

## Investigation 14: Moderator comments

### Personal engagement Exploration Analysis Evaluation Communication Total

x/2	x/6	x/6	x/6	x/4	x/24
2	6	5	5	3	21

### Personal engagement

This criterion assesses the extent to which the student engages with the exploration and makes it his or her own. Personal engagement may be recognized in different attributes and skills. These could include addressing personal interests or showing evidence of independent thinking, creativity or initiative in the designing, implementation or presentation of the investigation.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below. <b>The evidence of personal engagement with the exploration is limited with little independent thinking, initiative or creativity.</b>
1	<ul style="list-style-type: none"><li>The justification given for choosing the research question and/or the topic under investigation does not demonstrate <b>personal significance, interest or curiosity</b>.</li><li>There is little evidence of <b>personal input and initiative</b> in the designing, implementation or presentation of the investigation.</li></ul> <b>The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or creativity.</b>
2	<ul style="list-style-type: none"><li>The justification given for choosing the research question and/or the topic under investigation demonstrates <b>personal significance, interest or curiosity</b>.</li><li>There is evidence of <b>personal input and initiative</b> in the designing, implementation or presentation of the investigation.</li></ul>
<b>Moderator's award</b>	<b>Moderator's comment:</b> The reflective theory of knowledge/nature of science connections showed that the student was really thinking about the topic. Although later the data was overanalysed, once again the student was showing plenty of their own input.
2	

### Exploration

This criterion assesses the extent to which the student establishes the scientific context for the work, states a clear and focused research question and uses concepts and techniques appropriate to Diploma Programme level. Where appropriate, this criterion also assesses awareness of safety, environmental and ethical considerations.

Mark	Descriptor
0	The student's report does not reach a standard described by the descriptors below.

- 1-2
  - The topic of the investigation is identified and a research question of some relevance is **stated, but it is not focused**.
  - The background information provided for the investigation is **superficial** or of limited relevance and does not aid the understanding of the context of the investigation.
  - The methodology of the investigation is only appropriate to address the research question to a very limited extent, since it takes into consideration few of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.
  - The report shows evidence of limited awareness of the significant safety, ethical or environmental issues that are **relevant to the methodology of the investigation**.\*
  
- 3-4
  - The topic of the investigation is identified and a relevant but not fully focused research question is described.
  - The background information provided for the investigation is mainly appropriate and relevant and aids the understanding of the context of the investigation.
  - The methodology of the investigation is mainly appropriate to address the research question but has limitations, since it takes into consideration only some of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.
  - The report shows evidence of some awareness of the significant safety, ethical or environmental issues that are **relevant to the methodology of the investigation**.\*
  
- 5-6
  - The topic of the investigation is identified, and a relevant and fully focused research question is clearly described.
  - The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation.
  - The methodology of the investigation is highly appropriate to address the research question because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.
  - The report shows evidence of full awareness of the significant safety, ethical or environmental issues that are **relevant to the methodology of the investigation**.\*

**Moderator's award** 6 **Moderator's comment:** The topic was identified, and the research questions were relevant. Although it is preferred to have a single research question, there was a precedent in the original TSM for a secondary data exercise to be extended with a supplementary research question since the data is quite easy to gather, so it is accepted here. The methodology proposed is appropriate and the student has considered reliability through comparing the data sources. There weren't really any relevant safety or environmental considerations, as the student noted.

\* This indicator should only be applied when appropriate to the investigation.

## Analysis

This criterion assesses the extent to which the student's report provides evidence that the student has selected, recorded, processed and **interpreted** the data in ways that are relevant to the research question and can support a conclusion.

Mark	Descriptor
0	<p>The student's report does not reach a standard described by the descriptors below.</p> <ul style="list-style-type: none"><li>• The report includes <b>insufficient relevant</b> raw data to support a valid conclusion to the research question.</li><li>• Some <b>basic</b> data processing is carried out but is either too <b>inaccurate or too insufficient to lead to a valid</b> conclusion.</li></ul>
1–2	<ul style="list-style-type: none"><li>• The report shows evidence of little consideration of the impact of measurement uncertainty on the analysis.</li><li>• The processed data is incorrectly or insufficiently interpreted so that the conclusion is invalid or very incomplete.</li></ul>
3–4	<ul style="list-style-type: none"><li>• The report includes relevant but incomplete quantitative and qualitative raw data that could support a simple or partially valid conclusion to the research question.</li><li>• Appropriate and sufficient data processing is carried out that could lead to a broadly valid conclusion, but there are significant inaccuracies and inconsistencies in the processing.</li><li>• The report shows evidence of some consideration of the impact of measurement uncertainty on the analysis.</li><li>• The processed data is interpreted so that a broadly valid but incomplete or limited conclusion to the research question can be deduced.</li></ul>
5–6	<ul style="list-style-type: none"><li>• The report includes sufficient relevant quantitative and qualitative raw data that could support a detailed and valid conclusion to the research question.</li><li>• Appropriate and sufficient data processing is carried out with <b>the accuracy</b> required to enable a conclusion to the research question to be drawn that is fully <b>consistent</b> with the experimental data.</li><li>• The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis.</li><li>• The processed data is correctly interpreted so that a completely valid and detailed conclusion to the research question can be deduced.</li></ul>

**Moderator's comment:** The student has collected plenty of secondary data. The example calculation based on the NIST data is in error, but this doesn't feed through to the conclusions since this data strand is discontinued. It is difficult to evidence appropriate considerations of uncertainties in this type of secondary data research, but the standard deviation calculations were an overstretch when only two or three values had been averaged. The data is mostly interpreted well, although in places it is more about commenting on differences between individual data points rather than about established trends. This over-interpretation will not be penalized.

## Evaluation

This criterion assesses the extent to which the student's report provides evidence of evaluation of the investigation and the results with regard to the research question and the accepted scientific context.

Mark	Descriptor
0	<p>The student's report does not reach a standard described by the descriptors below.</p> <ul style="list-style-type: none"> <li>• A conclusion is <b>outlined</b> that is not relevant to the research question or is not supported by the data presented.</li> <li>• The conclusion makes superficial comparison to the accepted scientific context.</li> </ul>
1–2	<ul style="list-style-type: none"> <li>• Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are <b>outlined</b> but are restricted to an <b>account of the practical or procedural issues</b> faced.</li> <li>• The student has <b>outlined</b> very few realistic and relevant suggestions for the improvement and extension of the investigation.</li> </ul>
3–4	<ul style="list-style-type: none"> <li>• A conclusion is <b>described</b> that is relevant to the research question and supported by the data presented.</li> <li>• A conclusion is described that makes some relevant comparison to the accepted scientific context.</li> <li>• Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are <b>described</b> and provide evidence of some awareness of the <b>methodological issues</b> involved in establishing the conclusion.</li> <li>• The student has <b>described</b> some realistic and relevant suggestions for the improvement and extension of the investigation.</li> </ul>
5–6	<ul style="list-style-type: none"> <li>• A detailed conclusion is <b>described and justified</b> that is entirely relevant to the research question and fully supported by the data presented.</li> <li>• A conclusion is correctly <b>described and justified</b> through relevant comparison to the accepted scientific context.</li> <li>• Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are <b>discussed</b> and provide evidence of a clear understanding of the <b>methodological issues</b> involved in establishing the conclusion.</li> <li>• The student has <b>discussed</b> realistic and relevant suggestions for the improvement and extension of the investigation.</li> </ul>
<b>Moderator's award</b>	<ul style="list-style-type: none"> <li>• <b>Moderator's comment:</b> The student draws conclusions that are largely consistent with the data, although in places too much is inferred from too little evidence. The student tries very hard to justify conclusions using appropriate and relevant concepts. This was good. There is a reflection throughout on weaknesses in the methodology, such as discarding the NIST data-based calculations. There are some modifications, which are more extensions. The extensions are relevant.</li> </ul>
5	

**Communication**

This criterion assesses whether the investigation is presented and reported in a way that supports effective communication of the focus, process and outcomes.

<b>Mark</b>	<b>Descriptor</b>
0	<p>The student's report does not reach a standard described by the descriptors below.</p> <p><b>The presentation of the investigation is unclear, making it difficult to understand the focus, process and outcomes.</b></p> <ul style="list-style-type: none"><li>• The report is not well structured and is unclear: The necessary information on focus, process and outcomes is missing or is presented in an incoherent or disorganized way.</li></ul>
1–2	<ul style="list-style-type: none"><li>• The understanding of the focus, process and outcomes of the investigation is obscured by the presence of inappropriate or irrelevant information.</li><li>• There are many errors in the use of subject-specific terminology and conventions.*</li></ul> <p><b>The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes.</b></p>
3–4	<ul style="list-style-type: none"><li>• The report is well structured and clear: The necessary information on focus, process and outcomes is present and presented in a coherent way.</li><li>• The report is relevant and concise, thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.</li><li>• The use of subject-specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.</li></ul>
<b>Moderator's award</b>	<p><b>Moderator's comment:</b> The structure of the report is fine, methodology described appropriately, and generally the use of terminology (with one or two slips) is good. However, the graphs are far from clear and do not sufficiently help understanding.</p>
3	

\* For example, incorrect/missing labelling of graphs, tables, images; use of units, decimal places. For issues of referencing and citations, refer to the "Academic honesty" section.