**Formal Writing Guide and Lab Report Format[[1]](#footnote-0)**

***General Tips***

**Be clear and concise** – Write succinct and to-the-point sentences without the use of language that is too complex or overblown. Avoid the use of subjective statements or phrases with no quantitative value such as: “good/bad”, “easy/hard”, “a lot/a little”, “probably”.

**Use proper tense** – The experimental section and any reference to previously published work should use the past tense. For example you would write: “The solutions were prepared by diluting the 0.1 M stock solution of Cu2+.” The results and discussion section should be written in the present tense. For example: “According to Figure 1, the absorbance of Cu2+ at 570 nm increases along with concentration.”

**Passive voice -** Although it is sometimes necessary to use “we” or “our” in discussing results, the use of first person “I” should be avoided in technical writing. Instead of writing, ‘I dissolved the solid to prepare a solution.’ It would be more appropriate to write, ‘The solid was dissolved to prepare a solution.’

**Only use peer-reviewed sources** – Any background research needed for your report should come from peer-reviewed sources such as scientific journals, textbooks, technical manuals or websites associated with scientific organizations or academic institutions (Wikipedia is not an acceptable website). Proper citation using the ACS format must be included for each reference. See the References section for proper formatting.

**Do not copy from sources** – The purpose of using sources is to gather information necessary to write a good introduction or discussion of your data. However, the writing has to be your own and not simply paraphrasing what is written elsewhere. Paraphrasing a source even if it is referenced constitutes plagiarism and is considered a series violation of academic conduct. **Any and all instances of plagiarism either from published sources or your classmates will be reported to the NCSU Office of Student Conduct.**

**General format for the formal lab report** –

* Title (name of the experiment)
* Your full name and the name(s) of your lab partner(s)
* Introduction
* Experimental
* Results and Discussion
* Conclusion
* References

**Introduction**

This section provides the reader with a short description of the background and significance of the experiment. The introduction should include a description of the basic chemistry involved with the experiment and a description of the purpose of the experiment (what is being tested). Your primary source of information for this section should be the lab manual and course textbook. All information gathered from outside sources must be referenced using in text citations (see ***References***). This section should also include relevant chemical equations, figures, and definitions of any technical terms (see ***Non-text Entries***). Use the bulleted list below to help you organize the Introduction section.

* Purpose of the experiment (what was the intended goal, what chemical principles were highlighted, new techniques encountered)
* Detailed description of what was observed. Make sure to include specific examples of each type of reaction or concept studied.
* Specific description of what information was be obtained from experiment

**Experimental**

The Experimental section includes a brief *yet clear* summary of the experiment. This section should be written out in paragraph form and should not include the list of steps shown in the procedure section of each experiment. Instead, describe briefly what specific reagents/concentrations or equipment that was used. Include a statement referring the reader to the lab manual for the detailed procedure.

**Results and Discussion**

The purpose of this section of the formal lab report is to present the results and discuss the analysis of said results. You should think of this section as a story describing the evidence you collected and your analysis of this evidence. Before you begin writing your story you should think about a logical sequence for presenting your work. The goal is to include enough detail so that someone not familiar with the experiment can understand what chemical concepts you investigated, what your results were and how you interpreted the results. The writing should show off your full understanding of the experiment, and your chemical knowledge when interpreting the data. It is helpful to begin this section by clearly stating the result(s) of the experiment and then follow up with the details. The results should be presented in the form of equations, charts, graphs, tables, etc. (See Non-text entries section below). It is important to note that not all data obtained in lab is worth including in the formal lab report. Using your data tables from lab, decide what data is relevant to the discussion you plan on presenting in this section. The analysis of results should address the precision and accuracy of the data and any sources of error. In addition to the interpretation of data, any results that required calculations beyond the data obtained experimentally must be shown. If a series of similar calculations is required, a sample calculation prior to reporting the data obtained from those calculations is sufficient. Use the bulleted list below to help you organize the R&D section.

* Begin with a sentence or two summarizing the results of the experiment. You need to state mean values and deviations as well as % error if applicable. Means must always be accompanied by the deviation and vice-versa.
* Next introduce the first data table, plot or equation by stating clearly what the information represents. All tables, plots and equations must be preceded by a short introduction. Do not just paste tables and plots without any comments.
* Next discuss the precision and accuracy of the data. Use the criteria described in the Evaluation of Data section in the Introduction of the Basic Training Experiment.
* Discuss any specific sources of error. Human error is not an acceptable source.

**Conclusion**

The conclusion is a brief synopsis of the accomplishments of the experiment and must refer to specific results obtained. This may seem repetitive as you likely discussed specific results in the Results and Discussion section, however, the Conclusion section must also refer to specific data. State whether or not the purpose of performing the experiment was achieved. Also include a statement about the reliability and/or significance of the experimental results. Improvements to the procedure may also be stated in the conclusion if appropriate.

**References**

This section provides a list of all referenced material from an outside source. To determine whether or not a reference is needed, simply ask if you had to look up the information you are including in the text. If so, the reference should be cited using a superscript number (for each new reference) outside the punctuation. The list of references is numbed according to the in-text citation and follows the order in which they are cited in the text (not alphabetical). Proper citation using the ACS format must be included for each reference. Below are examples of the most common types of sources that may be used when writing formal lab reports.

**Lab Manual:**

NCSU Department of Chemistry CH102 SE or CH202 SE Lab Manual, Semester, Year

**Books:**

Author 1; Author 2; Author 3; etc. Chapter Title. In *Book Title,* Edition Number; Editor 1, Editor 2, etc., Eds.; Series Information (if any); Publisher: Place of Publication, Year; Volume Number, Pagination.

Example of Book citations:

Dresselhaus, M.; Dresselhaus, G.; Eklund, P. *Science of Fullerenes and Carbon Nanotubes*; Academic: New York, 1996; pp 126-141.

**Websites (**Only websites ofscientific organizations or academic institutions allowed. Wikipedia is not an acceptable source)

Author (if any). Title of Site. URL (accessed Month Day, Year)

Example of Website citation:

North Carolina State University. Department of Chemistry Home Page. http://www.ncsu.edu/chemistry/ (access Date).

**Non-text entries**

The non-text entries (equations, tables, and figures) will be the focus of the reader’s eye and therefore should provide a concise message. Poorly prepared entries are not only distracting to the reader but reflect poorly on the author. The most common methods to include non-text entries are described below

**Equations** – A chemical or mathematical equation should be entered as a separate line of text and labeled with a number in parentheses to allow for quick reference in the text. For more complex mathematical equations with fractions and special characters you must use the Equation editor function. **For example, in Word, select Insert → Object then choose Microsoft Equation to access the editor.**

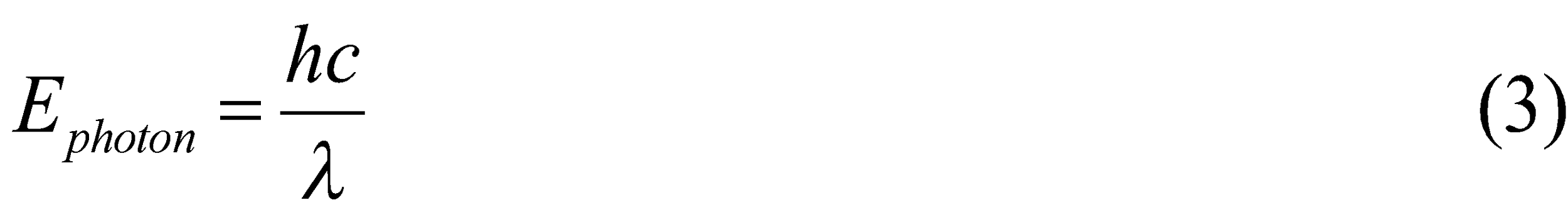
Sample chemical equation entry

*For this experiment, Ca2+ will be removed from the water sample by precipitation as the oxalate salt (equation 5), using an excess of precipitating buffer solution (NH4Cl, (NH4)2C2O4, NH4OH).*

Ca2+(aq) + C2O42-(aq) → CaC2O4(s) (5)

Sample mathematical equation entry

*The relationship between energy of a photon and wavelength (λ) is expressed by equation 3 shown below;*



*where h is the Planck constant (6.626x10-34 J⋅s) and c is the speed of light (2.998x108 m/s).*

**Tables** – The construction of a data table is useful for summarizing *related* numerical data. Tables are often found in the Results and Discussion section of the lab report and are numbered sequentially and introduced in the text prior to their entry.

Tables must have captions entered above the table which lead with “Table #.” in bold and italics followed by a descriptive title. The only grid lines shown are those which separate the column headings from the table entries. Any additional notes about the table can be labeled with a lowercase letter and then explained as a footnote to the table directly below. Be sure that each entry has the correct number of significant figures and that any error reported is also associated with the data. A sample table follows; note that units are reported in the heading, not with individual entries. Also, make sure you include leading zeros (0.1 not .1) when entering data. Also make sure the values are shown with the correct number of significant figures and written in scientific notation if smaller then 0.01 or larger than 1000. (Do not use 1.4e-4 for scientific notation. See proper format in Table 1.)

***Table 1.*** Absorbance of standard aqueous Cu2+ solutions

|  |  |
| --- | --- |
| **Concentration (M)** | **Absorbancea** |
| 9.8 x 10-5 | 0.1220 |
| 2.0 x 10-4 | 0.2110 |
| 3.2 x 10-4 | 0.3316 |
| 4.0 x 10-4 | 0.4260 |
| 5.4 x 10-4 | 0.5547 |

*a* Absorbance was measured at 750 nm.

***Table 2.*** pH as a function of added titrant

|  |  |
| --- | --- |
| **Volume NaOH (mL)** | **pH** |
| 10.679 | 8.643 |
| 10.696 | 8.448 |
| 10.710 | 8.109 |
| 10.718 | 7.845 |
| 10.725 | 7.418 |

**Figures** – The two most common figures encountered will include chemical structures and graphs. Regardless of what section they appear in, figures are numbered sequentially and introduced in the text prior to their entry.

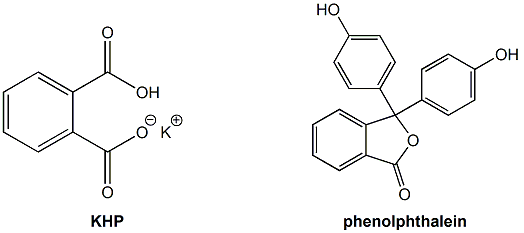
**Chemical structures entered as a figure**

Chemical structures like the ones drawn below can be generated using the ChemBioDraw software. This software is free to NCSU students and can be downloaded through the NCSU Library website: <http://www.lib.ncsu.edu/databases/chembiodraw>

The software is also available for use on the Fox Tutorial center computers

Tips for using ChemBioDraw

* When you finish drawing highlight the structure and select ‘Structure’ from the top toolbar and select ‘Clean up Structure’ from the pulldown menu. This will correct bond angles and bond lengths and make your structure look more professional.
* When the structure is finished you can simply copy and paste it into Word. The structures should not be too large (see example below). You can shrink the structure down to a size that is more appropriate for the document.



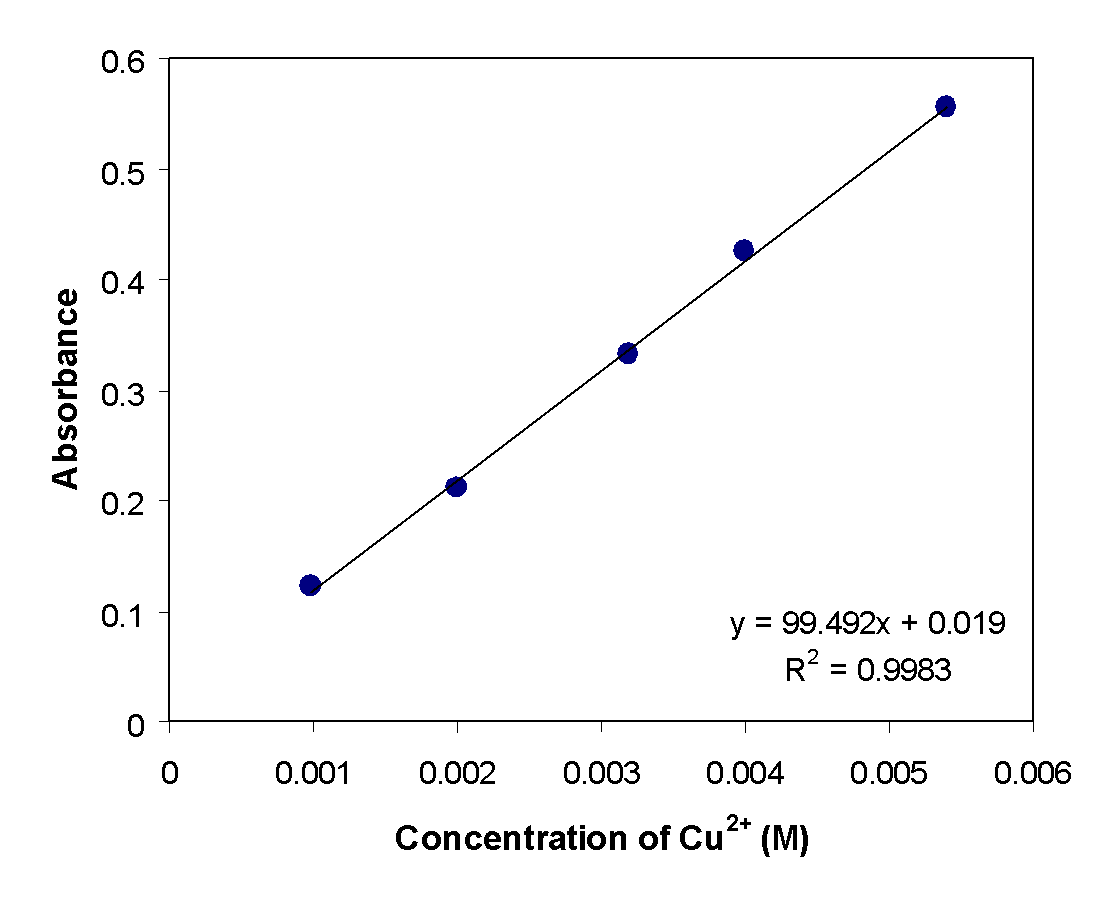
***Figure 2.*** Structure of KHC8O4H4 (KHP) and phenolphthalein.

Chemical structures as figures are useful for referencing throughout the report. In the figure, the structure can be labeled with a chemical name, an abbreviation or simply a number and can be referred to as such at any point in the text after the figure is shown.

**Plot entered as a figure**

The figure caption should lead with “Figure #.” in bold and italics, followed by a short yet descriptive title. Like the sample shown below, if a plot does not have a common name (calibration curve, titration curve, etc.), label the graph as “y-axis as a function of x-axis”. Avoid using “vs.” or “versus” in your figure label.

Be sure to label each axis and include any units in parentheses. For example, in the plot below, the units of concentration (M) are included after the label. Colored background should not be used and all gridlines must be deleted. Be aware that the default settings in a spreadsheet program are not often appropriate for a figure in a formal lab report (See plotting instructions below). *Hand drawn plots are not acceptable.*

***Figure 1.*** Absorbance of Cu2+ as a function of concentration. 

**Instructions on using Excel to generate a graph and add trendline:**

* Enter your x and y data in two separate columns
* Highlight the columns and plot as a **Scatter Plot (NOT Line plot)**
* When the plot is generated right click on any one data point. The menu will give you an option to **Add Trendline.** A new menu will open where you will click on **Options**. There you will check off two boxes, **Display equation on chart and Display R-squared value on chart**
* You can use Chart Layout to enter axis titles
* Right click on the gridlines and delete them
* Change background color to white

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