Internal Assessment Specifics

Introduction

Background — Provide the setting for your project. Explain the underlying physics behind your research. At the end of your background, the reader is not surprised by your research question. Start with broader concepts, and work your way to concepts and citations more closely related to your research question. Include sources used.

Statement of your question/variables — State your research question. Your dependent and independent variables will appear in a proper research question. List your dependent, independent and controlled variables and explicitly define them. You may also state a hypothesis (recommended). Also state why you have this hypothesis

Method

Materials — A listing of all materials or simulations used should be included here. List specifically which equipment you used.

Diagram of lab setup — Annotated to illustrate how the variables were specifically involved in the procedure. Diagrams are generally clearer than pictures. Your materials should be listed in conjunction with your diagram

Procedure — The procedure should be paragraph form. Include a rationale for how you selected your variations and the number of trials. Walk the reader through how you collected data in a narrative. A peer should be easily able to complete your procedure from this section. The data collected must be adequate so as to allow some sort of analysis involving statistics and/or graphing. There should be included an adequate data range (10-20 variations) and an adequate number of trials (3-5). Specifically state how each controlled variable is maintained unchanged throughout the procedure. Be sure to talk about safety or ethics concerns if there are any

Results

Raw data — This is a table representation of the data collected while carrying out the procedure. Your trials and variations should be at the very least 10 variations with 3 trials of each variation. The Gold standard would be 20 variations with 5 trials – but that would be if the data points are easy to get. The title of the table includes the independent and dependent variables. The independent variable is generally listed in the left-hand column, the dependent in the right. Units are clearly stated in the column headers. The uncertainty of measurements is stated, usually in a column heading. The same level of precision (number of decimal places) is used for all recorded values. Do not split a data table between pages. If absolutely necessary, due to large volumes of data, include title and complete column headings on the second page.

Data processing — This section is a brief explanation of the manner you have chosen to process your raw data. Justification should be given as to how the processing will allow the hypothesis or research question to be adequately fulfilled. One example showing how you actually transfer one piece of raw data into processed data using the explanation in this section should be included. If your processing utilizes a graphical approach like linearization, explain how.

Processed data presentation — Tables again will be utilized here. Use the same guidelines for a proper table as mention above. If a graph is going to be used be certain it is properly done including title, axis labeling, units, etc. Error bars should be utilized on the graph if at all possible as they represent uncertainties and errors associated with the raw data. The final results should reflect the correct number of significant figures.

Conclusion

Evaluation — State a conclusion which is based on a logical interpretation of the data obtained in the procedure. This conclusion will either support or refute the hypothesis if you made one. Give justification for your conclusion using graphed data or specific processed data. Do not talk of "proof" in this section. (Experiments either support or disprove hypotheses) Compare your results and conclusion to any known or accepted values from the scientific literature. This may help to establish validity of the results. Be certain to include a reference to any literature that is quoted.

Limitations — Comment on the weakness of the study and how the quality of the data may have been affected by these weaknesses. Discuss procedure problems. Mention the precision and accuracy of the measurements. Do error bars or statistical analysis indicate valid, reliable data?

Improvements that could be made based on the weaknesses just discussed. Specifically mention modifications to the procedure which may produce more valid and reliable results. These modifications should be realistic and clearly stated.

Checklist for your IA

- □ A descriptive title

Introduction

- □ Your (first) paragraph reflects personal significance, interest, and curiosity
- □ You organize background information from broad to narrow. The first things you talk about are less related to your research, the last things are specifically the physics you think is behind your research – the most closely related. When the reader sees your statement of the problem, they say "of course!!!".
- □ You have a clear statement of the problem. Keep it simple. "The purpose of this investigation therefore, is to find the relationship, if any, between IV and DV" – or something like that.
- □ You state your variables – dependent, independent, and controlled and define them explicitly.
- □ You state a hypothesis (optional but recommended) and state why you have that hypothesis.
- □ Any sources cited are included in your bibliography.

Method/Procedure

- □ Your procedure is a narrative, not an ordered list. You talk us through how you collected your data
- □ You address possible safety/ethics concerns. (with humor?)
- □ There is a diagram of your setup that is annotated with all the materials and equipment you used. You can include photos as well, but you do need a diagram.
- □ You describe how you manipulated your independent variable.
- □ You describe how you measured your dependent variable.
- □ You explain how the controlled variables you listed are kept constant.
- □ You state which variations you used of your independent variable, and how many trials (repetitions) of the measurements of your dependent variable you did.
- □ You explain why you chose those variations and number of trials.

Results/Analysis

- □ You have at the very least 10 variations with 3 trials of each variation. (If it is difficult to get your trials) It would be better to have 20 variations with 5 trials each if your data is easy to collect.
- □ Your raw data is included. If it is derived from thousands of computer gathered points, be creative, and walk us through using screenshots how you derived your table graph or gathered data from the computer data. If there are thousands of data points, you don't need to include all the points, just your derived data.
- □ Your data table includes the name of the quantity, the symbol for the quantity, and the units for that quantity, and the uncertainty of the quantity in the header of each column.
- □ The numbers in your data table include the same level of precision. (They are rounded to the same decimal place)
- □ You have a graph of the average of your raw data with error bars
- □ Any processing of raw data is described briefly and completely. You walk us through one sample of data processing.
- □ You have a graph of your processed data with error bars. (If you did something like calculate speed, or pressure, or viscosity) The error bars of the processed data follow the rules of error propagation we learned last year.
- □ You include your graphs in the body of the paper, and they have titles, axis labels and units.
- □ If your data is linear, you have graphed it with error bars and a linear trendline with the equation displayed, and have included max and min slopes, as well as the uncertainty of the slope.
- □ If your data is a curved line, you have done your best to linearize it using a log log graph, and you have linearized it with a $y^{1/n}$ line analysis (or ln(y) vs x if it is exponential). You include a trendline with max and min slopes for your linearized graph.

Conclusion and Evaluation

- □ You state a conclusion based on a logical interpretation of your data. Summarize the trend in the data, and explain why you think that is happening. Use Physics and terminology and knowledge. (i.e. make it seem that you just took a course in IB Physics)
- □ If you made a hypothesis you evaluate the truth of the hypothesis.
- □ If you are measuring a well known quantity, (like absolute zero) state its value and give it a bibliography reference.
- □ You discuss the limitations of your research (sources of error)
- □ You suggest improvements that could be made to minimize your cited sources of error – or other things about your work that could be improved.
- □ You suggest ideas for further research (thereby reflecting your personal curiosity for the subject)

- □ You include a bibliography for any sources cited