FOCAL LENGTH DETERMINATION of LENSES Exp-2

Purpose

- To determine focal lengths of lenses (convergent and/or divergent and lens sys- tems) with unknown focal lengths.

Related topics

Law of lenses, magnification, focal length, object distance, path of a ray, convex lens, concave lens, real image, virtual image.

Theory and Evaluation

Here we start with the definition of two important concepts of optics: lens and geometrical optics.

Lens is defined as: a piece of transparent material (such as glass) that has two opposite regular surfaces either both curved or one curved and the other plane and that is used either singly or combined in an optical instrument for forming an image by focusing rays of light [1].

Geometrical optics, or ray optics, describes light propagation in terms of rays. The ray in geometric optics is an abstraction useful for approximating the paths along which light propagates under certain circumstances [2].

The relationship between the focal length f of a lens, the object distance g and the image distance b is obtained from geometrical optics. Three particular rays, the focal, the parallel and the central ray, are used to construct the image (Figure ??). As is indicated in Figure ?? we define symbols as follows: From the laws of similar triangles we find following two equations. It is strongly recommended to you

G	object size
g	object-lens distance
B	image size
b	lens-image distance
f, f'	focal length

to derive them your own.

$$\frac{B}{G} = \frac{b}{g} \tag{3}$$

and

$$\frac{G}{B} = \frac{f}{b-f} \tag{4}$$

Depending on our wish we can express the focal length f in terms of quantities G, B, g, b, but most compact and famous one is:

$$\frac{1}{f} = \frac{1}{b} + \frac{1}{g} \tag{5}$$

From the measured b and g values you can experimentally find focal length of a lens. As it will be shown in Experimental Part, in order to decrease effect of natural errors arising during the measurement process we should repeat the measurement several times.

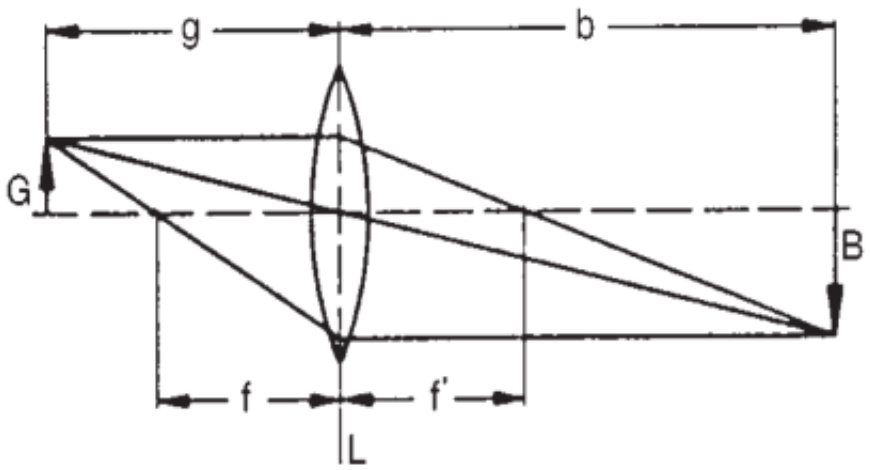

Figure 5: Lense configuration used in experiment [12]

Set-up, Procedure

1. Place the object (screen with arrow slit) in front of lens.
2. Shift the screen to the position where clear image is projected on to the screen.
3. Measure the distances of image and object from the lens, record your value in Table below.
4. Measure the height of object and image, record your value in table below.
5. Repeat step 3 and 4 for the other distances of object from the lens.
6. Repeat all steps for lens 2, record your value in Table below.