



## 2026 Sec 3 Physics Weighted Assessment 2

### Term 3 WA2 – Investigative Group Project (15%)

#### 1. Learning Outcomes

Students are able to:

- plan investigations, select techniques, apparatus and materials
- carry out an investigation to determine the relationship between 2 physical quantities
- evaluate methods and suggest possible improvements

#### 2. Task

In groups of 3 students (max two groups of 4), design, carry out and evaluate an investigation to determine the relationship between two physical quantities and present your findings in a report.

#### 3. Objectives of the Investigative Group Project

- (a) Select an interesting problem to investigate. Suggest how this problem is relevant to daily life / a real-world application.
- (b) Plan and carry out an investigation to demonstrate that you are able to:
- identify suitable variables in a problem
  - outline an experimental procedure to investigate the problem
  - select appropriate apparatus and techniques to measure these variables
  - tabulate and present experimental data with appropriate headings, and to an appropriate number of d.p / s.f.
  - plot a graph to illustrate the relationship between two variables
  - analyse the results and state a suitable conclusion
  - identify significant sources of error and suggest possible improvements to overcome or reduce these significant errors

**Reference:** *Physics GCE O Level Syllabus Practical Assessment*

#### 4. Guidelines

##### (a) Grouping

- Each group has 3 or 4 students.
- Appoint a responsible member to be the group leader.

##### (b) Choice of Topic & Project Proposal

- Do research, discuss and decide on a suitable topic of investigation.
- **Example:** The period of a pendulum depends on the mass of the pendulum.
- *Your investigation should **not** involve **the simple pendulum**.*
- *Your investigation should **not** be one that is **similar to any of the Sec 3 Physics** practical or directly reproduced from an Upper Secondary Physics textbook.*
- By **Term 3 Week 1 Friday 3 July 2026**, your group should have chosen a suitable topic, identified the Independent and Dependent Variable, and apparatus list and seek approval from your subject teacher.

##### Example:



- **Topic:** *The relationship between the period of a simple pendulum and the mass of the bob*
- **Independent variable:** *mass of the bob, measured with an electronic balance*
- **Dependent variable:** *period of the oscillations, measured with a stopwatch*
- **Apparatus list:**
  - *6 pendulum bobs of varying masses*
  - *1 electronic scale*
  - *thread*
  - *1 metre rule*
  - *1 retort stand with boss and clamp*
  - *1 brick to act as weight*
  - *1 split-cork*
  - *1 stopwatch*

**Note:** avoid investigating the same topics as other groups in the same class

##### (c) Investigation and Report

- Carry out the investigation.
- Write a report that includes all sections 1 to 11 (as delineated in **Annex A**).
- Submit this final report via *Google Form* by **23:59 h on the Submission Deadline, 12 August 2026 (Wednesday, Week 7)**.
- Refer to the sample given in **Annex B**.

5. Timeline for WA2

Week	Date (Day)	Tasks	Remarks
T3 W1		Study the requirements of WA2 (in S3 Physics Google Classroom) including: <ul style="list-style-type: none"> <li>Annex A – Sections of an Investigation Report</li> <li>Annex B – Sample Investigation Report</li> <li>Annex C – Rubrics</li> </ul>	Your physics teacher will clarify details and questions on WA2.
Term 3 Week 1		<ul style="list-style-type: none"> <li>Meet your group, choose a suitable topic, do research, choose a suitable topic and draft a plan for the investigation.</li> <li>Submit the plan to your teacher</li> </ul>	Refer to guidelines for details.
T3 W2	By 9 July (Thu)	<ul style="list-style-type: none"> <li>Approval of topic by your physics teacher.</li> </ul>	Teachers will only give feedback on suitability of the variables.
Term 3 Week 2 to Week 7		<ul style="list-style-type: none"> <li>Carry out the investigation once the draft plan is approved</li> <li>Learn to plot scatter-plot on Excel using these websites:               <ul style="list-style-type: none"> <li>▶ <a href="https://physics.shone.sg/notes/basics/best-fit-line-with-excel/">https://physics.shone.sg/notes/basics/best-fit-line-with-excel/</a></li> <li>▶ <a href="http://phyglossary.pbworks.com/w/page/148928511/using_Excel">http://phyglossary.pbworks.com/w/page/148928511/using_Excel</a></li> </ul> </li> <li>Write the final investigation report</li> </ul>	  
T3 Week 7	12 Aug Wed	<ul style="list-style-type: none"> <li>Complete and submit the final investigation report via <i>Google Classroom</i> by <b>23:59 h on 12 Aug 2026</b></li> </ul>	Link to Google Classroom will be provided by your Physics Teacher.  Submission by group leader.

## 6. FAQs

(a) What are some investigations that I should avoid?

- *Avoid experiments that do not involve physical quantities, are not physics topics, or cannot be verified using the scientific method.*

(b) Can I borrow apparatus from the lab?

- *No apparatus can be loaned out from any Science Laboratory for this WA2.*
- *You are encouraged to design your experiment with apparatus/materials that can be easily obtained or already available.*

(c) Will there be a session for us to use the apparatus in the lab?

Yes, the Physics teachers will open up the Physics Labs for a number of afternoons in Week 4 & Week 5 for those who really need to make use of Physics equipment/apparatus.

- *Some apparatus metre rule, digital callipers, digital micrometer screw gauge, electronic balance, spring balance, slotted masses, voltmeter, ammeter, dry cells, rheostat, connecting wires and thermometer.*

## Annex A: Sections of an Investigation Report

1. **Objective of experiment**
2. **Independent variable (IV)** (State 1 physical quantity)  
**Dependent variable (DV)** (State 1 physical quantity)  
**Variables to be kept constant (CV)** (State at least 2 physical quantities)
3. **List of apparatus and instruments needed**
4. **Diagram or photo of setup with clear labels**
5. **Procedure** (in numbered points)
6. **Table of results**
7. **Graph** (Use Excel and display equation for trendline)
8. **Discussion of results and conclusion**
9. **Significant sources of errors** (State at least 2)
10. **Areas for improvement** (State at least 1)
11. **A relevant real-world application or observation**  
(May be stated at the beginning or the end of the report)

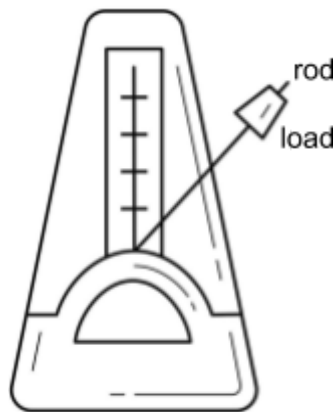
*Refer to [Annex B](#) for a sample of the details expected in each section of the draft plan and report.*

## Annex B: Sample Investigation Report

### **Real-world observation:**

- A metronome is a device used by musicians to set a regular beat when a rod is put into oscillation. The period of the rod can be increased by moving a load higher along the length of the rod.
- A metronome behaves like an inverted pendulum
- Our group would like to investigate if the period of the oscillations is also related to the mass of the load.

*Note to students: alternatively, you may also state an application of the investigated relationship at the end of the report*



A metronome

### **Objective of experiment:**

- To investigate the relationship between the time taken for a pendulum to complete one oscillation and the mass of the bob.

**Independent variable:** Mass of pendulum bob,  $m$

**Dependent variable:** Period of pendulum,  $T$

**Constant variables:** Length of pendulum,  $L$  and diameter of the pendulum,  $d$

### **List of apparatus:**

- 6 pendulum bobs of varying masses
- 1 electronic scale
- thread
- 1 metre rule
- 1 retort stand with boss and clamp
- 1 brick to act as weight
- 1 split-cork
- 1 stopwatch

### Diagram of set up:

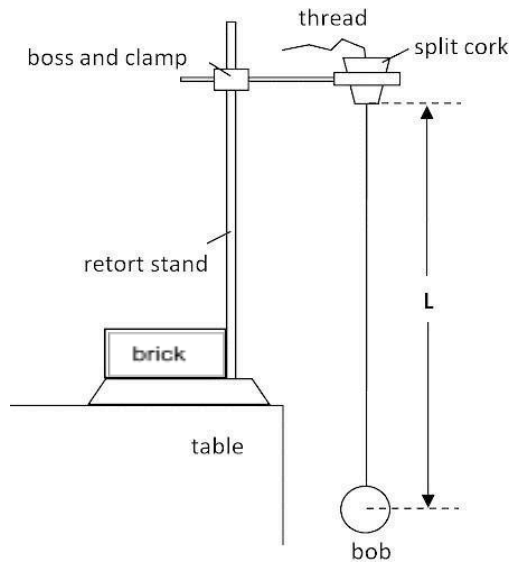


Figure 1

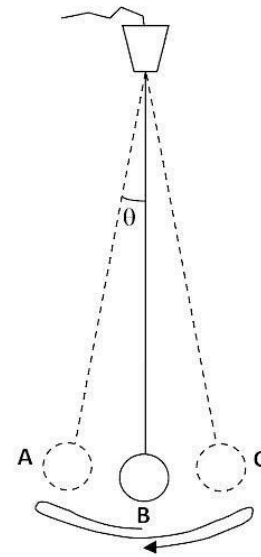


Figure 2

### Procedure:

1. Set up apparatus as shown in Figure 1 on a levelled surface.
2. Measure the diameter of the bob,  $d$  with the ruler and record it.
3. Measure the mass of the pendulum bob,  $m$  using an electronic balance and tabulate it as  $m$ .
4. Measure the length of the pendulum,  $L$  with a metre rule and record it. This length will be kept constant throughout the experiment.
5. Displace the pendulum bob slightly. The angular displacement  $\theta$  should be less than  $5^\circ$ .
6. Confirm that oscillations are regular then start to time for 20 oscillations using a stopwatch. Use the vertical pole of the retort stand as a reference line when counting.
7. Record the time for 20 oscillations as  $t_1$ .
8. Repeat steps 5 to 7 for the same mass of pendulum bob and record the time as  $t_2$ .
9. Calculate the average of  $t_1$  and  $t_2$  to obtain the average time,  $\langle t \rangle$ .
10. Divide  $\langle t \rangle$  by 20 to obtain the period of a single oscillation,  $T$ .
11. Repeat steps 4 to 10 for pendulum bobs of 5 different masses.
12. Record all data in a table.
13. Plot a graph of  $T$  against  $m$ .
14. Draw a conclusion about the relationship of  $T$  and  $m$ .

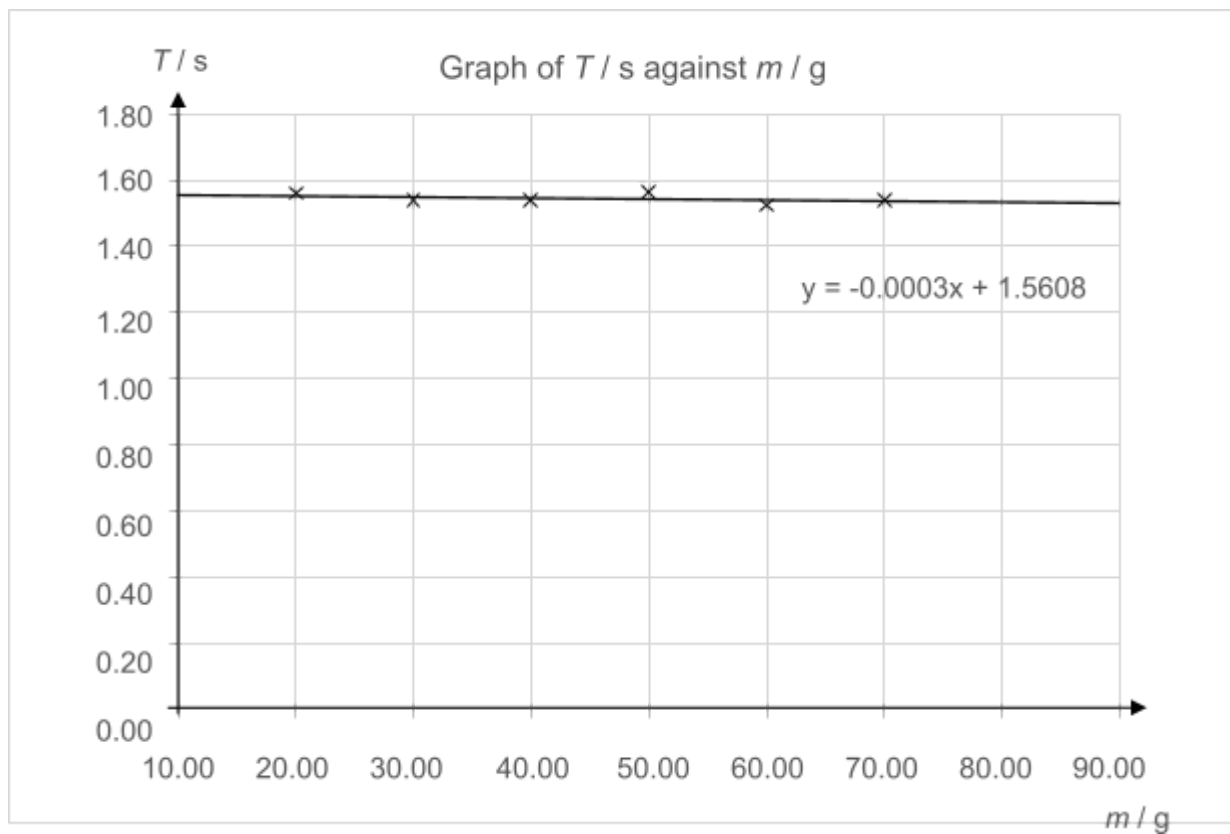
**Table of results:**

Diameter of pendulum bob,  $d = 1.8 \text{ cm}$

Length of pendulum,  $L = 60.0 \text{ cm}$

$m / \text{g}$	$t_1 / \text{s}$	$t_2 / \text{s}$	$\langle t \rangle / \text{s}$	$T / \text{s}$
20.00	31.0	31.4	31.2	1.56
30.00	30.9	30.7	30.8	1.54
40.00	30.5	31.1	30.8	1.54
50.00	31.2	31.4	31.3	1.57
60.00	30.8	30.3	30.6	1.53
70.00	30.9	30.7	30.8	1.54

**Graph:**



**Discussion of results:**

1. *The trendline indicates a gradient of - 0.0003 which is very close to 0. This means that the value of  $m$  hardly affects  $T$ .*
2. *From the table of data, it can be seen that the period measured for different values of  $m$  are all around 1.5 s to 1.6 s.*

**Conclusion:**

*The graph shows no apparent relationship between the two variables. This suggests that the period of the pendulum's oscillation is independent of the mass of the pendulum bob.*

**Significant sources of error:**

1. *The precision of the ruler is not suitable for measuring the diameter of the pendulum bob.*
2. *The pendulum bobs obtained may differ slightly in their dimensions and hence affect the length of the pendulum for the different trials.*

**Areas for improvement:**

1. *Use a pair of digital callipers or digital micrometer screw gauge to measure the diameter of the pendulum bob instead of a metre rule to improve the precision of the values of  $d$ .*
2. *Measure the diameter of each pendulum bob. Divide the value by 2 to determine radius and the centre of the bob. Mark out the centre of the pendulum bob and ensure that  $L$  measured to the centre of the bob is kept constant.*

## Annex C: Rubrics (MAX SCORE 25)

Late submission of any part of the project will result in penalties as indicated in the student handbook.

Score Criteria	0	1	2	3
<b>Choice of apparatus &amp; Diagram of setup</b>	<i><b>NONE</b> of the following is satisfied</i>	<i>Only <b>ONE</b> of the following is satisfied</i>	<i><b>Most</b> of the following are satisfied</i>	<i><b>ALL</b> of the following are satisfied and</i>
	<input type="checkbox"/> Key apparatus is/are listed and appropriate for use. <input type="checkbox"/> Diagram and/or photo of the setup is accurate and clear in showing how measurements are made. <input type="checkbox"/> Diagram and/or photo of the setup is fully and correctly labelled.			
<b>Variable</b>	<i><b>NONE</b> of the following is satisfied</i>	<i>Only <b>ONE</b> of the following is satisfied</i>	<i>Only <b>TWO</b> of the following are satisfied</i>	<i><b>ALL</b> of the following are satisfied</i>
	<input type="checkbox"/> Dependent, independent variables are identified correctly. <input type="checkbox"/> Constant variables are identified correctly. <input type="checkbox"/> Constant variables are ensured to remain constant throughout the experiment (can be mentioned in procedure)			
<b>Procedure</b>	<i><b>NONE</b> of the following is satisfied</i>	<i>Only <b>ONE</b> of the following is satisfied</i>	<i>Only <b>TWO</b> of the following are satisfied</i>	<i><b>ALL</b> of the following are satisfied</i>
	<input type="checkbox"/> Measure the independent variable using an appropriate apparatus. <input type="checkbox"/> Describe the step(s) of experiment to measure the dependent variable (directly or indirectly). <input type="checkbox"/> Steps taken to improve accuracy of results. / Precautions taken while executing the experiment.			
<b>Table of Results</b>	<i><b>THREE or more errors</b></i>	<i>Only <b>TWO</b> errors</i>	<i>Only <b>ONE</b> errors</i>	<i><b>NO</b> errors</i>
	Recording & presentation of results <input type="checkbox"/> headers (symbols, units). <input type="checkbox"/> decimal place (d.p.) of raw data recorded. <input type="checkbox"/> decimal place (d.p.) or significant figures (s.f.) of processed data. <input type="checkbox"/> at least 6 sets of data over a suitable range.			
<b>Graph</b>	<i><b>None</b> of the following is satisfied</i>	<i>Only <b>ONE</b> of the following is satisfied</i>	<i>Only <b>TWO</b> of the following is satisfied</i>	<i><b>All</b> of the following are satisfied</i>
	<input type="checkbox"/> Axes of the graph are labelled with correct physical quantities and units. <input type="checkbox"/> The trendline chosen to represent the relationship between the independent & dependent variables is appropriate & the equation is displayed. <input type="checkbox"/> Values of interval are clearly stated.			
<b>Analysis of Results and Conclusion</b>	<i><b>None</b> of the following is satisfied</i>	<i>Only <b>one</b> of the following is satisfied</i>	<i><b>Both</b> of the following are satisfied</i>	
	The relationship between the independent and dependent variables <input type="checkbox"/> is clearly stated. <input type="checkbox"/> is correct based on evidence from the data and graph.			
<b>Sources of error</b>	<input type="checkbox"/> Sources of error are not significant, incorrect or discussed briefly.	<input type="checkbox"/> At least one significant source of error is explained clearly.	<input type="checkbox"/> Two significant sources of error are explained clearly.	

Score Criteria	0	1	2	3
<b>Areas for improvement</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Areas for improvement are trivial, incorrect or discussed briefly.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> At least one area of improvement is explained clearly.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Two possible areas for improvements are suggested clearly (to overcome or reduce at least one of the significant sources of error.)</li> </ul>	
<b>Real-world observation or application</b>	No apparent relationship between the investigation and the suggested observation or application.	Suggested real-world observation or application is related to the investigation. (diagram not required)		
<b>Communication and Presentation</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Report lacks clear structure or headings.</li> <li><input type="checkbox"/> Language is often informal or vague, and frequent grammatical errors or typos make the report difficult to follow.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Report is well organised with clear headings.</li> <li><input type="checkbox"/> Free of major grammatical errors and typos.</li> </ul>		
<b>Peer evaluation</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Requires constant reminder/assistance to complete their allocated task/role</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Requires minimal reminder to complete their allocated task/role</li> <li><input type="checkbox"/> Good team player</li> <li><input type="checkbox"/> Good individual contribution</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Excellent team player</li> <li><input type="checkbox"/> Excellent individual contribution</li> </ul>	