Investigation 10: How temperature affects the vibration rate of a tuning fork (Hands-on)

To view the various elements of this example, please use the icons at the side of the screen.

Note: The comments in the annotated examples match the labelling on teacher forms.

Examiner comments

Personal engagement	Exploration	Analysis	Evaluation	Communication	Total
x/2	x/6	x/6	x/6	x/4	x/24
1	3	2	2	3	**11**

Personal engagement

This criterion assesses the extent to which the student engages with the exploration and makes it their 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

	The evidence of personal engagement with the exploration is limited with little independent thinking, initiative or creativity.
1	• The justification given for choosing the research question and/or the topic under investigation does not demonstrate **personal significance, interest or curiosity**. • There is little evidence of **personal input and initiative** in the designing, implementation or presentation of the investigation.

	Moderator's comment
Moderator's award 1	The student demonstrates a slight personal connection with the research topic and there is also some evidence of personal input in the design and implementation of the investigation. A more insightful and justified personal engagement is needed for level 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
1–2	• 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.
3–4	• The topic of the investigation is identified and a relevant but not fully focused research question is described. • 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***.

	Moderator's comment
Moderator's award 3	Although the topic of temperature and frequency of a tuning fork is most appropriate for an internal assessment investigation, the student does not demonstrate a fully focused approach. The theoretical context needs more explicit relevance, and the

method needs to allow for more data. The student shows some awareness of the key safety issues. The basic research idea could have been turned into a top-notch investigation. Unfortunately, this exploration falls short in this aspect.

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
1–2	• Some **basic** data processing is carried out but is either **too inaccurate or too insufficient to lead to a valid** conclusion. • The report shows evidence of little consideration of the impact of measurement uncertainty on the analysis. • The processed data is incorrectly or insufficiently interpreted so that the conclusion is invalid or very incomplete.
3–4	• The report includes relevant but incomplete quantitative and qualitative raw data that could support a simple or partially valid conclusion to the research question.

Moderator's comment

Moderator's award 2	Although measurements of frequency and temperature are relevant for this study, the amount of data and the accuracy of the data are not good enough to establish a justified or even reasonable conclusion. Indeed, one graph is drawn as a curve and another graph is drawn with a linear relationship. Uncertainty bars were made up to fit the data. This study included relevant but insufficient data, the processing is basic but confused, there is the expression of errors and uncertainties but this is not related to the measurements themselves, and the overall interpretation is confused. The criterion of analysis earns low marks, but the student did approach analysis in a plausible manner and the final mark was determined using the best-fit model.

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
1–2	• A conclusion is **outlined** which is not relevant to the research question or is not supported by the data presented. • The conclusion makes superficial comparison to the accepted scientific context. • The student has **outlined** very few realistic and relevant suggestions for the

improvement and extension of the investigation.

Moderator's comment

Moderator's award

2

The poor quality of data and the confused analysis of the data make it difficult to reach a sound conclusion. In fact, the student merely repeats his or her research question and claims it has been proven. The student could have looked up data tables to find the expected expansion of the tuning fork and then re-calculated the frequency and compared this with his or her result. It would not compare at all. Although the stated confusion relates to the research question, there is no comparison to what should have happened, no comparison to an accepted theory. There was no account of strengths or weaknesses of the method, and the improvements and extensions are limited at best.

Communication

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

Mark	Descriptor
1–2	**The presentation of the investigation is unclear, making it difficult to understand the focus, process and outcomes.** • The understanding of the focus, process and outcomes of the investigation is obscured by the presence of inappropriate or irrelevant information.
3–4	**The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes.** • The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way. • The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.

Moderator's comment

Moderator's award

3

This rather brief report has somewhat of a logical form and we understand what the student is doing. The focus, process and outcomes of the investigation are far from adequate, and some of the discussion is related but not relevant. The moderator has difficulty here, as a mark of 2 is too low while a mark 3 is too generous. If we ignore the weak or poor physics and just read the overall report, in a holistic way, then the final mark can be justified.

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  Student work (PDF)

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  Annotated student work (PDF)

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  Examiner comments