

Further Science coursework

by Joseph Gauntlett

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Simple Pendulums- introduction

For this experiment on simple pendulums we will be using the simple harmonic motion kit ES7 conducted in an engineering science lab. In order to achieve a successful experiment, we have been given the motion kit itself as well as a handout booklet that includes tables to fill out and a list of experimental procedures to follow. The procedures booklet included a diagram to construct the steps listed that need to be taken in order to complete the experiment.

What makes a 'simple' pendulum is the fact that it is a single mass(m) connected to a single piece of string at a length(l) with a single pivot point. A more advanced example of a pendulum experiment could include a second mass attached to the bottom of the first mass with a second length of string or cable. This could also include a second or third piece of string attached to both a mass and a pivot point that would limit newtons second law for rotational systems.

Experimental Procedure

Starting with the setup of the experiment we were shown figure one that needed to be replicated using some but not all of the pieces within the simple harmonic motion kit(ES7), figure one is shown below.

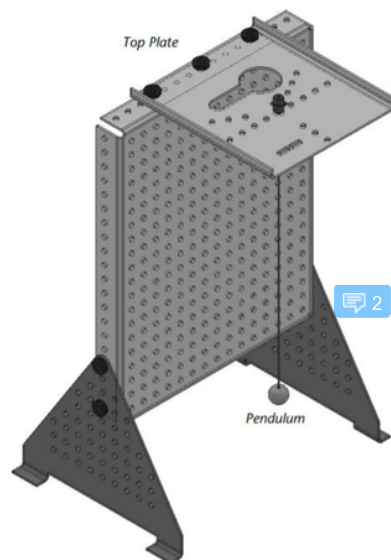


Figure 1 Experiment Setup

Citation Needed

As you can see by using a number of metal plates and screws you are able to build a self-supporting structure with top plate for the pendulum to hang from and must have enough room for the pendulum to freely swing from a starting point of 10cm (0.1m) out from the centre. Once assembled the pendulum was timed to see how long in seconds it would take to do fifty complete swings; recorded on a stopwatch, then by dividing this time by fifty it gave us an actual time per swing for each length of string, the string started at a length of 0.5m then got reduced too 0.2m in intervals of 0.05m. After the seven results are recorded in the table we moved on from using the lighter pendulum made of plastic to the heavier one with a metal ball, this followed the exact same test requirements with the same number of

swings being recorded however due to it being heavier it had a slight impacts on the results. We could have recorded data for shorter lengths of string, but the theory would suggest it's likely it would swing too fast to accurately measure with the apparatus available.

Citation Needed

For each of the lines of results collected in the table below we were given the standard $g=9.81$ as well as left open columns to find the square root of the length ($\sqrt{l}$) as well as the actual period (T); time taken for fifty swings divided by 50. This will give us all the units and measurements needed in order to calculate the theoretical period $T = 2\pi\sqrt{\frac{L}{g}}$. We were also told to use our actual T previous calculated to find $\left(\frac{T}{2\pi}\right)^2$.

Results

Results

Pendulum-Lightest

Length (l) (m)	$\sqrt{l}$	50 Swings (s)	Actual Period (T) Units	$T = 2\pi\sqrt{\frac{L}{g}}$	$\left(\frac{T}{2\pi}\right)^2$	
0.5	0.707	72.64	1.453	1.419	0.051	
0.45	0.671	66.03	1.321	1.346	0.046	
0.4	0.632	63.57	1.271	1.269	0.041	
0.35	0.592	58.1	1.162	1.167	0.034	
0.3	0.548	54.93	1.099	1.099	0.031	
0.25	0.5	51.3	1.026	1.003	0.025	
0.2	0.447	44.59	0.892	0.897	0.02	
						$g = 9.81$

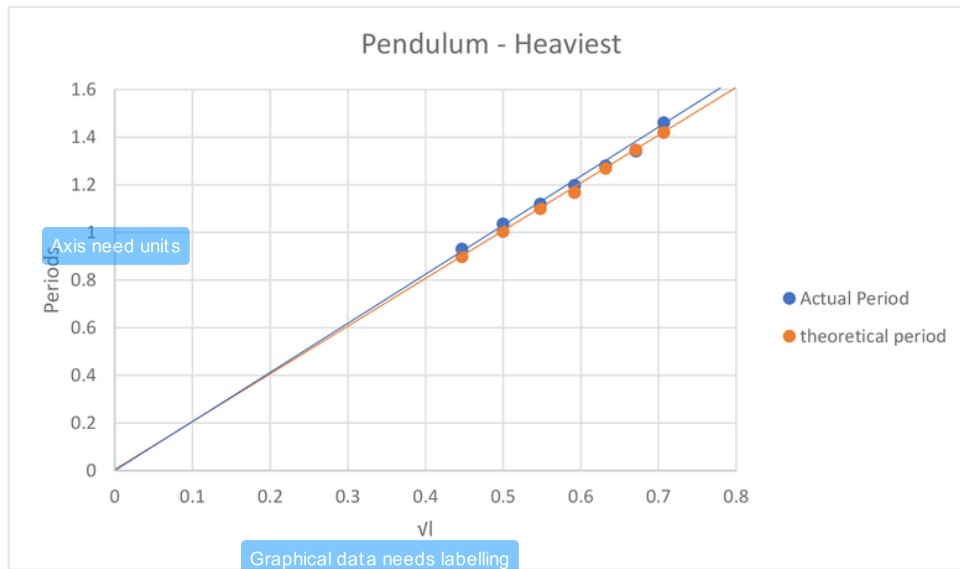
Table needs labelling

Pendulum-Heaviest

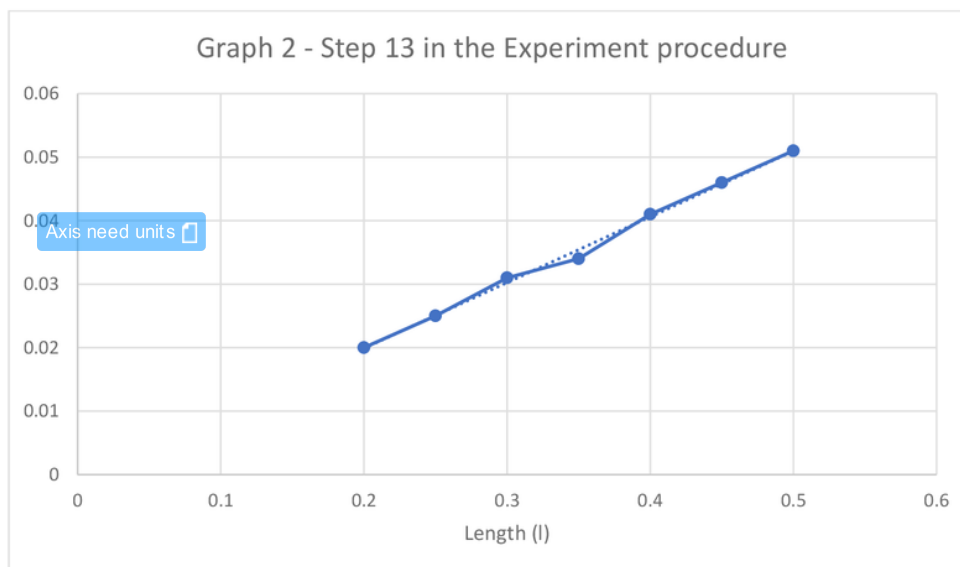
Length (l) (m)	$\sqrt{l}$	50 Swings (s)	Actual Period (T)	$T = 2\pi\sqrt{\frac{L}{g}}$	$\left(\frac{T}{2\pi}\right)^2$	
0.5	0.707	73	1.46	1.419	0.051	
0.45	0.671	67.04	1.341	1.346	0.046	
0.4	0.632	63.97	1.279	1.269	0.041	
0.35	0.592	59.83	1.197	1.167	0.034	
0.3	0.548	55.94	1.119	1.099	0.031	
0.25	0.5	51.74	1.035	1.003	0.025	
0.2	0.447	46.49	0.93	0.897	0.02	
						$G=9.81$

Table needs labelling

As you can see by the results the heavier pendulum took just a fraction longer to complete the fifty full swings then the lighter plastic alternative. Following the experiment procedure steps, we're instructed to create two graphs using the results from the heavier pendulum. This is assumed to be since heavier pendulum inevitably was closer to the theoretical period.



As you can see from the gradient lines of best fit, the lower length of the string on the heavy pendulum the closer the actual period is too the theoretical period. This suggests that if the experiment conditions enabled us to continue with shorter lengths of string beyond the 0.2m stopping point the actual period would be increasingly closer to the theoretical period; much like if the conditions were extended to measure longer lengths of string the actual period would further deviate from the theoretical period. However as previously stated shorter lengths of string would be harder to measure accurately so therefore the experiment ended at 0.2m.



For Graph 2 in order to calculate the gradient you divide the change in two x values by the change in two y values in this equation $\frac{x_2 - x_1}{y_2 - y_1} = G = \frac{0.5 - 0.2}{0.051 - 0.02} = 9.677$

Theoretical gradient; 9.81. Actual Gradient; 9.677



Analysis

The lack of deviation between the theoretical gradient and the actual gradient shows that the controlled variables of the experiment were well contained that helped achieve accurate results with no discrepancies. Although these discrepancies may not directly affect the gradient it would show on the graph 2 where the gradient line; presented by the dotted line, would have a point that is significantly diverged from the gradient line. With the gradient of the actual period we are able to calculate the equation of the line by using $y=mx+c$ where m is your gradient and c is the constant that can be calculated by subbing in the values you've previously acquired.

Citation Needed

This shows that no matter the weight of the pendulum the shorter the length of the rope the less time taken in order to complete fifty swings. In this example the lighter of the two pendulums took the least amount of time to complete the full fifty swings, however I think with further testing you'd reach a point in which the ball would take longer then heavier options. A way to test that would be to retry this with a polystyrene ball as well as ping pong ball, this would create an extra control variable to be able create a more detailed account of factors affecting swings of simple pendulums.

Citation Needed

A way to test that

Conclusion

Conclusion

In conclusion, using the ES7 Simple Motion pack we were able to follow out an accurate experiment within the controlled variables in order to produce a set of results that are within an acceptable degree of accuracy close to the theoretical values calculated. This enabled the creation of two tables of which covers the results of both the lighter and the heavier pendulum experiments. With use of the heavier pendulums results, I was able to create two graphs showing the similarities between the calculated values of the heavier pendulums against the theoretical values of a pendulum.

In order to create more accurate results and eliminate extraneous variables it would be achieved by having more than one person counting the swings to eliminate human error as well as having more people timing the completion of fifty swings in which a mean can be created for the table of results.

Improvements could be gained by using a multitude of different experiments into simple harmonic motions as well as complicated motions. As previously mentioned with the addition of another tether point it would insight into how weight displacement affects the swings.



Evaluation

Further work

Bibliography

Further Science coursework

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

40/100

PAGE 1

QM

Title Page | Skills Prof P

All assignments you submit to this university need a title page, this must include, the title of the assignment, your name, your module, your programme and the lecturers name.

QM

Contents page | Skills Prof P

All professional reports you submit need a contents page.

QM

Chapter numbering | Skills Prof P

Technical reports need to have numbered chapters e.g 1.0 Introduction, 2.0 Research, 2.1 Background etc

QM

Justify text both sides of the page | Skills Prof P



Comment 1 | K & U

What are you expecting to find?



Comment 2 | Practical

It would have been good to label some of this equipment up.

QM

Citation Needed | Literature

Cite Source:

Please use the link below to find links to information regarding specific citation styles:
http://www.plagiarism.org/plag_article_citation_styles.html



Comment 3 | Skills Prof P

Like swimming?

PAGE 2



Comment 4 | Practical

I think bullet points would make this more readable.

QM

Citation Needed | Literature

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

http://www.plagiarism.org/plag_article_citation_styles.html

Additional Comment Use the guidelines as the citation.



Comment 5 | Practical

This stuff should be in the analysis as it is not experimental procedure.

QM

Results | Skills Prof P

Results chapter should only include the raw data from your experimental procedure and the spread sheet should go into your Analysis chapter.



Comment 6 | Cognitive

This column needs a better label.

QM

Units | Cognitive

Every column needs units.

QM

Table needs labelling | Skills Prof P

Tables should be labelled 'Table 1:Title (citation)' underneath the object and then referred to accordingly in the text.

QM

Table needs labelling | Skills Prof P

Tables should be labelled 'Table 1:Title (citation)' underneath the object and then referred to accordingly in the text.

PAGE 3



Comment 7 | Skills Prof P

This should be in your analysis chapter.

QM

Axis need units | Cognitive

QM

Graphical data needs labelling | Skills Prof P

Graphs should be labelled 'Figure 1:Title (citation)' underneath the object and then referred to accordingly in the text.



Comment 8 | Skills Prof P

Shorter?

QM

Axis need units | Cognitive

Additional Comment This graph is meaning less since this axis has no label.



Comment 9 | Cognitive

Excel can do this for you more accurately.



Comment 10 | Cognitive

Units?

PAGE 4



Comment 11 | Cognitive

Great value, shame about the units!

QM

Citation Needed | Literature

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

http://www.plagiarism.org/plag_article_citation_styles.html

QM

Citation Needed | Literature

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

http://www.plagiarism.org/plag_article_citation_styles.html

QM

Citation Needed | K & U

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

http://www.plagiarism.org/plag_article_citation_styles.html

Additional Comment Why would you speculate without evidence?

QM

Conclusion | K & U

What you should have done here is research other people who have conducted a similar experiment and then quoted their findings to give your work credibility.



Comment 12

Your analytical work has turned out well, although I think you could have demonstrated your understanding better through citing similar experiments with the same findings. Generally you have much to improve on in terms of your report writing skills, have you looked at the handbook on Moodle?

QM

Evaluation | Skills Prof P

This is where you talk about eliminating errors as far as possible.

Additional Comment Chapter missing

QM

Further work | Skills Prof P

Given unlimited time and equipment, how could you make this experiment better?

Additional Comment Chapter missing

QM

Bibliography | Skills Prof P

You needed to have more citations to justify your findings and give your work validity and you also needed to use more text books.

Additional Comment Chapter missing, although you have no evidence of external reading, unacceptable in university.

LITERATURE

0 / 0

Engagement with literature (including reading, referencing, academic conventions and academic honesty)

FAIL 0-29% (0)	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.
UNSATISFACTORY 30-39% (0)	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.
SATISFACTORY 40-49% (0)	Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.
GOOD 50-59% (0)	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts rather than other sources. Referencing may show minor inaccuracies or inconsistencies.
VERY GOOD 60-69% (0)	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing, with no/very few inaccuracies or inconsistencies.
EXCELLENT 70-79% (0)	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.
EXCEPTIONAL 80-100% (0)	Exceptional engagement with an extensive range of relevant and credible literature. High-level referencing skills consistently applied.

K & U

0 / 0

Knowledge and understanding (Knowledge of the basic underlying concepts and principles of a subject.)

FAIL 0-29% (0)	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies.
UNSATISFACTORY 30-39% (0)	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.
SATISFACTORY 40-49% (0)	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing.
GOOD 50-59% (0)	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.
VERY GOOD 60-69% (0)	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding.

EXCELLENT 70-79% (0)	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.
EXCEPTIONAL 80-100% (0)	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles.

COGNITIVE

0 / 0

Cognitive and intellectual skills (Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)

FAIL 0-29% (0)	Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.
UNSATISFACTORY 30-39% (0)	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.
SATISFACTORY 40-49% (0)	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.
GOOD 50-59% (0)	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements.
VERY GOOD 60-69% (0)	Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.
EXCELLENT 70-79% (0)	Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements.
EXCEPTIONAL 80-100% (0)	Exceptional evaluation of the underlying concepts and principles based evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements.

PRACTICAL

0 / 0

Practical skills (Different approaches to solving problems in particular contexts.)

FAIL 0-29% (0)	Limited or no use of taught, basic methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Very weak evidence of different approaches to problem-solving in particular contexts.
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UNSATISFACTORY 30-39% (0)	Rudimentary application of taught, basic methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak evidence of different approaches to problem-solving in particular contexts.
SATISFACTORY 40-49% (0)	An adequate awareness and mostly appropriate application of basic methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Can identify problems in particular contexts and propose basic alternative approaches or solutions though there may be errors.
GOOD 50-59% (0)	A good and appropriate application of basic methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Good evidence of different approaches to problem-solving in particular contexts and proposes mostly appropriate solutions.
VERY GOOD 60-69% (0)	A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.
EXCELLENT 70-79% (0)	An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.
EXCEPTIONAL 80-100% (0)	Exceptional levels of application and deployment skills in particular practical contexts. Outstanding identification of problems in particular contexts and formulation of wholly appropriate, thoughtful solutions / different approaches.

SKILLS PROF P

0 / 0

Transferable skills for life and professional practice (Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)

FAIL 0-29% (0)	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.
UNSATISFACTORY 30-39% (0)	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.
SATISFACTORY 40-49% (0)	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.

GOOD 50-59% (0)	Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with some areas of strength and some of minor weakness.
VERY GOOD 60-69% (0)	Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.
EXCELLENT 70-79% (0)	Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility with an appetite for further development.
EXCEPTIONAL 80-100% (0)	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team, with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development.