Chemistry 141 Lab
Professor Abrash
Week One
FAQ

What is this thing?

It's answers to a sequence of frequently asked questions. I'll be handing one out at the beginning of lab each week. Usually they will only address the background of the lab, its procedure, and the next week's assignments. Just this once, it will also deal with a number of administrative issues.

Who are you?

I'm Professor Sam Abrash. I've been teaching chemistry here for 21 years, and my specialty is Physical Chemistry.

How can we reach you?

My work phone number is 289-8248. My email address is sabrash@richmond.edu. You should feel free to call or email, but if I don't answer the phone when you call, email is a better way to get a quick response from me.

Will you be holding office hours?

Yes, but I won't be setting formal times. I'll be in most days before 9 A.M., and will be here most days until 5 PM or later, and you can come by my office any time you want. I'll be teaching MWF from 9 A.M. to Noon, and Monday afternoons, but any other time is free game. If I'm busy when you stop by, I'll make an appointment to meet with you, usually later the same day.

Where is your office?

It's room C-208 in the Science Center. If you come by and my lights are off, don't assume I'm not there. I like to work with the lights off as long as it isn't too dark. Give a knock or two and give me a minute to respond.

What now?

We'll review the syllabus.

Is this the syllabus?

No. It's in your lab manual, on pages v to xiii.

Are you going to go over everything in there?

No. It's your responsibility to read and understand all this material. However, I will be going over some critical points, like our attendance policy, what you're supposed to do before you come to lab each week, and how you'll be graded.

What is the attendance policy?

Attendance is required for every meeting of lab.

What if we don't show up?

It depends on if you have an excused absence or not. If your absence is not excused, then you get a zero. However, if your absence is excused, you MIGHT have an opportunity to make up the lab and avoid the zero.

What's an excused absence?

An absence is excused if there is a very good excuse, like serious illness on your part, death in the family, or an official University event that requires you to travel off campus.

What do you mean MIGHT have an opportunity to make up the lab?

Each experiment is set up for only one week, so any make up labs need to be completed the week your lab was originally scheduled. The only way we allow this to be done is for you to do the experiment in one of the other lab sections. Many of them are completely full, so there will be no space for you. The only way to guarantee that you'll have an opportunity to make up your lab is to let me know in advance (preferably the previous week) so that you have time to make arrangements with another instructor to make up the lab. The other instructors are not required to let you do the experiment in their section, but they usually do their best.

What if something comes up at the last moment, and there's no space in lab?

If it's a truly excused absence, and there really was no opportunity to work things out in advance, and there is no space in any of the other sections, then we'll work something out.

What do we need to do before we come to lab each week?

There are several things:

- Read the experiment write up for the week.
- Answer all the questions in the prelab assignment.
- Create a preliminary notebook record. This will include the title of the experiment, its objective, the chemicals you'll be using, and all necessary safety precautions for the experiment.

You mention a laboratory notebook. Can we use any notebook we want?

No. We require that you use a special notebook sold in the bookstore that has carbon copies for each page. That way you can tear out the carbons to hand in for grading each week, but keep the original record intact?

What if we forget our notebook? Can we just use regular paper that week?

Yes, but there will be a grade penalty.

What? Why?

Experimental notebooks are supposed to be complete archival records of (at least) what you did, what you observed, and what you measured during an experiment. One way of ensuring that the record is complete and has not been tampered with is to keep the record in a bound notebook with numbered pages. Keeping your record elsewhere calls into question the integrity of your record and of your work.

What else do we have to have in our notebooks?

During lab you'll need to make a complete record of the steps that you took in your experiment, and all data, including qualitative data (observations) and quantitative data (results of measurements). In some cases you'll need to include citations for literature references.

Can we write down the steps of the experiment in advance?

I understand the reason for wanting to do this. It helps you to prepare for the experiment, and frees you from the tedious task of writing down everything that you do as you do it. HOWEVER, there is one big problem. When you write the procedure in advance, it is simply a record of what you PLAN to do, not what you've done. There is a way to make this approach work, though.

Well, what is it?

If you like this approach, write out the procedure in full in advance, but leave a full line blank in between each step. That way you can either leave it as is, or if what you actually did differed in any way, can indicate the change in the blank space you've left. However, it's important to remember to indicate the changes, if you make them.

What do we have to turn in each week?

Several things:

- The prelab for that week's experiment

- The carbon copies of the notebook pages for the current week
- The laboratory summary report for the previous week's experiment.

What does the summary report consist of?

It can vary from week to week in the details, but the report for next week's lab on the titration of vinegar is fairly typical. It includes (in addition to the notebook pages, turned in the previous week)

- Filled in Data Report Sheets (these can be found in your lab manual, at the end of the experiment
- A set of sample calculations
- A brief discussion of the results

The summary report should be typed or neatly written out in ink.

Will we ever do anything more involved than the summary report?

Yes, but only once when you do your project. I'll describe that in greater detail when we get to that point.

Is that everything we'll be turning in?

Most weeks yes, but there will be three weeks during the semester when you'll have to turn in a report sheet for the Library reading assignments. In these reading assignments, you'll choose an article from the literature (a list of suggested sources is on page xi), read it and do a one page summary. The weeks in which these are due are given in the schedule of experiments on page vi and are indicated next to the date of the experiment with a capital R.

In addition, there will be one week in which you will indicate to me the project you've chosen for the end of the semester, along with your choice of group members for the project. The week for this is indicated with a capital P next to the date of the experiment.

How are we graded?

Each lab is assigned a value of 100 points (with the exception of the projects which are 325 points). You'll receive a letter grade for the lab, which will be based on the prelab exercise, the summary report, and the notebook pages for the experiment. In order to reduce some of the pressure in this course, the department has chosen to narrow the range of grades typically given for lab reports. In general, a very good effort will be awarded a B+, while a below average effort will be awarded a C+. Grades above B+ or below C+ will be (hopefully) very rare, and will be reserved for very exceptionally good work, or very exceptionally poor work. It is important to understand that even if you consistently get B+ as a grade for individual lab reports, your semester grade will be higher. This is, in part, because we will average B+ as a 91 in your lab grade, and in part because your

grade for your three library exercises will be either 100% or 0%, which will hopefully help to increase your average.

OK. So that's the syllabus. What next?

We need to discuss safety.

Can't we just read what's in the manual?

It's critical that you read the safety material in the manual, but safety is so important that we should go over it in detail. In addition there are two points that are so important that I will also reproduce them here.

What's the first?

It regards Eye Safety. You must wear either safety glasses or safety goggles at all times when you are in lab. In addition, while contact lenses are no longer forbidden in chemistry labs, I still believe that they represent a significant hazard. If you can avoid wearing them great. If you can't then I strongly recommend that you wear googles rather than glasses because of the increased hazard.

And the second?

Open toed shoes (sandals, flip flops etc) are not allowed in lab. Since this isn't just our policy but is also a state law, I cannot allow anyone wearing open toed shoes to do an experiment. If you have to miss a lab for this reason it will count as an unexcused absence.

What do we do next?

It's time to move from the syllabus to some content, but first let's fill out some forms, assign lab drawers, check in, and then take a brief break. After the break will talk briefly about significant figures, and then have a quick lesson in some of the features we'll be using in Microsoft Excel.

What specifically happens now?

- Assign partners and drawers
- Fill out ONE Laboratory Drawer Inventory Form per partnership (they're on page xix)
- Fill out your Student Info Form
- Sign the extra copy I have of the safety form on page xvii.

OK. We're back. You said we were going to talk about significant figures next. What are significant figures, and why are they more significant than any other figures?

From one point of view, Michelango's David is a significant figure, and the Madonna and Christ figures in his Pietá are significant figures, but that's an art historical point of view.

However from a scientific point of view, the concept of significant figure is intimately tied to the process of measurement. Every measurement we make has a number associated with it, and the number of digits in that number that we have read from our device is the number of significant digits.

For example. If we measure length with a meter stick with only centimeter markings on it, we can estimate only to about .2 cm, and a typical reading might be 141.2 cm. This is 4 significant figures. If we have a mm ruler, we can read to .2 mm, and the same measurement might be 141.24 mm, 5 significant figures. So the more precise your measuring device is, the more significant figures there are in your measurement.

How do you count the number of significant digits in a number that's written down?

Basically you just count the digits, but you need to know a few rules. Leading zeros do not count, i.e.

359 is three significant figures.
00359 is also three significant figures.

Trailing zeros after the decimal do count.

359.0 is four significant figures
359.00 is five significant figures

Trailing zeros when there is no decimal are ambigious. I.e, if the number is 300, are the final zeros because we've made a measurement and our number is 300 exactly, or are they just place holders.

How do we tell if they count or not?

Two ways. One is if the number has an uncertainty reported with it. In that case, the last significant digit is the one in the largest place of the reported uncertainty. I.e

If a number is reported as 300±20, then since the uncertainty is in the 10s place, the tens place is the last significant digit and this would be two significant figures (the 3 and the first zero.)

If a number is reported as 300±2, then the uncertainty is in the one's place, and there are three significant figures.

The other way to tell is if the number is written in scientific notation. Then there ARE no numbers with trailing zeros and no decimal.

If our number is 300, and there is only one significant figure, then it's written as $3. \times 10^2$

If there are two significant figures, then it's written as 3.0×10^2.

If there are three significant figures, then it's written as 3.00×10^2

So the clear message here is to use scientific notation to write down your answers whenever possible.

How do we know how many significant figures to keep in a calculation?

For multiplication and division the rule is easy – you keep the smaller number of significant figures between the two numbers being multiplied.

I.E. , the number 357 x 26, the answer would have only two significant figures, and would be 9.3×10^3.

As a second example in the product .004727 x .000353, the first number has 4 significant figures and the second three because leading zeros are not considered significant, so the product will have three significant figures, and would be 1.67×10^{-6}

For addition and subtraction, the trick is to identify the last significant figure in each of the numbers being added (or subtracted). Then the last significant figure in the sum (or difference) is the one that was originally farther to the left.

Example
353.3
+ 747.2856

The final three is the last significant figure in 353.3. The 6 is the last significant figure in the 747.2856. The 3 is farther to the left than the 6, so the last place we will keep in the sum will be one occupied by the .3, so the answer will be 1100.6

OK. What next?

Now we'll do our excel exercise. However, since Dr. Case has laid out what you need to do step by step, I won't add anything here.

What do we need for next week, then?

- Safety glasses or goggles
- Closed toed shoes
- A laboratory manual
- A laboratory notebook
- A completed prelab exercise for our first experiment, "The Titration of Vinegar"
- A completed prelab entry in your notebook