A04-245E-Y22

Three-in-one Triple Sophisticated Geometrical Optics

Experiments:

I Mirror and Optical Instrument

1. Use the law of refraction to study the principle of focal length of convex and concave lenses, and the measurement of magnification.

2. Learn principles of focal length of convex and concave lenses and magnification calculation.

3. Observe the chromatic and spherical aberration in the experiment process.

II. Interference and Diffraction of Light (Semiconductor)

4. Single-slit diffraction and double-slit interference of laser light

5. Interference phenomenon of grating

III. Geometrical optics experiments

6. Understand the phenomenon of optics geometry: Direct light, reflection, refraction and dispersion.

7. Imaging and focal length of convex and concave lenses

8. Refraction of prism

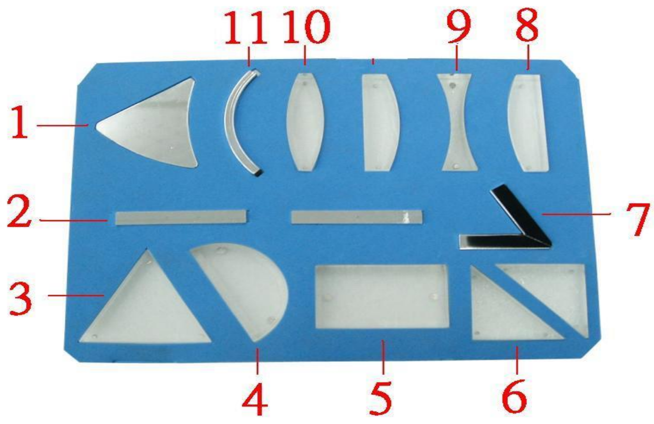
9. Refraction of semicircular mirror

10. Refraction of parallel bricks

11. Focal length of compound lenses

Instrument list					
No.	**Accessory**	**Qty**	**No.**	**Accessory**	**Qty**
1.	Optical slideway	1	2.	Slide implement	5
3.	LED light source	1	4.	Power supply (3VDC)	1
5.	Convex lens (with handle)	4	6.	Concave lens (with handle)	2
7.	Convex mirror (with handle)	2	8.	Concave mirror (with handle)	2
9.	Filter screen (with handle)	1	10.	Cross-shaped screen (with handle)	1
11.	Screen (with handle)	1	12.	Penumbral screen (with handle)	1
13.	Screen holder	1	14.	Optical specimen holder	
15.	Semiconductor laser light	1	16.	Single- and double- slit specimen	1
17.	Grating specimen	1	18.	Grating	1
19.	Scaled round disk base	1	20.	Scaled round disk	1
21.	Sophisticated geometric optics set	1			
21-1	Plane concave and convex mirror	1	21-2	Plane reflection mirror	2
21-3	Equal triangle prism	1	21-4	Semicircular lens	1
21-5	Rectangular prism	1	21-6	Right angle isosceles prism	2
21-7	Angle mirror	1	21-8	Plane convex lens	2
21-9	Concave lens	1	21-10	Convex lens	1
21-11	Concave and convex mirror	1			

			
1.	2.	3.	4.
			
5.	6.	7.	8.
			
9.	10.	11.	12.
			
13.	14.	15.	16.
			
17.	18.	19.	20.



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Mirror and Optical Instrument

Purpose

1. Use the law of refraction to study the principle of focal length of convex and concave lenses, and the measurement of magnification.

2. Learn principles of focal length of convex and concave lenses and magnification calculation.

3. Observe the chromatic and spherical aberration in the experiment process.

Theory

(I) Convex lens imaging:

Place an object in front of a convex lens. When the light of object travels to the convex lens, the light changes its direction based on the law of refraction. After passing through the lens, the extended lines converge behind the lens, creating a "real image," as shown in **Figure 1**.

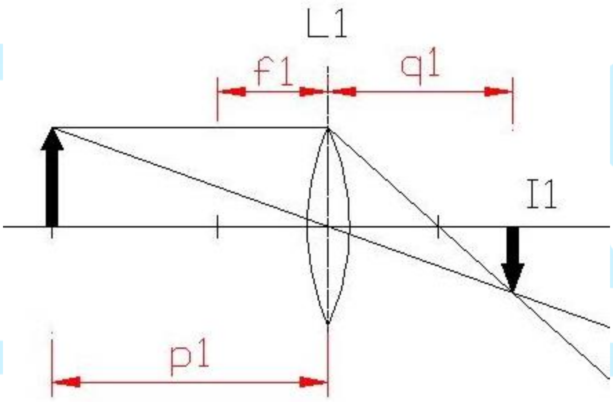

Figure 1

p： Object distance, the distance from the object to the lens. (If the object is in front of the lens, p is +. If the object is behind the lens, p is -.)

q： Image distance, the distance from the image to the lens. (If the image is in front of the lens, q is -. If the image is behind the lens, q is +.)

f： Focal length, the focal length of the lens. (The focal length of convex lens must be +.)

H： Object height

H_0： Image height

According to the law of refraction, trigonometric function and approximation, the imaging formula of convex lens can be expressed as

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \text{ ....(1)}$$

The magnification M is

$$M=q/p \text{ ....(2)} \quad \text{or}$$

$$M=H/H_0 \text{ ....(3)}$$

In the experiment, adjust the object distance p and measure the image distance q. Use formula (1) to calculate the focal length f of convex lens. Use formula (2) or (3) to calculate the magnification.

(II) Imaging of a concave lens

Place an object in front of a concave lens. When the light of object travels to the lens, the light changes it direction based on the law of refraction. After the light passes through the lens, the extended lines converge in front of the lens, creating a “virtual image," as shown in **Figure 2**.

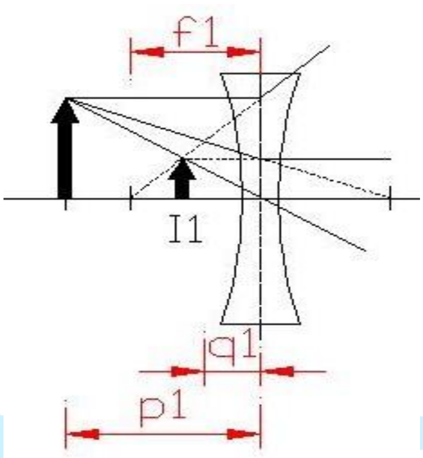

Figure 2

p： Object distance, the distance from the object to the lens. (If the object is in front of the lens, p is +. If the object is behind the lens, p is -.)

q： Image distance, the distance from the image to the lens. (If the image is in front of the lens, q is -. If the image is behind the lens, q is +.)

f： Focal length, the focal length of lens. (The focal length of concave lens must be -.)

H： Object height

H_0： Image height

According to the law of refraction, trigonometric function and approximation, the imaging formula of concave lens can be expressed as

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \quad \text{............(4)}$$

The magnification M is

$$M = q/p \quad \text{................(5)} \quad \text{or}$$

$$M = H/H_0 \quad \text{............(6)}$$

The image of concave lens is a virtual image in the experiment so we have to use a convex lens L1 to from a real image I1. With the help of the convex lens, the concave lens L_2 can from a real image I2, as

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