

Experiment 6: Refraction – Convex and Concave Lenses

EQUIPMENT NEEDED

- Ray box (multiple white rays)
- Convex lens
- Concave lens
- Metric rule
- Second convex lens (optional)

Purpose

To explore the difference between convex and concave lenses and to determine their focal lengths.

Theory

Parallel rays of light passing through a thin convex lens cross at the focal point of the lens. The focal length is measured from the center of the lens to the focal point.

Procedure

- ① Place the ray box on a white piece of paper. Using five white rays from the ray box, shine the rays straight into the convex lens. See Figure 6.1.

NOTE: Concave and Convex lenses have only one flat edge. Place flat edge on surface.

Trace around the surface of the lens and trace the incident and transmitted rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.

- ② The place where the five refracted rays cross each other is the focal point of the lens. Measure the focal length from the center of the convex lens to the focal point. Record the result in Table 6.1.

Table 6.1 Results

	Convex Lens	Concave Lens
Focal Length		

- ③ Repeat the procedure for the concave lens. Note that in Step 2, the rays leaving the lens are diverging and they will not cross. Use a rule to extend the outgoing rays straight back through the lens. The focal point is where these extended rays cross.
- ④ Nest the convex and concave lenses together and place them in the path of the parallel rays. Trace the rays. What does this tell you about the relationship between the focal lengths of these two lenses?

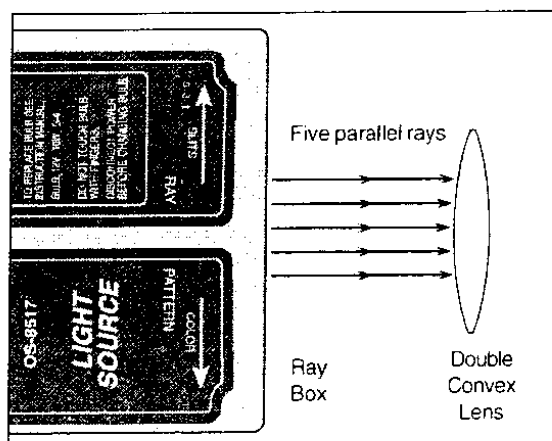


Figure 6.1

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- ⑤ Slide the convex and concave lenses apart to observe the effect of a combination of two lenses. Then reverse the order of the lenses. Trace at least one pattern of this type.
 - ⑥ Place the convex lens in the path of the five rays. Block out the center 3 rays (the mirror on edge works well) and mark the focal point for the outer two rays. Next, block out the outer two rays (or slide the mask to the position that gives 3 rays) and mark the focal point for the inner 3 rays. Are the two focal points the same?
 - ⑦ If you have a second convex lens, place both convex lenses in the path of the five rays. The distance between the lenses should be less than the focal length of the lenses. Compare the quality of the focus of this two lens system to the focus of a single lens. Do all five rays cross in the same place?