

Writing the Formal Lab Report

"Measuring Manganese in Steel with Standard Addition"

CH 2250: Techniques in Laboratory Chemistry
Plymouth State University, Spring 2014

In addition to the normal "lab duplicate notebook reports" due for labs in CH 2250, you will write a formal lab report on your analysis of the manganese content in a steel sample from Lab 10a/b

Due Dates, Submission, and Late Assignments

- A full **first draft** of the lab report must be submitted in *hard-copy* form by the start of lab Thursday, April 24
- **The final draft** of the lab report must be submitted in *hard-copy* form by the start of lab Thursday, May 8
- No late assignments will be accepted.

Notes on the Report:

This is a formal report. Envision that you are presenting these results to a manager at work, who is only vaguely familiar with the details of chemical analysis, or to a lawyer, who will use the results in a court case. The writing must be clear enough for someone who understands some chemistry to know what was done and what the results are, but who does not know this exact procedure and has not done it themselves. There must be enough detail that it can be repeated by someone who did not do the experiment, but who understands the techniques. Finally, it must be professionally written and formatted, as such a document would be if you were, for example, contracted by a lawyer to do the work. Would you be willing to hand this to someone who was paying you to do it and say "I am proud of this work, and I am certain of my results"?

1. Formatting, etc.

- a) You are expect to create the report using a modern word processor (Word, OpenOffice, etc.). As such, symbols, subscripts, superscripts, etc. should be available and used as needed.
- b) The Lab Report should be typed and printed using a 12 point Times New Roman (or equivalent) font with single or 1.5 spacing.
- c) Margins should be between 0.5 and 1" on a side.
- d) Your grade is not based on the length of the paper. Do not use smaller/larger fonts or margins to make the report appear shorter or longer.
- e) Your name and experiment title should appear at the top of each page (in a header) after the first one
- f) Pages should be numbered.
- g) An obvious organization system should exist. For example, section headings should stand apart from the rest of the text by being bolded or underlined.
- h) This is a report—it should report what was done in a style that is readable to someone who did not do the lab. You should NOT present this as a bulleted list of questions and answers, but rather a narrative that explains what was done, what data were collected, and how the data were analyzed.

2. Figures, reactions, tables, equations, and calculations
 - a) All figures, reactions, tables, equations, and calculations must be numbered and labeled (e.g., “Fig 1: Mn Standard Addition Curve,” “Eqn 1: Calculating Concentration in Stock Solution.”)
 - b) All figures, reactions, tables, equations, and calculations must be referenced by number in the narrative text (e.g., “Figure 1 shows the standard addition curve used to calculate the concentration in Sample Solution 1.0”)
 - c) Graphs must be produced using a computer program (such as Excel) and embedded into the text, not stapled as a last page.
 - d) Calculations may be done by hand on a printed version of the report. You do NOT need to attempt to format calculations in a word processor or use an equation editor. Just label the calculation, then leave enough room to enter it by hand.
 - e) You must show a sample of every type of calculation done. BUT you do not need to show every single calculation. For repetitive calculations, simply show one sample and then tabulate the results of all calculations.
 - f) Reactions must be typed into the document, be on their own separate lines, and incorporate subscripts and states (e.g., 'g', 'aq').
 - g) Calculations can be cumbersome and time consuming to format into a written report. Word and other word processors offer equations editors that can make this a little easier and more professional looking. You are welcome to use these, but they are not always straightforward to learn to use. Therefore, you may hand-write your calculations in the reports you hand in. In the typed version of your reports, each calculation should be given a number (i.e., “Calculation 1”) and then left blank space where you will write the equation in.
3. The Lab Report should be neatly organized and contain the following, clearly labeled sections:
 - a) Title
 - Should appear in large font at the top of the first page. No need for a “title” page.
 - b) Introduction and Purpose
 - A brief description of what was done in lab, including most importantly the reactions that were run.
 - Should include a brief description of what standard addition is and why it is used.
 - c) Procedure with observations: A formal, concise report of WHAT WAS DONE. As such it:
 - **MUST NOT BE A VERBATIM COPY OF THE LAB PROCEDURE.** If the procedure is cut-and-pasted, you will receive 0 points for this portion, even if some editing is done to the pasted text.
 - Must be written in the **past tense**.
 - Must include the actual values for masses, volumes, concentrations, times, etc. used (e.g., the lab procedure may say “weight 0.5 g” but your report should say something more like “0.5023 g were weighed.”)
 - Should not be overly detailed. Obvious steps may be omitted, and most steps should be summarized.
 - You may choose to write the procedure in either the 3rd person passive voice (e.g., “The solution was titrated with 0.1234M HCl to a pink endpoint”) or the 1st person active voice (“We titrated the solution with 0.1234M HCl to a pink endpoint”). Whichever voice you choose, be consistent throughout the text.
 - Should be written in bullet/list form, not as a paragraph.

- Should include observations related to individual procedural steps (e.g., “after boiling for over an hour, the solution was amber-brown and contained a small amount of visible black precipitate”).
- Should include references to the data collected in the steps (e.g., “These data are presented below in Table 1”).
- Should include both part 'a' and part 'b' of the lab. It should be clear which part is which.

d) Results and Analysis

- Will contain all the data you collected and the values calculated from them in tables
- MUST have narrative text that explains the data collected and the analysis thereof. (e.g., “Table 1 contains the titration data for determining the concentration of HCl, as well as the calculated concentration values. A sample of how these concentrations were calculated is given below as Calculation 1.”)
- Must show all the calculations done, including a graph of the standard addition curve with the best-fit line

e) Discussion and Conclusion

- Must contain the **sample identification** and the final manganese weight percent values calculated. Repeat the actual numerical values (not the calculations) here that you calculated in Analysis.
- Discuss the degree to which you feel your results are accurate. If there were obvious errors in the data collection or you suspect something is wrong, discuss there here.
- Discuss potential sources of error. BE SPECIFIC. For example:
 - Bad: “human error,” “calculation may be wrong,” “equipment failure”
 - Good: “when weighing out the sample, it was noted that the balance did not readily settle on a number in the fourth digit,” “the color change of the titration was subtle and difficult to determine exactly.”
- Should NOT contain phrases such as “this was a successful lab,” or “I enjoyed this lab.” These are not discussions of or conclusions drawn from the data!

f) References

- List any references used in performing the lab and analyzing the data. At the very least, this must contain a detailed reference to the lab procedure.
- Any style of referencing is acceptable, as long as it is 1) consistent, and 2) detailed enough that the item being referenced could be found by someone who did not do this lab. An example reference style is:

For Books: Authors, "Title," Publisher, City, pages, year.

Example: A. R. Katritzky and J. M. Lagowski, "The Principles of Heterocyclic Chemistry," Chapman and Hall, 350pp, London, 1967.

For Journal publications: Authors, "Title." *Journal*, Vol(Issue):Pages (Year).

Einsle O., Tezcan F.A., Andrade S.L.A., Schmid B., Yoshida M., and Howard J.B. "Nitrogenase MoFe-Protein at 1.16 Å Resolution: A Central Ligand in the FeMo-Cofactor." *Science*, **297**(10):1696-1700 (2002).

3. Draft versus Final report

- a) The main differences between the draft and final versions will be that the final report will include data and results from both “10b” analyses, and a significant amount of the grade in the final version will be based on the accuracy of your final answer. Otherwise, the draft version should be a complete draft including all portions that the final draft will contain.

- b) Although it is a “draft” version, it is worth 60 points (see grading rubric below)—the same value as a typical lab report. It will be graded in a similar manner to notebook reports, so you should strive for the same level of quality as your normal notebook reports.
- c) The final draft should report the data and the final calculated values for both times that you did the standard addition analysis (10b). However, you need only show the analysis for one set of the data. It is up to you decide whether 1) your final answer is an average of the 2 calculated answers, or 2) you will use only one of the calculated answers as your final answer. If you decide to take option 2, you should discuss in Conclusions why you are throwing out the other data and taking this option. Your grade will not be affected by which option you choose—you are encouraged to take whichever option you believe will result in the best answer.
- d) The procedure in the final draft need only describe one of the part 10b's that you did. Unless you choose to base your final answer on the first 10b analysis, the final version of the report should describe the second time you did the analysis.

Grading Rubric

Draft Report (60 pts)		
Name and Title	Does your name and the title appear at the top of the each page in a header? Is the title descriptive of the lab?	3 pts
Introduction with Purpose	Does it describe briefly what was done in lab and why? Does it state explicitly and correctly what the purpose(s) of the lab is? Does it include well-formated reactions? Does it explain what standard addition is and why it is used, especially in this lab?	6 pts
Procedure with observations	Does it describe what was done in lab? Is it in the past tense? Is it in a consistent voice? Is it in your own words? Does it include exact details (e.g., exact masses), observations, and references to the data collected? Is it as succinct as possible (does not include unnecessary or obvious steps, such as “We obtained the sample from the instructor”).	6 pts
Results and Analysis	Does it contain all the data collected? Are data well organized in tables? Is there a narrative text that references and briefly describes/discusses the data? Are all calculations (or samples if the same calculation was done more then once) shown? Are the calculations correct? Is there narrative text describing the calculations so that the calculations can be easily followed? Is the standard addition curve shown and the best-fit line given? Are results tabulated when appropriate?	20 pts
Conclusions	Are the final answers and the sample ID repeated? Is there a discussion of any possible errors and the anticipated accuracy of the results?	5 pts
References	Are references given? Are the appropriately formated? Are the detailed enough that someone could locate the reference?	4 pts
Formating and Organization	Is the report properly formated (see “1. Formatting” above)? Are section headings, etc. given and made to stand out (e.g., bolded)? Are pages numbered? Are tables, figures, calculations, etc. numbered and titled? Are subscripts and superscripts used appropriately? Are chemical elements given the proper capitalization? Are units generally given for numbers? Are significant figures generally correct?	10 pts
Writing Style	Is the writing formal and technical? Is proper grammar used? Is spelling generally correct (a couple of typos are OK)?	6 pts

Final Report (100 pts)														
Name and Title	Does your name and the title appear at the top of the each page in a header? Is the title descriptive of the lab?												3 pts	
Introduction with Purpose	Does it describe briefly what was done in lab and why? Does it state explicitly and correctly what the purpose(s) of the lab is? Does it include well-formated reactions? Does it explain what standard addition is and why it is used, especially in this lab?												6 pts	
Procedure with observations	*Note: Unless you choose to base your final answer only on the first 10b analysis, the final version of the report should describe the second time you did the analysis. Be sure to state which analysis is described. Does it describe what was done in lab? Is it in the past tense? Is it in a consistent voice? Is it in your own words? Does it include exact details (e.g., exact masses), observations, and references to the data collected? Is it as succinct as possible (does not include unnecessary or obvious steps, such as “We obtained the sample from the instructor”). Did you do anything differently the second time you ran the analysis?												8 pts	
Results and Analysis	Does it contain all the data collected (including both analyses)? Are data well organized in tables? Is there a narrative text that references and briefly describes/discusses the data? *Note: Unless you choose to base your final answer only on the first 10b analysis, the final version of the report should describe the second time you did the analysis. Be sure to state which analysis is described. Are all calculations (or samples if the same calculation was done more then once) shown? Is there narrative text describing the calculations so that the calculations can be easily followed? Is the standard addition curve shown and the best-fit line given? Are results from both analysis given and tabulated?												16 pts	
Conclusions	Are the final answers and the sample ID repeated? Is there a discussion of any possible errors and the anticipated accuracy of the results? Are you basing your answer on one or both of the 10b analyses and why?												10 pts	
References	Are references given? Are the appropriately formated? Are the detailed enough that someone could locate the reference?												4 pts	
Formating and Organization	Is the report properly formated (see “1. Formatting” above)? Are section headings, etc. given and made to stand out (e.g., bolded)? Are pages numbered? Are tables, figures, calculations, etc. numbered and titled? Are subscripts and superscripts used appropriately? Are chemical elements given the proper capitalization? Are proper units given for all numbers? Are proper significant figures used for all numbers?												12 pts	
Writing Style	Is the writing formal and technical? Is proper grammar used? Is spelling generally correct (a couple of typos are OK)?												6 pts	
Comments Addressed?	Did you address all the comments given in the first draft?												10 pts	
Accuracy	Points will be awarded based on :												25 pts	
	max % error	3%	5%	7%	10%	15%	20%	25%	35%	50%	75%	100 %		> 100
	Points	25	24	23	22	20	18	15	12	9	6	3		0