SPA5201 - Physics Laboratory

Lecture 2

General advice on logbooks

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- 60% of the overall marks will be awarded for your laboratory logbook
- You **do not have** to hand in your logbook at the end of every lab session
- Logbooks will be marked every week and returned, marked with an accompanying marksheet, at the start of the next laboratory session
- Please feel free to approach the relevant academic for more detailed feedback on experiments they have marked (having taken into account their comments/corrections in your logbook)

Physics Lab Feedback Sheet

Week: _____ **Experiment:** _____ **Student:** _____

Format / Presentation / Timeline	**0**	**3**	**7**	**12**	**15**
	Badly formatted. Illegible. Missing timeline.	Minimal timeline with many gaps. Legible but with several issues, e.g. poor handwriting, poor structure, in pencil, missing axis labels/units etc.	Legible, in pen. Sensible layout in sections. Timeline mostly present. Some issues, e.g. incorrect axis labels or wrong units.	Very good overall structure and presentation, with only a few minor issues. Good, complete timeline.	Excellent structure/format. Hardly any presentation problems. Detailed, complete timeline.
Description of Method	**0**	**3**	**7**	**12**	**15**
	Missing or very poor.	Poor description of method and/or apparatus. Mostly lacking in detail. Unclear what steps were performed.	Sensible description of method and apparatus, but may have too much/ too little detail. States specific actions that were performed.	Good, insightful explanation of method and apparatus. Explains specific actions, as well as steps taken to get better results.	Excellent understanding and control over method and apparatus. Full, detailed account of what was done and improvements that were made.
Observations	**0**	**3**	**7**	**12**	**15**
	Missing.	Minimal observations. Little information on experimental conditions.	Some useful observations but unclear or lacking in detail. Basic description of experimental conditions.	Useful observations of physical phenomena, apparatus behaviour, and conditions during experiment.	Detailed, insightful observations covering all relevant aspects of the experiment. Clear understanding of relevance of the observations.
Physical Understanding	**0**	**3**	**7**	**12**	**15**
	Missing, or very poor.	Unclear and/or minimal discussion of relevant physics, or significant errors in understanding.	Basic level of correct physics, but not well connected to experiment; or more in-depth/relevant physics, but with mistakes.	Demonstrates good understanding of relevant physics, few mistakes. Physical implications of the experiment well-explained.	Excellent level of understanding, very few mistakes. Clear discussion of relevance/implications. Goes significantly beyond the lab script.
Interpretation and Discussion of Results	**0**	**3**	**7**	**12**	**15**
	Missing, or very poor.	Only basic calculations performed (or more complex calculations with serious errors). Limited or flawed discussion of results.	Appropriate calculations with minor mistakes or omissions. Basic but sensible discussion of results and their implications.	Full set of calculations with only minor issues. Detailed discussion with well-justified interpretation. Discusses possible improvements.	Full and rigorous calculations, with no problems. Complete and well-reasoned discussion with insights beyond what is written in the script.
Error/ Uncertainty Analysis	**0**	**3**	**7**	**12**	**15**
	Missing errors and uncertainty analysis.	Only a basic discussion of sources of error/uncertainty. Unjustified or often missing error estimates.	Broad but reasonably basic discussion of sources of error. Basic attempt at error propagation.	Thoughtful discussion of sources of error. Competent estimation and propagation of errors.	Thorough and insightful discussion of the source of errors. Full treatment for propagation of errors.
Conclusions	**0**	**2**	**5**	**7**	**10**
	Missing.	Very short. No summary. No discussion of findings.	Short. Summary of method/ findings is present, but lacks detail.	Good summary of experiment, results, and physical implications.	Excellent summary of experiment, results, and physical implications.

Marker: **Total mark:**

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Marker: **Total mark:**

I shall discuss each category in reasonable detail in turn today, But first, some general advice:

General logbook guidelines – part 1

- Logbooks should contain detailed notes of all your activities in the lab along with times and dates
- Use ink in your logbook
- Cross out using single lines
- Number each page
- The logbook on its own should be sufficient to:
  - Enable you to write a formal report on a given experiment
  - Enable someone else to write a formal report on a given experiment
  - Enable someone else to reproduce a given experiment

General logbook guidelines – part 2

- Logbooks should be legible and clearly set out, but are not “works of art”. They are a vital experimental tool, “warts and all”
- Note everything that occurs
  - You cannot “go back” to record a vital setting/quantity/observation post hoc
  - Within reason, nothing is “too trivial” to record…
- Feel free to sketch or take and print photographs using your smartphone
- If you find yourselves discussing a point with each other, the demonstrators or academics, then it is certainly worth keeping a record in your logbook

General logbook guidelines – part 3

- Never, ever, use loose “scrap” paper
- Answer all questions posed by the lab scripts in your logbook
- Read through the relevant lab script before you begin your laboratory session

More specific logbook guidelines – part 1

- Begin each experiment with a title, date and the purpose of the experiment
- Note all your actions and observations, including the time.
- Make use of sensibly titled sections, subsections etc
- Note all equipment settings (e.g. at RT, I set to yy mA, varying B between qq and pp mT, recording V_h)
- Record all measurements immediately in your logbook
  - Use tables where necessary
- Record quantities with units and relevant errors as you go along
- Record all calculations in the logbook

More specific logbook guidelines – part 2

- Plot graphs as you proceed
  - And paste these into your logbook
- If the data is recorded by a computer, note all relevant filenames and directory locations
- If you are unsure of any experimental detail and seek assistance make a note of the explanation/advice received
- At the end of each experimental section note any preliminary conclusions reached
- Conclusions and Discussions should be concise and whenever possible quantitative

Specific advice relating to the markscheme - 1

	0	3	7	12	15
Format / Presentation / Timeline	Badly formatted. Illegible. Missing timeline.	Minimal timeline with many gaps. Legible but with several issues, e.g. poor handwriting, poor structure, in pencil, missing axis labels/units etc.	Legible, in pen. Sensible layout in sections. Timeline mostly present. Some issues, e.g. incorrect axis labels or wrong units.	Very good overall structure and presentation, with only a few minor issues. Good, complete timeline.	Excellent structure/format. Hardly any presentation problems. Detailed, complete timeline.

- Include the date and relevant times
  - You may include comments on how swift or time consuming a given procedure proved to be
- Write meaningful titles
  - e.g. “Setting up and aligning the interferometer optics”
  - or “electron mobility calculation”

  NOT “Part 1” or “Calculations”
- Include subsections if necessary
  - e.g. “maximising the laser output using the photodiode”
  - or “error estimation for V_s”

Specific advice relating to the markscheme – 1 cont.

	0	3	7	12	15
Format / Presentation / Timeline	Badly formatted. Illegible. Missing timeline.	Minimal timeline with many gaps. Legible but with several issues, e.g. poor handwriting, poor structure, in pencil, missing axis labels/units etc.	Legible, in pen. Sensible layout in sections. Timeline mostly present. Some issues, e.g. incorrect axis labels or wrong units.	Very good overall structure and presentation, with only a few minor issues. Good, complete timeline.	Excellent structure/format. Hardly any presentation problems. Detailed, complete timeline.

- Follow the conventions of scientific writing in your logbook
  - e.g. number and caption your tables, figures etc
- Write neatly and legibly
  - Use correct English (spelling, punctuation, grammar)
  - Ensure all calculations are legible/intelligible
- Set out the logbook neatly/sensibly
  - Paste in graphs so that they are legible, correctly labelled, captioned etc
  - Label and caption all data tables
  - You may wish to leave spare space for extra notes etc
- Do not use pencil for writing text
  - But may wish to use for sketches diagrams etc
- Organise your logbook logically
  - Use sections, subsections etc

Specific advice relating to the markscheme - 2

	0	3	7	12	15
Description of Method	Missing or very poor.	Poor description of method and/or apparatus. Mostly lacking in detail. Unclear what steps were performed.	Sensible description of method and apparatus, but may have too much/ too little detail. States specific actions that were performed.	Good, insightful explanation of method and apparatus. Explains specific actions, as well as steps taken to get better results.	Excellent understanding and control over method and apparatus. Full, detailed account of what was done and improvements that were made.

- Include all procedures and settings
  - record all relevant values and units
  - make notes on relative importance of specific steps
  - Include relevant explanations relating to specific steps/procedures/settings etc
- Use diagrams/sketches/schematics where applicable
  - Hand drawn
  - Photographs
  - Reproductions of the lab script
  - Oscilloscope traces
- The level of detail should be sufficient to allow for reproducibility of your experiment
- Remember to give the reasons for carrying out (purpose) specific procedures

Specific advice relating to the markscheme - 3

	0	3	7	12	15
Observations	Missing.	Minimal observations. Little information on experimental conditions.	Some useful observations but unclear or lacking in detail. Basic description of experimental conditions.	Useful observations of physical phenomena, apparatus behaviour, and conditions during experiment.	Detailed, insightful observations covering all relevant aspects of the experiment. Clear understanding of relevance of the observations.

- Observations are both quantitative and qualitative
  - e.g. “current saturated at 150 ± 20 mA”
  - or “the interference pattern is extremely sensitive to vibrations and disappears if the optical bench is touched”
  - or “the sample voltage oscillates with approximately 5 mV amplitude”
- You should include your understanding of the relevant importance of specific observations
  - i.e. is a specific phenomenon/observation/effect critical or irrelevant/negligible
- Again, diagrams/photographs/sketches can be very useful
- Remember to include anything unexpected or not mentioned in the laboratory script!

Specific advice relating to the markscheme - 4

	0	3	7	12	15
Physical Understanding	Missing, or very poor.	Unclear and/or minimal discussion of relevant physics, or significant errors in understanding.	Basic level of correct physics, but not well connected to experiment; or more in-depth/relevant physics, but with mistakes.	Demonstrates good understanding of relevant physics, few mistakes. Physical implications of the experiment well-explained.	Excellent level of understanding, very few mistakes. Clear discussion of relevance/implications. Goes significantly beyond the lab script.

- This relates to the higher level understanding of an experiment
  - Requires complete understanding of the basic Physical principles behind the experiment
- Can be qualitative as well as quantitative
  - e.g. physical explanation of deviations from theoretical behaviour
  - correct identification of “unphysical” values
  - Identifying key assumptions etc
- Includes physics/phenomena not necessarily mentioned in the laboratory script
- Includes correct scientific criticism/discussion of the experiment design/procedure and/or results obtained

Specific advice relating to the markscheme - 5

	0	3	7	12	15
Interpretation and Discussion of Results	Missing, or very poor.	Only basic calculations performed (or more complex calculations with serious errors). Limited or flawed discussion of results.	Appropriate calculations with minor mistakes or omissions. Basic but sensible discussion of results and their implications.	Full set of calculations with only minor issues. Detailed discussion with well-justified interpretation. Discusses possible improvements.	Full and rigorous calculations, with no problems. Complete and well-reasoned discussion with insights beyond what is written in the script.

- All calculations should be carried out correctly and clearly
  - Consistent values with associated errors, units
  - Calculations should be intelligible!
  - Calculations should be complete
- The discussion is both qualitative and quantitative
  - Can relate to specific procedures
  - Can relate to specific values/results
  - Can also include the more general physical context
- Ensure you answer all questions specifically posed in the laboratory script
- Ensure you carry out all comparisons specifically indicated in the laboratory script
- Ensure you discuss all your results and the experimental method, suggest sensible improvements if relevant

Specific advice relating to the markscheme - 6

	0	3	7	12	15
Error/ Uncertainty Analysis	Missing errors and uncertainty analysis.	Only a basic discussion of sources of error/uncertainty. Unjustified or often missing error estimates.	Broad but reasonably basic discussion of sources of error. Basic attempt at error propagation.	Thoughtful discussion of sources of error. Competent estimation and propagation of errors.	Thorough and insightful discussion of the source of errors. Full treatment for propagation of errors.

- Include relevant errors in all measured and calculated quantities
  - Note the origin of specific errors, e.g. instrumental, random, systematic
  - Quantify errors with a clear explanation of how you chose (calculated) specific values
  - Propagate errors for every calculated quantity
- Identify the sources of error, their nature and discuss them
  - Comment on which sources are dominant, negligible, avoidable, unavoidable
- Make good use of repeat measurements where possible/necessary
- Make use of the errors associated with all calculated quantities for the purposes of discussion/comparison
- Suggest possible methods to reduce errors
- Include relevant errors in all tables and graphs

Warning!

- **Never** quote the percentage difference between your experimental and the literature values of a quantity as the “error”
- this is an example of incorrect Physics taught by many boards at A level
- it will be penalised severely

- You are encouraged to compare experimental and literature values using the actual (propagated) error you have calculated for the experimental result
  - e.g. “…the two values differ by less than one standard deviation (error) in X and are therefore in agreement…”
- See Lecture 3 for more details

Specific advice relating to the markscheme - 7

	0	2	5	7	10
Conclusions	Missing.	Very short. No summary. No discussion of findings.	Short. Summary of method/ findings is present, but lacks detail.	Good summary of experiment, results, and physical implications.	Excellent summary of experiment, results, and physical implications.

- You must write an overall conclusion at the end of your experiment
- Use any interim conclusions reached on completing each experimental section
  - This includes calculated quantities and their associated errors
  - Includes criticism/discussion of the experimental procedures
- Be quantitative whenever possible
  - Include relevant values for quantities calculated
  - A thorough error analysis is vital for this!
- Include any comparisons made between your values/results and those in the relevant literature if applicable
- Include suggested improvements/changes to the method or analysis if applicable

General advice relating to the mark scheme

- Although the scheme is divided into sections, there will be overlap between different sections
- Read through your corrected logbooks and marksheets and note comments made by the assessor
- Seek advice on improving your performance if necessary
- It should be possible to obtain full marks even if a specific experiment has not proceeded as expected/described in the laboratory script

- the QMPlus webpage includes some examples of good practice (as well as poor practice)

Overall (Strategic) aims of Plab

- Methodology: Choosing and executing appropriate methods, understanding their strengths and weaknesses.
- Observation: Making sense of what you see, and using that information to gain a deeper understanding.
- Interpretation: Understanding the connection between (messy, imperfect) data and theoretical physical understanding.
- Problem solving: Identifying issues and proposing (novel) solutions.
- Quantifying uncertainty: Working out how uncertainty and imprecision limit the physical conclusions you can draw.
- Presenting information: Describing your motivations and results with clarity and precision. Highlighting and justifying important conclusions.
- Project management: Planning complex projects, safety, managing your time.

There will be two more lectures later this week (Friday)

Specific topics covered are:

Identifying, quantifying and propagating errors (lecture 3)

Plotting graphs, including software and curve fitting (lecture 4)

I shall take a practical, “experimentalist”, approach to these…