Guidance in writing the IA report

Before starting the report

Before writing the report, it is worth spending the time writing out ALL of the work that has been done on a whiteboard or A3 piece of paper:

- Write down every piece of experimentation that has been done and ring each one.
- Draw a line between each ring, showing the correct order of the work, so that there is a clear logic to what has been done.
- The lines drawn between the rings, might have a comment explaining the reason for moving from the one experiment to the next.

Before getting into the form of the report, note the following format suggestions:

- Arial font size 12.
- 1.15 or 1.5 spacing – do not use double-spacing.
- Numbered pages.
- Portrait orientation (rather than landscape) – except for items such as a graph or illustration.
- Do not make margins large.
- Make sure that formulas look correct – unless you have a better method, use Equation Editor.
- Do NOT use Insert-Symbol to put symbols into your work – use the symbol font where possible.
- Use a Header e.g., student name / Physics IA / Title.
- Use a footer for the page number.
- ALL Figure, Graphs and Tables should be numbered and have a caption.
- Tables: Centre the data and make sure the decimal places and Sig Figs are correct.
- Graphs should have error bars and a correct line. If the graph is curved, do NOT include a formula from excel unless there is a good reason to – curve fitting is not a good reason. Gridlines are needed – using the Design menu, select Quick Layout number 10.
The Form of the Report should typically be:

1. Title.
2. Contents.
3. Introduction.
   Why is this an interesting piece of work to do? If you have a personal interest because it links to something you are engaged with, then briefly discuss this.
4. Background Physics.
   Consider all the Physics you have used in the work and detail it in this section.
5. Research Question. This may well be a repeat of the Title of the Report.
6. Preliminary Experiments.
   Each mini experiment or investigation should be given its own space in the report and it should be fully analysed at the point in the report where it is described (more details below).
7. Final Experiment.
   This is the experiment or investigation that addresses the Research Question. Where possible and space allows, it should be clear in the method, where the preliminary experiments informed the design of this final piece of work.
   This might discuss how the work could be extended, what problems are still to be overcome, where the work still has problems, etc.
    Very often in practical work for physics, a bibliography is not needed. The Background Physics section however, will often have material which will be taken from a text book – all such material should be referenced here.
Preliminary Experiments

For each experiment, you should start the discussion on its own page – you can worry about fitting the report into a maximum of 12 pages later.

Fully describe your experiment including why you are doing it. Where appropriate, ensure that you include how you will …

- … measure the input variable,
- … measure the output variable,
- … ensure a fair test,
- … check reliability,
- … think about safety.

Give a fully labelled diagram.

You should analyse this as fully as you can:

- If there is a graph which is not a straight line, then how can you turn it into one?
- Your conclusions should be stated, along with any problems which came up.
- There should be some obvious reason why you are moving onto the next step of the investigation.
- If you have data that produces a straight line, think about the significance (if there is one!) of:
  - The gradient.
  - The intercept.
  - The area under the graph.

Remember that if there should not be an intercept and there is, then speculate on why this may be so.

The above process is repeated for each and every experiment. This may seem like a huge amount of work but usually, it is only a problem for the first few experiments. After that, the experiments are very similar and you can refer to a previous set up rather than describe it again.
Graphs

The use of graphs

One of the main aims of experimentation is to investigate the world we live in to see how it works. A powerful way of doing this is to perform fair tests and then plot graphs. Moderation has shown that a large number of students rarely plot graphs, preferring to present data and analysis as a collection of numbers (i.e., data) in Tables. This is generally a problem since it is clear to most people that the best way of seeing the data is to plot a graph – it needs to be the natural thing to do – to plot a graph of the input variable vs output variable.

The process of graphing should generally follow:

➤ Plot the input-output graph.

The three outcome are now:

➤ The graph shows no obvious trend. ➤ The graph is a straight line. ➤ The graph is a curve.

The analysis now stops because there is little the student can say about the physics beyond the fact that there is no link between the input and output variables.

The students should now calculate the slope and the intercept – with uncertainties.

The students should now consider how to convert the curve into a straight line. A second graph can then be plotted to support the trend that the student may be suggesting.

Once the straight line is produced, the student should ask themselves:

➤ What is the physical significance of the slope?
➤ What is the physical significant of the intercept?
➤ What is the physical significance of the area under the graph?
Experimental points for discussion

If you do not know what you should be considering when thinking about an experiment and its results, you may wish to think about the following:

Methodology

- Was the method good or not – which bits worked well?
- What were the hardest parts of the work?
- How could the method have been improved?
- For each improvement, what influence would this have on the input, output or controlled variables?
- Did all the equipment work correctly? If not, why not?
- What changes could have been made to the equipment to improve the data?

Input variable

- How was the input variable actually measured?
- What was the hardest part of measuring the input variable?
- Could the input variable have been measured in a better way?

Output variable

- How was the output variable actually measured?
- What was the hardest part of measuring the output variable?
- Could the output variable have been measured in a better way?

Fair Testing

- What does fair testing mean?
- Was this experimentation fair?
- In what way was the work unfair?
- What changes could have been made to ensure better fair testing?

Safety

- Were there any safety issues with the experimentation?
- Could this experimentation have been safer?

Data reliability

- How do we assess the reliability of data?
- Was the data reliable?
- If the data is not reliable, suggest why?
- How many repeats were taken? Was this enough?

Range

- What was the range for the input and output variable?
- In this experiment, could the range for the input variable have been higher?
- Was the range good enough to see a trend?
- How many data points were actually measured? Was this enough?
- Were the data points uniformly spaced or not? If not, why?
Precision

- How do we assess the *precision* of the data?
- Did the data produce a straight line?
- Was the data precise or not?

Accuracy

- How do we assess the *accuracy* of the data?
- Did the data produce a straight line?
- Did the data go through the origin?
- If there is an offset can you explain its value?
- Was the data accurate or not?
The marking scheme

The task will have the same assessment criteria for SL and HL. The five assessment criteria are: **Personal Engagement / Exploration / Analysis / Evaluation / Communication.**

<table>
<thead>
<tr>
<th>Personal engagement</th>
<th>Exploration</th>
<th>Analysis</th>
<th>Evaluation</th>
<th>Communication</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (8%)</td>
<td>6 (25%)</td>
<td>6 (25%)</td>
<td>6 (25%)</td>
<td>4 (17%)</td>
<td>24 (100%)</td>
</tr>
</tbody>
</table>

The marks for each of these 5 areas are based on using multiple indicators, as outlined below.

### Personal Engagement

**Comments**
- This is Not for including any contrived comments about why you found the work *fascinating*. It is for a student becoming *engaged* with the work – showing care and attention to the work such that you have tried hard to ensure that the data you have collected and analysed is of the best quality it can be.
- Preliminary experiments are a good way of showing this - the fact that these were planned out by the student (*Initiative*), having thought about the RQ in detail (*independence*) and carried out in order to control variables or assess their influence (*creativity*) shows a significant personal engagement.
- The depth and clarity of the background info in the report, can also show that a student has put a lot of care and effort into the work.

### Exploration

**Comments**
- The topic should be clear in the report.
- The RQ should be clearly stated and focused, not vague.
- The background information should be well-laid out, and cover all the material needed to allow both the student and the reader, to get a good level of understanding of the science behind the work carried out. The depth and clarity of the background information should enhance an understanding of the work that has been carried out.
- The methods used, should be clear and able to produce good raw data, so a sensible and well-justified conclusions could be made.

### Analysis

**Comments**
- The amount of raw data produced in the work should allow sensible and detailed conclusions to be made.
- The data processing should be appropriate and lead to valid conclusions.
- Uncertainties were considered at all stages of the work and shown to have been given due care and attention through the preliminary experiments that have been carried out.
- Conclusions should be sensible and based on a correct interpretation of the data.

### Evaluation

**Comments**
- The conclusions should be well explained and supported by a correct interpretation or processing of the data.
- The conclusions should be discussed using correct and appropriate science.
- Limitations and possible weaknesses should be considered and shown to have been given due care and attention through the preliminary experiments that have been carried out.
- Assumptions should be stated where appropriate.
- The limitations and possible improvements to the methods used, should be clearly considered.
- Improvements and/or the extension of the work should be sensible, realistic and add to the research and a positive way.

### Communication

**Comments**
- The report should be very well presented. Descriptions should be clear with ALL Figures/Graphs/Tables numbered, with captions and appropriate referencing within the text.
- The structure of the report should be clear. The report should be easy to read and give a sense not only of the work carried out, but also the approach brought to this research. Scientific terms should be used correctly throughout the report.
Final comments

The report MUST be no longer than 12 pages. Do not initially worry about this. Produce a good report about the work done and the final layout can be adjusted later.