

### Lab Report

*Complete this report YOURSELF except DATA taking parts! This report will not be submitted (except the very last page), but you should carefully complete it as preparation for the applied exam.*

#### Suggested Pre-Lab Questions

**Q1.** Write down the relation between focal length and radius of curvature for a mirror.

**Q2.** Write down the relation between focal length and radius of curvature for a lens.

**Q3.** Write down the index of refraction formula for a prism.

**Q4.** What is the definition of index of refraction and what is the unit of it?

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# EXP.1: Reflection and Refraction

## Experiment

**OBJECTIVE :** To study the law of reflection, principles of mirrors, lenses, and prism by ray tracing.

**THEORY :** In this experiment you will be tracing the light rays reflected or refracted from various optical elements and determine some relevant quantities of these elements. Here are some crucial points you may need.

- In a plane mirror the incident and reflected angles with respect to the normal are equal
- Focal lengths of concave and convex mirrors are simply half the radius of curvature for the respective surface.

$$f = \frac{R}{2}$$

- Focal length and the radius of curvature of a lens is related through the following expression:

$$\frac{1}{f} = (n - 1) \frac{2}{R}$$

where n is the index of refraction.

- We can calculate the index of refraction of the transparent material a prism made of as following:

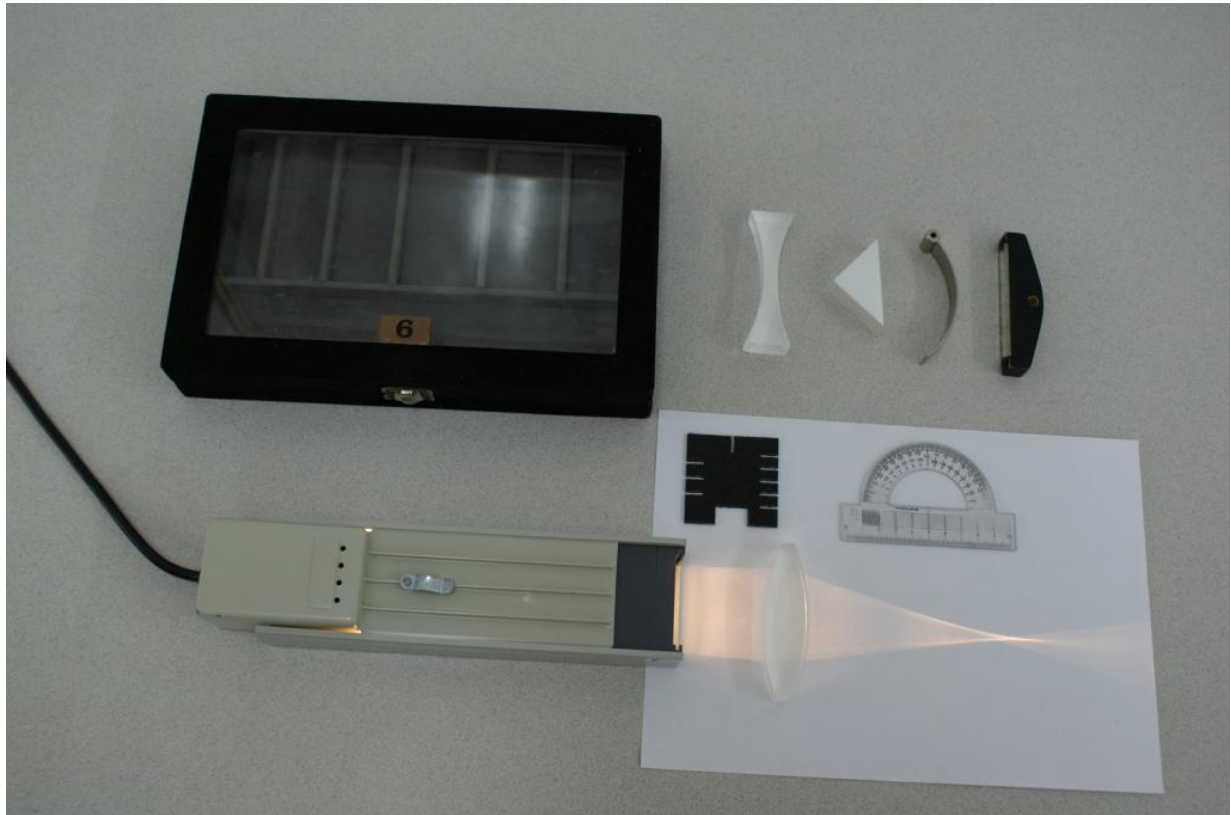
$$n = \frac{\sin\left(\frac{D_{\min} + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

where A is the prism angle at the corner that the light rays are refracted and  $D_{\min}$  is the minimum angle of deviation between the incident and the refracted rays.

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## EXP.1: Reflection and Refraction

**APPARATUS :** Ray box, lens, mirror and prism set, ruler, protractor.



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### **PROCEDURE :**

1. For each of the following experiments, place the optical element and light source on a different sheet of paper. Draw the outline of the optical element, paths of incident, reflected, and refracted rays as needed.
2. You will determine the radii of curvatures using the Chord Method. First draw at least two chords on the curved (circular) outline of the elements. Then draw perpendicular bisectors to each of the chords. The center of the circle is where the bisectors intersect. You can determine the radius by measuring the perpendicular distance between the intersection point and any point on the curved outline.
3. Show your Chord Method Analysis on the back of each corresponding sheet.
4. In case of the prism, determine the minimum angle of deviation  $D_{\min}$  and then the index of refraction for the material of the prism.

PART – 1: REFLECTION

A) **Plane Mirror :**

Incident ray angle  $\theta_i =$  .....

Reflected ray angle  $\theta_r =$  .....

B) **Concave – Converging Mirror:**

Focal Length of the mirror  $f_{EV} =$  .....

Radius of the mirror  
(From Chord Method)  $R =$  .....

Focal length of the mirror  
(From Chord Method)  $f_{CV} =$  .....

**% difference in focal lengths** = .....

C) **Convex – Diverging Mirror:**

Focal Length of the mirror  $f_{EV} =$  .....

Radius of the mirror  
(From Chord Method)  $R =$  .....

Focal length of the mirror  
(From Chord Method)  $f_{CV} =$  .....

Thickness of the mirror  $x =$  .....

**% difference in focal lengths** = .....

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PART – 2: REFRACTION

D) Convex – Converging Lens :

Refraction Index  $n$  = .....

Focal Length of the lens  $f_{EV}$  = .....

Radius of the convex lens  
(From Chord Method)  $R$  = .....

Focal length of the convex lens  
(From Chord Method)  $f_{CV}$  = .....

**% difference in focal lengths** = .....

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E) Concave – Diverging Lens:

Refraction Index  $n$  = .....

Focal Length of the lens  $f_{EV}$  = .....

Radius of the concave lens  
(From Chord Method)  $R$  = .....

Focal length of the concave lens  
(From Chord Method)  $f_{CV}$  = .....

**% difference in focal lengths** = .....

## EXP.1: Reflection and Refraction

### F) Prism:

Minimum deviation  
between incident  
and refracted rays

$$D_{\min} = \dots\dots\dots$$

Prism angle

$$A = \dots\dots\dots$$

Index of Refraction

$$n_{EV} = \dots\dots\dots$$

True Value for the  
Index of Refraction

$$n_{TV} = \dots\dots\dots$$

**% difference for  $n$**

$$= \dots\dots\dots$$

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**In the next experiment, which is an applied exam, you will have a different setup and experiment, but the same principles (significant figures, units etc.) will be tested. You should study the experiment before the exam, try to get familiar with device usage and data taking/analysis today!**

## EXP.1: Reflection and Refraction

### Post-Lab Report

**Aim** of the experiment:

**Suggestions** for possible solutions to the problems experienced during the experiment:

**Conclusion:**

7 I have completed this experiment myself as specified in the lab sheet and as explained by the lab instructor.

**Name & Surname:**

**Student ID:**

**Lab Section:**

**Table #:**

**Date:**

Signature of the  
student

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As the instructor of this Lab Section I confirm that the student has participated in and completed this experiment on time.

Stamp of the PHYS  
Labs and signature of  
the instructor

*This page serves as proof of the fact that the student participated in and completed the experiment, only if it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.*