

# Preface

## GETTING STARTED

These labs have been developed with a view to providing the students with meaningful and significant experience with experimental processes. Particular attention has been given to ensure that students come away from this experience with a wide range of basic skills, in both experimentation and data analysis that can be used in other fields of study.

The lab itself consists of three components: a PreLab, an InLab, and a PostLab.

- The PreLab requires students to read through the experimental procedure and answer some basic questions to show their understanding of the principles and procedures involved in the lab. This ensures that the student is prepared to do the experiment and get the maximum benefit from it.
- The InLab component forms the core of the lab. Students take data based on their observation and then analyze the data.
- The PostLab questions are directly related to the experimental procedure and the principles that form the basis of each lab, and as such, it gives the students yet another opportunity to review what they learned in the lab.

Ideally, the Pre and Post Lab components should be done outside of the lab. The student should complete the PreLab component before the start of the lab and the PostLab component will be done, again outside lab hours, after the data analysis has been done.

## ROLE OF WEBASSIGN

Your physics department decides whether to use WebAssign for labs. The rules regarding due dates, number of submissions, etc. are set by your lab coordinator or TA and not by WebAssign.

The introductory labs are designed to train you in the proper way to conduct experiments in any scientific field. Scientific data requires that you follow strict rules regarding the number of significant figures, please see Appendix A in your eBook for details. Engineering and scientific results that do not use these rules lose credibility. The sigfig requirements in submitting an answer in WebAssign are based on these rules. Be sure to pay attention to how you enter your values.

## LAB SYLLABUS

### Assignments

- Lab assignments are common for all students taking the lab. The lab coordinator is responsible for deciding which questions are posted in WebAssign.
- The scheduling of lab assignments is an important task so that you are asked the right question at the right time. Your lab coordinator is responsible for setting the due dates.
- Depending on the policy for your lab section, you may or may not be able to receive a time extension for completing the lab.

- For each question in WebAssign you are allowed a specific number of submissions. In general, you have 5 submissions. However, for multiple choice questions the maximum number of submissions is one less the number of choices. For example, if there are 3 choices, you only have 2 submissions. For yes/no or true/false questions, you only have one submission.
- In most cases, each submission, after the first two, will result in a reduction in the number of points awarded.
- If you need more submissions, you should ask your lab TA. Depending on the lab policy, your TA may or may not increase the number of submissions.
- Some questions are a tutorial type of question where clicking the submit or skip button will open up the next part of the question. *Note:* If you skip a part, you *will not* be able to go back and submit that part again. You will lose points for any parts you skip.
- Note the due dates for each assignment. In general, the due date for PreLabs is one (1) hour before start of lab, for InLabs ten (10) minutes after the lab ends, and PostLabs one (1) hour before the start of next week's lab.
- *Extensions are up to the discretion of the lab TA.*
- To help remind you of upcoming assignments, turn on Notifications, found on your home page of WebAssign.

### **Expectations of a Physics Lab Student**

- You must bring a printed copy of the lab worksheet in the eBook (available from the My eBooks tab on your home page). No printers are available in the lab rooms. You must maintain a notebook with the worksheet for each lab properly filled in with relevant data and calculations. If there is a problem with WebAssign's grading of your responses, the worksheet can be used to determine your grade for that lab.
- You must bring a calculator and a pen or pencil.
- You must arrive on time. It is unfair to your group lab members to be late.
- You are expected to be a good group member: include all members of the group in lab activities, work effectively and efficiently as a group member, and assist other group members when needed.
- You must check your WebAssign regularly for important announcements and newly posted assignments.

### **Grading**

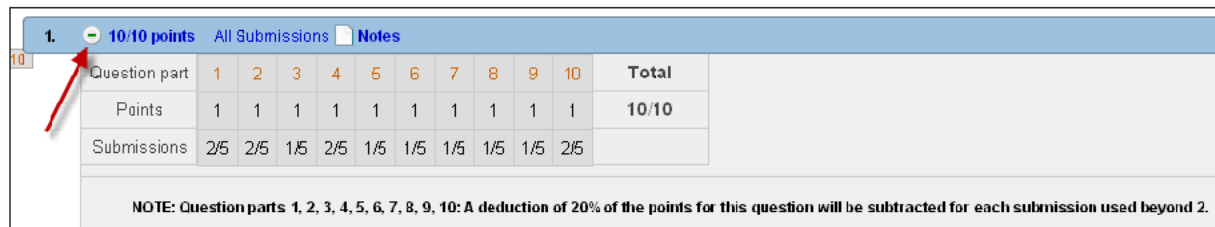
Each lab consists of a PreLab, InLab, and a PostLab. PreLabs are worth 20%, InLab 50%, and PostLabs 30% of the final lab grade.

For correct answers, the number of points you receive depends on the number of submissions you use. In general, no more than 5 submissions are allowed. For most questions, except for essay questions, after the first two submissions:

- the next submission is worth 80% of the points for that part,

- the fourth submission is worth 60%, and
- the fifth submission is worth 40%.

Click the + sign after the question number to determine whether a penalty is being applied based on the number of submissions.



The screenshot shows a question interface for question 1, worth 10/10 points. A red arrow points to a minus sign icon next to the question number. Below the question header is a table with 10 columns representing question parts and a 'Total' column. The table shows points and submission counts for each part. A note at the bottom states that a 20% deduction of points will be applied for each submission used beyond the second submission for each of the 10 parts.

Question part	1	2	3	4	5	6	7	8	9	10	Total
Points	1	1	1	1	1	1	1	1	1	1	10/10
Submissions	2/5	2/5	1/5	2/5	1/5	1/5	1/5	1/5	1/5	2/5	

**NOTE: Question parts 1, 2, 3, 4, 5, 6, 7, 8, 9, 10: A deduction of 20% of the points for this question will be subtracted for each submission used beyond 2.**

## Plagiarism and Working Together

Complete all WebAssign free response questions in your own words. Data collected from previous semesters (even if it was collected by you) or data that was collected by your group members while you were not present is not acceptable. All suspected plagiarism will be evaluated and appropriate action will be taken.

## Attendance

Arrive on time, if you are more than 10 minutes late for your scheduled lab, you may be asked to leave and you may not be able to make up the lab.

If you miss a lab, please consult with your lab TA.

## WORKING IN GROUPS

### Group Roles for Labs

In your labs, you will be working in *cooperative* groups. To help you work through the labs and learn the material effectively, each group member will be assigned a specific role.

Your responsibility for each role is defined on the chart below.

Role	Actions	What It Sounds Like
Lab Manager	<ul style="list-style-type: none"> <li>· Direct the sequence of steps.</li> <li>· Keep your group "on-track."</li> <li>· Make sure everyone in your group participates</li> <li>· Watch the time spent on each step.</li> </ul>	<ul style="list-style-type: none"> <li>· "Do we have all of the equipment we need?"</li> <li>· "We need to move on to the next step."</li> <li>· "Let's come back to this later if we have time."</li> <li>· "Chris, what do you think about this idea?"</li> </ul>
Recorder	<ul style="list-style-type: none"> <li>· Act as a scribe for you group.</li> <li>· Check for understanding of all members.</li> <li>· Make sure all members of your group agree on plans and actions.</li> <li>· Enter the results into WebAssign for the group.</li> </ul>	<ul style="list-style-type: none"> <li>· "Can you repeat that reading?"</li> <li>· "Do we all understand this diagram?"</li> <li>· "Are we in agreement on this?"</li> <li>· "Do we all agree on the values I am entering into WebAssign?"</li> </ul>
Skeptic	<ul style="list-style-type: none"> <li>· Help your group avoid coming to agreement too quickly.</li> <li>· Check for understanding of all members.</li> <li>· Make sure all possibilities are explored.</li> <li>· Suggest alternative ideas.</li> </ul>	<ul style="list-style-type: none"> <li>· "Can you repeat that reading?"</li> <li>· "What other possibilities are there?"</li> <li>· "Let's try to look at this another way."</li> <li>· "I'm not sure we're on the right track."</li> </ul>
Energizer/Summarizer*	<ul style="list-style-type: none"> <li>· Energize your group when motivation is low by:               <ul style="list-style-type: none"> <li>· Suggesting a new idea</li> <li>· Through humor</li> <li>· Being enthusiastic</li> </ul> </li> <li>· Summarize or restate your group's findings and conclusions.</li> </ul>	<ul style="list-style-type: none"> <li>· "We can do this!"</li> <li>· "That's a great idea!"</li> <li>· "So here's what we've decided."</li> </ul>

\*This is a separate role if there are four members in your lab group, otherwise everyone should assume this role.

## TIPS FROM STUDENTS

These tips are based on written comments from 275 former physics lab students who used WebAssign for their lab assignments.

### Overall Suggestions

You have plenty of time to finish the lab, so don't rush. Make sure to get everything right. It helps a lot to read the PreLab so you are familiar with what to do from the start of the lab. Even just skimming through the PreLab helps. Make sure that you did not make any calculation errors by going back and checking your answer before you submit it. Make sure at least one person in your group has printed out the lab procedure. It's really annoying when no one brings it to class...

- Be patient, work with other classmates (it is also an easy way to make friends), and have fun.
- Be prepared for a lab that you can learn from!
- Try not to get too frustrated at the WebAssign PreLabs, they're aggravating and horrible but doable. The lab itself is a lot of fun and a helpful learning experience, it's just WebAssign completely ruins the lab experience.
- Take your time and do the assignment in advance so you can ask for help if you need to.
- I would say that the MOST IMPORTANT advice is to read, and reread the directions carefully BEFORE coming to class.
- Have the lab manual open while doing the PreLab.
- Read the lab manual carefully to gather equations for use in all assignments.
- The questions about calculating uncertainty are difficult.
- I knew I would lose points before I started the assignment, but there is no real way to avoid losing points if you are not sure of the answer.
- Be more concerned with accuracy and less with time.
- WebAssign is wrong about as often as you are.
- Labs take time, start early.
- Try to enjoy what you are doing instead of trying to get in and out of the lab.
- WebAssign is very moody.

### Working in Groups

Don't just rely on your lab partners to do the work, even if they are really smart. If you don't study the material and prepare for the lab, you won't get a good grade, which is the bottom line.

- Lab is a TEAM effort, not just letting one person do the work.

- Work as a team.
- If your group is not really talking, take it upon yourself to read the questions out loud and state your questions. Yes, they can all read, but just reading it out loud puts everyone on the same page and helps encourage others to be vocal.
- Work hard and work together, no one likes a slacker.
- Work in groups. Best way to make sure you get the full amount of points.

## Deadlines

Devote plenty of time to working on the pre- and post-labs. They are often much more difficult than the in-labs, and require a significant amount of time to complete. Begin your assignments early, and by early I mean not the night before it's due or even the hour before it's due. If you begin working on them early, it allows you to double-check your answers before submitting them.

- Reading the entire lab procedure can save lots of time.
- Don't wait until the night before!
- Start on the pre and post labs before the day that they are due.
- Do NOT Procrastinate.
- It is wise not to wait to do the assignment until the last minute since they are detailed.

## Be Careful when Answering WebAssign

Make sure that your answer is right before you submit it. I realized that after I read the instructions. Double and triple check your work. I realized too late that I would lose points.

- Read the directions carefully.
- Make sure you know exactly what the question is asking for.
- Calculate twice, submit once.
- NEVER guess.
- Take your time when answering questions.
- My biggest problem wasn't getting the right answer. It was entering the right answer.
- Follow the instructions and read carefully so as not to lose points to careless mistakes.
- Read the lab manual very carefully. The answers can be tricky.

## Answering Questions with Formulas

Leave extra time to work on formulas with uncertainty. They are difficult at first, but after clicking on the links next to the WebAssign questions to learn how to write out uncertainty formulas and reading it several times through, it will be to your benefit for correctness and time.

- Work it out on paper first and have the TA check the answers. Putting a random equation into WA can be a little overwhelming depending on the number of variables.

- Solving for the equations was difficult.
- Half of the algebraic answers aren't in the text and aren't particularly intuitive. Try combining formulae.
- Make extra sure formulae are written exactly correct or WebAssign will eat you.
- Don't even try them on your own, work in a group and make sure you have the correct answer before submitting the formula—you WILL NOT get the answer correct on your first try on your own.

### Labs Requiring the Use of Excel

Excel is hard to understand at first, but you get used to it and it is one of the easier parts of lab. Use Excel for your calculations. When you go back and have to redo an early calculation, it's SO much easier to have to only make one change in a spreadsheet than to have to recalculate everything. Excel is something great to learn. It was very helpful when doing slope problems or anything that had to do with creating an equation of your data.

- Get familiar with Excel because it is very useful when you know how to use the formulas.
- Excel is way faster than using a calculator.
- Learn Excel early. You use the same techniques all year.
- Familiarize yourself with the Linest function.
- Make sure you plot the right information on the  $x$ - and  $y$ -axis. It's really easy to switch these without knowing it.
- Learn Excel. Even if you dislike Microsoft products, Excel is an excellent tool in your arsenal for physics.

### Entering the Correct Number of Sig Figs

Sometimes if I rounded too much while doing my work, it would count it incorrectly even if all my work was done correctly. So I would recommend not rounding by very much. Unless it specifies how many sig figs to use, I typically give my answers to 3 or 4 sig figs. Pay attention to addition/subtraction and multiplication/division. Sig Figs do matter and if you get them wrong, you will see a big red X beside the question.

- Pay attention to how many significant figures there are.
- NEVER ROUND.
- Ask your TA. They typically know how many sig figs is needed.
- Give at least 3.
- Make sure you use at least 4.
- Always keep at least 4 if you're not sure how many there should be.
- They are good to use for problems that build on each other, and as a safety I used three.

- You cannot round answers early in the problem.
- Ask, ask, ask. Always ask how many significant figures are required if you don't know.
- WebAssign always wants uncertainty given to 1 significant figure, remember that!
- In ALL science classes sig figs are VERY important so learn them early in your classes.
- Using 5 significant figures will help calculations from being slightly off.
- Webassign is crazy when it comes to sig figs.
- Percents are two sig figs and percent error is 1.
- Avoid rounding as much as possible.
- If there is no sig fig icon, enter as many numbers as you can. Otherwise, always look for the icon and be careful with how many you use.

### **Entering Numerical Answers with Units**

Many experimental answers require both a number and a unit. It saves time and points if you enter both the first time.

- Keep track of the units.
- ALWAYS include units.

### **Using Submissions when Answering Questions**

I realized that after two submissions you lose points. Then I read the directions for the class. I was pretty stunned because I had never had a class do this before. Keep track of how many submissions you use. Sometimes you end up submitting and forget that you lose points after the first two tries. Just think of every submission like it's your last. I hated losing points because of silly mistakes so double check your answers before you submit them.

- Although you have quite a few tries to get a problem correct, you'll quickly realize that those fractions of points that are taken off add up rather quickly and harshly.
- Use your submissions for the correct answer. Don't just guess unless you really don't know or cannot figure out the answer.
- If you are going to guess, make it educated because after the 2nd submission your points will go down.

### **Getting Help**

Work with your classmates on the assignments. Often times, they are really hard and you'll need more than 2 submissions. When you work as a group, you have overall a higher number of submissions. If you have any questions, it is valuable to talk to your TA during their "office hours." Get a group of friends in the same class and work on the pre and post labs together. If you can't find that, ask your lab partners if they would be willing to get together and work on it. The assignments start out easy, but believe me, they get so much harder! Also, it is wise not to wait to do the assignment until the last minute since they are detailed.



- Always ask your TA before submitting assignments if you are unsure of your responses.
- Don't try to do the labs by yourself. It wastes submissions and you lose points.
- Don't be afraid to ask questions on things you don't understand.
- Getting to know people in your lab to help with the WebAssign questions is extremely helpful.
- Explain it to your TA then submit..