Graphing Motion Investigation

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Figure 1- Motion

Introduction

Motion is everywhere around us. We live in a moving universe, on a moving planet. We are moving from place to place and we are moving objects on a daily basis, even air particles around us are moving. We have found many ways to describe motion: whether it is up a hill, or down a ramp; circular or in a straight line; fast or slow; to the left or to the right; with a constant speed or with an increasing or decreasing speed. A simple way to represent motion is by graphing it. A graph can tell us everything about an object's motion just by looking at it. In today's experiment, you will capture the motion of an object in a video clip and plot a graph showing the course of motion.

Risk analysis

The experiment involves dropping a ball or a given projectile, therefore make sure you do not hit yourself or any of your classmates. Ensure the surrounding area is free from glassware to avoid breakage.

Questions

What information can you get when you read a displacement-time graph or the velocity-time graph?

How can you obtain the velocity from a displacement-time graph?

How can you determine acceleration from a velocity-time graph?

Make your own hypothesis about what you expect to find and discuss it with your team members, once the whole group agrees on a hypothesis, write it down to test it.

Aim

Collecting two velocity/time graphs for:

a. A ball dropped with an initial velocity of zero.
b. A ball thrown upwards with an initial vertical velocity.

This is followed by determining the acceleration due to gravity from the velocity/time graphs.

Plan

The experiment involves dropping and throwing a ball, capturing a video clip and taking measurements. Form groups of three and assign a role to each member in the group.

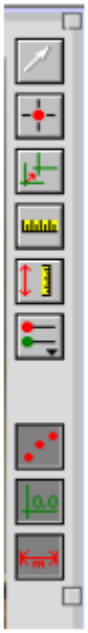
Materials

1. LoggerPro (3.8.4)
2. Laptop with webcam
3. 1 metre ruler
4. Tennis ball

Conduct

Procedure

1. Load LoggerPro and select ***insert*** then ***video capture.***
2. Select your webcam.
3. When prompted ensure your metre ruler fits within the field of view and that you have a blank background. The metre ruler will provide you with an appropriate scale.
4. Press start capture and collect a simple video of the ball falling. You may need to practice to ensure that you have a reasonable video. The video should only be around 4-5 seconds.
5. In LoggerPro select the ***enable video analysis*** which is at the base of your movie clip.  if you are not happy with the quality of the video then delete and capture another video.
6. Enter in an origin and a scale. Use the metre ruler to set a scale of 1m. The best origin is the starting point of the tennis ball's drop or throw.



7. You now need to add points. For every frame you will need to enter in a point. Take the centre of the tennis ball as your point. The image may become a bit blurry as the ball increases in velocity so measure from the centre of the image.
8. Please play the clip to ensure you have a good set of points. If not, delete and repeat.
9. Select the Y(m) for the Y-axis. To select different axis on LoggerPro just place the mouse curser over the vertical axis legend and several options will appear. This is the vertical displacement/time graph. Copy the graph into the student word document.
10. Select the Y Velocity (m/s) for the Y axis. From your graph you are to select the points where the tennis ball is in free fall and then do a line of best fit (Using R=). You can do this from the data analysis icons at the top of LoggerPro. Ensure you do not include points where the ball is still being held.

11. You are to repeat the process for a ball thrown upwards with an initial vertical velocity. This part will involve a certain amount of practice.
12. Answer the analysis questions.

<u>Analysis</u>

Part 1: A ball being dropped with an initial velocity of zero

Paste into the document your displacement/time graph.

Paste into the document your velocity/time graph.

Analysis Questions:

1. Describe the shape of the displacement time graph.

2. Describe the shape of the velocity time graph.

3. What is the gradient of your velocity time graph?

4. How can a result closer to g ($9.8ms^{-2}$) be achieved?

Part 2: A ball thrown upwards with an initial vertical velocity

Paste into the document your displacement/time graph.

Paste into the document your velocity/time graph.

Analysis Questions

1. Describe the shape of the displacement time graph.

2. Describe the shape of the velocity time graph.

3. What is the gradient of your velocity time graph?

4. What can you say about the tennis ball's acceleration as the ball is in flight?

<u>Problem Solves</u>

Discussion

- Do your results agree with your hypothesis?

- What sources of error could have interfered with your results?

- Does your interpretation of the graph agree with the motion of the ball? Explain.

Conclusion

Summarize your results and explain the importance of these type of graphs.

Link to figure 1 https://www.flickr.com/photos/spodzone/2610601621/in/photolist-4YG1UM-cQeG7y-grCXUY-4QdVDd-f1dJye-6n1U8Q-f1dFp8-grEPxU-aj9EQ4-grEan6-68QCQP-SS86mJ-8p4Dou-grEwSi-fgNpzz-f1t4WJ-V7Jm2o-6SoDum-aLGBPk-2YLyju-2p9fT-f1t653-ax5YyZ-6nFh3c-8XNQpT-

f1t8nA-grAxLH-bKFLz-7eY45Z-grFCUX-grB6TQ-71R1bH-8p4FK1-f1t6AU-6SjCzG-8XRTeq-8XRTDf-bKFLE-4t75tr-4ckwRN-9Xp19d-nuNvk4-pcNFSd-du2EXe-4989KS-4pGNwR-5PoBP8-bxe6Th-f1sUTh-8p1sJR Author ShinyPhotoScotland Licence https://creativecommons.org/licenses/by-nc-nd/2.0/