

## Controlled Assessment – Additional Science / Physics ISA PU2.x

### Friction (Specimen)

For use from May 20xx to April 20xx

#### Teachers' Notes

#### This ISA relates to Additional Science / Physics Unit 2: P2.1.3 Forces and braking

A vehicle's braking distance can be affected by adverse road and weather conditions and poor condition of the vehicle

#### Overview

Candidates should:

- develop hypotheses and plan practical ways to test them
- make risk assessments and manage risks when carrying out practical work
- collect, process, analyse and interpret primary and secondary data, including the use of appropriate technology to draw evidence-based conclusions
- review methodology to assess fitness for purpose, and review predictions in light of outcomes.

The teacher should describe the context in which the investigation is set and outline the problem that is to be investigated.

Candidates need to develop their **own** hypothesis. They should research **two** possible methods to investigate it, and develop a detailed plan for one of these methods.

Once the candidates have researched and written up their own plan in the first part of the ISA they should carry out their investigation providing that it is workable, safe and manageable in the laboratory.

Candidates then take Section 1 of the ISA, which contains questions about their research and their plan.

Candidates then carry out experimental work and process their results.

After this, candidates take Section 2 of the ISA, in which they analyse their results and use data selected from a data sheet of secondary data to comment on the outcomes of their experimental work.

#### Risk Assessment

It is the responsibility of the centre to ensure that a risk assessment is carried out.

## Stage 1 – Planning research (Limited control)

Candidates should be given the opportunity to carry out an investigation concerning friction. This should be set in a context by the centre. Examples of suitable contexts could include, eg the design of car tyres or road surfaces. Whichever context is chosen, the teacher must take care to present it in such a way that it does not limit the candidates' choice of method for the investigation.

Candidates should then independently research an appropriate plan and decide for themselves factors such as the range, interval and number of repeat readings that they should take, and the variables that need to be controlled.

They will need to undertake independent research to identify **two** different methods that could be used. During this time they may make **one** A4 side of their **own** research notes for use during Section 1 of the ISA. The sheet for making these notes is attached.

Candidates may use technology such as the Internet or CD-ROMs, textbooks or any other appropriate sources of information for their research.

Candidates should also research the context of this investigation to find out how the results of their experiment might be useful in the specified context.

There is no set time allocation for this research, but it is anticipated that it should take no longer than 3 hours of work. This research may be done in the laboratory or elsewhere.

The teacher should check and sign these notes before allowing the candidate to use them during the completion of Section 1 of the ISA. The candidate may use these notes while completing Section 1 and Section 2 of the ISA. When the candidate has completed Section 2, the notes should be stapled to the ISA.

## Stage 2 – Reporting on the planning research (High control)

**For this stage, candidates must work individually under direct supervision.**

After candidates have completed their research they should be given Section 1 of the ISA and should work on their own, under controlled conditions, to answer it. Candidates may take brief notes of up to **one** A4 side of their **own** research into the formal assessment period. These must be checked to ensure they do not contain plagiarised text, detailed planning grids or a pre-prepared draft.

**Section 1 requires candidates to:**

- report on their research into how to test the hypothesis they have made
- outline two possible methods from their research to investigate their hypothesis
- give reasons for why one method is preferable to the other
- write a detailed plan of their chosen method
- identify possible hazards and write down how the risks may be minimised
- draw a suitable blank table in which the results could be recorded for the method they have planned.

Candidates may choose to use technology to draw the table, eg a computer spreadsheet. **This must be done under the direct supervision of the teacher.** It should **not** be stored, but should be printed immediately and attached to the ISA paper.

While answering Section 1 of the ISA, candidates must **not** be allowed to use textbooks, the Internet or any other source of help apart from (a maximum of) **one** A4 side of their **own** research notes.

### **Stage 3 – Practical work (Limited control)**

**For this stage, candidates may work individually or in groups.**

Candidates may work in groups to carry out their plans, but each candidate must contribute to the collection of data.

Candidates may use appropriate technology during the practical work, eg data loggers or sensors. If the teacher deems that the plan provided by the candidate is unworkable, unsafe or unmanageable or for any other reason unsuitable, then the teacher may provide a plan. An example of a suitable plan is attached to these notes.

The teacher may also provide a blank table for the results if the table produced by the candidate is inadequate. In such cases the candidate would not be able to score full marks for producing a table.

### **Stage 4 – Processing primary data (High control)**

**For this stage, candidates must work individually under direct supervision.**

Candidates should be given back their table of results, and be asked to display these on a bar chart or line graph. Candidates must decide for themselves which format is the more appropriate for any particular investigation. Candidates may use appropriate technology to do this, eg a graph-drawing program on a computer.

If a candidate chooses to use a computer, this must be under the direct supervision of the teacher and the bar chart or line graph must be printed straight away.

Candidates must not be allowed to take their results and chart or graph away, the teacher must collect them at the end of the lesson.

### **Stage 5 – Analysing results (High control)**

**For this stage, candidates must work individually under direct supervision.**

Candidates take Section 2 of the ISA.

They require:

- a copy of the question paper
- a copy of the AQA supplied Data Sheet
- their own table of results
- their own chart or graph
- their A4 sheet of research notes.

The teacher should have recorded the marks for each candidate's table and chart or graph before these are given back. This ensures that a candidate cannot gain an unfair advantage by making any alterations to them at this stage.

AQA provides the Data Sheet of secondary data. In Section 2 of the ISA, candidates are required to select and process data from the sheet.

Candidates' work must not be annotated, either by the teacher or the candidate, with additional information which would give them an unfair advantage during the ISA, eg the use of the terms independent/dependent variable.

**Section 2 requires candidates to:**

- analyse their own results
- draw a conclusion
- match their results to the manufacturer's hypothesis
- evaluate the method of collection and the quality of the resulting data
- analyse secondary data drawn from the same topic area as their experimental work
- relate their findings to the context set in the ISA.

If the teacher deems that the plan provided by the candidate is unworkable, unsafe or unmanageable or for any other reason unsuitable, then the teacher may provide a plan. The following is an example of a method that could be supplied by the teacher.

### **Preparation for Example Method**

Teachers will need to experiment first to find the most appropriate mass and elastic band to use. At least three different types of surface should be available, and preferably five.

These could be, for example:

- the bench surface
- cardboard
- lino
- carpet
- cloth

Strips of these materials may be laid on the bench to provide a different textured surface.

## **Example of a Method Sheet for Physics PU2.X Controlled Assessment.**

### **Friction**

**It is the responsibility of the centre to ensure that a risk assessment is carried out.**

Candidates should investigate how the nature of the surface affects the amount of friction.

You will need to prepare a table for the results.

#### **Apparatus List:**

1 kg mass  
Small plastic box (eg margarine tub)  
Elastic band  
G-clamps  
Ruler

#### **Method**

1. Place the 1 kg mass in the small plastic box.
2. Stretch the elastic band between two suitable fixed supports, eg 2 G-clamps, one on each side of the bench.
3. Pull the elastic band back and use it to catapult the box containing the 1 kg mass so that it slides along the bench.
4. Measure the distance travelled by the box.
5. Repeat using different types of surface.

**GCSE Science A (4405/ 4406) Additional Science (4408/4409)  
Biology (4401) Chemistry (4402) Physics (4403)**

SCA4P

AS4P

BL4P

CH4P

PH4P

Centre Number \_\_\_\_\_ Centre Name \_\_\_\_\_

Candidate's Name \_\_\_\_\_ Candidate's Number \_\_\_\_\_

Investigation Title  
\_\_\_\_\_

ISA number: \_\_\_\_\_

The notes the candidate takes into the Controlled Assessment task are to be recorded in the spaces on this sheet.

This sheet should be given to the teacher for checking before it is used in Section 1 of the ISA.

When Section 1 of the ISA has been completed, this sheet should be retained by the teacher for subsequent use with Section 2

When Section 2 of the ISA has been completed, this sheet should be stapled to it.

**Declaration**

I confirm that these are the only preparation notes used in the Controlled Assessment task.

Teacher signature

Candidate signature

Date: \_\_\_\_\_

*This form can be downloaded from Secure Key Materials in e-AQA*

**Hypothesis**

**Research sources**

**Method(s)**

**Equipment**

**Risk assessment issues**

**Relating the investigation to the context**

Centre Number						Candidate Number					
Surname						Other Names					
<b>Notice to Candidate.</b> The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.											
<b>Candidate Declaration.</b> I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.											
Candidate Signature						Date					

For Teacher's Use	
Section	Mark
Section 1 (/20)	
Section 2 (/30)	
<b>TOTAL</b> (max 50)	



General Certificate of Secondary Education

June 20xx

## Additional Science / Physics (Specimen)

### Controlled Assessment ISA PU2.x Friction Section 1

For submission on 7 May 20xx

Time allowed: up to 45 minutes

**For this paper you must have:**

- your research notes
  - a pencil and a ruler.
- You may use a calculator.

#### Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section 1** the spaces provided. You may use extra paper.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.

#### Information

- The marks for questions are shown in brackets.
- The maximum mark for this Section 1 paper is 20.
- The maximum mark for the Controlled Assessment Unit is 50.
- You are reminded of the need for good English and clear presentation in your answers.

**Details of additional assistance (if any).** Has the candidate received any help or information from anyone other than the subject teacher(s) in the production of this work? If the answer is yes give the details below or on a separate page.

Yes  No

#### Teacher Declaration:

I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date .....

As part of AQA's commitment to assist students, AQA may make your CAU available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your CAU is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns please contact AQA

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**Section 1**

Your task is to do an investigation to find out if the type of surface affects the amount of friction.

- 1 Think about the research that you carried out on this investigation.

Name the **two** most useful sources that you used for your research.

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Explain why these sources were the most useful.

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(3 marks)

- 2 Write a hypothesis about how the type of surface may affect the amount of friction.

Use information from your research to explain why you made this hypothesis.

Hypothesis.....  
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Explanation.....  
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(3 marks)





A large rectangular box containing 25 horizontal dotted lines for writing.

*(9 marks)*

4 In your research, you will have found other methods that you could have used.  
Outline **one other** method that you could have used and explain why you decided **not** to use this method.

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(3 marks)

5 You will need a table for your results.  
If you have not already produced a table for all the data that will need to be recorded, you should do so now.  
You may use technology such as ICT to do this if you wish.  
Attach your table below.  
Make sure that you hand in your A4 side of research notes and your blank table for the results with this paper.  
You will be awarded up to two marks for your table.

(2 marks)

<hr/> <b>20</b>
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**END OF SECTION 1**

Centre Number						Candidate Number					
Surname						Other Names					
<b>Notice to Candidate.</b> The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.											
<b>Candidate Declaration.</b> I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.											
Candidate Signature						Date					

For Teacher's Use	
Section	Mark
Section 1 (/20)	
Section 2 (/30)	
TOTAL (/50)	



General Certificate of Secondary Education

June 20xx

## Additional Science / Physics (Specimen)

### Controlled Assessment ISA PU2.x Friction Section 2

For submission on 7 May 20xx

Time allowed: up to 50 minutes

#### For this paper you must have:

- results tables and charts/ graphs from your own investigation
  - the Data Sheet(enclosed)
  - your research notes
  - a pencil and rule
- You may use a calculator.

#### Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section 1** the spaces provided. You may use extra paper.
- Do all rough work in this book.
- Cross through any work you do not want to be marked.

#### Information

- The marks for questions are shown in brackets.
- The maximum mark for this Section 1 paper is 20.
- The maximum mark for the Controlled Assessment Unit is 50.
- You are reminded of the need for good English and clear presentation in your answers.

**Details of additional assistance (if any).** Has the candidate received any help or information from anyone other than the subject teacher(s) in the production of this work? If the answer is yes give the details below or on a separate page.

Yes  No

#### Teacher Declaration:

I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date .....

As part of AQA's commitment to assist students, AQA may make your CAU available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your CAU is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns please contact AQA.

To see how AQA complies with the Data Protection Act 1988 please see our Privacy Statement at [aqa.org.uk](http://aqa.org.uk).

1 (a) What conclusion can you make from **your** investigation about a link between the amount of friction and the roughness of the surface?

You should use any pattern that you can see in your results to support your conclusion. You should quote some figures from your data to support your answer.

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(3 marks)

1 (b) Compare your results with those of others in your class or with your teacher's results.

1 (b) (i) Do you think that your results are **reproducible**?

Explain the reason for your answer.

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(3 marks)

1 (b) (ii) Explain how you could use repeated results such as those from the rest of the class to obtain a more **accurate** answer.

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(3 marks)

2 Think about the quality of your results.

Do you think that you got any anomalous results?

Explain your answer by quoting some data from your investigation.

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(3 marks)

3 Look at the Case Studies on the data sheet.

3 (a) Use results from the table in **Case Study 1** to sketch a graph to show the effect of the roughness of the surface on the amount of friction.



(2 marks)

3 (b) Look at Case Studies 1 to 3.

Does the data in **Case Studies 1 to 3** support or contradict **your** hypothesis for this investigation?

Give the reasons for your answer using data from these Case Studies.

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(3 marks)

3 (c) Look at Case Study 4.

Compare the data from your investigation to the data shown on this graph.

Explain how far the data shown supports or contradicts **your** hypothesis.

You should use examples from **Case Study 4** and your own investigation.

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(3 marks)

**4** A manufacturer of car tyres is investigating how to increase the friction between the tyre and the road.  
The manufacturer’s hypothesis is that the nature of the road surface will affect the friction between the road and the tyre. They think that the rougher the surface the greater the friction between the surface and the tyre.

**4 (a)** Do **your** results support or contradict their hypothesis?  
Explain your answer. You should quote some figures from your data to support your answer.

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*(3 marks)*

**4 (b)** It is very important that road surfaces provide sufficient friction for cars to be able to stop quickly in an emergency.  
Suggest how ideas from your investigation and the investigations on the Data sheet could be used by the designers of road surfaces.

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*(3 marks)*

**5** Make sure that you hand in your A4 sheet of notes, results tables, and charts or graphs with this paper.  
You will be awarded up to four marks for your chart or graph.

*(4 marks)*

**END OF QUESTIONS**

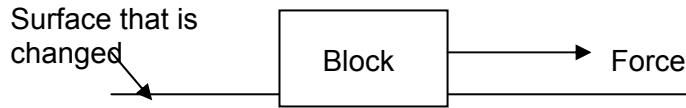
<u>30</u>
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## Data Sheet for Physics Controlled Assessment PU2.x Friction

### Case Study 1

A student carried out an investigation similar to the one you did.  
The student measured the force needed to make a block start moving on different types of surface.



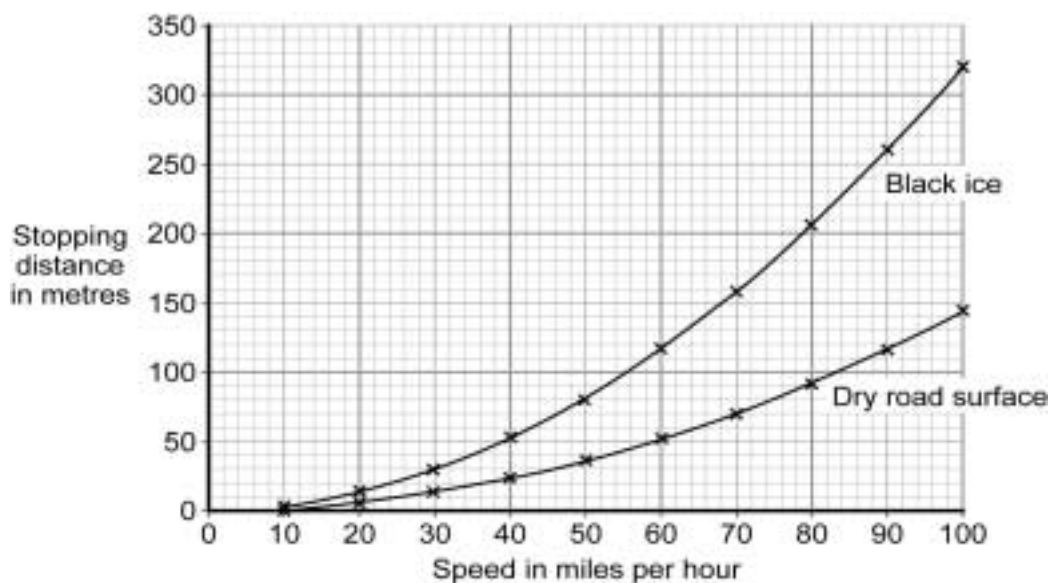
Here are some of the student's results.

Type of surface	Force needed to start block moving in newtons
Glass	2
Sandpaper	7
Wood	4
Cloth	6

### Case Study 2

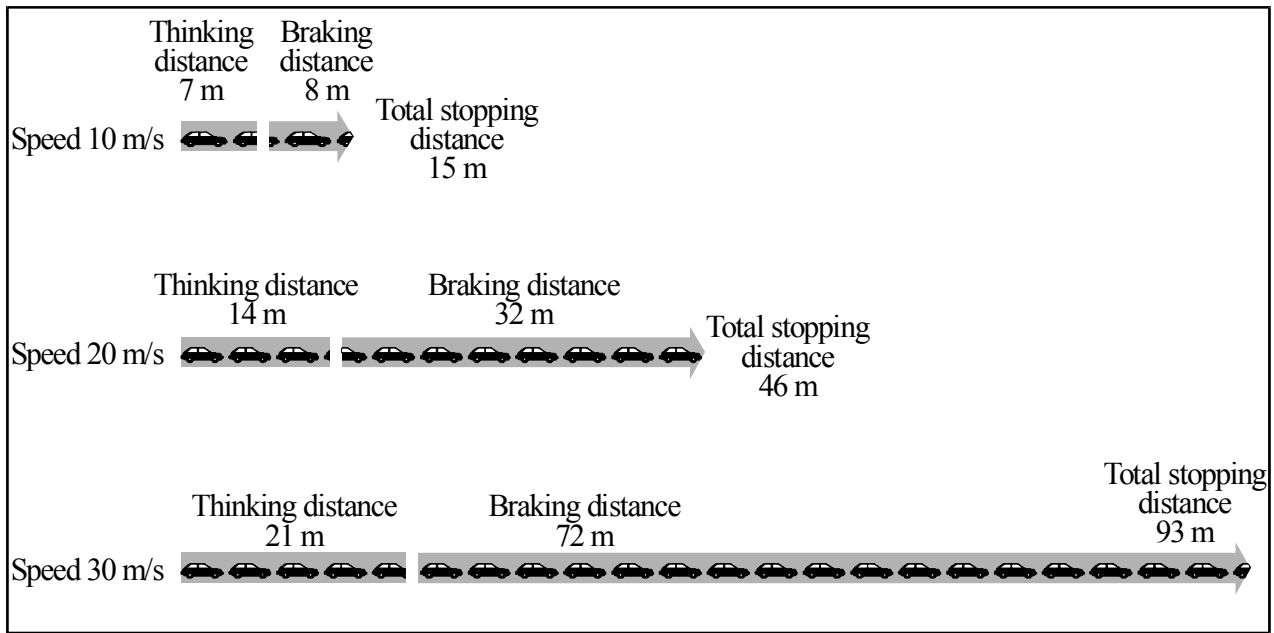
A tyre manufacturer has produced three new types of tyre.  
Their scientists tested the tyres by driving them at 90 km/h, then braking hard.  
When they braked hard, the wheels locked and stopped turning so that the car slid to a halt.  
They then measured the distance that the car slid.  
Some of their results are shown in the table below, and some are shown on the graph.

Tyre type	Distance of slide in metres			
	Dry Road	Wet Road	Icy Road	Mean
A	100	110	130	113
B	80	120	140	113
C	66	130	140	112



### Case Study 3

The diagram below shows the thinking distances, braking distances and total stopping distances at different speeds.



### Case Study 4

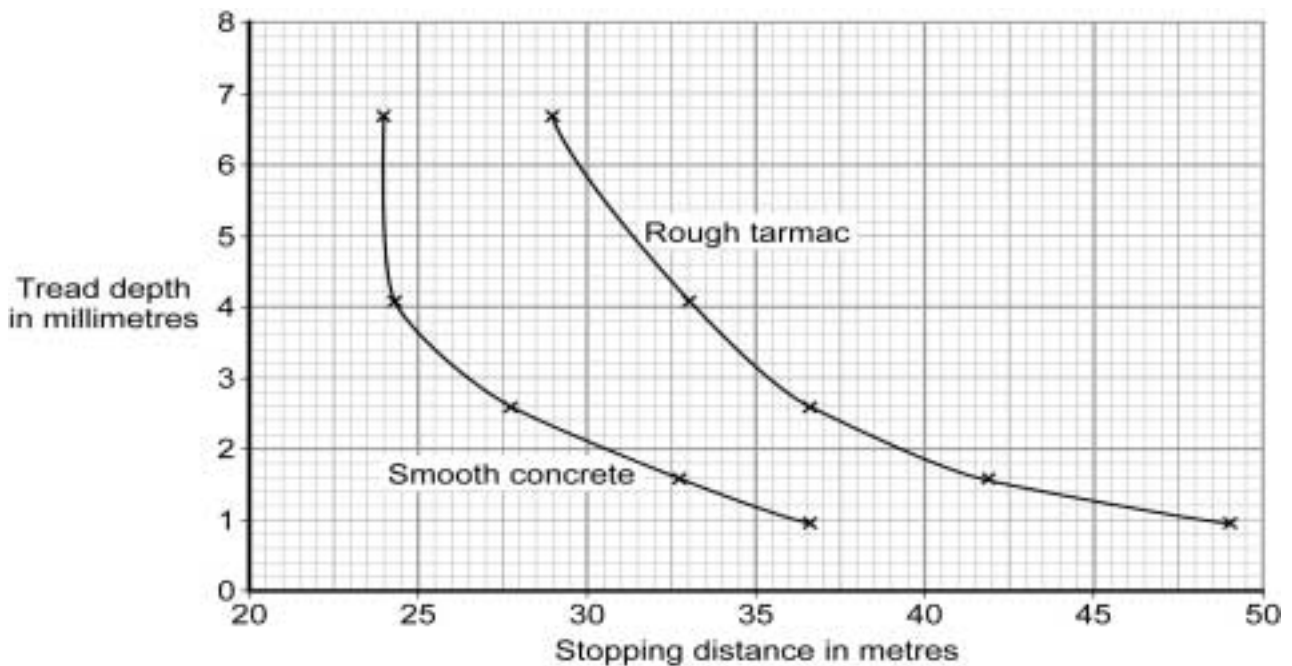
A local authority is planning to resurface a major road and have asked the Transport and Road Laboratory (TRL) to do some testing for them.

The TRL has tested two different types of road surface.

For each surface they measured the stopping distance when tyres of different tread depth were used.

The tread depth is the depth of the grooves that are cut into the surface of the tyre.

The results are shown on the graph below.



# GCSE Science – Controlled Assessment ISA – Marking Guidelines

## Additional Science / Physics ISA – PU2.x Friction (Specimen)

For use from 1 May 20xx to 30 April 20xx

Please mark in red ink, and use one tick for one mark. Each part of each question must show some red ink to indicate that it has been seen. Subtotals for each part of each question should be written in the right-hand margin.

Enter the marks for **Section 1 and Section 2** and the **total mark** on the front cover of the answer booklet and fasten them together with the results table(s) and the graphical work and the candidate's research work from Section 1 of the ISA.

The teacher must sign and date the front cover of the ISA.

The papers must be kept in a secure place and must **not** be returned to the candidates.

These Marking Guidelines are largely generic. Teachers will be given additional guidance on how to relate these generic mark schemes to particular investigations.

### SECTION 1

#### The initial research

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark. The layout on the ISA has been designed to help the candidate to structure an answer, but it does not matter if the candidate has written part of the answer in what you consider to be the wrong section.

Sources need not be identified in great detail, eg the exact URL is not required for an Internet source, simply the name of the website.

	3 marks	2 marks	1 mark	0 marks
Q No 1	The candidate identifies <b>two</b> relevant sources and explains why these were found to be useful	The candidate identifies at least <b>one</b> relevant source and explains why this was found to be useful  <b>or</b> The candidate identifies <b>two</b> relevant sources but fails to explain why they were useful	The candidate identifies at least <b>one</b> source but fails to explain why this was found to be useful  <b>or</b> The candidate refers to a poorly defined source (eg 'A physics text book') but explains why it was found to be useful	No relevant content

**PU2.x Physics – Friction – Specimen ISA – Marking Guidelines**

**The research hypothesis**

<b>Q No 2</b>	<p>Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.</p> <p>The layout on the ISA has been designed to help the candidate to structure an answer, but it does not matter if the candidate has written part of the answer in what you consider to be the wrong section</p>			
	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
	<p>There is a clear hypothesis that identifies both the independent and the dependent variable</p> <p>The hypothesis is justified by information from the candidate's research</p>	<p>There is a clear statement that identifies both the independent and the dependent variable, and includes a plausible qualitative hypothesis, however the justification is unclear</p>	<p>The candidate has made a simple hypothesis that by implication identifies the independent and dependent variables, but there is no justification</p>	<p>No relevant content</p>

**PU2.x Physics – Friction – Specimen ISA – Marking Guidelines**

**Writing the plan**

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.

	<b>9, 8 or 7 marks</b>	<b>6, 5 or 4 marks</b>	<b>3, 2 or 1 marks</b>	<b>0 marks</b>
<b>Q No 3</b>	<p>There is a clear and detailed scientific description of how the investigation should be carried out</p> <p>Control variables are clearly identified, with details of how they will be monitored or controlled, so that the method gives valid results</p> <p>Equipment and its use is clearly described and appropriate</p> <p>Most of the major hazards are identified, together with an assessment of the associated risks and corresponding control measures</p> <p>There is an appropriate and logical sequence of steps</p> <p>A range of appropriate and relevant specialist terms are used accurately</p> <p>The response shows very few errors in spelling, punctuation and grammar</p>	<p>There is a description of how the investigation should be done so that valid results can be collected</p> <p>At least one control variable is identified</p> <p>Most of the necessary equipment required is described</p> <p>The major hazard is identified, together with a corresponding control measure but the risk assessment is weak or absent</p> <p>A sequence of steps is shown</p> <p>Some errors in spelling, punctuation and grammar</p>	<p>The method described is weak but shows some understanding of the sequence of an investigation</p> <p>Equipment is mentioned but is not always appropriate</p> <p>An appropriate hazard is identified, but the corresponding risk assessment and control measure is weak or absent</p> <p>There are frequent errors in spelling, punctuation and grammar</p>	<p>No relevant content</p>

**PU2.x Physics – Friction – Specimen ISA – Marking Guidelines**

**Consequences of the initial research**

Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
<b>Q No 4</b>	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
	An alternative method is outlined in sufficient detail so that the necessary steps are clear  Sensible explanations are given as to why this alternative method would not have been as good as the one chosen	An alternative method is outlined briefly although some of the necessary steps may not be clear  A suggestion is given as to why this alternative method would not have been as good as the one chosen	An alternative method is outlined briefly although some of the necessary steps may not be clear  <b>or</b> A suggestion is given as to why this alternative method would not have been as good as the one chosen	No relevant content

**Table for Results**

<b>Q No 6</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
	Headings and units all correct for all measured variables	Table with incomplete headings or units for the measured variables. At least half of the required elements should be present	No table or a table with incomplete headings or units for the measured variables.  Fewer than half of the required elements are present

**PU2.x Physics – Friction – Specimen ISA – Marking Guidelines**

<b>SECTION 2</b>				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
<b>Analysing results</b>				
	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
<b>Q No 1 (a)</b>	The candidate correctly concludes whether or not there is a quantitative relationship between the variables investigated, and quotes some data to support this	The candidate correctly concludes whether or not there is a quantitative relationship between the variables investigated, but fails to quote any data to support this	The candidate correctly concludes whether or not there is a qualitative relationship between the variables investigated, but fails to quote any data to support this	No relevant content
<b>Q No 1 (b) (i)</b>	<p>Candidate states whether or not the results are considered reproducible <b>and</b> explains the reason:-</p> <p><b>Either:</b></p> <p>There is a clear description of a pattern in the results</p> <p>Repeated results confirm similar values obtained, with some specific examples given</p> <p>Other members of the class obtained similar results</p> <p><b>or:</b></p> <p>There is reference to a wide scatter of results and no emerging pattern</p> <p>Repeated results give widely different values, with some specific examples given</p> <p>Other members of the class obtained very different results</p>	<p>Candidate states whether or not the results are considered accurate <b>and</b> explains the reason:-</p> <p><b>Either:</b></p> <p>There is reference to a pattern in the results, but the description is not clear</p> <p>Repeated results confirm similar values obtained, but no specific examples given</p> <p>Other members of the class obtained similar results</p> <p><b>or:</b></p> <p>There is reference to a wide scatter of results and no emerging pattern</p> <p>Repeated results give widely different values, but no specific examples given</p> <p>Other members of the class obtained very different results</p>	<p>Candidate states whether or not the results are considered accurate <b>and</b> explains the reason:-</p> <p><b>Either:</b></p> <p>There is reference to a pattern in the results, but the nature of the pattern is not made clear.</p> <p>There is reference to either the candidate's own repeats or the results of others in the class</p> <p><b>or:</b></p> <p>There is reference to a wide scatter of results and no emerging pattern, but no reference to repeated results or to the results of others in the class</p>	No relevant content

**PU2.x Physics – Friction – Specimen ISA – Marking Guidelines**

	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
<b>Q No 1 (b) (ii)</b>	<p>Candidate explains that the data should first be inspected for anomalous results, and these discarded</p> <p>The remaining results should then be added together and divided by the number of values</p> <p>in order to calculate a mean</p>	<p>Candidate explains that the data should first be inspected for anomalous results, and these discarded</p> <p>Candidate states that a mean should be calculated, but does not explain clearly how this should be done</p>	<p>Candidate states that a mean should be calculated, but does not explain how to do this</p>	<p>No relevant content</p>
<b>Q No 2</b>	<p>Candidate correctly states clearly whether there are or are not any anomalous results</p> <p>Candidate explains that anomalous results are ones that do not fit the pattern</p> <p>Candidate quotes some data from the results to support this, eg by specifying results that are considered to be anomalous or by referring to the fact that, eg all results are very close to a line of best fit</p>	<p>Candidate correctly states clearly whether there are or are not any anomalous results</p> <p>Candidate explains that anomalous results are ones that do not fit the pattern but fails to quote any data from the results to support this</p>	<p>Candidate correctly states clearly whether there are or are not any anomalous results, but fails to explain how the data justifies this statement</p>	<p>No relevant content</p>
	<p>N.B. the candidate's response must match the candidate's own data.</p>			



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<b>Secondary Research</b>				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
<b>Q No 3 (a)</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>	
	Both axes labelled correctly Sketch has the general correct shape, showing force increasing with roughness	Both axes labelled correctly but sketch does not have the correct shape	Axes not labelled correctly and the sketch line does not represent the data	
<b>Q No 3 (b)</b>	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
	The candidate states that some of the data strongly supports the original hypothesis, and quotes some data from tables that support this  There is an appreciation that there is some conflicting evidence  The candidate realises that stopping distance is related to the amount of friction present  There is evidence that the candidate has inspected the data critically	The candidate states that overall the data strongly supports the original hypothesis, although may not quote data to support this  The candidate realises that stopping distance is related to the amount of friction present	A clear statement is made that evidence from Case Studies 1 and 2 supports the hypothesis  The point is made that the rougher the surface the greater the amount of friction	No relevant comment
<b>Q No 3 (c)</b>	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
	Candidate comments that as this experiment involved a categoric variable it was not directly comparable to their investigation  Rougher surfaces cause more friction, with an example from this table and their data	Candidate comments that rougher surfaces cause more friction, with an example from this table and their data  Comment that the data is not directly comparable will probably be lacking	Simple remark about rougher surfaces causing more friction	No relevant comment

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<b>The manufacturer's hypothesis</b>				
Read through the whole of the candidate's answer and use the Marking Guidelines below to arrive at a 'best-fit' mark, as candidates may meet some criteria but not others in a level.				
	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
<b>Q No 4 (a)</b>	<p>The review of the hypothesis is appropriate and valid and correctly states, with reason(s) why the hypothesis is or is not supported</p> <p>Numerical data from the results is quoted to support the assertion</p>	<p>The review of the hypothesis is appropriate and valid and correctly states whether or not the hypothesis is or is not supported, but fails to explain clearly the reason for this</p> <p>References to the data are mainly qualitative</p>	There is a review of the hypothesis that is appropriate but there is little clarity and detail	No relevant content
	<b>3 marks</b>	<b>2 marks</b>	<b>1 mark</b>	<b>0 marks</b>
<b>Q No 4 (b)</b>	<p>The candidate has related ideas from the investigation and the research to the design.</p> <p>There is a clear explanation of how these ideas can be applied to the design</p>	<p>The candidate has related an idea from the investigation or the research into this context.</p> <p>There is a brief explanation of how this idea can be applied to the design</p>	The candidate has related an idea from the investigation or the research to the design but how this idea could be applied is unclear	No relevant content

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Graph or chart			
	Answer	Additional Guidance	Mark
Q No 5	X axis: suitable scales chosen and labelled with quantity and units	Scale should be such that the plots occupy at least one third of each axis Accept axes reversed	1
	Y axis: suitable scales chosen and labelled with quantity and units	It may not always be necessary to show the origin	1
	Points or bars plotted correctly to within $\pm 1$ mm	Allow one plotting error out of each 5 points/bars plotted	1
	Suitable line drawn on graph or bars correctly labelled on bar chart	Allow error carried forward from incorrect points If wrong type of graph / chart, maximum <b>3</b> marks If the independent variable is: <ul style="list-style-type: none"> <li><i>continuous</i>, should draw a <i>best fit line</i></li> </ul> <b>NB</b> If no line possible because there is no correlation, candidates should state this on the graph to gain the mark <ul style="list-style-type: none"> <li><i>categoric</i>, should draw a bar chart</li> </ul>	1