

## PHYSICS 5CL LABORATORY INTRODUCTION AND REMINDERS

- ***Reminder! You are required to have a lab notebook for each lab to record your observations. You can upload any photos or documents to your bCourses DropBox which will serve as an electronic portion of your lab notebook.***

### STRUCTURE OF THE LABS

Each lab will be divided into the following sections:

- Objectives – A very brief rundown of the goals each lab is meant to achieve.
- Lab Overview – A brief rundown of the experiments you will run in the lab.
- Equipment – A list of the equipment being used for each lab.
- Theory and Background – A review of the relevant physics being explored in the lab.
- Pre-Lab Preparation Questions – A set of problems that is to be done before coming to lab.
- Experiments
  - Tier 1 experiments – Experiments that you will be guided through step-by-step.
  - Tier 2 experiments – Experiments whose overall structure is outlined, but not detailed.
  - Tier 3 experiments – Experiments where you will design the experimental procedure.
- Capstone Project Jumping off Points – The semester will conclude with a capstone project. In each lab a few ideas are presented as potential jumping off points for projects.

### LAB NOTEBOOK REMINDERS

- *Many useful formulas were presented to you in the “Theory and Background” portion of the lab. You may want to copy these into your lab notebook to have as a quick reference.*
- *Record your actions and all observations and measurements in your lab notebook. You may also want to take pictures or make sketches of any new lab setups you prepare. Make sure you clearly label and answer any posed questions in your lab notebook.*
- *Document everything in your lab notebook! Make sketches, detail procedural steps, record observations, start data tables, answer posed questions, etc.*
- *Feel free to use a program such as Python to help you with any data analysis, graphing, statistics, etc. but be sure to attach any scripts you use to your lab notebook.*
- *Remember to upload any document, picture, program, or script to your electronic lab notebook.*

### EXPERIMENTS

We refer to each of the main setups in lab as “Experiments.” One lab will typically have multiple experiments, each meant to explore a different method or procedure or to explore a different aspect of the system under study. Unlike Physics 5BL, where entire labs were labeled as Tier 1 or Tier 2, in 5CL each lab will have Tier 1 experiments, Tier 2 experiments, and Tier 3 experiments.

## Checkpoints

Towards the end of each experiment will be one or more checkpoints:

### **CHECKPOINT 2**

**Call the GSI over to discuss Experiment 2 at this point before moving on.**

You will check in with the GSI or instructor when you reach these checkpoints to go over the experiment and to make sure that you are on the right track. This also lets us monitor your progress.

## The format of Tier 1 Experiments

As in Physics 5BL, Tier 1 experiments are intended to be a more step-by-step walkthrough to introduce you to the proper procedures to use in lab. The step-by-step nature of these experiments makes this part of the lab very wordy.

The following formats have been employed to help you keep track of what you are supposed to do:

- Bullet points indicate procedural steps. Even though you are being walked through many of the individual steps in these Tier 1 parts, it is always good experimental practice to record your actions and all observations and measurements in your lab notebook. You may also want to take pictures or make sketches of any new lab setups you prepare.
- a) Letters indicate questions or particularly important measurements. Make sure you clearly label and answer each of these questions in your lab notebook.
- *Triangular points on italicized paragraphs indicate important points to keep in mind throughout the experiment.*

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## The format of Tier 2 Experiments

As in Physics 5BL, Tier 2 experiments will give you a little less guidance and are intended to help you learn how to apply experimental procedures and analyses.

The following formats have been employed to help you keep track of what you are supposed to do:

- Bullet points indicate particular procedural steps or general setups that you will have to construct. Since you are given a little more freedom here, it is essential that you record your setups, actions, observations, and measurements in your lab notebook. You should take pictures or make sketches of any new lab setups you prepare.
- a) Letters indicate questions or particularly important measurements. Make sure you clearly label and answer each of these questions in your lab notebook. Again, given the less structured nature of Tier 2, these may be framed as more general questions. You may have to figure out intermediate steps on your own.
- *Triangular points on italicized paragraphs indicate important points to keep in mind throughout the experiment.*
- ◎ *Bullseyes on italicized paragraphs are hints and reminders. There will be fewer and fewer of these as the lab progresses.*

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## The format of Tier 3 Experiments

Tier 3 is new to Physics 5CL! In these experiments we will provide you with materials and ask you to determine or study some physical quantity or aspect of a system. It is up to you to devise the experimental procedure, carry out the experiment, and perform the appropriate data analysis to come up with the answer. These are meant to exercise your experimental legs and so only the bare minimum of guidance is presented in the labs. However, you can often adapt methods and procedures detailed in Tier 1 or Tier 2 experiments to suit your purposes.

It is crucial in Tier 3 experiments to record a detailed account of your experimental procedure in your lab notebook.

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## Lab Cleanup

- *You are expected to return your lab station to the state you found it in or better at the end of each lab session! All power supplies, lights, lasers, and equipment (such as the multimeters) must be turned off. Any equipment you set up on the optical bench that wasn't already prepared for you should be removed and sorted neatly for the next group to use. Failure to properly clean up your lab space at the end of section will result in lost points.*

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