

Velocity and acceleration (video analysis) lab report



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Velocity and Acceleration (Video Analysis) NAME Abstract: With using the new software this lab was different than the rest. We determined many solutions using video analysis. We used a frictionless track with a " car" and recorded using loggerpro software. We used this software to determine average velocity and instantaneous velocity. With this information we than discovered the average acceleration, mine was . 2115. After that we were able to find ? a, then finally the free-fall acceleration, I got 1. 693.

Overall this was a fun and difficult experiment, but I learned a ton about acceleration and velocity. Introduction: The average person might hear the word physics and have no idea what it really means. The formal definition is; sciencethat deals with matter and energy and their interactions. Now that definition is nice and short, and doesn't explain into too much detail, but that is the gist of it. And hopefully can help you understand this lab a little bit more. The next question an average person is going to ask is when is this even used in real life?

But there are many examples, for one; 2-d vectors and projectile are used when using a cannonball, or any other ball flying through the air, every motion on a flat surface. Another example is hitting a golf ball, which can be in kinematics or in dynamics. If only motion of a golf ball is discussed, with terms like velocity, acceleration, displacement etc. then it's in kinematics. If mass, force, and impulse are also mentioned, than its dynamics. Those are just two of many different examples. The example that ties into this lab is hitting the golf ball, well the part about acceleration and velocity.

So, if this lab is completed correctly and not only will you be able to determine the acceleration and velocity of the car on the tract but of your

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golf ball as well, which could be fun to see who's is the highest with your friends. So before you know it you will be using physics in your everyday life and have fun doing it. But in this lab we will be finding a little bit more than just velocity and acceleration of low friction systems, we will also obtain a value for instantaneous velocity, which is used if we reduce the time interval between t_i and t_f to a very small value.

Also the value for the free-fall acceleration g , this will be found using analytical and graphical methods, where the slope will also be determined. And I believe having fun while doing it. So, don't think of physics as this hard useless subject because it is not! In fact, if understood it can be a useful and fun subject to learn. Theory: To describe object's motion we have a parameter called velocity which gives both the direction and speed of the object's motion. Average velocity can be found with net displacement total time taken or $\frac{x_f - x_i}{t_f - t_i}$.

In the first part of the experiment we will observe the motion at constant and even velocity. Constant means a quantity where the value does not change with time. Even is a quantity where the value does not change with space coordinates. If a system could be found in which a mass moves with no friction, then that motion would be both even and constant. While it is impossible to take away friction completely, it is somewhat easy to minimize friction to almost none. The device available for studying nearly frictionless motion and the one we will be using is called a linear air track.

Next is to find the value for instantaneous velocity which can be found with the equation; $v_3 = \frac{x_4 - x_2}{t_4 - t_2}$, $v_4 = \frac{x_7 - x_5}{t_7 - t_5}$, and so on, this must be done eight to ten times. So, if we determine the net displacement and take that

and divide it by the total time taken, then we can establish the average velocity and the instantaneous velocity. Next we have to obtain the acceleration and the free-fall acceleration. These are found separately though and take two different methods, although they are very similar. First we must place a 1.7 cm block under the linear air track to rise it up which is essential to find the free-fall acceleration and the average acceleration. To find the acceleration we will be using an equation, which is; $a = \frac{V_f - V_i}{T_f - T_i}$. And for the free-fall acceleration it is simply used with analytical and graphing with an equation, which is; $Mg \sin \theta = Ma$. So, if we determine the velocity, then the acceleration can be calculated, and take that data and we can determine the free-fall acceleration. Experiment: First, before beginning this experiment you need to make sure you have the correct materials.

You will need; an air track, an air car, a computer, a web cam, loggerPro® software, a USB thumb drive, a meter stick, and a calculator. Once you have the proper equipment you are now ready to start the lab. First you turn on the vacuum cleaner, next set the car on the track. After that give the car a small push, if it runs good then you are good to go. Start up the LoggerPro® software, select "insert", then "Video Capture". A pop up will appear and click on "Logitech HD Webcam C310" and click "OK". A live image will appear.

Put the web cam in a place in which you can see the whole track. On the computer click "Start Capture" button (which will start the recording), once it starts a lab partner will take the car (should be already placed at the beginning of the track) and give it a slight push and wait till the car hits the end of the track and comes back to the beginning to stop the recording.

Then close the window. Now that the video is taken, you will need to extract the data. First click the scale button and trace the meter stick, set it as one meter.

Then click " add points" and track the car from the beginning till the end (only when moving). Press Ctrl-R to rearrange the windows, this will give a better view. Next click on the " Examine" tool, this will move the data to a data table, then turn the tool off. Once this is finished select the " Linear Fit" tool then select the " VideoAnalysisX", this will draw a best fit line and then save. Next take the 1. 27 cm block and place it under one end of the track, this will be the end of the track where the test is run.

Then in LoggerPro® open a new page and record a video doing the same steps you previously did. Once this is complete calculate the instantaneous velocity at various points. This is done by selecting " Data", " New Manual Column.. ", name this column " Vinst" and set the unit to " m/s"; then click " Done". This is when the equation comes in, once each point is determined you will have to manually plug in the value into the " Vinst" column. Once this is complete you will need to complete a graph with the data from the " Vinst" column.

Now the last step is just to do the calculations. Data ; Results:
 Acceleration= . 65-. 105-2. 4 = . 552. 6 or . 2115 ? $a = 12a_{max} - a_{min} = 12.684. 5 - . 564. 8 = . 0172$ Free-fall acceleration = $Mg \sin\theta = Ma = g = a \sin\theta = \sin\theta = h/l = 1. 27\text{cm}/125\text{cm} = . 0102$ $g = ah = (. 0172)(125)1. 27 = 1. 693$
 Discussion: With using the new software this lab was different than the rest. We determined many solutions using video analysis. We used a frictionless track with a " car" and recorded using loggerpro software.

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