CHEG237W Chemical Engineering Lab

Part I-1. Lab Overview and Safety
Part I-2. How to Write a Good Lab Report
Part II-1. Data Treatment and Statistics
Part II-2. Analysis of Kinetics Data
Part I - 2. How to Write a Good Lab Report
Why Writing a Lab Report?

- Planning a Lab and preparation
- Performing an experiment
- Taking lab notes
- Analysis of Data
- Discussion
- Conclusions
- Reporting – Goal: convey your conclusions and convince the readers

Good writing:
  - Sound thinking and professional
Bad writing:
  - Bad working habit and unprofessional
Why should we stick to a certain standard format?

Letter - minor report

Introduction

Polyothioesters can accurately convey a charge (apropos charge) or whereas using highly ordered complexes or molecular structures. Their polymericity—via different factors can have an additional function especially, not only due to their applications in technological contexts but also because of their importance in polymer science and technology. Through the combination of the electronic structure (e.g., charge density, the gap, and the homolepticity of polyelectrolytes), the charge and balance between the basic elements in macromolecules, serve (macromolecular) as the polyelectrolyte–solute complexes can be designed. Leading to unique mechanical, electronic, optical, and biological properties for specific applications.

An example of a charged polyelectrolyte with a disordered treatment or chemical functionality. DAA has sound structural, and chemical function (or diffusion) with a variety of physical properties and mechanical applications. DAA’s composition with ionic liquids and polymers is not only due to their applications in mechanical, electronic, and optical devices. Ionic liquids for DAA composition with ionic liquids and polymers is a new trend in the field of biocomposites and polymer science. In this study, we have developed a novel approach to include sulfonated polyethyleneglycol (SPEG) for the design of novel DAA complexes. SPEG-terminated polyethyleneglycol (SPEG-PEG) is covalently bonded to the backbone of polyethyleneglycol (PEG) and polyethylene glycol (PEG).

Quantitative results of thermodynamic analysis were confirmed by variable-temperature 1H NMR (in Figure 1). Variable-temperature 1H NMR (in Figure 1) and variable-temperature NMR (in Figure 2) were performed to characterize the fundamental properties of DAA complexes. The variable-temperature 1H NMR (in Figure 1) and variable-temperature NMR (in Figure 2) were performed to characterize the fundamental properties of DAA complexes. The fundamental properties of DAA complexes were characterized by 1H NMR, 13C NMR, and variable-temperature 1H NMR (in Figure 2).
Major Report Format

Introductory Materials
1. Title Page
2. Abstract or summary
3. Table of Contents (optional)

Body of the report
4. Introduction
   objective and significance, approach review, and theory
5. Experimental: apparatus and materials, procedure, and safety (sometimes optional)
6. Result & discussion (sometimes separated)
7. Conclusions
8. Recommendations (optional)
9. Bibliography
Appendices

15. Original data

16. Sample Calculations

17. Table of intermediate derived data of calculated values, which are too long to include in the text.

18. Long derivations of equations (if needed)

19. Calibration curves, and other graphs if too numerous and repetitive to include in the body of the report.

20. Supplementary exposition (if needed)

21. Supplementary bibliography (if needed)
Title Page
Consult the Laboratory Manual for an example of a Title Page showing both content and format

Abstract
1. The MOST important part of a report
2. Write the abstract LAST
3. A concise overview—single paragraph and 250 to 300 words
   What is the focus and objective?
   What have you done?
   How did you do it?
   What conclusions have you reached?
4. No inclusion of any figure, table, or complicated equation
Introduction

Some “DO”s
• Be concise – the problem and its importance, relevance to this report
• Synopsis of theory and relevant equations
• Enough information and theory such that a competent engineering in another field (e.g., mechanical) could follow the explanation
• Use references to back up your theory and equations
• The last sentence gives a concise statement of your objectives

Some “Do Not”s
• Do not go into details
• Do not use extensive theory and equations
• Do not give conclusions or recommendations
Experimental

Apparatus
• A schematic drawing with sufficient labels and important dimensions
• A brief description of the most relevant equipment and analytical methods

Procedures
• Use paragraphs instead of bullets
• Clear enough that a worker at a later time could repeat the experiment and obtain the same or similar results
• Can combine with the Apparatus section

Safety Considerations
• State all hazards associated with equipment and chemicals
• Define appropriate precautions to avoid accidents
• Suggest safety-related improvements in equipment, procedure, and analytical methods
• Safety section is not normally included unless a specific safety incident has occurred.
Results

- Objectively present important facts from observed data
- For clarity, other information may be added: intermediate results, a basic calculation method, or important assumptions
- Do not merely include tables or figures; Interpretation of the illustration should be provided
- Only include the most pertinent results
- Put all raw data and tables of calculated intermediate data in the Appendix
- Avoid presenting the same information by two different methods: DO NOT INCLUDE A TABLE OF VALUES AND A GRAPH WITH THE SAME DATA
- Be quantitative, not qualitative
- Include uncertainty analysis; error propagation, statistics, and possible reasons for errors
Results and Discussion

Discussion of Results
• Second most important part
• A critical interpretation and theoretical and practical evaluation of results
• Note to discuss the following:
  • Physical significance of the observed results and their impact on practical application of technology
  • The reliability and accuracy: identify major sources of error and their impact
  • A comparison of the observed results with expected/predicted values, and a possible explanation of the discrepancies (analysis of model assumptions)
  • A critique of experimental methods, procedures, and equipment and suggested improvements

Results and discussion are often combined, especially in nowadays literature. In way, we can avoid going back and forth between figures and tables in the result section.
Conclusions and Recommendations

Conclusions and Recommendations
• It is rather short, because there should be relatively few significant conclusions.
• The conclusions should be based on the results obtained rather than on opinions and speculations.
• A suggested aid in writing this section would be to review the specific objectives of the project.
• For each objective, there should be a conclusion that can be scientifically drawn based on the results.
• List the conclusions in order of importance.
• Any recommendations for improvement or expansion of the experiment may be included.
• All recommendations should be specific and backed by supporting statements.
## References

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## References – cont’d

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<td><strong>Web page</strong></td>
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### ACS Reference Styles (required)

http://courses.chem.psu.edu/chem431/ManuscriptFiles/QuickRefGuide2.pdf
ACS Reference Styles

A QUICK GUIDE TO REFERENCE CITATIONS USING THE ACS STYLE GUIDE

Listing sources of information at the end of a paper is an important part of professional scholarship and writing. Many disciplines have specific requirements for the format of these references. In chemistry the standard is the ACS Style Guide, 3rd ed., published by the American Chemical Society. Chapter 5 of that publication is devoted to references and contains many examples. This guide is not a substitute for the ACS Style Guide. It includes most commonly asked questions, but it doesn’t have every possible document type or variation that could occur. I’ve also included notations of the appropriate pages in the ACS Style Guide.

EXCEPTIONS TO THE RULES:

Two commonly encountered exceptions to the rules are below. Instructions in the NBT Chemistry WebBook indicate that it should be cited like a book even though it is a web site. (Based on ACS Style Guide p. 187)


Organic Synthesis and Inorganic Synthesis, although they look like books, are commonly cited like journals—except that book format should be used for the collective volumes of Organic Syntheses. (Based on ACS Style Guide p. 185 and p. 196)


ABSTRACTS:

There are some variations if the item being indexed is not a journal article.

Journal article indexed in a print publication: p. 585.


Journal article indexed in web-based index: based on p. 185 and p. 212.


BOOKS:

There are many different variations on how to properly cite books. Whether or not the book is in a series, has an editor, is cited in its entirety or only in part, has different editions, etc. all cause variations in the format. Basic citation format: p. 185-186.


Chapter: p. 187


Non-ACS series, one author for whole volume, no editor: p. 189


Non-ACS series, edited with separately authored chapters: p. 187


DATA SETS: based on p. 197


DISCUSSIONS AND THESIS: p. 201-202


ENCYCLOPEDIAS: p. 196


HANDBOOKS:

Electronic: based on p. 212


Print: based on pp. 188-199

CRC Handbook of Chemistry and Physics, 71st ed.; Lide, D.R., Ed.; CRC Press: Boca Raton, FL, 2000; Chapter 4, p. 73.


JOURNALS:

Although the ACS Style Guide indicates that the article title provides valuable information (p. 178-177), in practice the article title is often omitted from journal citations.

Articles from print journals: p. 178-199


Articles from electronic journals: p. 213


MATERIAL SAFETY DATA SHEETS:

Also includes other related publications, such as the International Chemical Safety Cards, based on p. 203-204; see also entries under Web Sites.


WEB SITES:

Based on p. 211-213; see also entries under Material Safety Data Sheets.


A NOTE ABOUT JOURNAL ABBREVIATIONS:

Chemists use a set of standard abbreviations for journal titles and the names of conferences proceedings. These abbreviations are published in CAS.R; the Chemical Abstracts Service Indexer. When you look at a page in CAS.R; note that although full titles of the journals are given, the entries are actually arranged in order of the abbreviations, which are in italics type. The ACS Style Guide has a listing on pp. 276-279 of abbreviations for over 1500 heavily used chemistry journals.

A NOTE ABOUT PERSONAL NAMES:

Personal names often cause problems when preparing bibliographies or reference lists. Western European names generally are arranged with the given name first and the family name last. That means that when you are creating a bibliography, you would reverse the order, so that the family name would come first, followed by a comma and then the given name (cf. Hille, B.). Not all Western European names follow this pattern exactly, however, and names of authors from other parts of the world certainly don’t! All the possible permutations of personal names are too numerous to list here. However, the Chicago Manual of Style has done an excellent job for names of professional organizations (sections 7.47-15) and alphabetizing (sections 10.15-17.125).

RESOURCE LIST

The ACS Style Guide, a Manual for Authors, Reviewers, and Editors; Dodg, J.S., Ed.; American Chemical Society: Washington, DC, 1995. (Copies are in the Physical Science Library on permanent reserve as well as in the reference collection. There is also a circulating copy, call number QD45.S34 1997.)

CAS.R—Chemical Abstracts Service Source Index: 1987-1995 Cumulative, Chemical Abstracts Service: Columbus, OH, 2000. (Also has supplements, see Physical Sciences Library reference desk copy number 0000053; call number QD45.S34 1987.)

1. **Prepare a detailed outline** for major reports (1 or 2 pages).
   You should have a nearly complete outline constructed before you begin to write. Do not hesitate to modify the outline as new ideas occur during the writing of the report. The report should explain the purpose of the work, place it in perspective relative to published information, describe the experiment, which was performed, and results, which were obtained, and present the conclusions that were reached.

2. Identify the tables and figures by number to illustrate the points being made.

3. **Write short paragraphs** containing typically 3 to 5 sentences. Use **subheadings** to divide the report into logical units. Use of subheadings and short paragraphs make reports easier to read and improve the mood of the reader (grader). Avoid long sentences. Vary the lengths of sentences. Do not put more than a single idea in a sentence.

4. If there is the slightest **doubt about spelling**, consult the dictionary. There is no excuse for misspelled words, especially when using a word processor.

5. Hyphenate compound adjectives. For example: 20-in. pipe, copper-constantan thermocouple, heat-transfer coefficient, stirred-tank reactor, 8-in. impeller.
Writing Styles (cont’d)

6. Effective writing usually places the verb near the beginning of the sentence, close to the subject. Examples:

   Poor
   The mass-transfer coefficient, shown in Figure 1 as a function of temperature and compared with theory in Table 2, was calculated from Equation (3).

   Better
   The mass-transfer coefficient was calculated from Equation (3). Figure 1 shows the effect of temperature on that coefficient and Table 2 gives a comparison with theory.

   Poor
   The temperature of the liquid, the flow rate of the vapor, the pressure of the evaporator, and the power input to the motor were measured.

   Better
   The following were measured: liquid temperature, vapor flow rate, evaporator pressure, and power input to the motor.
7. **Use tenses carefully.** Use the past tense for acts that are now history and the present tense for results that are contemporary. Avoid the future tense; it is rarely needed.

   Example:
   
   The temperature of the vapor *was* measured with an iron-constantan thermocouple.
   
   Figure 1 *shows* the variation of vapor temperature with time.

8. **Short qualifying phrases are best placed at the beginning of a sentence.**

   Example:
   
   **Poor**
   
   The pressure of the evaporator was constant at 3 psia but it is difficult to say exactly because the pressure meter was flopping back and forth.
   
   **Better**
   
   Although the pressure meter fluctuated, the average evaporator pressure was nearly constant at 3 psia.
9. **Use relative pronouns properly.** In defining clauses the pronoun *that* is appropriate.
   
   Example:
   
   The particle volume *that* was measured by displacement was greater than the calculated volume.
   
   In non-defining clauses the pronoun *which* is appropriate, and the clause should be set off by commas.
   
   Example:
   
   The measured particle volume, *which* was greater by 3% than the calculated volume, was used in the porosity determination.

10. **Avoid unattached (dangling) participles.** Active participles should be attached to a noun or pronoun except in rare circumstances where, by usage, they have acquired the power of adverbs (e.g., roughly speaking).

    **Poor**
    
    Substituting for $x$ from Equation (6), the expression for velocity becomes:

    **Better**
    
    Substituting for $x$ from Equation (6), we find the expression for velocity to be:

    **Best**
    
    Avoid participles by using a preposition. Example: Upon substitution for $x$ from Equation (6), the expression for velocity becomes:
11. **Avoid extra words.**

    Consistent with clarity, use only the minimum number of words necessary to say what you want to say. After writing a paragraph, go back over it and remove all words that are not essential.

12. **Use simple, direct words and sentences and avoid jargon or false elegance.**

    Here is an example of a passage written by a sociologist on three characteristics of teenage culture:

    a. Compulsive independence is an antagonism to adult expectations and authority. This involves recalcitrance to adult standards of responsibility.

    b. Compulsive conformity within the peer groups of age mates. It is intolerable to be “different.”

    c. Romanticism: an unrealistic idealization of emotionally significant objects.

    This wordy passage can be expressed by one simple sentence:
    Teenagers tend to be disobedient, group-minded, and unrealistic.
13. Avoid essentially meaningless phrases such as
   - It may be stated that…
   - You will find it interesting to know…
   - For your information…
   - In this connection the statement may be made that …
   - At this point in time it may be appropriate to…
   - In order to…

14. Avoid generalities and be as specific as possible. Also whenever possible, be quantitative rather than qualitative and positive rather than negative.
   Examples:
   - **Poor**
     - The temperature measurement was not accurate because the thermometer was no good.
   - **Better**
     - The accuracy of the temperature measurement can be improved by better thermometer calibration.
   - **Poor**
     - Figure 1 shows that the data are in bad agreement with the values calculated from Equation (3).
   - **Better**
     - Figure 1 shows that the experimental heat-transfer coefficients are about 60 percent larger than those predicted by Equation (3).
Minor Report Format

Introductory Materials
1. Title page
2. Abstract or summary

Body of the report
3. No separated sections of Introduction, Experimental, Result & discussion and Conclusions; Recommendations (optional)
4. Bibliography
1. Use letter-size paper and clear plastic binding (NO 1” folders)
2. Margin: 1.5” top and left and 1” bottom and right
3. Page number: top centered
4. Double spaced
5. Figures and tables can be inserted using text boxes in MS Word
6. Equations should be a separate line and numbered for easy referencing
7. Report lengths, excluding title page, abstract and table of content, bibliography, and appendix
   - Major report: more than 16 pages (i.e., four-page article)
   - Minor report: less than 8 pages (i.e., two-page communication)
8. Any format of CHEATING is FORBIDDEN!
Avoid Misconduct

VI. Forms of Academic and Scholarly Misconduct

UConn publication, *Responsibilities of Community Life: The Student Code*, categorizes academic and scholarly misconduct as follows:

♦ Cheating
  ♦ **Plagiarism** (taking the thoughts, words, or ideas of others and passing them off as your own)
  ♦ **Misrepresentation** (e.g. claiming work done by another individual as your own)
  ♦ Unauthorized Possession, Use, or Destruction of Academic or Research Materials
  ♦ Computer Violations
  ♦ **Fabrication or Falsification in Research** (e.g. deliberate falsification of experimental results)
  ♦ Research Violations
  ♦ Conflicts of Interest
  ♦ Tampering
  ♦ Any Attempt to Influence Improperly
  ♦ **Aiding or Abetting** (e.g. helping someone commit any act of academic misconduct)
  ♦ Any Impropriety or Act of Misconduct Committed by a Graduate Student in a Teaching Role
Plotting a Good Figure

Scientific Plot Software:
Origin, SigmaPlot, Excel, etc

Fig. 1. Saponification of IPAc at 50 °C
Sketch a Good Reaction Scheme

Chemical structure drawing software:
ChemWindow and Cambridge ChemDraw:
http://scistore.cambridgesoft.com/sitelicense.cfm?sid=70

Scheme 1. Schematic Representation of the Synthesis of Disubstituted Fc–Peptide Dendrimers

\[ \text{H-Glu(OEt)OEt} \rightarrow \text{G1} \]
A Good Table

Don’t plot Figures if you have already had a Table, and vise versa

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<th>OEt groups</th>
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