LABORATORY WORK: IB

A Guide To Internal Assessment in IB: Practical Scheme of Work (PSOW)

To satisfactorily complete the **Internal Assessment, (IA)**, 60 hours of Lab work needs to be completed. This includes 10 h or Group 4 Project.
This constitutes 24% of the total mark for IA (of the final mark for IB).

Practical Scheme of Work (PSOW)
This is a "summary of all the investigative / practical activities carried out by a student in the IB program". PSOW may include a variety of investigations, such as…

Short-term investigations/ practicals, long-term practicals/projects, computer simulations, general data collection & analysis, general lab work, field work, work carried out at NRC, or at Carleton Universtiy etc.
It acts as a record of IA work, indicates when formative assessments are made, gives information about levels of performance, and indicates "purpose" of investigations. It is used to judge standards of marking and to review practical scheme of work.

Portfolio of Investigations
This is "a compilation (evidence) of all practical work done by an individual candidate, relating to PSOW".
Log Book
This is a candidate's personal record of activities related to their practical work…

Each investigation must include:

- Title/ brief description of experiment
- The date(s) when each investigation is carried out,
- Outline/brief description including contribution from Group 4 Project,
- Topic, syllabus / Option the investigation is most relevant to,
- Indicate the time each investigation takes in house (including time for planning and evaluation, but **not** write up time),
- Indicate skills assessed for each practical,
- Levels achieved on a 0 – 3 for each relevant criteria,
- Written instructions/worksheets/guidelines provided by me,
- Outline of verbal instructions,
- Observations/ drawings/ diagrams,
- Raw data, personal jottings/notes
- Outcome of data manipulation exercises, results of computer simulation exercises.

Each experiment does not have to be assessed for every criteria. "Full write-ups" of 3-6 investigations are required, the remaining investigations, may be in a variety of forms that focus on only one or more assessment criteria.

ASSESSMENT CRITERIA

There are 8 criteria assessed:

- Pl(a) Defined problem(s)/research question(s): formulated hypotheses(es); selected any relevant variables
- Pl(b) Designed realistic procedures including appropriate apparatus/materials; methods for the control of variables; methods for the collection of data.
- DC Observed data with precision; recorded raw data with precision; presented them in an organized way (using a range of appropriate scientific methods/techniques).
- DPP Transformed data, manipulated data, presented data in a variety of appropriate ways to provide effective communication.
- CE Evaluated the result(s) of experiment(s); evaluated the procedure(s); suggested modifications to the procedure(s) where appropriate, and draw conclusions.
- MS Carried out a range of techniques proficiently; due attention is paid to safety; followed instructions.
- PS(a) Worked within a team; recognized the contributions of others; encouraged the contribution of others.
- PS(b) Approached investigations, etc. with self-motivation and perseverance; and in an ethical manner; paid due attention to the environmental impact.

Suggestions for Planning: Pl_a and Pl_b

Research Question
Give a clear and specific statement of your aim for the experiment. If a general question already has been suggested, make it more specific and relevant to your individual experiment.

Hypothesis
Formulate an hypothesis only if a meaningful statement is possible. Avoid an hypothesis if you already know the expected result or if you have no idea what result you might obtain. In these cases, state that no meaningful hypothesis is possible. Explain the basis of a meaningful hypothesis, be quantitative where possible.

Variables
State variables explicitly, and explain why each is relevant. Indicate which variables are independent and which dependant (manipulated and responding). Indicate which variables need to be controlled.

Apparatus and Materials
Be as specific as possible (e.g. 50 cm^3 beaker rather than "beaker").

Control Of Variables
Refer to variables that need to be controlled. Give an explicit procedure for how each variable will be controlled. Indicate how the procedure will control the variable.

Method / Procedure
Provide enough detail that another person could repeat your work. Standard procedure (e.g. titrations, melting points) need little detail. The procedure should be appropriate to the level of uncertainty needed (e.g. don't use a measuring cylinder to dispense the analyse for a titration).

The procedure should explain how the quantities being used were determined to be suitable, by using calculations. The procedure should explain how the relevant data will be collected (e.g. repeated trials where appropriate, and the tables necessary.)

A fully labelled diagram is acceptable. A realistic method that pays attention to safety should be designed.

Suggestions for Tabulating Observations: DC

Both quantitative and qualitative observations can be tabulated, (use of a table makes observations well-organized and thus easier to interpret.)
Give an identifying title to each table.
Organize observations into rows and columns for greatest efficiency and clarity.

Table 1: Change of temperature as Naphthalene is Cooled

Time (s)	Temperature (°C)
Uncertainty ± 2 s	Uncertainty ± 0.3 °C
0	92.1
30	87.3
60	83.6
	81.0

Table 2: Change of Temperature as Naphthalene is Cooled.

Time(s) Uncertainty ± 2s	0	30	60	90	120
Temperature(°C) Uncertainty ± 0.3 °C	92.1	87.3	83.6	81.0	80.8

Note:
The arrangement of Table 1 is preferred to that of Table 2, even though it may take up more space on the page.

The contents of the column should be identified as shown: quantity/ unit. This means that the units do not have to be included in the individual cells.

Uncertainties should be included, but need to be entered only once for each column or row.

Arrange entries so that they follow logically. This may be different from the order in which the data are observed (mass of beaker with water, mass of empty beaker, mass of water).

All raw data should be recorded, not just the final value of mass or volume resulting from the subtraction of one value from another.

Significant figures should be used correctly throughout the table.

Suggestions for Data Processing and presentation: DPP

Calculations of Results

Do one sample calculation; identical calculations do not need to be repeated. Show all steps clearly, explaining method if not obvious. Often it is preferable to set up an equation for an entire calculation, rather than carrying it out in separate steps. Use significant figures appropriately. Keep one extra significant figure throughout a calculation to reduce rounding errors; the final result should be consistent with the number of significant figures in the experimental measurement and any subsequent calculations based on them. For repeated trials, calculate a final result for each trial; do not use an average of raw data. Calculate an average result, based on final results of repeated trials.

Calculations of Errors and Uncertainties

Error should be calculated where possible.

Presentation of Results

Criteria:

Easy to follow and understand, comprehensive
Appropriate to the nature of the results
Consider summarizing results and/or conclusions in a table
Graphs may be useful:

- Show title, heading to identify your graph
- Choose axes, the independent variable is plotted on the horizontal axis)
- Label axes (quantity/unit)
- Use an appropriate size (larger, rather than smaller)
- Use an appropriate scale, the origin may not need to be included, range of values to cover all points
- Label equal intervals, but not every square
- Indicate points clearly, locate points by an X or small dot with a circle around it
- Show relationship by fitting points to line(s) or a smooth curve
- Graphs may be hand-drawn or computer generated

Suggestions for Conclusion and Evaluation: CE

Conclusions

Draw conclusions from your results, don't just restate the results. Conclusions should be clearly related to the research question and purpose of the experiment. Explain how your conclusions follow from the results. Compare with literature or accepted value where possible. Calculate percent error where comparison is possible.

Limitations to Conclusions

Are tests conclusive? Are other interpretations possible? Consider magnitudes of errors and uncertainties in considering limitations.

Limitations of Procedures

Are there flaws in the procedure which could affect the results? Are important variables not controlled? Are measurements and observations reliable? Is precision unknown because of lack of replications? Analyse sources of error – indicate direction and magnitude of effect on final result, where possible.

Improvements

For identified weaknesses, suggest improvements. Suggestions should be realistic, not involving unavailable equipment or materials. Suggestions should be specific, not vague (e.g. "more careful work"). Proposed changes may do any or all of the following: eliminate or reduce errors, improve control of variables, provide other procedures for better measurements. State if modifications are unnecessary or impossible (i.e., standard procedures were used.)