

Using Data Loggers

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Introduction

The aim of this workshop is to demonstrate and practice the use of data loggers while carrying out mandatory experiments from the preliminary and HSC syllabus. Four experiments have been chosen to familiarize you with different probes. It is envisaged that you could then use these skills in other experiments as well. The data logger being used is the Data Harvest Easy Sense Advanced.

Experiment 1

Syllabus Reference 9.3.3

- plan, choose equipment or resources for, and perform a first hand investigation to demonstrate the production of an alternating current

Resources

Data logger with voltage probe.
Hand operated AC generator

Method

1. Connect the voltage probe to the hand operated AC generator.
2. Set the data logger for fast logging.
3. Start the data logger and turn the handle of the generator.

Data logger settings.

1. Turn the data logger on by pressing the *Enter* button and make sure the LCD screen says *Easylog enter to begin*.
2. Plug the data logger into the computer. From this moment all control of the logger is made using the computer, do not press any of the buttons on the logger.
3. Plug the voltage probe into the number one port.
4. Start the Sensing Science program.
5. Click on the *Graph* button. The computer automatically determines which probe is attached and the axes of the graph will already show voltage. The table of results can be viewed simultaneously with the graph by clicking and dragging out the far left of the screen.
6. Press the new icon at the bottom left of the screen. This sends you through a series of screens that allow you to set up what you want to measure.
7. Screen 1- choose *Fast*. You then have the choice of how many readings are to be made choose 4000 you then choose the time interval between readings choose *200 microseconds*.
Finished.
8. Screen 2 - If you press next on screen one you get to a screen that allows you to set the start and end conditions
9. To start the logger click on the red arrow icon at the bottom left of the screen. Unlike normal logging when doing a fastlog you don't see the graph being drawn. A dialogue box comes up saying that the logger is recording then downloading the data. The graph and data table then appear.

In this experiment the data logger is being used as a CRO. Some models of data loggers have scope settings which are simple to use. The students actually find it easier to use than the CRO since the graph is stationary and can be zoomed. By using the interval tool you can choose a full wavelength very accurately and the period can be read off the bottom of the screen.

Experiment 2

Syllabus reference 8.4.4

- perform first hand investigations to gather and data and analyse the change in momentum during collisions

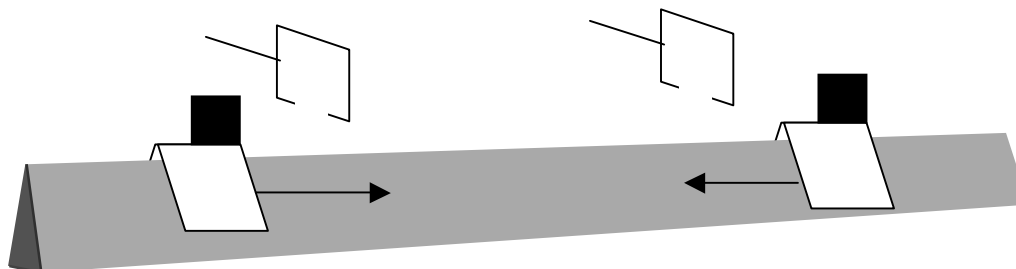
Resources

Data logger with light gates

Linear air track

Two gliders

Cardboard flags



Method

1. Push both gliders simultaneously.
2. (The logger will calculate their speed as they pass through the light gates in one direction then after the collision as they head back their speeds are calculated again.)
3. Use the values from the data logger to calculate momentum before and after the collision.

Data Logger set-up

1. Turn the data logger on by pressing the enter button and make sure the LCD screen says Easylog enter to begin.
2. Plug the data logger into the computer. From this moment all control of the logger is made using the computer, do not press any of the buttons on the logger.
3. Plug the light gates into the number 5 and 6 digital ports.
4. Start the Sensing Science program.
5. Click on the *Timing* button. The computer automatically determines which probe is attached.
6. You need to press the *New* button in the top left hand corner next to the red arrow. This sends you through a series of screens that allow you to set up what you want to measure.
7. Screen 1- choose *Velocity*
Next.
8. Screen 2- choose *Velocity at A or B*
input the length of the card that will pass through the light gates
Next.
9. Screen 3- choose *Repeated events*
Table
Finish.

Interpreting results

For each collision you will have four data values. Two from gate A and two from gate B. The first of A and B is before the collision and the second of A and B for after the collision.

Care must be taken to prevent the gliders from bouncing off the end of the track and returning back through the light gates again.

Since the program has already calculated the speed it is simple to calculate momentum before and after the collision.

All other types of collisions can also be investigated using a similar procedure.

Experiment 3

Syllabus reference 8.2.3

- plan, choose equipment or resources for and perform a first-hand investigation and gather information to model the inverse square law for light intensity and distance from the source.

Resources

Data logger
Light intensity probe
Torch
Metre rule

Method

1. Shine the torch at the light intensity probe of the data logger.
2. Take readings of light intensity at increasing distances from the probe.

Data Logger set-up

This experiment will use the data logger remotely

1. Turn the data logger on by pressing the *Enter* button and make sure the LCD screen says *Easylog enter to begin*.
2. Use the arrow button, below the *Enter* button, to scroll through the various modes until you reach *Snapshot*.
3. Plug the light intensity probe into the number 1 port.
4. When you are ready to begin recording press *Enter*. Each time you press *Enter* it records the light intensity.
5. When you finish press *stop*.
6. Use the arrow to scroll back to *Easylog enter to begin*.
7. Plug the data logger into the computer.
8. Open the Sensing Science program and choose *Graph*.
9. Click on the Collect Remote button in the bottom right corner.
10. A screen comes up with all the remote data that has been saved on the data logger. Choose the one that you want and then click *Retrieve*.
11. The graph of the information comes up immediately.
12. To change the scale click *Display* then *Auto scale*.
13. To change the X-axis click *Display* then *Display Wizard* then in the X- axis choose *Reading number*.

Obviously this experiment is best carried out in a darkened room. The students should design the experiment themselves. They usually choose distances that are too large and then redesign their method, excellent results are obtained by increasing the distance by 2 cm at a time from 0 - 20 cm. To highlight the features of a laser the experiment can be repeated with a laser pointer with good results.

Experiment 4

Acceleration due to gravity

Syllabus reference 9.2.1

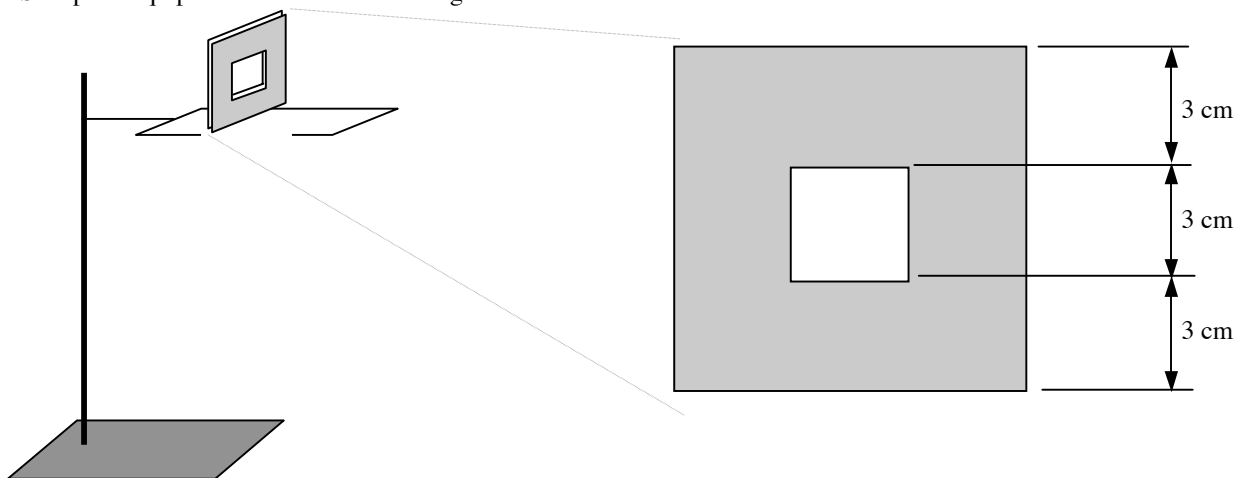
perform an investigation and gather information to determine a value for the acceleration due to gravity using pendulum computer assisted and /or other strategies to explain possible sources of variations from the value 9.8 ms^{-2} .

Resources

Data logger
Light gates
Cardboard

Method

1. Set up the equipment as shown in the diagram.



2. Set up the data logger for measuring acceleration.
3. Start the data logger,
4. Release the cardboard so that it falls through the light gate. (The closer the cardboard to the light gate the more likely it is to fall through without tilting in any direction)

Data Logger set-up

1. Turn the data logger on by pressing the enter button and make sure the LCD screen says *Easylog enter to begin*.
2. Plug the data logger into the computer. From this moment all control of the logger is made using the computer, do not press any of the buttons on the logger.
3. Plug the light gate into the number 5 digital port.
4. Start the Sensing Science program.
5. Click on the *Timing* button. The computer automatically determines which probe is attached.
6. You need to press the *New* button in the top left hand corner next to the red arrow. This sends you through a series of screens that allow you to set up what you want to measure.
7. Screen 1- choose *Acceleration*
Next.
8. Screen 2- chooses *Acceleration at A*.
input the length of the segments that will pass through the light gates
Next.
9. Screen 3- choose *Repeated events*
Table
Finish.
10. Carry out the experiment as many times as you like. The table shows the acceleration.
11. To show the average value, highlight all the values then go to the *Analyse* menu at the top of the screen and select *Average*. The average is written at the bottom left of the screen.

Two light gates can be used to measure acceleration, but for an object in free fall the likelihood of not falling through straight increases. I have had success with marbles falling through a glass tube.

Other Demonstrations

Period of the sound from a tuning fork

This uses the data logger on fast logging just like in **Experiment 1**. By using the Sensing Science Setup program you can change the sound probe from measuring loudness to measuring voltage (and hence period). Set the fast logging to 50 microseconds and 4000 samples. Once you have taken your reading click on *zoom* then select the area of the graph you wish to enlarge. This can be repeated several times to continue enlarging the selection. You then click *interval*, click and drag over one full wavelength on the graph. The period of the wave is displayed at the bottom of the screen.

Force in a collision

This also uses fast logging mode. The force sensor needs to be set to zero. Crash the air track glider into the force probe. Zoom in on the section of the graph where the collision occurred. Once again by zooming in and using the interval selector you can identify the force involved in the collision as well as the time that the force was applied. If you have found the mass and velocity of the trolley you can demonstrate $FT=mv$.