Lab Reports

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1. General Information about the Lab Reports and Lab Manual

- While the Precalculations are done individually, the lab reports are done as a group (one for each lab per group of two or three students). The assigned grade for the **Lab Report – Group Portion** will be the same for each group member unless points are deducted for individual students as described on the cover page.
- Lab reports do not have to be typed, but hand-written portions must be neat and clear. However, all plots and tables must be generated by computer (using Excel, EES, MathCad, MatLab, etc.).
- Lab reports are due before you leave the lab – you have three hours to complete the lab and lab report.
- The lab report must include the Cover Page, Results, and Discussion, along with any additional figures, tables, or plots, as required. The report must be stapled or clipped together. ***The results, including tables and plots, account for typically 50 or 60 points of the lab report grade*** (out of 80 total points).
- Only one copy per group of the section of the lab called "Lab Report – Group Portion" is required.
- The lab manual for each lab experiment also contains discussion questions that are to be answered by the students as a group. ***The Discussion questions account for typically 20 or 30 points of the lab report grade*** (out of 80 total points).

2. Specific Details about Lab Report Writing and Neatness and Grammar

- Figures, tables, and plots generated on additional sheets of paper should be clearly labeled, titled, and numbered, (e.g. "Table 4. Head loss measurements through a 3/4-inch copper pipe."), referred to in the report (e.g. "...See Table 4 ... See Figure 7 ..."), and attached to the report immediately following the page on which they are first referred.
- ***Points will be deducted from the lab report grade for lack of neatness and for grammar errors***. Particular items about which to be careful include:
  - The subject and verb must agree. ("A group of tests was performed ... The data were plotted ...")
  - "Data" is a plural word. ("Data were recorded at two locations ... these data are plotted ...")
  - The plural word "they" should not be used as a neuter singular subject. (Incorrect: "If a student does this, they will learn that ..." Correct: "If a student does this, he or she will learn that ...")
  - Don't leave "dangling participles" or "dangling prepositions". (Incorrect: "He left his hat on the desk he sat at." Correct: "He left his hat on the desk at which he sat.")
  - Use ***third person***, ***past tense***. Example: Instead of "... we measured the length of each tube...", it is more proper in a technical report to write "... the length of each tube was measured..."
- Units must be included in all calculations in the lab reports.

$$\mathrm{Re} = \frac{Vd}{\nu} = \frac{(45.6\ \mathrm{m/s})(0.1016\ \mathrm{m})}{1.750\times10^{-5}\ \mathrm{m^2/s}} = 2.65\times10^{5}$$

correct

$$\mathrm{Re} = \frac{Vd}{\nu} = \frac{(45.6)(0.1016)}{1.750\times10^{-5}} = 2.65\times10^{5}$$

incorrect

When grading the lab reports, points will be deducted if units are not shown in the calculations.

- It is incorrect to report numerical values of ***final answers*** to more than the maximum number of significant digits of precision associated with any one measurement. In the lab experiments, the typical precision varies significantly from instrument to instrument. For example, if velocity V is measured as 45.6 m/s (3 significant digits), diameter d is measured as 0.1016 m (4 significant digits), and kinematic viscosity ν is interpolated from a table as 1.750×10^{-5} m^2/s (4 significant digits), the Reynolds number would be precise to only three significant digits:

$$\mathrm{Re} = \frac{Vd}{\nu} = \frac{(45.6\ \mathrm{m/s})(0.1016\ \mathrm{m})}{1.750\times10^{-5}\ \mathrm{m^2/s}} = 2.647406\times10^{5} \cong 2.65\times10^{5}$$

correct

$$\mathrm{Re} = \frac{Vd}{\nu} = \frac{(45.6\ \mathrm{m/s})(0.1016\ \mathrm{m})}{1.750\times10^{-5}\ \mathrm{m^2/s}} = 2.647406\times10^{5}$$

incorrect

Although a calculator may have 8 or 10 digits, only the first three digits are meaningful in this example! When grading the lab reports, points will be deducted for use of excessive number of digits. *Note*: It is okay to list excessive digits in *intermediate* values to avoid round-off error, but not in final answers.

3. Specific Details about Figures and Tables

- When data are generated with lots of scatter, data points should *not* be connected on a plot by straight lines as one might do for a Dow-Jones stock market plot. The ups and downs in experimental measurements are usually caused by non-repeatable inaccuracies, and should *not* be emphasized. Instead, a smooth curve (or straight line if the data warrant one) should be drawn through the points. Figure 1 shows examples of both correct and incorrect ways to plot scientific data with scatter:

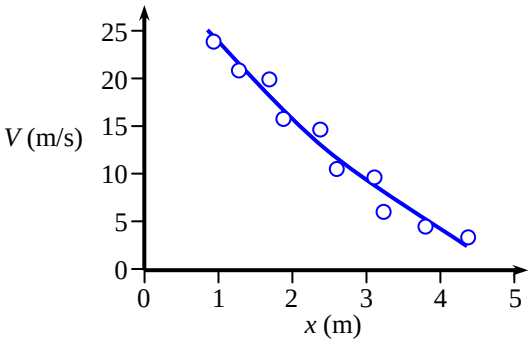

Figure 1. Correct plot of scattered data.

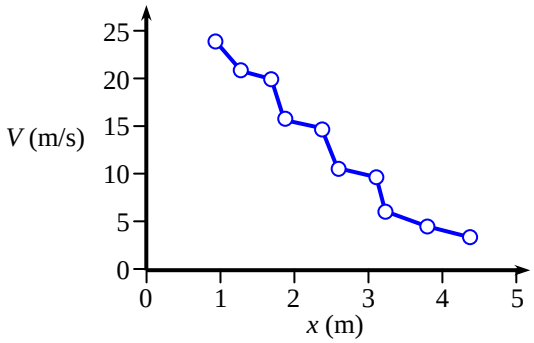

Figure 2. Incorrect plot of scattered data.

- When generating tables of results, units must always be included as part of the caption for each column. Care must be taken when using exponents in tables. This is a common mistake. Suppose for example that there is a column of data for kinematic viscosity ν in units of m^2/s, with calculated values of 1.45×10^{-4} m^2/s, 1.83×10^{-4} m^2/s, 2.65×10^{-4} m^2/s, etc. Table 1 shows both correct and incorrect ways of tabulating these data:

Table 1. Correct and incorrect ways of tabulating data.

ν (m^2/s)	$\nu \times 10^4$ (m^2/s)	$\nu \times 10^{-4}$ (m^2/s)
1.45×10^{-4}	1.45	1.45
1.83×10^{-4}	1.83	1.83
2.65×10^{-4}	2.65	2.65
.	.	.
.	.	.
.	.	.
correct and preferred	**correct but not preferred**	**incorrect**

Notice that the first column is preferred because there is no possibility of confusion. The second column is correct, but confusing because some readers may erroneously interpret the first value as 1.45×10^4 m^2/s, rather than the intended 1.45×10^{-4} m^2/s. Note that the proper way to interpret the second column is as follows: The numerical value listed (according to the column caption) is actually the value of ν *multiplied by* 10^4. Thus the first value is 1.45 *divided by* 10^4, i.e. $\nu = 1.45 \times 10^{-4}$ m^2/s, which is correct. The third column is clearly incorrect, but can also be confused. To play it safe, numbers should always be tabulated as in the first column to avoid confusion!

- The convention for figure and table captions is as follows:
  - Figure captions are placed *below* the figure.
  - Table captions are placed *above* the table.

  Proper placement of captions is illustrated in Figures 1 and 2 above, and in Table 1 above.