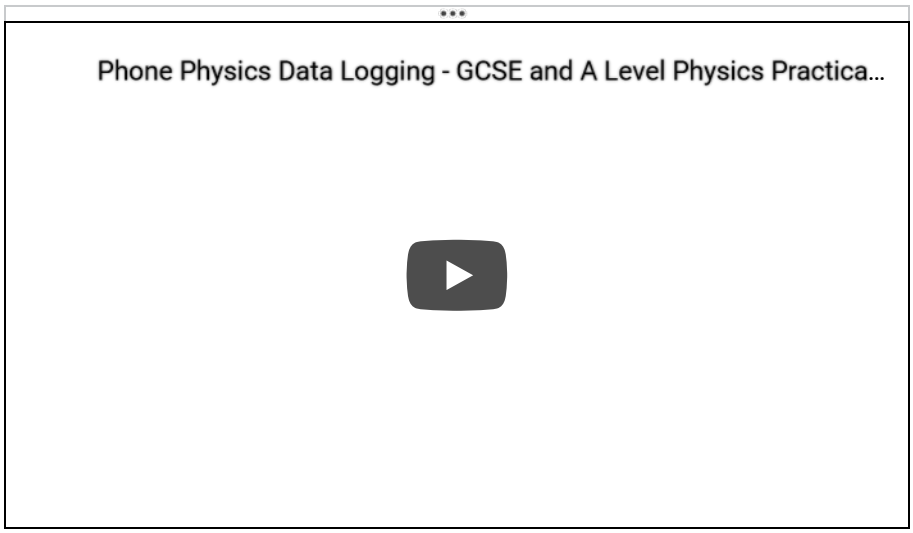
Tasks Lecture 5 - Investigating SHM

Sunday, May 31, 2020 1:09 PM

Watch the video at:
[Phone Physics Data Logging - GCSE and A Level Physics Practical Tip]



Download the free Physics Toolbox app:
https://play.google.com/store/apps/details?id=com.chrystianvieyra.physicstoolboxsuite&hl=en_GB
https://apps.apple.com/gb/app/physics-toolbox-sensor-suite/id1128914250

Experiment: You are going to make a simple pendulum out of string and some form of holder for your phone. You will vary the length of the pendulum and see how time period varies.

Setting up:

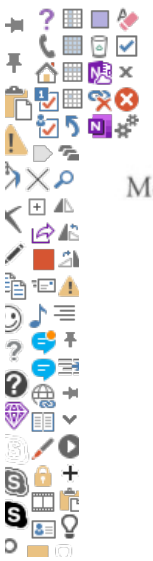
1. Make a sling to hold your phone in; this coud be as simple as a piece of card you can fold and tape together to attach to the end of the pendulum string.
2. Make sure your phone is in a case, or you are doing this over a carpeted area so that your phone will not be damaged if it drops out
3. Open the app and set it on to linear accelerometer. Move it around a little: flat, vertically and side-to-side and notice the coloured x, y and x graphs. This time you will be using the white graph which is the modulus of acceleration (a scalar version of acceleration in the three dimensions).

Analysis

1. What shape of graph do you get from the smartphone?
2. Plot a graph of length, l, versus time period, T. Think about the shape of this graph and think if there are any equations for graphs that are similar in shape to this one.
3. Now plot time period squared against length, T^2 vs l, and comment on the shape of this graph. What does this show about the relationship between the two variables?
4. Comment on the spread of data from your line of best fit on your graph. Think if there are any ways you could improve this precision. Perhaps even conduct the experiment again using this stopwatch to

   measure 10 full swings and dividing that time by 10 to give you the time period.
5. Think about where you measured your length from and to. What does this say about the validity of your results?
6. Repeat the experiment once more and allow your pendulum amplitude to decrease to near zero. Use ideas about conservation of energy to explain this decrease in amplitude. Think of ways that you could speed up this decline in amplitude or allow the Pendulum to swing for longer.

Put a screenshot of your results here:



Method

1. Decide on a range of lengths of Pendulum perhaps something between 1 m and 10 cm.
2. Hang pendulum apparatus from the longest length, start the linear accelerometer app and let your pendulum swing freely from a small angle.
3. Use the graph on the physics toolbox app to calculate a time period, which is the time taken for one full swing of the pendulum. You can pause the recording you can zoom in to one full cycle of the graph, or you could use the graph to find the time for ten full swings and divide this by ten to give you one time period. You could even export the data

and analyse it in something like Google sheets or Excel.

4. Repeat the experiment for different lengths of the Pendulum within your range, try to get at least 7 good data points.

question 5 to explain how you know that your pendulum was undergoing SHM.

Upload your answers to the questions here:

Questions

1. Apart from length what other variable do you think affects the time period of a pendulum? Hint: you may like to research the equation for time period of a pendulum.
2. Design a practical to test your hypothesis from question 1.
3. The pendulum in a grandfather clock takes two seconds to complete a full cycle, calculate the length of the Pendulum.
4. The grandfather clock from question 3 is moved to the moon. Calculate how long it takes for the second-hand to go around the clock once. The gravitational field strength on the moon is 1.6N/kg.
5. Sketch a graph of displacement vs time, then velocity vs time, then acceleration vs time for a simple pendulum through 3 full swings. Comment on the shape of these graphs.
6. Look back at your notes for analysis point 6. You should have seen the graph continue sinusoidally with a decreasing amplitude. How does the time period change over this decline in amplitude? This decline in amplitude is called damping; by research define damping and suggest two examples of when it would be beneficial to damp periodic motion.
7. Pendulums are an example of periodic Simple Harmonic Motion

(SHM). Use research to define SHM and use you graphs from