Investigation 4: Investigating the force on an electric charge moving through a magnetic field (Simulation)

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

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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.

- 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**

The student shows some initiative in searching for various simulations to find the one that would help confirm the known equation. The motivation of developing a better understanding of the equation is admirable, but there is no insight, independent thinking or creativity here, and the feeling is that the student is going through the motions.

**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.

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| 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.  
- 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. |
| 3–4  | - The topic of the investigation is identified and a relevant but not fully focused research question is described. |

**Moderator’s comment**

**Moderator’s award**

The only explicit scientific context for this investigation is when the student mentions the quantities in the equation. It is assumed that the angle of the plane to the magnetic field is perpendicular, hence \( \sin \theta = 1 \). This assumption is okay but there is no real background information. Scientific context means more than having studied it in class. Nonetheless, the research question is stated, although the student does not appreciate the issue of proof versus confirmation or proof versus mere illustration. There is no
thought given to the method; the student assumes we know he or she will just enter
values and record data for the three parameters. Holding controlled variables constant is
recognition of the process, but reliability and sufficiency of data are not considered. In a
simulation, this descriptor of exploration may not always be relevant or appropriate for
assessment. The moderator would like to give this a 0 mark, but the research question
and the method are commensurate with the course, so achievement level 1 is awarded.

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.

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| 1–2  | - The report shows evidence of little consideration of the impact of measurement
      uncertainty on the analysis. |
| 3–4  | - 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.  
- The processed data is interpreted so that a broadly valid but incomplete or limited
  conclusion to the research question can be deduced. |
| 5–6  | - The report includes sufficient relevant quantitative and qualitative raw data that
  could support a detailed and valid conclusion to the research question. |

Moderator’s comment

There is no doubt that the student has selected, recorded and interpreted the data in a
relevant way to answer the research question. The only processing was constructing the
graphs. Errors were not discussed but uncertainties were considered, most likely due to
the least count. This is often all that can be done when working with a simulation. The
least count uncertainty approach with the charge data is obviously inappropriate, but
the student did not think of this. The accuracy of the results was addressed, even if the
small percentage was a result of rounding off. The student’s research project is so
simplistic that there is no question that the simulation will provide a valid conclusion.
As a result the moderator finds it difficult to assess analysis. The descriptor about
appropriate consideration of uncertainties on analysis can be said to have been
addressed, if only superficially with no true understanding. The descriptor about a
conclusion has been addressed by the student, although the depth of the conclusion is
limited. Overall, this criterion falls someplace between 4 and 5; using the best-fit
approach and an overview of the entire work resulted in a mark of 4.
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.

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| 1–2  | • Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **outlined** but are restricted to an **account of the practical or procedural issues** faced.  
• The student has **outlined** very few realistic and relevant suggestions for the improvement and extension of the investigation. |
| 3–4  | • A conclusion is **described** which is relevant to the research question and supported by the data presented.  
• A conclusion is described which makes some relevant comparison to the accepted scientific context. |

Moderator’s comment

The student clearly answered the research question(s). The method was to illustrate the given equation. He or she did not do an “interesting” scientific investigation with the data, however. The student’s appreciation of the results (the limits of a simulation) counts here as a justified conclusion. There is no way to compare the results with the accepted values, as this was a virtual experiment, so comparing to itself is sufficient here. No thought is given to the scope or limit of the method, data analysis or any other aspect of the methodology. There are a few obvious extensions mentioned, but nothing that is really different in kind than the equation illustrations that were already done. There are no suggestions for improvements (doing a real lab is not an improvement). Using the best-fit method of assessment the moderator decided that the evaluation criterion earns a mark in the 3–4 markband. Given the unimaginative nature of this investigation a final mark of 3 was awarded.

Communication

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

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| 3–4  | • The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way.  
• The report is relevant and concise thereby facilitating a ready understanding of |
the focus, process and outcomes of the investigation.
- The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.

Moderator's comment

The report is structured in a clear and logical way. The language is mostly appropriate and mistakes in the use of terms like "prove" do not really hamper the reader's understanding of the report. There were some digressions when the inappropriate simulations were discussed and the thoughts about a real mechanical investigation of the equation (not a plausible idea) but overall the report flows. The graphs and data are nicely presented. The positive and negative nature of charge is nicely appreciated. More depth would have improved the quality of the communication aspect of the report.