Bring this packet with you to every lab and consult frequently.

Name ______________________________________ Section Time ________

TA Name __________________________________ TA Office Hours: ______________________

TA Email __________________________________ Drawer # and Combo ____________________

Lab Orientation & Safety Exercise

Complete during the first lab meeting, check with TA for completeness & credit

Get to know your space! Work with your lab partner to find the following items in the lab and their corresponding tag. There are some items for which there are multiple locations, such as sinks, but only one tag. Find that tag! Other items may not in the room at all! Make a lab map on the back page and mark the locations by number. Describe the proper use or purpose of each item on the following pages using the instructions provided on the tags. **You must have a complete map & description before leaving the lab.**

Emergency Response

1. Fire Extinguisher (find the closest one in the hallway)
2. Fire Alarm (find the closest one in the hallway)
3. Safety Shower
4. Eyewash Station
5. Evacuation Procedure (find the tag, copy the map, and follow it)
6. First Aid Kit (Go to the stockroom)
7. Broken Glassware Box, Dust Pan & Broom
8. Spill Control Center

Day-to-Day

9. Balance Station
10. Sink & Flood Hose
11. Chemical Waste Station
12. Dry Waste Box
13. Chemical Fume Hoods
14. Reagent Station (Chemical Reacting Agents)
15. Disposable Gloves

Equipment

16. Equipment Room (GC & IR)
17. Rota-vap
18. Water Re-circulation Pumps (water lines)
19. Ring stands
20. Clamps
21. Vacuum Tubing
22. Hot/stir plates

Other…

23. Your TA – introduce yourself and politely ask them to show you the instrument room
24. One-word hazard definitions & precautions
25. NFPA Labels - Copy and color the NFPA label description from the bulletin board then classify the sample labels posted.
26. Lab coats

TA Initials ________ (completed)

Bring this packet with you to every lab and consult frequently.

1. Fire Alarm	**2. Fire Extinguisher**
3. Safety Shower	**4. Eyewash Station**
5. Evacuation Procedure	**6. First Aid Kit**
7. Broken Glassware Box, **Dust Pan & Broom**	**8. Spill Control Center**

TA Initials ________ (completed)

Bring this packet with you to every lab and consult frequently.

9. Balance Station	**10. Sink & Flood Hose (2 separate tags)**
11. Chemical Waste Station	**12. Dry Waste Box**
13. Chemical Fume Hoods	**14. Reagent Station**
15. Disposable Gloves	**16. Equipment Room**

TA Initials ________ (completed)

Bring this packet with you to every lab and consult frequently.

17. Rota-vap	18. Water Pump & Water Lines
19. Ring Stands	20. Clamps
21. Vacuum Tubing	22. Hot/Stir Plates

24. Hazard Definitions

Irritant -

Flammable -

Lachrymator -

Carcinogen -

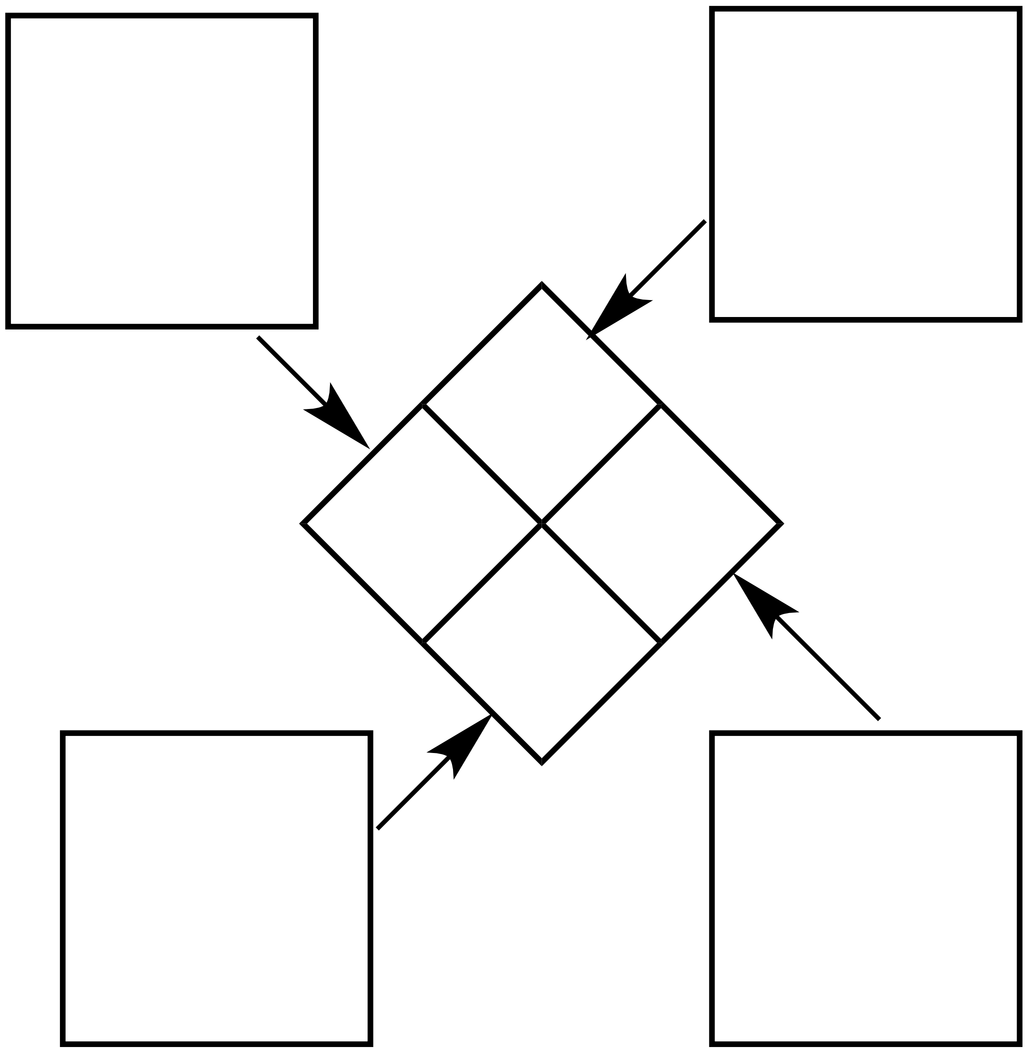
Corrosive –

What should you do in the event of chemical exposure (contact to skin)?

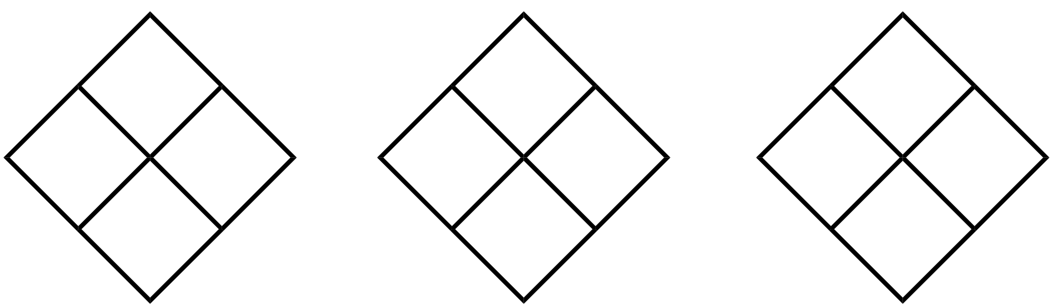
TA Initials ________ (completed)

Bring this packet with you to every lab and consult frequently.

25. National Fire Protection Association (NFPA) Hazard Rating System



Fill in & color the sample labels given on the bulletin board and describe the hazards.



26. Notes on using lab coats…

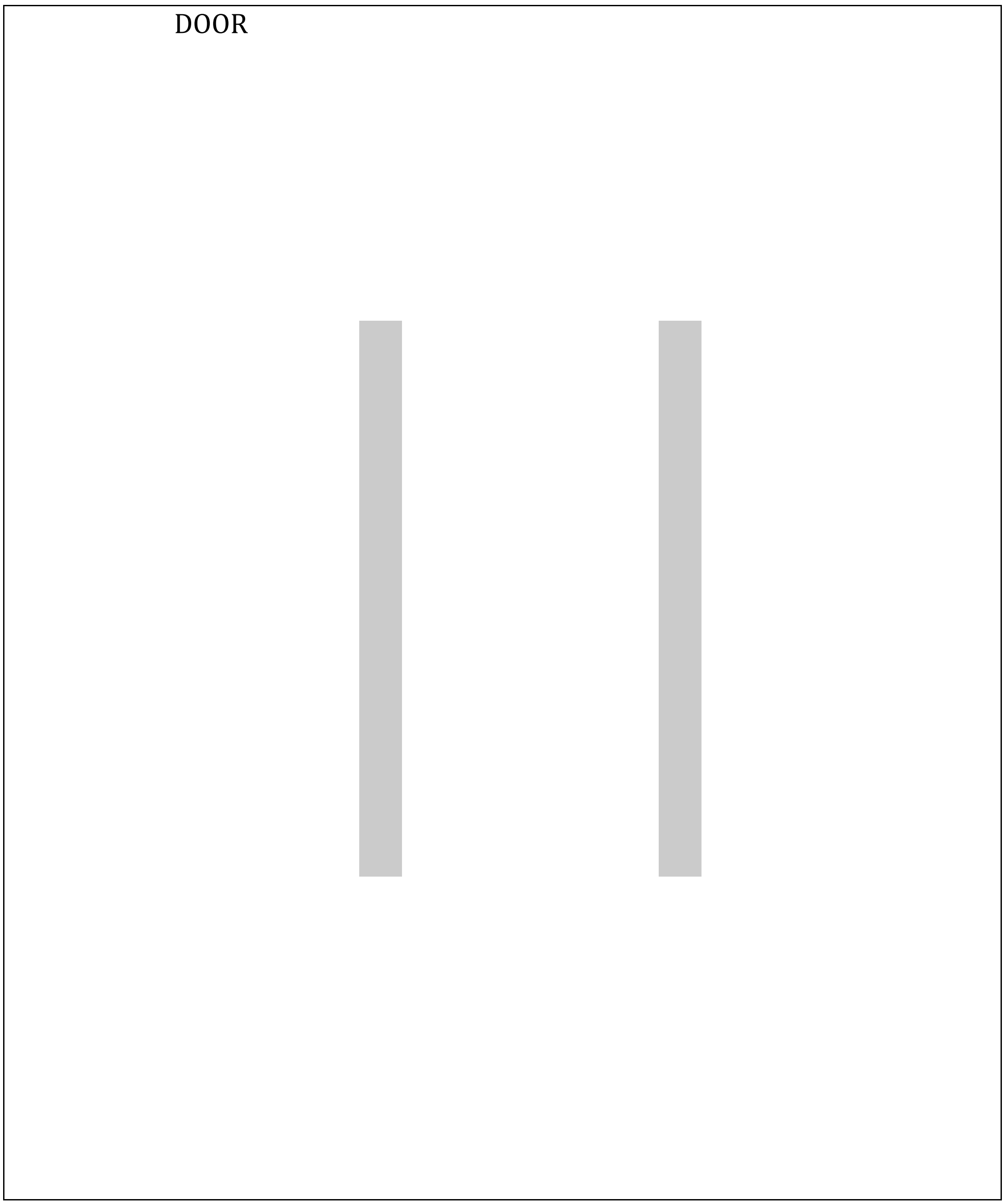
TA Initials ________ (completed)

Bring this packet with you to every lab and consult frequently.

LAB MAP, Thimann Labs, Room ________

Add the locations of items to make a map by number (1-26). Always refer to this map in future labs before asking where something is!

HALLWAY



TA Initials ________ (completed)

Read carefully and bring this worksheet to every lab.

Lab Worksheet: Error Analysis

Check your work with your TA for completeness & credit

Determining the degree of uncertainty:

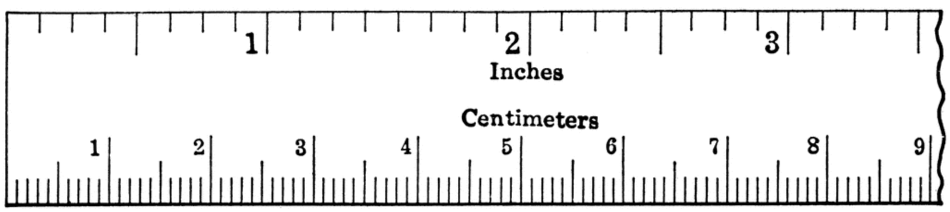
It is customary to report experimental results with the degree of uncertainty stated:

result = value measured ± uncertainty

This naturally raises the question of how do you estimate the uncertainty of a measured value? The answer to this question lies in determining the smallest fraction of the smallest division marked on a measuring device that can be estimated with reasonable accuracy.

Determining the least count and the Instrument Limit of Error (ILE):

The **least count** is the smallest division (graduation) that is marked on a measuring device. For example, the **ruler below has a least count of 0.125 (1/8) inches and 0.1 centimeters**. Notice the least count refers to the graduations (lines) on the measuring tool and not the numbers provided.



1) What is the least count for the following pieces of lab glassware in your locker? Include units.

a) 10 mL graduated cylinder: _________

b) 100 mL graduated cylinder: _________

c) 1 mL pluringe: _________

d) 3 mL pluringe: _________

e) 50 mL beaker: __________

f) 250 mL Erlenmeyer flask: _________

g) Consider the balances in the lab. Report the least count (smallest number) of the different types of balances below – choose any two with different digital readouts. You may need to go into the instrument room. Don't forget to include units!

Balance #1 _______________

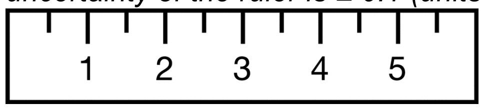
Balance #2 _______________

TA Initials ___________ (completed table & pipet/pluringe technique)

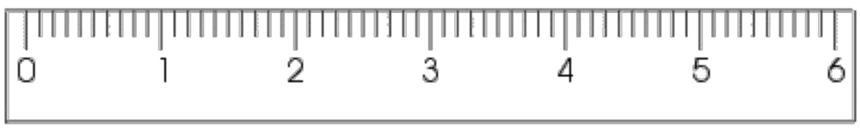
Read carefully and bring this worksheet to every lab.

The **<u>instrument limit of error (ILE)</u>** is the estimated accuracy to which a measuring device can be read. The ILE is a reflection of the uncertainty in measurements made with a particular device and is always equal to or smaller than the least count. The ILE is generally taken to be the least count or some fraction (1/2, 1/5, 1/10, etc.) of the least count. There are no set rules for which fraction of the least count to use in determining the ILE and different observers may report different ILE's.

- **If the space between the scale divisions is large**, you may be comfortable in estimating a fraction of 1/5 or 1/10 of the least count. A reader may estimate between the lines to 1/5 of the least count (0.5) in the figure below: 0.1, 0.2, 0.3, 0.4, or 0.5… (1/5 x 0.5 = 0.1). "*The uncertainty of the ruler is ± 0.1 (units not provided).*"



- **If the divisions are closer together**, you may only be able to estimate to the nearest 1/2 of the least count (0.1 cm). The reader may only estimate on the line or in between it in the centimeters ruler below: 0.05 cm or 0.10 cm…(1/2 x 0.1 cm = 0.05 cm). "*The uncertainty of the ruler is ± 0.05 cm.*"



- There are also situations where the divisions are so close to each other that you may only be able to estimate to the least count (smallest fraction = 1). The deciding factor is an evaluation of the smallest fraction of the least count that *you* can <u>accurately</u> estimate.
- **In digital readouts**, such as the balances, the reader has no say in determining the least fraction. *Consider how the last decimal place is determined*. There are many more sig figs than those provided so the <u>last decimal place was rounded either up or down</u>.

2) Estimate the ILE for the following instruments (include units for least count & ILE). If you are confused, carefully re-read the points above for examples. **Use distilled water to take one measurement with each device. Measure any amount within the capacity of the instrument. Report the measurement with proper sig figs and uncertainty (ILE).**

(Least Count) x (Fraction) = ILE

Table 1. Summary of Instrument Uncertainties

Equipment	**Least Count**	**Fraction**	**ILE**	**Measurement (value ± ILE with units)**
10 mL grad. Cylinder				
100 mL grad. Cylinder				
1 mL pluringe*				
3 mL pluringe*				
50 mL beaker				
250 mL Erlenmeyer				
Balance #1				
Balance #2				

TA Initials ___________ (completed table & pipet/pluringe technique)

Read carefully and bring this worksheet to every lab.

B. Reporting the degree of uncertainty for individual measurements:

When discussing the systematic error of a particular measurement it is appropriate to express the standard error as a percentage of the volume being measured, percent intrinsic error (%IE).

% IE = (ILE / volume measured) x 100%

3) Calculate the % intrinsic error when a 10 mL graduated cylinder is used to measure the following volumes:

a) 1 mL:

b) 2.5 mL:

c) 5.0 mL:

d) 10.0 mL:

Which is the most practical volume to measure with a 10 mL graduated cylinder?

4) Calculate the % intrinsic error when 0.5 mL of liquid is measured using the following:

a) 10 mL graduated cylinder:

b) 1 mL pluringe:

c) 3 mL pluringe:

d) 50 mL beaker:

Which is best to use when measuring 0.5 mL?

5) General conclusions about when to use which piece of glassware:

TA Initials ___________ (completed table & pipet/pluringe technique)

Read carefully and bring this worksheet to every lab.

C. Vocabulary

In scientific research collecting and reporting quantitative data requires the experimenter to declare the extent to which they are certain that the results reported are due to the experimental conditions and not due to random chance or errors in data collection or analysis. In other words, scientists must state the degree of accuracy and reproducibility for the results reported. In reality, accuracy and reproducibility are actually expressed in terms of the level of uncertainty associated with the measurements used to generate data.

6. Experimental results may be described in terms of (write a definition for each term):

   a) Accuracy:

   b) Precision:

   c) Reliability:

7. In the space provided, write brief definitions for the following sources of uncertainty in measurements:

   a) Human (experimenter) error:

   b) Intrinsic (systematic) error:

   c) Indeterminate (random) error:

8. In general, error analysis for an experiment does not include ________________ error because this type of error is usually the result of carelessness on the part of the experimenter.

9. The ________________________ error can be assessed by taking multiple measurements then reporting the average and standard deviation.

10. The ___________________ error for a measuring device like a graduated cylinder can be assessed by determining the ILE from the least count.

TA Initials ____________ (completed table & pipet/pluringe technique)

Basics of Scientific Writing

A good technical writer is concise yet descriptive and does not confuse the reader by packing too much information into one sentence. Publication in any journal requires the authors to follow strict guidelines. It is unlikely that a paper will be accepted for publication if the provided guidelines are not followed. This document is designed to help students get started with proper technical writing skills. A significant portion of each lab report grade is devoted to proper writing, neatness, and organization (10-20%). Carefully review the guidelines for each section of the lab report.

Part A: Attention to Detail – complete on Day 1

- Choose one font, one font size, and stick to it (suggested Arial or Times New Roman, font size 10-12), except for changes to font size for headings. Otherwise, there are no specific font or document setting requirements for 108 lab reports.
- Use spell-check then have a human read it for anything spell-check may not catch (especially chemical names).
- Use subscript and superscript where appropriate (H_2O not H2O or worse H20; cm^2 not cm2).
- Give tables proper titles and headings. Tables should not span over two pages (get it on one).
- Avoid casual language. Words like “whatever” and “kinda” do not belong in technical documents!

Small mistakes can have a big impact on the impression of the author. Carefully read each sentence below, indicate each mistake, and re-write the sentence properly.

1) The procedure for this experiment can be find on 40 and 41 of the attached lad notebook pages.

2) The results in this experiment show the different colors that can be obtained bye dying the fabrics.

3) The solution was kind of blue-ish.

4) Sodiun dithionite (Na_2S207) was the oxidizing agent.

Part B: Writing in the passive voice – complete on Day 1

Science writing, particularly technical writing, is unlike expository writing in that the passive voice is usually preferred in technical science writing. The passive voice enables the writer to maintain an objective stance when describing the purpose, procedure, results, and conclusions in an experiment. Objectivity can also be conveyed by avoiding the use of possessive pronouns like I, we, our, my, etc. **Past tense is used except when stating facts, which are in the present tense.**
For example, *"Limonene eluted first from the column, indicating that it is less polar than carvone."*

Each example below contains far more words or information than necessary, not to mention inclusion of personal pronouns and unprofessional writing style. Carefully read, indicate the errors, and re-write the sentences properly.

1) The whole meaning of this lab is determining the percent yield of the reaction and looking for the synthesis of indigo.

2) To begin the synthesis we had to place o-nitrobenzaldehyde into a beaker and add water and acetone into it. We used a magnetic stirring bar to stir it while we added NaOH solution. After a certain time we waited for it to cool inside an ice bath them remove it and drop it inside a Buchner funnel.

3) The following are two different incorrect ways of writing the results sentence in a chemical synthesis. Reconstruct these sentences into one using the following format:
"(Chemical name) was isolated as a (description of product) (xx mg, xx % recovery)."

"The actual yield of the blue indigo dye for this experiment was about 0.7 grams or about 70% of what was supposed to be yielded."

"For the percent yield of this reaction we ended up with 70% of indigo synthesized, and the mass was 0.7 g."

5) "Based on how it came out for me, I made plenty of mistakes so it did not come out the way I had hoped."

6) "Me and my lab partner found that the beaker was the least accurate because the % error was the highest out of all of the glasswares at 27%."

Part C: The Abstract – complete this section during the distillation of citrus oils (Exp 2)

The abstract is an especially concise description of the experiment. It should briefly state the purpose of the experiment, including the experimental purpose to the learning objectives. The abstract should include a brief synopsis of the general experimental procedure (without using specific amounts or sizes of glassware), as well as a statement about the primary results and conclusions. **This can typically be accomplished in *four-six* brief sentences.** Use the following to gather the content of the abstract then construct concise, grammatically correct sentences to convey this information.

Use the Experiment 2 handout, the instructions below, and the sample data on the next page to write a concise, grammatically correct abstract for the first experiment.

Carefully read the full lab handout (including introduction and procedure) before you begin.

Purpose

What was the experimental purpose? This is typically, but not always, found in the experiment title. What were the primary learning objectives? These would be new techniques, principles, or reactions observed. Begin the abstract with the following:

"The purpose of this experiment was to (experimental purpose) so that (learning objectives)."

Procedure

This is the most challenging section to keep short but it is possible to convey the procedural guidelines in **2-3 sentences. Avoid run-on sentences!** Include the chemicals and techniques used. Do not include equipment unless it is significant to the outcome of the experiment (microcolumn, GC, TLC, etc.).

Results

Report the final result or results. Refer to the in-lab questions for guidance and decide on only the most important information to present to the reader (this will not be every result). Use one to two complete sentences to state the result(s) in words and numbers in parentheses with units.

Conclusion

How successful was your experiment? Were the results as expected? Do not assume the reader knows the expected result. This is not the place for emotions – avoid phrases like "I think the results were good"! Keep it factual and use only one sentence. The following are two suggested ways to begin the conclusion sentence.

"The experiment was successful / not successful based on…"
"The results were as expected / not as expected based on…

Work alone **to write the abstract, keeping each section separate (purpose, procedure, results, conclusion) and bring it to the TA. He or she will provide feedback and likely send you back for a re-write. *You cannot leave the lab until your TA approves of your abstract.* It is in your best interest to stay because the abstract is worth 10% of the lab report!**

Isolation and GC Analysis of Citrus Oils - Sample Data, Exp 3
You will use some, but not all, of this data to construct the abstract.

Mass of orange peels: 150.00 g

Distillation temperature

Temperature at first drop: 95 °C

Temperature at last drop: 100 °C

Approximate volume of citrus oil: 3.2 mL

Mass of citrus oil: 2.88 g

There should be copies of GC chromatograms available for students to practice measuring retention times and integration. Report your findings in the tables below. This data is for practice and the writing exercise only. Use the provided sample GC chromatograms to practice these calculations during your downtime for Exp 2. Use your own data from the GC chromatograms you obtain in your report.

Table 1. Standard GC Retention times

Sample	**Corrected t_R (s)**
α-pinene standard	
β-pinene stnd.	
Limonene stnd.	
γ-terpinene stnd.	
Carvone stnd.*	
Citrals stnd.*	

* Carvone and citrals standards will not be injected in Exp 2.

Table 2. GC Analysis of Citrus Oil

Peak #	**Peak ID****	**Corrected t_R (s)**	**Integration (cm^2)**	**% Composition***
1				
2				
3				
4				
5				
6				

** Use corrected retention times to assign each peak to one of the standards. Note that not all standards may be present, some peaks overlap, and other unknown peaks may appear.

Table 3. GC Analysis of Unknown Oil #4

Peak #	**Peak ID****	**Corrected t_R (s)**	**Integration (cm^2)**	**% Composition***
1				
2				