

Lenses

by Richard N. Tarrant, Richard J. Thompson

Experiment Overview

This experiment serves as the sole exposure to optics for physics students in first year. There are different versions of this experiment for the three first year streams – Fundamentals, Regular and Advanced.

This is the version used for Fundamentals students, who have not studied physics in year 12, or those who have obtained poor results (<65) in year 12 secondary school physics.

There are no optics lectures in first year physics, and there is no assessment in optics other than the checkpoints for completing the experiment as part of their laboratory mark (Lab. is 20 % of their semester mark).

The students explore the imaging behaviour of a single lens, are introduced to ray tracing and the lens equation, and explore the construction of a simple two-lens system (a telescope) using lenses mounted on an optical rail.

Learning Experience

In the past, Fundamentals students found this experiment too difficult and too lengthy. We have rewritten the experiment for semester one, 2011, and anecdotally, Fundamentals students have been coping much better. We would greatly appreciate ASELL input for our second version for 2012.

Aims and Objectives

On completion of this session, students should:

- have explored the imaging behaviour of a simple lens,
- understand ray tracing to predict the images formed by a simple lens,
- learn how to use the lens equation to predict the images formed by a simple lens,
- explored the construction of a simple optical system using two lenses,
- understand the basic optics of telescopes and microscopes.

Level of Experiment

This experiment is designed for first year students in their first semester of university Physics. It is either the first, second or third experiments undertaken by students in the Fundamentals stream. The Physics Fundamentals course has been developed for students who have not studied Physics in year 12, or those who obtained poor results (<65) at year 12 level. Most of these students are studying physics only because their course of study requires it (often to their surprise and consternation!).

Keyword Descriptions of the Experiment

Domain

optics

Specific Descriptors

light rays, ray tracing, lenses, focal length, image, telescope, microscope

Course Context

PHYS1002 PHYSICS 1 (FUNDAMENTALS)

Prerequisite Knowledge and Skills

This is a first semester unit, with no assumed knowledge, other than very basic high school algebra (no calculus).

Time Required to Complete

Prior to Lab: 1 hour

In Laboratory: 3 hours

After Laboratory: none

Experiment History

This experiment has been used within the School of Physics with little change for many years. This is the first version of a rewrite to make the Lenses experiment more appropriate for students without year 12 physics.

Comments

The students carry out the preparatory work downloaded from The University of Sydney *eLearning* site and completed prior to beginning the laboratory session. Students who have not completed the prework by the start of the laboratory session lose 1 (of a possible 4) checkpoints for the session.

The students perform the experiment in teams of three using a single team logbook. The laboratory notes are in the bound laboratory manual, containing all of the semester's experiments, as well as general introductory material including OH&S requirements, laboratory rules, notes on experimental methods, and some sample logbook entries. At back of the manual (which each student is required to purchase) are extensive pages of relevant formulae, methods of data analysis including calculation and propagation of errors, drawing of graphs, and a brief primer on using Microsoft EXCEL for analysing and plotting data.

The experiment notes in the laboratory manual are written as a series of logbook points, designed to encourage the students to think, discuss and work as a team. At each of the several checkpoints, a

tutor discusses the logbook entries with the group and provides feedback. If the work is satisfactory the checkpoint is awarded and the group may then proceed. If not, the work is revised until a checkpoint is awarded.

References

R.D. Knight, B. Jones & S. Field, *College Physics: A Strategic Approach*, Pearson 2nded. 2010