Athabasca University

PHYS 202 Lab Manual - V 1.6 (Lab Information)

Lab Team

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Introduction

Lab work is an important part of the introductory physics course. It provides students with a medium to practice experimental and analytical skills and helps students to understand the basis of knowledge and the relation between theoretical and empirical work in physics.

The lab component for this course is based on the concept of the home lab, which involves performing real physics experiments outside the conventional lab setting. The list of equipment required is provided in the Lab Kit, in addition to some common household items.

The Experiments

The PHYS 202 Lab Manual consists of the following six home labs

Experiment 1: Basic Electricity and Graphing

After completing this experiment, you should be able to

- state and demonstrate Ohm's law.
- construct simple electric circuits on a breadboard.
- make parallel and series connections of resistors.
- demonstrate the charging and discharging processes of a capacitor.
- use the multimeter to make voltage, current and resistance measurements.

Experiment 2: Magnetic Fields of Solenoids

After completing this experiment, you should be able to

- describe the magnetic field configuration of an ideal solenoid.
- describe the magnetic field configuration of a real solenoid.

- state the dipole behaviour of the magnetic field along the axis of a relatively short solenoid.
- make magnetic field measurements using a magnetic field sensor.

Experiment 3: Earth's Magnetic Field

After completing this experiment, you should be able to

- define the meaning of inclination and declination angles of Earth's magnetic field.
- describe the Earth's magnetic field near your location .
- measure the Earth's magnetic field near your location.

Experiment 4: Geometric Optics

After completing this experiment, you should be able to

- demonstrate the phenomenon of refraction between two transparent objects.
- demonstrate Snell's law using a transparent object with planer surfaces.
- discuss the main differences between converging and diverging lenses.
- demonstrate the predictions of the lens equation using a converging lens.
- generate images using a two-lens system.

Experiment 5: Polarization of Light

After completing this experiment, you should be able to

- define polarization and describe a polaroid slide.
- describe the effect of a polaroid slide on normal unpolarized light.
- demonstrate the effect of a polaroid slide on transmitted polarized light.
- demonstrate the use of a light sensor to measure the intensity of transmitted light as a function of polarization angle.

Experiment 6: Diffraction of Light

After completing this experiment, you should be able to:

- describe diffraction grating and explain the phenomenon of diffraction.
- demonstrate the predictions of the diffraction equation using a laser beam.
- demonstrate the interference pattern generated by a real double slit.
- demonstrate the the complementarity principle of optics using a piece of human hair.

Lab Software

This lab requires the Logger Pro software produced by Vernier Software & Technology. It is an interface program that allows you to monitor temperature measurements on your computer. The software is also needed in the analysis of your experimental data.

Note that some of the documents in this manual are saved in the Portable Document Format (PDF), to make them more printer friendly. These files can be opened using the free Adobe Reader Software.

Lab Equipment

When you are ready to do the lab experiments, you should request a lab kit from the Athabasca University Science Lab. The kit will be mailed to you shortly after requesting it. Sometimes there will be a waiting list if the demand for the kits is high. When you receive the kit package, (see picture below), make sure that it contains a card for return postage (does not apply to international students).

Lab Kit Contents

1. Multimeter
2. Two test leads
3. Gripper clips (may be mounted on leads)
4. Two gripper test cables
5. Go!Link
6. Magnetic Field Sensor
7. Light Sensor
8. Laser Pointer
9. LED Flashlight
10. Biconvex lens on stand
11. Biconcave lens on stand
12. Stand (slotted piece of wood)
13. Mounted Solenoid
14. Slits mounted in slide
15. Transmission Diffraction grading mounted in slide
16. Two pieces of polaroid material, plane of polarization marked by a bar
17. Glass slide
18. Power resistor 12 Ohm
19. Large value resistor (100 KΩ to 1 MΩ)
20. Resistors (10 small value)
21. Pushbutton switch
22. Two electrolytic capacitors
23. Breadboard
24. Battery clip
25. Battery (9 V)
26. Five pieces of wire
27. Refraction Block
28. Large paper clip
29. Paper ruler

Lab Safety

Due care should be taken with moving objects, hot and cold liquids, and other potentially hazardous situations and materials. No materials used are to be connected to electrical power outlets. The level of risk involved in doing these labs is comparable to that of day-to-day activities, and care has been taken to avoid suggesting activities which produce hazards.

It is your decision to proceed with any experiment. In making that decision, you control your situation and assume any risks involved. You are responsible to act in a responsible manner to avoid hazard to yourself or others.

Neither the author of this Lab Manual, Athabasca University, or any equipment supplier can be held liable for consequences of any action undertaken in association with these laboratory exercises. If you cannot safely do these labs, please withdraw from the course.

Evaluation

The lab component of the course is mandatory. It counts for 20% of the total course mark. You are expected to attempt six experiments, according to the guidelines presented in the Lab Manual, and prepare a lab report for each experiment. All reports should be submitted to your tutor for assessment as mentioned in the course outline. Note that it is important to accumulate a total lab average of at least 50% to pass the course.

Experiments	**Overall Mark**
Experiment 1	3.33%
Experiment 2	3.33%
Experiment 3	3.33%
Experiment 4	3.33%
Experiment 5	3.34%
Experiment 6	3.34%
Total 20 %	**100%**

If you have lab credit from elsewhere you may wish to inquire about transfer of lab credit. Such transfer and any evaluation associated with it are entirely at the discretion of Athabasca University. For more information see Physics Lab Exemptions. You will be required to submit original lab materials, done by you, for evaluation toward potential transfer of credit. You must discuss this possibility with the course coordinator before submitting any such materials.

The Lab Report

Reports are an effective way of communicating important information, and their use is stressed in this lab. There is little point in doing a wonderful experiment with great results if you cannot effectively communicate your findings to others. Sometimes the results will not seem so great, and writing the report will help you understand what went wrong. On the other hand, the results we are seeking are relatively straightforward, so these reports needn't be overly long.

The lab report serves several purposes and gives an organized framework for recording your procedures and results. Although some students may have encountered laboratory reports before and may feel that there is a standard format for them, this is not entirely true. In this course you will have some freedom in organizing your report. Just make sure to include the following sections:

1. **Cover Page:** The cover page should include the name and number of the course, the version of the lab manual, the title of the experiment, your name, your student ID number and the date.
2. **Introduction:** Provide your theoretical background including all formulas needed in the analysis.
3. **Setup and Procedure:** Give a clear and detailed description of your actions while performing the experiment. If there is more than one part to the lab, it is usually best to describe the actions and observations separately for each part.
4. **Data:** Organize and present the data that you collected in the experiment. You should also provide a description of the trend and behaviour of the collected data. Do not include calculations or analysis in this section of the report.
5. **Analysis and Discussion:** This is a very important section of the lab report. Give a detailed analysis of your data, showing all your calculations including sample calculations for new calculated columns in data tables. You may also need to produce graphs and perform appropriate fits using the Logger Pro. Provide a thorough discussion of the validity of the proposed theory in light of your analysis and results. A suggested analysis is included with each lab. Errors in the observations may affect your conclusions; discuss their role here.
6. **Conclusion:** Present a brief summary of your findings in this experiment, including the final numerical results.