you will no longer need to do that for the labs.
2. Acoustic Stopwatch
 - a. Use it to record some length of time (ex. 2 seconds) and compare to a normal stopwatch or clock. If the times match, then the acoustic stopwatch tool probably works on your phone.
If it does not work, explain that in your **eJournal**. Make sure you at least have a normal stopwatch (on your phone is fine) that you can use for the experiments.
 - b. Take a screenshot of the app (showing the threshold and delay) and copy it into your **eJournal**. If the acoustic stopwatch didn't work for you, skip the screenshot.
3. Audio Spectrum
 - a. Follow the instructions in the video to capture a frequency on the audio spectrum graph.
 - b. Use the pick data tool to identify the frequency, take a screenshot of the graph, and copy it into your **eJournal**.

Spring Balance

1. If you have your lab kit, follow the instructions in the video to set up and zero your spring balance. Note that you may need to re-zero your spring balance for each lab, especially when the orientation is different than the last time.
2. Weigh a Hot Wheels car and ball from your lab kit and record the masses in your **eJournal**.

*If you do not have your lab kit yet, notify your instructor and record in your eJournal that you do not have it yet. Once it comes, try out this exercise so you will be ready to use it for the labs.

Sample Experiment

1. Watch the video with the rolling ball experiment.
2. Answer the questions about the experiment procedures in your **eJournal**.

Part 3 – Analysis Tools:

Before proceeding, make sure you have downloaded the experiment video file (Rolling_Ball.MOV).

Google Drive, Docs, and Sheets

Follow along with the video and practice using these tools. If you are enrolled as an Andrews student, you have access to Google's office tools through your Andrews University Google account. If you are not enrolled through Andrews, you will need to use a personal Google account or a Google account through your institution.

Tracker

1. Open Tracker
2. Open the video file
3. Calibrate the video by placing a "Calibration Stick" on the ruler and setting the length to 0.305 m.
4. Add the coordinate axes to the video and adjust the position and angle as shown in the video
5. Create and name a "Point Mass"
6. Track the position of the ball as it moves across the screen.
7. Set the table to include only x , v_x , and a_x
8. Save the Tracker file
9. Export the data as a CSV file with the delimiter set to comma.
Don't forget to add the file extension (.csv) as part of the file name.
10. Back up the video in Tracker so that the ball is in view, export a "Thumbnail Image" of the "Entire Frame" or "Main View", and copy this into your **eJournal**.

Google Sheets and Graphical Analysis

1. Open and name a new Google Sheet
2. Import the CSV file that you exported from Tracker
3. Generate a scatter plot of position vs time
 - a. Add a trendline to the plot and show the equation
Note: The equation will be displayed as $x = mx + b$. Don't confuse these two x 's as the same variable. The first one is the y -axis variable (which we named x). The second one is just the x -axis variable and regardless of what we call it, they always put x .
 - b. Export a PNG image of the graph and copy it into your **eJournal**
4. Select the table cells and increase the number of significant figures (decimal places)
5. Copy the cells for time, position, velocity, and acceleration (exclude the column headers)
6. Open Graphical Analysis and switch to table view

7. Add and label enough columns for the data
8. Paste the data in from Google Sheets
9. Open a graph of position vs time
10. Add a title to the graph
11. Add a “Linear” curve fit to the graph
12. Record the slope of the graph in Google Sheets
13. In Graphical Analysis, add a second graph of velocity vs time
14. Apply the statistics to the velocity graph
15. Record the mean velocity in Google Sheets
16. In Google Sheets, calculate the percent difference between the two velocity values (from position and velocity graphs)
 - a. $\%Diff = \frac{|v_1 - v_2|}{v_2} \times 100\%$
 Note: If you calculate it with a spreadsheet, you can leave off the x100% and just format the cell as a percent.
17. Add a title to the velocity graph and export the two graphs as a “Graph Image”. Copy this image into your **eJournal**.
18. In Google Sheets, calculate the mean and standard deviation of velocity and acceleration.
19. Generate a calculated column for translational kinetic energy ($KE_T = \frac{1}{2}mv^2$, $m = 0.062\text{kg}$)
20. Calculate the mean and standard deviation of kinetic energy

In your **eJournal**, record the following in the table with appropriate units:

1. Velocity value from position graph, velocity value from velocity graph, and percent difference
2. Mean and standard deviation of velocity, acceleration, and translational kinetic energy