

Chem 51LB Experiment 2

Report Scaffold

Substitution Reactions, Purification, and Identification

READ THESE INSTRUCTIONS FIRST

Instructions:

Report scaffolds are provided to help you learn how to write about the experiments you conduct. We will start by providing general questions for each section and examples of specific questions connected to the current experiment. For this assignment, answer the **specific** questions provided using complete sentences in the third person passive voice, but keep the general questions in mind. As we move through the quarter the report scaffolds will provide less and less support by removing the specific questions and then not providing a scaffold at all!

Each question in this scaffold is numbered. In a separate document, number your responses to the *Experiment-Specific Questions* only. Do not write the specific questions in your separate document as these will only take up the space you need for your responses to those questions. Also, do not include the general questions. The document containing your responses should not exceed a total of five pages. Mechanism drawings may be attached at the end of your document (in the appendix) and do not count toward the five page limit.

Unless the rubric specifies otherwise, all responses should be included in the body of your report submission and count toward the page limit. This includes results tables. Check the rubric for the assignment that tells you what to include. All other materials (i.e. mechanisms, calculations, images) may go in the appendix and do not count toward the page limit.

Post-Lab Report Format: MUST BE TYPED IN WORD OR A SIMILAR PROGRAM, NOT AN ELN PAGE! Times New Roman;

12 pt. font; double spaced; 1" margins; no more than 5 pages; use 3rd person passive voice only (For example, "We dissolved the white solid in 10 mL of hot water," should be written as, "The white solid was dissolved in 10 mL of hot water.>"). Include your name, student ID number, and lab course code. This format is **NOT OPTIONAL** and TAs will return work as unsatisfactory if the format is not followed.

Purpose/Introduction

General Questions:

What were we trying to accomplish with this experiment? How did we plan to accomplish this? The purpose of an experiment is not simply to introduce a student to a technique or reaction!

Experiment-Specific Questions (answer these):

- 1. What reaction was conducted in this experiment? What reagents were used? How was the reaction set up? Don't provide too much detail here! You should answer this question in 1-2 sentences!*
- 2. Did you know the exact reagents you were using or was there an unknown involved? If an unknown was involved, the purpose should include determining what that unknown compound was! Mention all possible unknowns. Again, this can be answered in one sentence! You might be able to combine this sentence with the one above!*
- 3. What techniques were used to purify and identify the product(s) of the reaction? Don't go into detail here. Just list each and its purpose in a sentence.*

Theory

General Questions:

Assume you are writing for another student who has taken organic chemistry before but might have forgotten some of the details of reactions and lab techniques. What information about

the reaction and techniques being used in this experiment would you need to remind them of to make sure they understand what you did, why you did it, and what the results mean?

Experiment-Specific Questions (answer these):

4. *What two types of reactions happen in this experiment? What components does each reaction have? What are the important factors of nucleophilic substitution reactions? You should include some depth for aspects relevant to this particular experiment, but you don't need to go into much depth for factors that are not directly related. See rubric for more detailed information.*

5. *How is melting point being used in this experiment? Why are we using it? What would someone need to know about how melting point works to understand how and why it is being used and to understand the data and results? Don't include any results here. You are providing the proper background for the reader to be able to interpret your results later.*

6. *How is recrystallization being used in this experiment? Why are we using it? What would someone need to know about how recrystallization works to understand how and why it is being used and to understand the data and results?*

7. *How is thin layer chromatography (TLC) being used in this experiment? Why are we using it? What would someone need to know about how thin layer chromatography works to understand how and why it is being used and to understand the data and results?*

8. *How is nuclear magnetic resonance (NMR) being used in this experiment? Why are we using it? What information do chemical shift, splitting, and integration provide that would help someone determine a chemical's identity? Keep this to no more than 3 sentences.*

Results

General Questions:

What important data were obtained in this experiment? The data provided in this section should relate to the purpose(s) of the experiment, but you do not need to point out the connections here. Do not explain your results yet. Just provide them in an organized format. Don't forget to include any assigned unknown number! You should include a table to organize your data.

Experiment-Specific Question (answer these):

9. *What was your unknown number? What product was obtained? What unknown identity does that lead you to?*

10. *What yield (mass) and percent yield were obtained?*

11. *What percent recovery was obtained from recrystallization?*

12. *What melting point data were obtained?*

13. *What TLC data were obtained?*

14. *What NMR data were obtained? You should present this data in a table similar to the tables you made in the spectroscopy lab.*

Discussion and Error Analysis

General questions:

How do the data obtained relate to the purpose(s) of the experiment? How do you know the identity of the product and/or unknown? Do the results make sense? What conclusions can you draw from the data? What conclusions can you NOT draw from the data? (Note that although you are provided with distinct, individual questions here, sometimes the answers to these questions might overlap with each other. That's ok! In a lab report you would need to decide how to tie these answers together.)

Experiment Specific Questions (answer these):

15. *What product did you obtain, and how did you decide that was the product? Use your data to build an argument for your conclusion! What is the identity of your unknown based on these arguments?*

16. Does the yield of your product make sense? If the yield is high (>100%), why could it be? If the yield is lower than 100%, where might yield have been lost (NOT mechanical errors unless they were significant)? Remember that matter is neither created nor destroyed. You might not be able to say with certainty but you can hypothesize. If you determine that no errors occurred, analyze a potential error. How might you go about testing this hypothesis assuming you had access to unlimited lab time, equipment, and chemicals? How would you test your hypothesis with an analytical technique? What results from your test would support your hypothesis? Why is it important to resolve this error? **Suggest a fix to the error and provide potential evidence to support the claim that the error occurred and affected your results.**

17. Does the recovery of your product make sense? If the recovery is high (>100%), why could it be? If the recovery is lower than 100%, why might this be? Was there a large amount of product lost in the recrystallization process? Was the lost mass attributed to separation of an impurity? If so, how do you know this? Avoid discussing mechanical errors unless they were significant. Remember that matter is neither created nor destroyed. You might not be able to say with certainty but you can hypothesize. If you determine that no errors occurred, analyze a potential error. If you have multiple hypotheses to explain your yield, how might you go about testing this hypothesis assuming you had access to unlimited lab time, equipment, and chemicals? How would you test your hypothesis with an analytical technique? What results from your test would support your hypothesis? Why is it important to resolve this error? **Suggest a fix to the error and provide potential evidence to support the claim that the error occurred and affected your results.**

18. Do your melting point data make sense? Was the melting point of the product you obtained higher or lower than expected? If so, what might explain this? As mentioned above, you might

not be able to say for sure, but you can certainly hypothesize and provide ways to test your hypotheses.

19. Do your TLC data make sense? What information does the TLC data provide? As mentioned above, you might not be able to say for sure why data doesn't make sense, but you can certainly hypothesize and provide ways to test your hypotheses.

20. Does your NMR data make sense? What information does the NMR data provide? As mentioned above, you might not be able to say for sure why data doesn't make sense, but you can certainly hypothesize and provide ways to test your hypotheses. A good place to consider starting with this is the table of NMR solvent impurities available on Canvas under the "Nucleophilic Substitution" module. Remember that in order for you to be able to say that a certain impurity is present in your sample, ALL peaks corresponding to the impurity must be present in the spectrum.

Conclusions and Future

Experiments:

General Questions:

How would you summarize your results and analysis in 1-2 sentences? In other words, what is it that you want the reader to remember after having read your paper?

What questions remain unanswered? What questions were raised by your results and analysis?

Experiment Specific Questions (answer these):

21. What was the identity of your product and unknown? What were the key pieces of data that led you to the identities? Was the substitution reaction successful and efficient? (1-2 sentences maximum here!)

22. If your identification data were inconclusive or questionable, how else might you go about identifying the product? (1-2 sentences maximum here!)

23. If your yield was not as high as you would have preferred, what steps might be taken (beyond mechanical errors such as not spilling) to increase the yield of the reaction? What is something you could do in a future experiment to increase your knowledge about what factor(s) may affect the results of the substitution reaction covered in this experiment? (1-2 sentences maximum here!)

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