Instructions for Writing Laboratory Reports
Organic II Lab, CHEM 2240L

Refer to pages 21- 25 in your laboratory manual for general instructions concerning the proper method of writing laboratory reports.
Some key aspects to remember include the following:

- Always type your report.
- Hand write in chemical reactions instead of “cutting and pasting”.
- Often it is best to neatly hand write the calculation section.
- Write in 3rd person passive voice. (No “I”, “we”, or other pronouns)
- Turn in report at the beginning of the next lab period.
- Use complete, concise and grammatically accurate sentences.
- Simple declarative sentences are often best.
- The conclusions are the crux of the report and are graded accordingly. Spend time and thought on this section.
- The conclusion should cover what you did, what you saw, what this indicated, and <u>the reason why</u>. (Did, saw, what, why.) Remember what you learned when writing 1021L rationales.
- The longer the conclusion doesn’t necessarily mean better quality.
- Do your own work and use your own words.

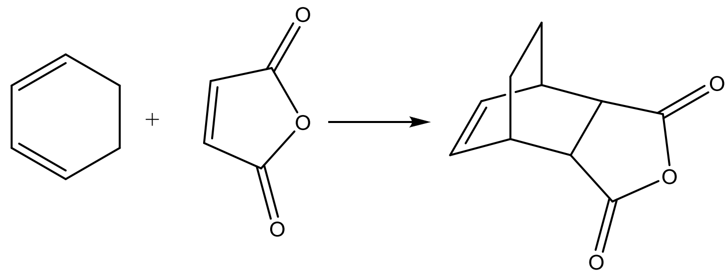
EXAMPLE OF ORGANIC LABORATORY REPORT [Each segment starts with an explanation of what is expected in brackets] This is followed by an example.

1. <u>Title</u> [List the title of the experiment] Diels-Alder reaction of Cyclohexadiene and Maleic Anhydride

2, 3. <u>Name, Lab Time, and Date</u>[Self explanitory] A.M. Brilliant, Monday 11:00, January 25, 2010

4. <u>Introduction</u> [Explain the brief theoretical background and benefit or value of the experimental procedure. State the exact reaction that will be carried out and state how the product will be analyzed.] Diels-Alder reactions are a very important method of forming 6 member rings in a single step. In this experiment maleic anhydride is reacting with 1,3-cyclohexadiene is to form Biclyclo[2.2.2]octa-5-ene 2,3-dicarboxylic acid anhydride (hereafter referred to as ‘product’). The product will be isolated by vacuum filtration and weighed. The purity of the product will be determined using melting point. This section is normally ~10% of grade.

5. <u>Chemical Reactions</u>- [Write a balanced chemical equation representing the reactions which occur during the lab. Don’t simply list the reagents used. This can be neatly hand drawn. Don’t simply plunk in some image from the internet, DRAW. If interested, a computer chemical drawing program is available.] This section is normally ~15% of grade.



5. References (List, in approved format all references which were used to carry out the reaction, write the introduction conclusion or to obtain literature values of chemical properties. Do not include any references that you did not actually read. Do not list the references that another book has listed, unless you yourself read them too. When referencing web addresses, list the title of the page, authors if evident, the complete web address and the date it was accessed.) This section is normally ~5% of grade. Only include references which you actually examined yourself.

1. Crago, K., DiMaggio, S., Foroozesh, M., Giannamore, V., Goloverda, G., Jordan, Tl, Morgan, K., Polito, M., Politzer, I., Ross, T., Sevenair, J., Organic Chemistry Laboratroy Manual, 6th Ed; Wiley Custom: Hoboken NJ, 2006, p 82-85

2. Experimental Organic Chemistry, 2nd ed. , J.C. Gilbert, S.F. Martin, Saunders, NY 1994, p 344-364

3. Diels-Alder Notes http://www.xula.edu/chemistry/documents/orgleclab/20DA.pdf (February 5, 2011)

4. Updated Diels-Alder procedure http://www.xula.edu/chemistry/documents/orgleclab/20DielsA.pdf (February 5, 2011)

5 Sigma-Aldrich MSDS Biclyclo[2.2.2]octa-5-ene 2,3-dicarboxylic acid anhydride http://www.sigmaaldrich.com/catalog/DisplayMSDSContent.do (March 19, 2011)

6. Data and Observations [This portion is selected from the data you recorded in your notebook while carrying out the experiment. Every experiment should have observations. Take some time to organize this data into a visually and intellectually reasonable manner. Be sure to include units and the appropriate number of decimal places. The hard data must be EXACTLY the same as what was recorded in the notebook. Changing numbers in any way will get points deducted.]

This section is normally 10-20% of grade- but you can't do the rest of report without it.

Volume of 1,3-cyclohexadiene = 1.76 ml.
Density of cyclohexadiene = 0.8405 g/ml
Mol. Wt. cyclohexadiene = 80.14 g/mol
Starting mass of Maleic Anhydride = 2.574g
Mol. Wt. Maleic Anhydride = 98.06 g/mol
Mass of collected product = 1.903 g
Mol. Wt. Product= 178.18 g/mol

The 1,3-cyclohexadiene was a clear colorless liquid.
The maleic anhydride was a white solid.
The product 'fell' out of solution as a white snow-like solid.
White crystalline product collected via vacuum filtration.
Product was rinsed with about a mL of cold methanol.
Some product stuck on filter paper.

Melting point of product = 142.0-145.5° C.

Literature melting point of product = 147° C.

7. Calculations. [Include a clear list of all calculations performed including appropriate units. Must determine the limiting reagent based on amounts of product (not starting material). Points will be deducted for erroneous use of significant figures. This is often better done by hand as it is difficult to type clear equations without a special program add on]
This section is normally 20-25% of grade.

Grams of product from 1,3-cyclohexadiene("CHD" used for abbreviation of Cyclohexadiene) =

$$\frac{Vol\_CHD(ml)}{} x \frac{Mass\_CHD(g)}{Vol(ml)} x \frac{Mol\_CHD(mol)}{Mass\_CHD(g)} x \frac{mol\_Prod}{mol\_CHD} x \frac{mass\_Prod(g)}{mol\_Prod(mol)} = mass\_prod(g)$$

$$\frac{1.76\_ml\_CHD}{} x \frac{0.8405\_g\_CHD}{1\_mL\_CHD} x \frac{1\_mol\_CHD}{80.14\_g\_CHD} x \frac{1\_mol\_Prod}{1\_mol\_CHD} x \frac{178.18\_g\_Prod}{1\_mol\_Prod} = 3.29\_g\_prod$$

(note: The vol. of CHD has 3.s.f., the mol wt of CHD has 4 s.f., the mol wt of Prod has 5 s.f. The "1"'s are exact numbers so they have an infinite number of s.f.Tthe number with the smallest number of sig figs is the vol of CHD with 3. Therefore the answer will have 3 s.f.)

Grams of product from Maleic Anhydride ("MA" used for abbreviation) =

$$\frac{mass\_MA(g)}{} x \frac{mole\_MA(mol)}{grams\_MA(g)} x \frac{mol\_Prod(mol)}{mol\_MA(mol)} x \frac{mass\_Prod(g)}{mol\_PRod(mol)} = mass\_Prod(g)$$

$$\frac{2.574\_g\_MA}{} x \frac{1\_mol\_MA}{98.06\_g\_MA} x \frac{1\_mol\_Prod}{1\_mol\_MA} x \frac{178.18\_g\_Prod}{!\_mol\_PRod} = 4.672 mass\_Prod(g)$$

(note: Both the mass of MA and mol.wt of MA have 4 s.f. The mol wt of Prod has 5. The "1"'s are exact numbers so they have an infinite number of s.f. Therefore the answer has 4 s.f.)

Determine L.R.Since 3.29 g is less than 4.672 grams, the limiting reagent is 1,3-cyclohexadiene. The theoretical maximum amount of product which can form is 3.29 g.

% Yield Product

$$\frac{Actual\_Mass\_Product\_Formed(g)}{Theoretical\_Maximum\_Mass\_Product(g)} x100\% = \%yield\_Product$$

$$\frac{1.903\_g\_Product}{3.29\_g\_product} x100\% = 57.7\_\%\_yield\_Product$$

(note: The actual mass has 4 s.f. The theo. Max. amount of product has 3 s.f. Therefore the answer has 3 s.f.)

8. Discussion and Conclusions. (This should explain what you did, what you observed (your results), what this indicates, and what this indicates. Discuss the results **you** obtained; not simply restating what was done. Comment on **ALL** yields and purities. Explain where sources of error could have originated. (Did, saw, what, why). It is good to start out discussing the overall reaction. Give a brief reintroduction into the experiment, then explain what was done and chemically explain all key steps involved. Do not use "I", "we", "our" or other pronouns. Write in the passive voice. Instead of "I heated 40 ml of water", write "Forty ml of water was heated."). This section is

normally ~25-33% of grade. A list of topics you need to be sure are covered in this section are often listed on blackboard. Consult with your instructor on this.

A Diels-Alder reaction was carried out between 1,3-cyclohexadiene and maleic anhydride to form a new bicyclic ring adduct. The reaction was carried out by combining 1.76 mL of cyclohexadiene and 2.574 grams of maleic anhydride in a 25 mL round bottom flask fitted with a condenser. The reaction was allowed to heat for approximately 30 minutes in a gently boiling water bath. During the course of the reaction a white precipitate formed, which indicated a reaction was taking place. After the 30 minutes was complete, the solution was removed from the water bath and allowed to cool to room temperature. Crystals were observed. This indicates that a new product was forming. The material was then immersed in an icebath to enhance the amount of crystal formation. The solid material was removed from the roundbottom flask, the flask was rinsed with cold methanol, and the crystals were collected via suction filtration. The 1.903 grams of product collected had a crystalline white appearance and a melting point of 142-145C.

The sparkly white appearance of the product indicates a reasonably high purity product. The observed melting point of 142-145^{o}C is close to but a bit lower than the literature melting point of 147^{o}C. The closeness of the obtained melting point to the literature value supports the identity of the product to be the desired cycloadduct. This slight deviation and breadth of melting points indicate a reasonably high purity, but also indicates that a small amount of impurities are present. One possible origin of these impurities is that the sample was not allowed to fully dry before the melting point was taken.

The 1,3-cyclohexadiene was the limiting reagent. The obtained percent yield was 57.7%. This is a moderate yield. Some reasons for the decrease in yield could be that some product remained stuck to the filter paper after suction filtration. Another explanation is that the solution was only allowed to remain in the ice bath for a few minutes, hence some of the product may have remained dissolved in solution and not precipitated out. In addition, it was difficult to remove all of the crystals from the round bottom flask.