Introduction

The purpose of the checklist is to try and develop uniform expectations for labs. All of the requirements are in order to make your work *professional*.

Explanation

General

- *Your own work*

  This is a reminder about avoiding subtle forms of plagiarism, including relying on your lab partner (or someone else) for most of the explanations or calculations. Don't reword someone else's ideas; develop your own thoughts and interpretations.

- *Complete*

  All things are requested for a reason; parts not done will reduce the learning involved.

- *Clear and appropriate "Purpose"*

  You should have a clear idea of what you are trying to achieve, so you can conclude whether or not you succeeded. Don't just regurgitate what's in the manual; think it over and come up with your own description of what this experiment teaches.

- *Flows*

  A lab *report* should not be just a string of calculations. There should be sufficient text so that if you came back to this report next year, you would be able to follow it.

- *Did not require help on or after due date*

  Good planning and time management are essential. I'm happy to answer questions and give suggestions when there's time for you to improve your report; I'm not as sympathetic when you didn't look at it until the night before it was due and then realized you were lost.

- *Correct grammar*

  By the time you are in university, this should not need to be justified. Your credibility will depend on your attention to detail. If you cannot communicate clearly and correctly, pepul wil beleave u r a doofus.

- *Correct spelling*

  This is like the previous point.

- *Complete sentences where required*

  Your goal is to *communicate* results, not merely record numbers, etc.

- *Legible*

  At university, this should not need to be justified. If you type your report, this shouldn't be a problem. (See the next item.)

- *Professionally presented*

  A professional report is not submitted on tractor–feed or non–standard size paper, but it is firmly bound (e.g. stapled), neat, etc.

- *Properly identified (e.g. name, partner)*

  Print your name and your partner's name, your student numbers and your lab section, along with the due date.

- *On time*

  To do this, you should aim to have the report finished and printed by the day before the due date so that if any problems occur you have time to fix them.

- *Checklist included*

  A blank checklist must be attached to the report for the marker to fill in.

- *Template included*

  The template which was signed in the lab, *not a copy*, must be included to verify that you were actually present in the lab.

Plagiarism Avoidance

Note: These points don't guarantee that no plagiarism has occurred, but they encourage an approach which should make it less likely to happen accidentally.

- *Data only shared with partner(s)*

  The data in *your* report should be data collected by you and your partner, and *no-one else*. If you were allowed to collect data with other people, then they need to be identified clearly in your report so that it is clear who participated.

- *Individual choice of sample data*

  If you and your partner(s) *use different values for your sample calculations*, then it will be much more clear that each of you has done the work independently.

- *Individual formatting*

  If you and your partner(s) *each create your own tables and your own equations*, then it will be much more clear that each of you has done the work independently.

- *Individual structure of text*

  If you and your partner(s) *each figure out your own organization for the text in your report, including the Discussion and Conclusions*, then it will be much more clear that each of you has done the work independently.

Data

- *Neat*

  Tabular data should be in boxes, with no page breaks within a table. Tables should not be split into multiple sections without reason, etc.

- *Table column headings informative*

  "y" and "x" don't help much here either. If space prevents you from having longer headings, add a note just above or below the table to clarify.

- *Units given*

  e.g. "Voltage $= 1.023 \pm 0.004$ " is not OK.

  Usually these should be part of column headings.

- *Uncertainties given*

  If uncertainties for all items in a column are the same, you may put a single note above or below the table to state the value of the uncertainty. Otherwise the uncertainties should be in the table with the data values.

- *Reasonable values*

  e.g. "Diameter $= -6.5$ *cm*. WAIT! This can't be! Diameter should be positive."

- *Reasonable uncertainties*

  In many cases, the uncertainty in measurements will be the precision measure of the instrument. In some cases, there will be an effective uncertainty bigger than that. In both cases, the precision measure should be clearly identified. If the effective uncertainty is larger, it needs to be clearly stated along with a rationale for how you determined the value you state.

- *Correct number of significant figures*

  Last digit of quoted value should be uncertain. e.g. "Voltage $= 1.023 \pm 0.004$ Volts" Note the 3 is uncertain. Both "Voltage $= 1.02 \pm 0.004$ Volts" and "Voltage $= 1.0235 \pm 0.004$ Volts" would be *wrong*.

- *Tables labeled (e.g. "Sample 1 Data")*

  Labels should be meaningful; e.g. "Mass sliding down incline" rather than just "Data" or "Part 3" will mean something to any reader, not only to people who are very familiar with the lab manual.

- *Tables given numbers (e.g. "Table #2")*

  ..and then any reference to the data can use this number.

Calculations and Results

- *Any required derivations done correctly*

  Watch for instructions to "show", "derive", etc.

- *Analysis explained where needed*

  Calculated values should not appear out of the blue.

- *Correct formulas used*

  This of course presumes the formula is actually *stated*.

- *Sample calculations shown where needed*

  Show one sample of any non-trivial calculation. (Any calculation not done in a previous lab is non-trivial.) For instance, in the first lab where you have to calculate an average along with the standard deviation and the standard deviation of the mean, you should show these. In subsequent labs, you don't need to show these calculations explicitly (although it's perfectly OK to do so).

- *All required values calculated*

  Be sure to find all of the results asked for in the lab.

- *Uncertainties included*

  Make sure all results have bounds on them.

- *Units included*

  All results should have units stated unless they are some of the *very* few dimensionless numbers.

- *Correct number of significant figures*

  This will depend on your uncertainties.

- *Appropriate use of standard form*

  There's an appendix in the lab manual explaining the standard form and when to use it.

- *Theoretical or reasonable value*

  Either compare to something expected OR give some rationale for whether this is in a reasonable ballpark.

- *Agreement of experiment with theory*

  This should be done in cases where the previous rule does not apply, e.g. in testing "laws", etc.

Linearizations

- *Independent (x) variable identified*

  If plotting, say, m vs. r^3 for spheres to calculate the density, then point out that the independent variable is r^3.

- *Dependent (y) variable identified*

  If plotting m vs. r^3 for spheres to calculate the density, then point out that the dependent variable is m.

- *Expected slope identified*

  This should be in terms of the initial variables, *other* than those used in the independent and dependent variables. So, if plotting m vs. r^3 for spheres to calculate the density, then point out that the slope should be $4/3\pi\rho$.

- *Expected y-intercept identified*

  This should be in terms of the initial variables, *other* than those used in the independent and dependent variables. So, if plotting m vs. r^3 for spheres to calculate the density, then point out that the y-intercept should be zero.

Graphs

- *Title meaningful*

  (not "y" vs. "x"); the title should give information otherwise NOT on the graph

- *Correct graph type and orientation*

  With rare exceptions, all graphs will be "xy" type; if an orientation is specified, such as "y" versus "x", then the dependent variable, e.g. "y", should be on the *vertical* axis and the independent variable, e.g. "x", should be on the *horizontal* axis.

- *Background colour and grid appropriate*

  The default grey background in many spreadsheets just looks bad in graphs; it obscures the data and serves no purpose. Grid lines should be either removed or in both dimensions. Gridlines in one direction only look odd on an "xy" graph.

- *Plotting data in table*

  The quantities plotted on the graph should actually be recorded. (e.g. if you have "diameter" as a graph variable, but you measured "radius", you should have "diameter" in a table so it's easy to compare what's plotted with what's written.)

- *Axis labels meaningful*

  "distance" is more meaningful than "x"

- *Correct axis units*

  The units should make sense for the quantity in the label

- *Points not connected*

  Your graphs should never look like dot–to–dot drawings

- *Error bars in both dimensions or note if too small*

  ..in both dimensions, or there should be a note on the graph if they are too small to show up in either dimension

- *Error bars correct size*

  This is why uncertainties are in the data tables; it should be easy for a reader to check that the table and graph agree.

- *Line of best fit shown without markers*

  There should be no suggestion that points used in plotting the line of best fit are data points

- *Number given (e.g. "Graph #3)*

  ..and then any reference to the data can use this number.

Least Squares Fits

- *Points used for fit clearly identified*

  If all data points are not used, it should be clear which ones *are*

- *Results given meaningful names*

  "st. err. of coeff." is meaningless; "slope" is meaningful

  If you don't know what some calculated quantity means, don't present it.

- *Correct units for slope and intercept*

  If the graph axes have units, the slope and intercept must have units.

- *Correct indication of "large" or "small"scatter*

  Whether to use standard errors or maximum and minimum slopes for the uncertainty must be indicated.

- *Reasonable points for maximum and minimum slopes if scatter "small"*

  If maximum and minimum slopes are needed, the points chosen must be reasonable.

Error Discussion

- *Sources listed are significant*

  The goal is to suggest things that may have had a noticeable effect, not just whatever you can think of; you're trying to *support* your results, not destroy them

- *Sources are prioritized*

  Most discussion should be of sources which contribute most to uncertainties in final results.

- *Systematic error consequences*

  When a systematic error is discussed, it should be clear which direction the results would be skewed by it. *Note: You must include at least one source of systematic error to discuss, even if you show that is is small enough that it can be ignored.*

- *Evidence: i.e. test or bound*

  You should indicate some concrete test or rationale for how big the effect may be; if you did not see any *concrete* evidence for a source of error, you should NOT use it.

- *Reasonable suggestions for improvement*

  This can refer to some ways to reduce sources of error, or to changes to the experiment to go further with the investigation. Research is *never* "done".

Conclusions

- *Relate to purpose*

  What you conclude should be related to the things you said you were going to study, observe, etc.

- *Major results stated*

  These are usually the final quantities for the things you were supposed to calculate.

- *Comparisons made where appropriate*

  How do your results compare to accepted values, etc.? Do your results agree within experimental error? If you have no accepted value, were the results *plausible*?

- *Agreement noted when found*

  When quantities agree within uncertainties, that should be clearly stated (including what that means; e.g. energy was conserved, etc.)

- *% difference only when no agreement*

  When quantities do not agree within uncertainties,that should be clearly stated (including what that means; e.g. energy was not conserved, etc.)

References

- *Source(s) of constants listed*

  Since you are not writing an *Introduction* section for your labs, there are not many references for your lab reports. However, when you have to look up constants then you should cite your sources for them.