Basic Optics Investigations

Introductory Optics

The purpose of this lab is to investigate basic optics systems, examining the relationship between image position, size and lens focal lengths, leading to an understanding of the lens equation.

Part A: General Observations

1. Position the light source at x = 0 cm, with the circle and arrows of the light source facing out along the track. Place the screen at x = 100 cm. Starting right in front of the screen, move the +200 mm lens slowly along the track toward the light source. Describe in detail what you observed.

2. Repeat question 1 using the +100 mm lens instead of the +200 mm lens.

3. Now place the screen at 50 cm. Flip the light source by 180 degrees so the slits and colors are pointed along the track and just hit the top of the screen. Arrange the slide on the light source so only the three colors hit the screen. Place the +100 mm lens at x = 20 cm and tilt the light source down slowly so colors can be seen on the screen having passed both over the top of the lens and through it. Describe what you see.

4. Describe what happens as the lens is slid closer to the screen.

5. How far from the screen is the lens when the colors merge to one? What color do they make?

6. Remove the +100 mm lens from the track. Slide the slide on the light source to get five lines of light appearing on the screen. Place the +100 mm lens back on the track close to the light source and move it toward the screen slowly. Describe what you see.

7. How far from the screen is the lens when the lines merge into one?

8. Predict where you should place the +200 mm lens to make the three colors become one.

9. Measure precisely where the +200 mm lens must be placed to best merge the colors to one.

Part B: Measurements

Complete the following measurements for the lenses. The light source (with circle and arrows facing down the track) should be at x = 0 cm, and the lens is to be placed at the position *p* given in the table. You need to find the distance *p'* from the lens to the screen when you have a sharp image (there may not be one) and you need to measure the diameter *h'* of the image of the largest circle on the screen. (The real source circle has a diameter of exactly 2.0 cm. This is *h*.) Be as accurate as possible.

+100 mm lens						
***p* (cm)**	***p'* (distance from lens to image)(cm)**	***h'* (cm)**	***p'/p***	***h'/h***	***1/p + 1/p' = 1/f***	***f***
5						
10						
11						
12						
15						
20						
25						
30						
40						
50						

10. What is the average value for f?

Repeat for the +200 mm lens (but note the positions of the lens are different).

+200 mm lens

p	*p*' (distance from lens to image)	*h*'	*p*'/*p*	*h*'/*h*	*1/p + 1/p*' = *1/f*	*f*
10						
20						
30						
40						
50						
60						
70						

11. What is the average value for f?

Discussion

12. Discuss what you notice about your answers to Q5, Q10 and the +100 mm label, and the answers to Q9, Q11 and the +200 mm label on the lenses.