# Lab Write-Up: Conclusion and evaluation, CE

**IB — Criteria**

| Levels/marks | Aspect 1 | Aspect 2 | Aspect 3 |
|---|---|---|---|
| | **Concluding** | **Evaluating procedure(s)** | **Improving the investigation** |
| **Complete/2** | States a conclusion, with justification, based on a reasonable interpretation of the data. | Evaluates weaknesses and limitations. | Suggests realistic improvements in respect of identified weaknesses and limitations. |
| **Partial/1** | States a conclusion bases on a reasonable interpretation of the data. | Identifies some weaknesses and limitations, but the evolution is weak or missing. | Suggests only superficial improvements. |
| **Not at all/0** | States no conclusion **or** the conclusion is based on an unreasonable interpretation of the data. | Identifies irrelevant weaknesses and limitations. | Suggests unrealistic improvements. |



## Aspect 1: Concluding

State your conclusion from the data collected and analyzed by you and from your hypothesis**,** even if it contradicts accepted theory and literature value.

Hence:

- Answer the question in the problem by summarizing the observations and / or inferences and indicating whether or not the original prediction was correct.
- Analysis of conclusion should include comparisons of different graphs, or any observed description of trends in the graphs.
- Balanced equations to summarize aspects of the conclusion should always be included.
- In addition the conclusion should state whether the results of the experiment support or refute the reasoning in the hypothesis.
- Compare with literature or accepted value or reasonable value where possible.
- Calculate percent error where possible.
- Compare your percentage error with the total estimated error, that was derived from the propagation of uncertainties.
- Justify your conclusion by discussing if any systematic or random errors were encountered.

## Aspect 2: Evaluating procedure

- Discuss the sources of errors in the observations made arising from limitations of the measuring instruments, limitations of the experimental procedure and skill of the experimenter.
- The evaluation includes your judgement of the procedure, i.e. the limitations of the procedure and comment upon how significant the weaknesses are.
- Comment upon the quality of the data collected.
- Comment upon the precision and accuracy of the measurements.
- Comment upon the management of time.

## Aspect 3: Improving the investigation

- For identified weaknesses and limitations identified in aspect 2 above, suggest improvements: suggestions should be realistic, not involving unavailable equipment or materials, suggestions should be specific, not vague (e.g. "More careful work").
- Purposed changes should try to eliminate or reduce errors, improve control of variables.
- Give suggestions as how to reduce/minimize systematic and/or random error.
- Address issues of precision and accuracy and reproducibility of the results.
- Provide other procedures for better measurements. (Think of the following areas of possible improvement: usage of additional or alternate equipment, apparatus or chemicals...)



Write your evaluation in paragraph form, using the topic sentences suggested below, or similar to them. Show as much independent, critical, and creative thought as possible in support of your judgement.

1. "The experimental design [name it] is judged to be adequate / in adequate because ...."
   Were you able to answer the problem/the research question using the chosen experimental design?
   Are there any obvious flaws in the design?
   what alternative designs [better or worse] are available?
2. "The procedure is judged to be adequate / inadequate because...."
   Were the steps you used in the laboratory correctly sequenced, and adequate to gather sufficient evidence?
   What improvements could be made to the procedure?
   What, steps, if not done correctly, would have significantly affected the results?
3. "The technological skills are judged to be adequate/inadequate because...."
   Which skills could you could you improve on that would have the greatest effect on the experimental results.
   Was the evidence from repeated trials similar?
4. "The percent difference between the experimental result and the predicted value is ...."
   How does this difference compare with your estimated total uncertainty?

5. "The prediction is judged to be verified/inconclusive because ..."
   How confident do you feel about your conclusion?