Formal lab Reports

We will be modeling our formal reports after a typical ACS journal article. Therefore, one of the first steps to understanding the format would be to look at Journal of Physical Chemistry B. Why B you ask, because this is the journal that relates to our current topic of discussion thermodynamics. The components of a formal report for this journal are:

0. *Title Page*: While this is not a part of the ACS format it is something I would like for you to include first. The title page should include the following: the name of your experiment, the date(s) it was performed, your name, the name(s) of your partner(s), and the date of your submission.

1. *Abstract*: This is a very concise statement of the nature of the experiment together with its major results. The abstract is best prepared after the rest of the report is written. It is the only part of the report that is single spaced, and should not be longer than five complete sentences. When writing this section you need to mention the system you studied, the methods you used, and the major result(s) you found.

2. *Introduction*: This section should introduce the study to be discussed, the nature of the problem(s) posed, and the approach you used to obtain the results. The introduction is the best place to explain the purpose of the study and also to put it in some kind of perspective. This is where you explain to your audience why they should read your paper or care about your work. In order to "hook" the reader you will need to provide historical information or previous work related to the study can be mentioned – HINT: You will want at least 3 peer-reviewed journal articles for your background to get this perspective. If your study is based on prior work, it is essential that those results and conclusions be acknowledged – otherwise, you will be treaded on someone's toes which is always a bad call.

3. *Theory*: This section is often a major portion of the formal report. Every synthesis, analytical technique, and physical measurement is based on theory. Thus, this section should include pertinent information and background, equations, balanced reactions, reported sources of error, an so forth. The bonding, structure, properties, and spectra of the compounds involved may be included. Depending on the journal, this section is sometimes paired with the introduction.

4. *Experimental*: Your experimental procedures should be described in sufficient detail so that any reader could reproduce the work. Some judgment must be exercised concerning the amount of detail included. For example, all the operations involved in common procedures such as titrating or weighing hardly need to be described, but details such as the indicator or grade of filter paper used are important. Often the sources or purity of reagents and the models of instruments used are mentioned if these are important for the evaluation of the work. It is sometimes helpful to identify each experimental procedure by a separate heading. Write all procedures in your own words, not words copied from a book or handout. To be kind to you, once you have shown me you can write a good experimental section I will allow you to refer to the original procedure. However, you will still need to include any deviations you may have had from this procedure with the intention that the reader would be able to replicate your results. (*You will not have an experimental section in this lab class*).

5. *Results*: This section contains only final experimental results and not raw data such as sample weights or burette readings. These latter data, if needed, are more appropriate in an appendix. Whenever possible, the results should be presented in clearly labeled tables or plots with all numbers having units and in parentheses an indication of their limits of error. The appropriate number of significant figures should be used for all numerical results. Experiments involving syntheses should report a percent yield and any IR or NMR spectra should be properly labeled with all significant peaks assigned. Again depending on the journal or the nature of your experiment this section may be combined with the next section. (*I would prefer you to have a Results & Discussion combined section*).

6. *Discussion*: In this section the above results are discussed in terms of their validity, relationship to theory or the work of others, and as to whether they satisfactorily fulfilled the purpose of the study as outlined in the introduction. All relevant information should be extracted from the data and explained with reference to theory or compared to literature values (properly cited) to the extent possible. Sources of error and their possible magnitude should be discussed here, especially if there is disagreement with published results. However, keep in mind that this section is intended to be a discussion of your results, not of your errors or mistakes. Therefore a lengthy discussion of precision or a statistical error analysis would more properly fit in an appendix, possibly in conjunction with a sample calculation of your results.

7. *Conclusions*: For rather long reports, it is appropriate and convenient to summarize the results and lead to a conclusion concerning the study. Shorter reports may not require this section. In general, this section is meant to explain your major findings and the success of your experiment in a concise way. It is also a good place to suggest future work which could be performed given the finding of your experiment.

8. *References*: In the text of the report itself, literature should be cited using a superscript numeral. This numeral will refer to one of the references listed in this section. No footnotes are required at the bottom of each page of the report, but a cited reference section of the report is mandatory. To see how references should be made – pick a journal article from the *Journal of Physical Chemistry A*, *B*, or *C* and see how their citations are formatted.

9. *Appendices*: One or more appendices may be included for raw data, error analyses, sample calculations, or any other extra material which would otherwise break the continuity of the report. Each appendix should be numbered and titled.

General Considerations for Formal Laboratory Reports

1. Papers should be typed, double spaced (except for the abstract), and the pages are to be numbered. Most if not all of you should be using Microsoft Word.

2. Long reports may include a table of contents which is placed right after the cover page.

3. Equations should be set off from the text and numbered sequentially near the right margin.

4. Graphs, figures, and tables should be carefully constructed, titled, and labeled with a number and a caption detailing the information they possess. These should then be referred to by number when they are discussed in your text.

5. Be sure to ask questions *before* the paper is turned in. Don't wait until it is graded to learn, for example, the proper format for references.

6. You should label the various sections of your formal report but there is no need to start each section on a new page.

Guidelines for Acceptable Graphs

1. Hand-drawn graphs on graph paper are not acceptable. Most of you will be using EXCEL.

2. The independent variable goes on the horizontal axis and the dependent variable on the vertical axis. The axes should be labeled and include units.

3. Construct the scale of each axis so that your data points are spread over most of the graph. Scale values should be given at reasonable intervals. Tick marks are recommended. However, a pet peeve of mine is gridlines – I do not like them so do not include them unless I tell you otherwise.

4. All graphs should have data points. It is common to use different symbols, such as circles, triangles, and squares, to distinguish among different sets of data. Error bars are sometimes used to indicate experimental uncertainty.

5. If required, connect your data points with a smooth curve. It may be appropriate to use some form of a least squares fit, linear or non-linear, for your data. If your data is to be compared to a theoretical model, this model also may be indicated by using a different type of line (e.g. dashed).

6. Be sure to give your graph a good descriptive title, usually across the top of the graph.

7. Do not include too much information in a single graph – it may make it difficult to interpret your data. When in doubt think of your reader.

8. Other pet peeves:
   - Do not include the legend on your graph if you only have one data set
   - Do not keep the ugly grey background – change it so that it is easier to see your data
   - Make sure the gridlines are gone – hate those.
   - Bold the “Figure #” and let the rest of your title be unbolded. This makes it easier for the reader to find the graph since often references may be made on other pages.