THE LABORATORY NOTEBOOK

Introduction:

You are required to keep a laboratory notebook in this class. The duplicate pages from that notebook will be collected and graded. In the real world of laboratory research, the notebook serves as the primary record of a scientist's work. All data, observations, and results from each experiment must be recorded directly in the notebook. There are four important standards that these lab notebooks must meet.

1. It must be an honest and accurate record of the work done and the results obtained.
2. It must be recorded as you perform the work. Data and observations are written in the notebook as the experiment occurs.
3. It must be a permanent record. Changes to the notebook can make it suspect with regard to the standards above. It must be written in pen. All corrections must be legible.
4. The record must be kept in such a way that a competent person familiar with the field can repeat the work based on the notebook.

Ordinarily, a laboratory notebook is for a scientist's own use. However, a company or research director/advisor will often keep the original copy for practical or legal reasons. Especially in commercial work, the notebook may become legal evidence in patent or copyright disputes. Reports on a scientist's work are almost always separate from the notebook. A report might take the form of a scientific paper, a written report to company management, or a legal report. A scientist uses the data and observations recorded in the notebook as the basis for these reports, but adds explanations and discussion of the work appropriate for the intended readers.

Your notebooks are monitored and graded to teach you the proper way to keep a notebook. To ensure that these standards are met, you are required to follow certain conventions regarding the keeping of laboratory notebooks. As you progress in your scientific education, you will learn additional requirements and best practices when keeping a proper laboratory notebook. One of the primary objectives in this course is to learn the fundamentals of good notebook practices.

As the semester progresses, you will be expected to write separate laboratory reports based on the data and observations that you recorded in your notebook during the performance of the experiment. The proper procedure for writing of this laboratory report will be discussed later in the semester.

In this course a separate data sheet is required at the end of each experiment. For the first few experiments you will be guided as how to prepare a proper data sheet.

Format:

There are many formats that are acceptable for lab notebooks in general. However, a company may require its employees to follow a standard format for their lab notebooks so that information can be found more easily. In the same way, it is useful to have everyone in the class use the same format. Therefore, in this class, we require you to follow a particular format that is described below. Failure to follow this format can result in point deductions when you lab notebooks are graded.

- Do not use the back of any page. Begin the first experiment on page 3, leaving pages 1 and 2 for a table of contents that you will build as you use the notebook. Your table of contents should include the title of each experiment and the number of the notebook page on which your description of that experiment begins. Each time that you begin a new experiment, make a table of contents entry for that experiment. Do not try to construct the table of contents ahead of time because changes may have to be made to it.
- Write in pen not pencil. When you make a ~~miskake~~ mistake, simply put a single line through the error, and write the correction after. The information that was stricken must still be legible. Do not totally [redacted] blank out or  scribble over a mistake. Do not use whiteout.
- Within your description of each experiment, keep each required section separate from the others. For example, don't mix data with procedures. Clearly label each section and separate it from other sections. Arrange the sections in the order prescribed and do not leave large blank spaces on a page. Do not skip any pages (except for the pages reserved for the table of contents).

Listed below are the different sections you must include in your lab notebook for each experiment. Additional instructions and comments on keeping the notebook follow each section. Before each lab period, complete sections 1-5 of your notebook for the experiment we are scheduled to do on that day. If you have not completed your notebook you will not be allowed to perform your experiment and you could lose the points for that experiment.

1. Date	There is a place for the date to be entered at the top of the page. This is the date on which you do the experiment. Enter the date on every page.
2. Name	Put your name in the space provided at the top of each page. If you work with a partner, also include your partner's name.
3. Title of Experiment	In this class you can use the title in the manual or the syllabus. Enter the title in the space marked "Experiment" at the top of the first page of your notebook write-up for each experiment. Your instructor may also require you to enter the title on subsequent pages. Even if he or she does not require it, it is a good idea to do this in case a duplicate page becomes separated from the rest of the pages after being removed from the notebook.

	There are spaces for the course and section at the top of each page also. Your instructor will let you know whether he or she requires you to use them.
4. Purpose	A brief description of the scientific purpose for doing the experiment serves as an introduction to the main body of the notebook write-up. It normally consists of one short paragraph of perhaps one to three sentences.
5. Procedure	Write a summarized description of the procedure that you will be using in the experiment. This section should be more than a handful of sentences but typically less than one page long. Include enough detail to allow a knowledgeable chemist to carry out the entire experiment just following your written procedure. Include enough detail to be able to perform the procedure but do not rewrite the procedure from the manual verbatim. The procedure should contain target volumes, masses and temperature. It should also specify any unique glassware or materials to be used. Drawings of set-ups are valuable when carrying out an unfamiliar method for the first time.
6. Data and Observation	This section is always found in both lab notebooks and reports of working chemists. It is probably the most important section of any laboratory notebook. Include in this section all of the measurements (mass, volume, times, temperatures) along with units and clear identifiers that you make in the laboratory. If the procedure calls for 4 g of starting material and you weigh out 3.965 g, record that as your number, not 4.00. Write data down directly into your lab notebook. Do NOT write data down on scratch pieces of paper and later neatly transfer to notebook. The data needs to be recorded directly in the notebook as it is obtained. Be sure to include observations such things as color and phase of all starting materials and products. Record all changes such as colors, bubbling, a new phase, precipitations and temperature shifts such as if a flask gets cold or warm. Often observations are just as important as hard data. Many new discoveries were made based on keen observations. Your instructor will deduct points for few or no observations.
7. Conclusion	After all of the data and observations have been collected, think about the experiment and whether the purpose was obtained. Make a brief, one to three sentence statement summarizing the findings and the success or failure of the stated objectives.
8. Signature & Date	Print your name (as signature) and date each page of notebook completed.

Two examples of sample pages of lab notebook are included next.

Example 1

TITLE	LAB 2	BOOK No.	1	DATE	9/17/09	30
NAME	CHAD LANDRIE	PROJECT No.	X	FROM PAGE No.	FIRST PAGE	

PRE-LAB

TITLE: LAB 2 - Chemical Proportionality: Carbonate and Hydrochloric Acid

INTRODUCTION:

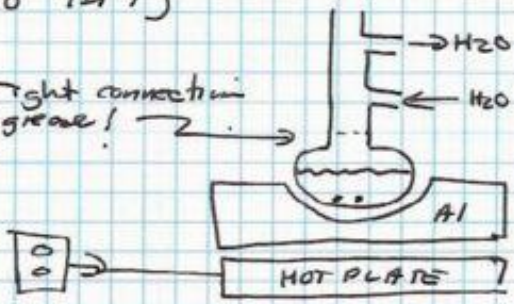
A solution of hydrochloric acid (HCl) in water can be neutralized by adding a weak base such as Na_2CO_3 (Na_2CO_3). The products of this reaction are sodium chloride (NaCl), carbon dioxide (CO_2) and water (H_2O). The reaction is complete (All HCl has reacted) when the evolution of CO_2 gas (seen as bubbles) ceases. In Part I of this experiment we will compare observations made when Na_2CO_3 is added to a solution of HCl(aq) and when it is added to pure water. Since water is not a strong acid (neutral), I hypothesize that no reaction will take place when Na_2CO_3 is added to pure H_2O and therefore no CO_2 gas (seen as bubbles) will be seen. In part II we will determine what mass of Na_2CO_3 is required to neutralize various volumes of HCl solution at 3 different concentrations. By determining the number of moles of Na_2CO_3 that are required to neutralize each number of moles of HCl, we can determine the ratio of chemical proportionality. Since we already have the balanced equation, we are able to predict that the ratio will be 2:1 moles HCl to moles Na_2CO_3. Finally, in part IV, we will use the same procedure to identify the concentration of an unknown sample of HCl solution.

→

SIGNATURE	DATE	WITNESSED BY	DATE
Chad Landrie	9/17/09	X	X

PUT THE BACK COVER UNDER THE COPY PAGE BEFORE WRITING

(5) Heat w/ sand bath or Al block (Turn on H_2O 1st!)



Make sure pieces fit together properly first; practice assembly B4 adding reagents

Tight connection + grease!

used Al block, as per instructor's info

(6) Heat to 120-130° : let soln boil for 15 minutes (PREP AB – let heat to boil : may not need to monitor T°)

boil start : 7:47 pm
boil end : 8:03 pm

(7) Remove from heat; allow to cool to RT OK to cool in water bath

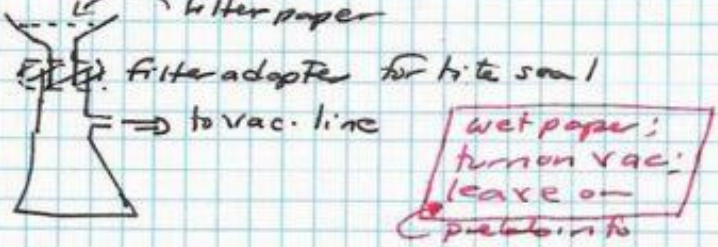
(8) Remove condenser; set flask in 50 mL beaker

(9) Add 3M H_2SO_4 in ~0.5-mL increments until set heavy white ppt that remains w/ mixing : then add addn 0.5 mL (should take 2-3 mL total)

V_{used} = 2.5 mL

(10) Cool in ice bath (beaker w/ ice)

(11) Vacuum filtration w/ Hirsch funnel



wet paper; turn on vac; leave on (pre-label info)

(12) Transfer solid to weighing paper then to 10-mL Erlenmeyer flask
Weigh crude! Save a bit!

weight = 0.182 g

(13) Recrystallization: add 2 mL H_2O + boiling stick or stone : heat to boil on hot plate. Add H_2O in 0.5-mL increments until all dissolves : Then add 0.5 mL more H_2O. Note antisolvent

$V_{H_2O\ used}$: 4.5 mL (but some evap)

(14) Let cool to RT on bench top; then cool in ice/water bath 5 minutes

many crystals! (14)

(15) Collect crystals by vac. filtration
fresh filter paper
(16) Rinse w/ cold H_2O; then pull air thru for a few minutes
(17) Put on watch glass or paper + leave to dry
watchglass or beaker ok; place in hood
(18) Once dry: weigh, determine melting point ★ obtain IR spectrum, NMR

crystals are white and in the form of beautiful long needles

mass: 0.162 g

mp: 156-159°C

★ melting point (instructor will demo no needed)
(a) place in capillary tube w/ one open end
(b) put tube in melting apparatus + heat slowly
(c) Note T° Range of melting

RESULTS

Calculations

limiting reagent is methyl salicylate ~~salicylic acid~~

$$\text{theor yield} = 0.235\text{g MS} \times \frac{1\text{mole MS}}{152\text{g MS}} \times \frac{1\text{mole SA}}{1\text{mole MS}} \times \frac{138\text{g}}{1\text{mole SA}}$$

$$= 0.213\text{g}$$

$$\%\text{ yield} = \frac{0.162\text{g}}{0.213\text{g}} 100 = 76.1\%$$

this should all be purple since it was done during or after the lab

NMR Results

Methyl salicylate has 8 unique carbons and thus 8 peaks in its NMR spectrum. Salicylic acid has lost one of these carbons (the OCH_3) so it has 7 carbons and 7 peaks. The peak at δ 52 ppm for the OCH_3 is gone in the spectrum of salicylic acid

CONCLUSION

attached to Lab Report sheet

↑ you may paste this in your lab notebook later, after you get the report back, along w/ the Report sheet itself (OK to paste on backs of pages) (15)

Example 2

This example combines the Procedure and Data & Observations into one section and shows the difference between initial observations made in the lab and summarizing of the results in the Report Form.

HYDRATED CRYSTALS

Purpose:

This experiment explores the physical and chemical properties of hydrated crystals.

Procedure/Data & Observation

Heat small sample of copper sulfate crystals	• Crystals appear blueish before heating • After heating for 5 min crystals become white on the outside • After heating for 10 min longer crystals become all white
Place some crystals in test tube and add water	• After adding water, crystals become blue again • Crystals do not dissolve in water

Results:

Before heating, copper sulfate crystals appeared blue in color. After heating, crystals began losing color and become progressively whitish in color. This process began quicker on the surface of the crystals, till eventually all the crystals become white in color after 15 minutes. The dried crystals were placed in a test tube and water drops added to them. After adding water, the crystals regained their blueish color but did not dissolve in water.