Name ________________________________ Section Day Tu W Th & Time _________

TA Name ______________________________ TA Office Hours: _______________

TA Email ___________________________________

Lab Orientation & Safety Exercise

Complete during the first lab meeting, check with TA for completeness & credit
KEEP THIS IN YOUR LAB NOTEBOOK AT ALL TIMES

Get to know your space! Work with your lab partner to find the following items in the lab and their corresponding tag. Fill in the blanks in this packet with the information on the tags. 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. **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
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 – go say hi!
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

LAB MAP, Thimann Labs, Room _________

Add the locations of benchtops & items to make a map by number (1-26).

DOOR TO HALLWAY

1. Fire Alarm

* Located at the ________________________building entrance and exit left of the elevator.

* Pull this alarm only if you see a fire. Don't assume someone else has called it in.

* Alert by-standers by yelling "____________**!**"

* Individuals should also notify the fire department by calling ____________________.

2. Fire Extinguisher

* Located in the hallway between rooms ____/_____ and ____/_____.

* Report the fire, ____________________,______________________, and EXIT the building.

* Only _________________________________ should attempt to extinguish a fire (…so you should probably not be using this, but it's good to know where it is).

3. Safety Shower

* To be used if student is splashed with a considerable amount of ________________that can not be___________________________________.

* DO NOT pull it to test it! Only do it if you need it. It puts out a set, large amount of water.

* If needed, disrobe and stand under the shower for __________ to wash away the chemical and reduce contact (___________________________).

* Call 911 for severe cases.

4. Eyewash Station

* You shouldn't need this because you should be ___________________________!

* Hold the eyelid open in the running eyebath for __________ min.

* Call _______or go to the _________________ if the injury requires further medical attention.

5. Evacuation Procedure

* Take the ________________ to evacuate the building instead of the ____________.

* Follow the map to the rendezvous point and take a quick spin on the __________. Follow the path down the little hill, cross the street, and **take a selfie next to the 'Thimann Laboratories Emergency Assembly Area' sign. Show your TA for proof!**

6. First Aid Kit

* Located in the ______________.

* Sufficient for ____________& ______________.

* All injuries must be reported to the TA followed by the completion of an "_____________________________Form" attained from the stockroom staff.

* For extensive injuries, student is escorted to the _______________ before ______ or immediately call _______ if after ________.

7. Broken Glassware Box, Dust Pan & Broom

* Disposal container for ______________________________ broken glassware.
* Please use the dust pan and broom to sweep up any tiny glass pieces.
* If it's not __________________________, it doesn't go in here!

8. Spill Control Center

* All spills must be _____________________________.
* ___________________ (__________) will neutralize solutions that are acidic / basic.
* _________________ should be used for absorbing spilled solvents.
* For spills larger than a few milliliters, it may be necessary to evacuate and call x911.

9. Balance Station

* Read the BALANCE ETIQUETTE SIGN * Use piece of ________________ to weigh solids.
* ________________________ to help the transfer.
* Bring the container you're transferring into – DO NOT walk around the lab with ___________ _________________________________!
* *Always* ________________ the balance pan and __________________________________.

NO SNOW STORMS of chemical powder here!

10. Sink

* After properly disposing of _________________, wash glassware with ____________ and _________________, then rinse twice with DI water.
* This is NOT a waste bin. Only _____________ and____________ down the drain!
* Note which sinks in this room, if any, have a flood hose.

11. Chemical Waste Station

* Waste bottles are kept here in __________________________________(bin to catch spills).
* *Read the waste label* – there may be more than one type of liquid waste.
* Pour *into* the waste bottle using the _________________provided (not onto the bottle. Yes, someone's done that before. Not cool).
* ________________________ if a waste bottle is full. Don't let the containers _____________.

12. Dry Waste Box

* For solid waste from experiments such as ____________, ___________, and _____________.
* DO NOT put ____in the dry waste box.
* If it's a liquid, it doesn't go in here!
* __________________ if you are unsure of what goes in the dry waste box AFTER reading the guidelines above and instructions in lab procedures.

13. Chemical Fume Hoods

* Minimizes your ____________________to________________________
* Work with the chemicals at least ____________________ into the hood
* Hood cover/sash should be_______________to the__________________or else!
* DO NOT put _______________ in the hood! * Keep surfaces clean – clean up spills

14. Reagent Station

* Take only what you need from bottles * Keep surfaces clean – clean up spills!
* Prevent contamination - DO NOT return _____________________to__________________
* Bring a _______________and ________ for transfer – DO NOT walk around with a full pipet!
* Carefully read labels twice * Carefully_________________________

15. Disposable Gloves

* This is a ______________ line of defense * Gloves do not make your hands _____________!
* ___________________gloves if you get chemicals on them
* Let your TA know if a box is ______________…also, be a good human and place said empty box in the ____________________!

16. Equipment Room

* GCs can be hot! Don't leave _____________________________________ on top
* Keep GC/IR kits tidy (_______________________) when in use
* Clean up spills when they happen
* Ask your TA to show you around the instrument room.

17. Rota-vap

* Used to____________________samples: Round-bottom flask is attached, rotation prevents boiling over as ____________ is applied to remove solvent, which is collected in the ________.
* Your TA will ________________________ and/or set this up for you the first couple times.
* Please _______________ when not in use. * Be respectful – empty that _______________!

18. Water Pump & Water Lines

* Don't let pumps _____________, check frequently
* Know your in's and out's – ________ is water in, ________is water out
* Water lines run near ___________________ – watch where you point those things!
* Only use the clamps to adjust flow – please do NOT________________________

19. Ring Stands

* Used to secure __________________ using __________________.
* Stack them in an _________________________
* Remove all _________________before returning

20. Clamps

* Separate clamps from _________________________
* Do not leave ______________________ or other items in this drawer
* If the threads on the clamp become worn and no longer work, please bring it to the __________________________ so we can try to fix it

21. Vacuum Tubing

* _______________________ tubing for connecting a vacuum line.
* Ask your TA where to connect to the __________________.
* Return tubing when you are finished.
* Do not use for_________________; vacuum only.

22. Hot/Stir Plates

* Note that there are separate dials for '_________' and '___________' and that different hotplates have different types of __________________ settings.
* Mind where the cord lies to prevent_______________________
* Set heat on or below _______ setting. These hot plates get ridiculously (unsafely) hot on ___.
* When finished, put them away neatly, no leaning towers of hot plates please.

23 – What is one of your TA's hobbies or interests?__________________________________

Share something similar with your TA 😊

24 & 25 are on the following pages

26. Lab Coats

* Worn over _______________________________.
* Must be worn with ____________________ during all experimentation and cleaning.
* Contaminated lab coats are considered waste. Notify your TA and bring the coat to the _____________________________ if you spill on your lab coat.
* Lab coats are shared with many sections – be considerate and do not leave _______________________________________in the pockets!
* Hang up coats neatly on the hanger labeled with the _________________________.

24. Hazard Definitions

In the case of exposure to any chemical, rinse the affected area immediately for ____________ and_________________________.

Copy the following precautions to be taken when handling the following types of chemicals then find the HAZARD TERMS below.

- *Irritant* – irritates the__________; minimize_______________, wear _______ &________
- *Flammable* – keep away from____________& potential______________, handle in ________________with______________ & _______________
- *Lachrymator* – induces______________; wear _____________&_________________
- *Carcinogen* – linked to______________________; minimize__________________, wear ______________&_______________, handle in___________________
- *Corrosive* – ________________ and ______________ the skin; minimize _________________; wear_____________& _______________.

HAZARD TERMS

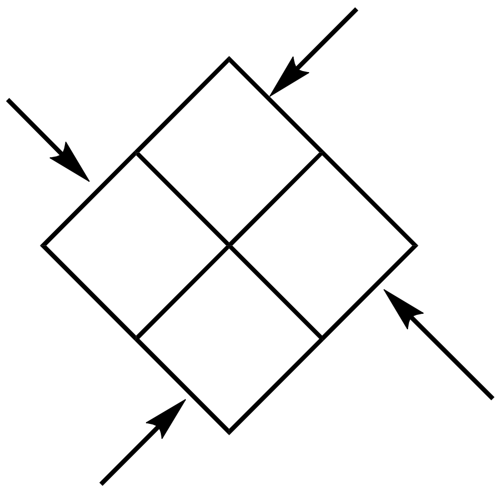
R	S	M	E	B	X	O	A	V	M	C	H	H	W	P
U	W	A	Y	L	D	Y	H	J	A	B	T	Y	K	Q
S	S	B	F	F	B	M	E	R	O	J	J	G	U	E
H	Q	H	D	E	I	A	C	X	I	S	T	R	K	T
S	L	U	G	R	T	I	M	I	O	B	W	O	T	P
N	C	D	C	C	N	Y	N	M	Y	K	Z	S	N	V
F	F	X	I	O	L	N	F	D	A	Y	W	C	A	Z
Z	B	X	G	Y	L	N	R	I	K	L	N	O	T	I
K	O	E	B	C	B	G	X	Z	R	N	F	P	I	T
T	N	V	Y	U	W	B	U	O	M	S	R	I	R	B
L	A	C	H	R	Y	M	A	T	O	R	T	C	R	W
Q	G	K	W	W	A	T	B	V	A	N	Q	W	I	T
X	D	M	S	E	V	I	S	O	R	R	O	C	U	J
J	R	O	M	A	T	H	L	T	B	J	P	M	I	Y
P	K	D	E	N	H	X	C	I	J	P	K	J	N	M

CARCINOGEN	CORROSIVE	FLAMMABLE
HYGROSCOPIC	IRRITANT	LACHRYMATOR
SAFETYFIRST	SLUG	TOXIC

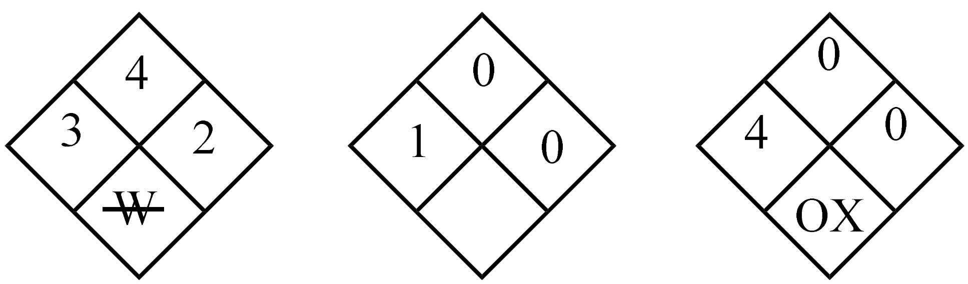
25 – <u>NFPA Labels</u> - Copy the NFPA label description from the bulletin board. Color them in if you have the equipment!

What does NFPA stand for? ____

Hazard Classifications



Classify each of the examples below using the ratings above. Forgive the lack of color, feel free to add your own!



Health Hazard			
Fire Hazard			
Specific Hazard			
Instability			

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:

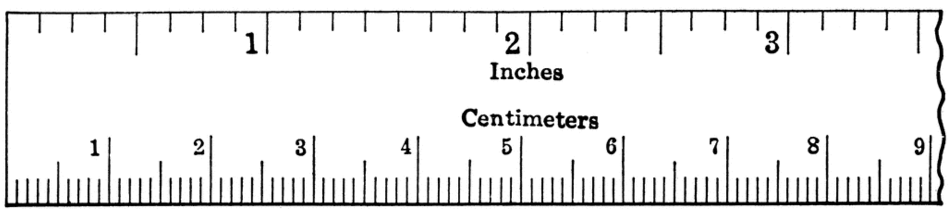
It is customary to report experimental results with the degree of uncertainty stated:

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 _______________

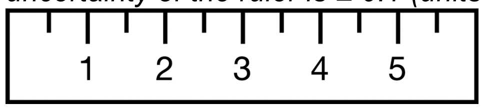
Balance #2 _______________

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

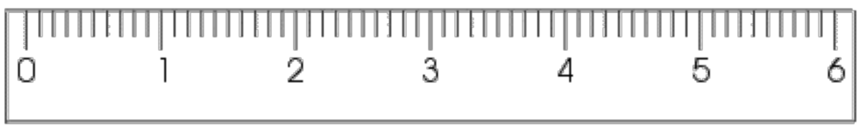
Read carefully and bring this worksheet to every lab.

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 in the first lab meeting

- 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 8L 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, then indicate and correct each mistake.

1) The procedure for this experiment can be found 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.

TA Initials ________ (completed first day of lab)

Part B: Writing in the passive voice – complete in the first lab meeting

The passive voice is used almost exclusively in technical science writing. The passive voice enables the writer to maintain an objective stance when describing the purpose, methods, results, and conclusions in an experiment. Objectivity can also be conveyed by avoiding the use of possessive pronouns like I, we, our, my, their, 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."*

The following examples were taken from student abstracts. Each contains more words or information than necessary as well as personal pronouns and generally unprofessional writing style. **Read the abstract requirements on the next page followed by the corresponding example on this page and re-write the sentences properly.**

PURPOSE

1) The whole meaning of our lab is looking for the synthesis of indigo and we dyed a piece of fabric with it.

METHODS

2) To begin the synthesis we had to place o-nitrobenzaldehyde into a beaker and add water and acetone into it without heat. We used a magnetic stirring bar to stir it while we added 3M 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 to vacuum filter the solid product called indigo.

RESULTS

3) "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."

CONCLUSION

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

TA Initials ________ (completed first day of lab)

Part C: The Abstract*)*

Instructions for writing the abstract during Experiment 2, Day 2 (down-time during GC analysis):
Revisit the sample data on the next page. Use concise, grammatically correct sentences to convey this information given the following guidelines. ***Work alone*** **and bring the abstract draft to your 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.***

The abstract is an especially concise description of the experiment (4 – 6 sentence paragraph). **CHEM 8L abstracts** are composed of the following.

- Purpose of the experiment, including the experimental purpose and learning objectives
- Brief synopsis of the methods used without procedural steps or specific amounts
- Main result(s)
- Conclusions reflecting on the results in the context of the purpose

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.

Format: "The purpose of this experiment was to experimental objective so that learning objective."
Example: "The purpose of this experiment was to purify crude acetanilide so that recrystallization and melting point analysis could be performed."

METHODS - How was the purpose carried out? Include the chemicals and/or techniques used without specific amounts. Do not include equipment unless it is significant to the purpose of the experiment (microcolumn, GC, TLC, etc.). **Avoid run-on sentences and do not re-state the entire procedure!**

Example: Acetanilide was recrystallized from water and activated charcoal. Gravity and vacuum filtrations were used to remove impurities and isolate the pure compound, which was analyzed by melting point.

RESULTS - Report the final result or results. Refer to the in-lab questions and **specific notes about the abstract within the experiment PDF**. Only the most important or pertinent information should be presented to the reader (this will not be every result). Use one to two complete sentences to state the result(s) in words. Any numerical data should be presented in parentheses with units.

Format: "(Chemical name) was isolated as a (description of product) (xx mg, xx % recovery)."
Example: "Acetanilide was obtained as shiny white crystals (0.252 g, 73% recovery)."

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.

Format Option 1: "The experiment was successful / not successful based on…"
Format Option 2: "The results were as expected / not as expected based on…"
Example: The purification of acetanilide was successful based on the increased melting point observed for the recrystallized sample.

Isolation and GC Analysis of Citrus Oils - Sample Data, Exp 2

Students 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: 95.3 °C

Temperature at last drop: 99.2 °C

Approximate volume of citrus oil: 3.20 mL

Mass of citrus oil: 2.88 g

GC chromatograms are available online and in the lab 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 perform these calculations during your downtime for Exp 2, Day 1. 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 std.	
Limonene std.	
γ-terpinene std.	
Carvone std.*	
Citrals std.*	

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

Table 2. GC Analysis of Citrus Oil (Unknown Oil #1)

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				